CREATING EDUCATIONAL MEDIA FOR STUDENTS IN THE UNITED KINGDOM

An Interactive Qualifying Project Report

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We, the Science Year IQP team submit that this report and our project work reflects a collaborative team effort from all four group members.

1. Abstract

The WPI Science Year IQP intends to contribute to efforts to revitalise interest in science among students ages ten to nineteen by capturing their attention and interest with interactive web-based computer games focusing on the popular themes of sports and inventions. In developing these games, the project team researched student interest in science and web-based games, the UK national curriculum, and educational game design and production. Final deliverables include comprehensive game design documents, detailed storyboards, and two Flash-based Internet games.

2. Executive Summary

Educators and industry representatives in the United Kingdom have expressed concern about the decline of interest in scientific study among children and young adults between 10 and 19 years of age. Resources and initiatives are needed for making science provocative and exciting to today's youth. Science Year is a UK government-based initiative that seeks to spawn interest in this target age group through various educational resources such as web-based games, nationwide projects, and CD-ROMs for use in the classroom. Science Year wishes to create web-based activities involving the themes of sports and inventions as another tool for stimulating interest in science and technology.

Since it is widely acknowledged that scientific and technological advances will continue to be responsible for many changes in our lives, the need for young scientists will also continue. Reaching out to young people and engaging them in science activities is critical for inspiring the scientists of tomorrow. A number of organisations have started to reach out to students through the Internet to help them develop scientific skills and interests. Building on the resources that Science Year has already developed to promote science to young people, the WPI Science Year IQP has researched and produced new, dynamic additions to their website. We have created two web-based games focused on sports and inventions that will interest young people in science and technology. Children throughout the United Kingdom will use these Internet games and will gain a better understanding of the pervasiveness and importance of science and technology.

In order to create web games that would stimulate interest in science and technology in young people, we employed a number of methods. We researched the interests of people in our target age group of 10 to 19, and we interviewed several students within this target age

group. By talking to these people, we tried to understand what types of games really got them engaged. Next, we researched both the national curriculum requirements in the United Kingdom and the fundamental strategies and techniques involved in designing educational media for younger audiences. We then began rigorous, daily brainstorming sessions, to generate ideas for our games. Concurrently, we worked with Science Year and their web-design affiliate Telepathy to gain an understanding of their past work, research, and expectations for our own final games. After each daily brainstorming session we selected a number of game candidates that we felt showed potential. We developed the candidates as short game summary sheets called design treatments, which briefed their gameplay, scientific interactions, and development specifications. After completing 22 design treatments, we put each game through a filtering process to select the finalists. Our criteria included the key points we found in our study of the types of games that interest children, and what we could feasibly build in seven weeks. The three filters that made up our criteria were the science filter, the entertainment filter and the feasibility filter. This process helped us to narrow our list of 22 games down to eight. We sought advice from Science Year and Telepathy about our finalists, and based on this advice, we were able to choose two game ideas that we thought most satisfied our goals. The games included a rock climbing game named 'Climbin' High' and an invention based game named 'Feed the Mind.'

Our background research provided us with insight on how to create games that would inspire young people's interest in science and technology. Observing students showed us that they tend to skip over lengthy written explanations in educational games and jump immediately to the actual gameplay. We also observed that the students played games with continuous game play and good graphics and often those with violent themes. The latter was of particular concern, as we choose to be conscious of the values our own games would

reflect concerning violence and other controversial content**.** Meeting with the Science Year team gave us valuable information concerning what kind of learning experience they wanted the games to offer and how science should be presented in the games. At the same time, we developed our own process for evaluating our game ideas, and this process helped us sculpt the goals and game 'traits' we wanted for our own games. Finally, Telepathy was a great help in aiding us to narrow down our selection to the final two games, while at the same time impressing upon us the limits of technology for game design. Their advice helped us realise the particular nuances of the software we would be using to create our games, allowing us to choose not only the most creative and educational game candidates, but also the most feasible.

Moving on to game production, we utilised several divisions of labour. We divided our team into two groups, one for each game. In addition, one member of each group researched the pertinent scientific background information while the other person worked at programming and developing the game. The people conducting research spent their time working out the details of our two final design documents and developing the wording and language of the scientific text in the games. Meanwhile, the people programming produced art, developed gameplay logic and mechanics, and gathered sound effects.

At the end of the production period, Science Year loaded our games to a secure section of their website. Members of the Science Year staff and a small focus group of student players provided their reactions and suggestions and we adjusted the games accordingly. We submitted our two final games to Science Year for presentation on their website, when the themes of sports and inventions become the site's primary focus.

Our team reached a number of conclusions while designing and producing our games. First, the short production schedule and limited resources hindered our game designs and creative ideas. Second, we found ways to build creativity into our games with small details and added options. Third, we derived value from observing the sorts of games and activities children already enjoy and working to build similar themes into games pertaining to less popular subject areas such as science. Finally, we concluded that educational media and new initiatives to present science to younger audiences do not need to present science in an unrealistic and purely 'fun' manner; they just need to present it within an environment that children enjoy interacting with in a way that they can understand and control.

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4. Introduction

Educators and industry representatives have expressed concern over the decline of interest in scientific study and careers among children and young adults between ten and nineteen years of age. Resources and initiatives are needed for making science provocative and exciting to the youth of today. Science Year is a government-based initiative that seeks to spawn interest in this target age group through various educational resources such as games, nationwide projects and CD-ROMs for use in the classroom. Science Year looks to create web-based activities involving the themes of sports and inventions as another tool for stimulating interest in science and technology.

Since it is widely acknowledged that scientific and technological advances continue to be responsible for many changes in our lifestyles, the need for young scientists is growing immensely. Reaching out to young adults and engaging them in science activities is critical to inspiring the scientists of tomorrow. A number of organisations have started to reach out to students through the Internet to help them develop scientific skills and interests.

Building on the resources that Science Year has already developed to promote science to young adults, the WPI Science Year IQP has researched and produced new, dynamic additions to their website. In particular, we have created web games that stimulate young adults by showing them the connection between the popular themes of sports and inventions and science and technology. Children throughout the United Kingdom will use these

interactive Internet games in their homes in order to gain a better understanding of how pervasive and important science is.

A number of methods have been utilised in order to achieve our goals. Research has been done on the topics of target age group, national curriculum requirements in the United Kingdom, and currently available web-based games as well as general concepts in web-based design, web-game design and presentation. Also, we have reviewed current and past attempts to inspire young adults with science, focusing on their successes, failures, and lessons for future initiatives. In talking to children, we tried to understand what gets them excited, and what types of games they like to play so we could create a dynamic game that engages them. We have also talked to game designers to find out what will be feasible for our game. We performed rigorous brainstorming sessions daily to spawn ideas for our games, and then took some of those ideas and elaborated on them further. After we completed twenty-five of those documents, we put them through a filter system of criteria in order to select two final designs for implementation into a Flash-based game. Finally, we have produced creative and dynamic web-based resources and games created with young adults in mind that focus on the specified themes of sport and invention.

5. Literature Review

5.1 Science Among Young Adults: An Image Problem

Science and technology are hugely important areas of knowledge for today's youth to embrace, surrounded as they are by a climate of technological advances. Young adults do not seem to realise the importance of their upcoming role in a technology-oriented society and do not seem to be stimulated by science. At the same time, these adolescents have difficulty linking their own personal interests to the wealth of scientific principles and phenomena they entail. While the causes of this difficulty are numerous, one central cause seems to be that of science's stereotypical image as being boring, geeky, and gender-specific - i.e., the work of eccentric middle-age men in white lab coats.

These stereotypes of science are perpetuated by all sorts of factors in contemporary society, from popular media such as television and movies to more general notions of how science is presented in education. Constantly bombarded by these images of science, young adults come to perceive the field as irrelevant to their own interests, and ultimately not the sort of study they want to pursue further. Consequently, new initiatives to get young adults excited and interested in the study need to change the popular image of science with examples and explanation of how the reality of science is relevant to them. However, before seeking to change this image, a better understanding of its forms and effects is needed.

5.1.1 It's Geeky!

Generally, scientists are perceived by students to be geeky and boring eccentrics. This stereotypical view often discourages young adults from studying science and technology out of fear that they will grow up to be viewed the same way. Once established by television, movies and video games, it is a difficult task to change these stereotypical images.

Bill Nye the Science Guy is a television icon that reaches out to children to teach them the importance and relevance of science through experimentation. Bill Nye, a goofy typecast scientist, tells children about science through various means. For instance, he teaches students about momentum by setting up a ruler on a level table with marbles laying stationary on it. Then he rolls another marble down the ruler and explains how the stationary marbles start to move due to conservation of momentum (Nye, 2001). Despite the fact that Nye has interesting experiments that might interest young adults in science, he may be perpetuating the stereotype of the geeky eccentric scientist.

A survey conducted by the University of Bath's psychology department interviewed teens about their attitudes towards scientists, and the results showed that "scientists were perceived in a negative light, as boring, work obsessed and geeks" (Scientists are 'boring eccentrics', 2000). The same study also concluded that scientists are thought of as "dangerous cranks" and lab rats. Also, Dowling states "Children as young as 8 may be put off the idea of becoming scientists because they see them as 'middle-aged white males who never have fun'" (Dowling, 2001). On a related note, it has been found that when a group of children were asked to draw a picture of their image of a scientist, the "boys never drew women and only very occasionally would a girl draw a female scientist" (Dowling, 2001).

5.1.2 Gender

Stereotypically, males are perceived as being the main proponents of science, while females are largely thought to have either minimal or supporting scientific roles. This gender-specific stereotype is one aspect of the problem with the popular image of science -- one that deters many women from scientific pursuits. Against a backdrop of declining interest in science and technology in general, in the UK the number of females interested in these fields are far lower than the number of males. Because technology has long been perceived as a male-dominated area, women have never felt as capable as men and have been less attracted to it (Eileen Heneberry).

Eileen Heneberry, a mathematics professor at Regis College, co-founded a program in 1994 to get Females Interested in Math and Science (FIMS), but unfortunately the response was less than desired. After trying for five years with FIMS, Mrs. Heneberry decided to incorporate males into the group, which was renamed STIMS for Students Interested in Math and Science. Upon the inclusion of boys, the number of girls dropped significantly, and the group was taken over by a male professor. It has also been observed that women's efforts in science are related to how comfortable they feel within their academic surroundings. When girls feel overwhelmed by boys, they do not excel to their full potential (Eileen Heneberry).

5.1.3 Science is Boring and Irrelevant?

Generally, science is portrayed as a boring and hard subject that involves a lot of memorisation. Due to the boring approach and non-stimulating material often used to present

science, young adults do not develop the interest necessary to further their education in these fields of study. As a result, the image of science is not only damaged by gender-specific or 'nerd' stereotypes, but by its bland presentation in educational settings as well.

"Surveys indicate that many pupils see science as uninteresting and irrelevant to their lives" (Bennett, 2001) which provokes the question: why? In 1921, when this issue was first raised, the authors of the School Science Review explained that the overall attractiveness of science needed to be increased by broadening the range of activities encompassed by science education and including applications of science in lesson plans (Bennett, 2001). Often times, science courses are far too narrow to satisfy students' natural curiosities, and since the courses are approached from a very vague and broad perspective (Eileen Heneberry), many students find themselves uninterested. Still in the 1920s, Thompson, an author of the School Science Review, knew that "more attention should be paid to those aspects of the sciences which bear directly on the objects and experiences of everyday life" (Bennett, 2001). Most researchers have come to believe this helps stimulate these students' interest in science and technology.

As early as 1941, professors started voicing their concerns over an apparent lack of scientific interest in the attitudes of their students. Teachers in general agreed that they must make science appear immediately useful, practical, and valuable. Educators are beginning to realise just how important knowledge application is to making the material less monotonous and more interactive. Evidence given to the Department for Education and Skills indicated that a new "curriculum that places more emphasis on education about science is likely to make more pupils respond more positively to science" (Bennett, 65). In general, children are unintentionally brought up to underestimate the importance of science and its applications.

This leads young adults to summarise their experiences with science as boring and irrelevant to their lives.

This need not be the case. For instance, the website "Microbe" tackles the myth that "being a microbiologist means you sit in a lab all day looking at slides under a microscope" (Science is Boring (And Other Myths), 1999). The website points out that a microbiologist could also travel to places like "Costa Rica seeking out new species of microbes…" or "…could meet some of the deadliest creatures on Earth head-on as…" they "…track down killers such as Ebola" (Science is Boring (And Other Myths), 1999). Websites like this spawn interest in young adults about science and technology by opening their eyes to the reality of what being a scientist means.

Generally students find themselves looking at technology and science from the wrong perspective. Science is full of interesting and amazing facts; students just do not know how to find them on their own. For example, if these students were able to see the connection between their favourite video game and science or that their favourite roller coaster could not be designed properly without an understanding of physics, their interest in science and technology might be increased.

5.2 Getting Them Interested: Efforts to Make Science Provocative for Children

5.2.1 General Strategies

The previous section discussed the lack of interest in science and technology and its link to general stereotypes and the manner of its presentation and image in our society. With all that is available today through technology, there have been many recent efforts to get young adults interested in science and technology, such as through interactive web games, experimental groups and television programs. These new efforts hope to breathe life into the world of science, changing the conception of it that many young adults have grown to accept.

In the United States, science instructors are beginning to incorporate new approaches in teaching science. Traditionally, science is taught in three general steps. First, the material is presented in the textbook. Second, the teacher displays practice problems or examples on the board, and then the students do more examples on their own. Finally, the students are allowed into the lab, with written step-by-step instructions, to complete an experiment to which the students generally already know the answer. A new intuitive approach puts the third experimental step first, so that students can explore the topic prior to learning about it. The learning process is more interesting when what is learned in the lab is applied to what is being learned in the textbook, since you then have first hand knowledge of what really happens. Teachers tend to emphasise learning the facts, rather than focusing on their application proving to be another problem with traditional science education. J. Myron Atkin (Gibbs and Fox, 1999) states that "Evidence suggests that examinations by themselves do

nothing to help students understand science better; some are even counterproductive. Other kinds of tests, however, could actually improve learning." These other tests that Atkin discusses involve more verbal examinations, where students can gain a great deal of self-confidence with their knowledge (Gibbs and Fox, 1999).

In Britain specifically, students are taught science from the age of five, and most of them enjoy it in the early stages of education. However, statistics show that at the secondary level many children begin to lose interest in science (Dowling, 2001). Programs such as Science Year have been established to facilitate and maintain enthusiasm for science in the secondary level of schooling. The strategies being used are the complete opposite of the traditional techniques of science education. The original technique involved straight memorisation and regurgitation of material without any complete understanding of it. The new programs replace this method with exploration and invention and build upon subjects that children already know and enjoy (Gibbs and Fox, 1999). By using this method children learn science in the context of their own interests rather than through abstract concepts that they may never grasp. This IQP project seeks to spur the interests of children in the world of science by linking the latter to specific themes such as sports and inventions.

5.2.2 Science in Sports

Sports are unlikely material for scientific study. Children usually think of sports and science as being entirely unrelated, but that is precisely what makes a scientific investigation into sports so useful as a teaching tool. There are many sources of scientific inquiry in sports ranging from the physics of hitting a baseball to the technological inventions that change the

way sports are played. Still other aspects of sports to explore include using technology to improve performance or enable handicapped people to participate in physical activities.

Technology is working its way into sports more and more. Some of the advancements being made are beneficial to the sport, while others are controversial or even detrimental. For instance, advances in ski equipment are directly related to the ever-increasing popularity of the sport. Prior to the development of curved, lightweight, composite skis and plastic boots, skiing was only for those strong and brave enough to handle the long, heavy, first-generation equipment. Some technological advancements have caused 'ripples' in sports such as Olympic swimming. The recent development of slick swimsuits that create less drag in the water than human skin has lead to a debate about whether or not such things should be allowed in the sport. Such advances in equipment can allow old records to be broken much more easily (Spadaccini, 1999).

Science has a hand in another performance enhancing aspect of sports, namely body enhancers. Technology has given mankind the knowledge and ability to enhance the human body. At this point in time, enhancements are achieved through the use of hormones and drugs, but in the not too distant future inborn enhancements may become a reality. Are such things natural? Will such people be allowed to compete with 'normal' humans? Ultimately, science is a tool that humans will use for whatever may be important to them, and sports seem to be one of those areas (Spadaccini, 1999).

Technology does not always cause problems in the realm of sports; it can be quite beneficial as well, especially for the disabled. When one thinks of skiing, they most likely think of a lot of physical activity. It would be pretty hard to ski with no legs, one would

think, but thanks to technology this is not necessarily the case. Disabled skiing is becoming more and more prevalent. There are devices for skiers with only one leg and even for skiers with no legs. Cycling for the disabled has gone a similar route with lightweight wheel chairs. Technology opens doors for those who would otherwise never be able to participate in the sports they love. This concept is one that can fuel interest in science and technology (Spadaccini, 1999).

There are many ways in which science and technology relate to sports. These provide a good source of material for reaching children with different interests in different sports. Sports are a useful tool for grabbing children's interest in science, because it is a topic essentially unrelated to science; this makes children more receptive to the scientific aspects involved. Once the connection is made that science is inherent in sports, children may think science is "pretty cool."

5.2.3 Science Inventions: Possibilities for Youth Outreach

Inventions, surely a centrepiece of scientific and technological endeavour, also offer a means of reaching out to children through their own creative thoughts and interests. Surely any child who has taken a ride in a car, gazed upon a rocket soaring into the air, or merely taken a gallon of milk from a refrigerator has thought at some point about how such things have come to be. At the same time they may also have thought and imagined all sorts of new inventions and devices, from star ships to jetpacks, with aid from Saturday morning cartoons or popular movies. Within this imagination and creativity lies the potential for a central

connection between science and the interests of young adults, as well for an explanation of how science and technology can make their ideas real.

In the present day, we see popular television shows and school programs already forging this connection through invention. The popular US FIRST program establishes a competition among high school students in the USA where they invent robots that complete various objectives. The Learning Channel's show "Junk Yard Wars" presents two teams of sophisticated engineers that create rockets, hovercrafts, and various other vehicles from spare parts. At the same time a myriad of science fiction movies and cartoons provide an endless number of imaginative inventions, from the 'Millennium Falcon' star ship of Star Wars to the morphing vehicles of Transformers.

As a result, science fiction in particular offers huge possibilities for developing enthusiasm in science through the theme of invention. Creative writers, often light years ahead of their time, imagine all sorts of fascinating inventions -- many of which influence the production of their real-world counterparts. Revealing this to children in a creative and interactive way would clearly bode well for connecting their interests to science.

Anthony F. Franco, a member of the Yale-New Haven Teachers Institute, provides a manifestation of this idea in a curriculum unit that he titles, "Search for Tomorrow: Science Fiction Literature and Today's Student." The unit explores the science fiction novels of the last hundred years, looking at how the authors developed their ideas as well as how they inspired inventors that followed them in history. To offer but one example, Franco looks at the Jules Verne classic, Twenty Thousand Leagues Under the Sea. Originally written in 1873, the story followed the adventures of a sophisticated underwater vehicle called the

'Nautilus' and its crew as they explored the depths of the world's oceans. As Franco describes, "Apparatus such as electrical clocks, generators and motors, stoves and heating coils, and electrical lights and searchlights were all accurately forecast by Verne" (1979). At the same time, underwater travel has since been developed and advanced by scientists and inventors who no doubt grew up reading Verne's book.

NASA's Breakthrough Propulsion Physics (BPP) project offers similar evidence of science fiction influencing real-world inventions, particularly in regards to the space program. It seems that Jules Verne, in addition to writing Twenty Thousand Leagues Under the Sea, also wrote a story involving transporting people to the moon "by blasting them out of a giant cannon," an idea which inspired the pioneers of rocketry (Millis, 2001). Later on, the spaceships of science fiction stories such as Flash Gordon and Buck Rogers inspired the design of the NASA Space Shuttle (Millis, 2001). Even the BPP project itself is based on researching real methods of making possible such staples of science fiction such as travelling at the speed of light or teleportation.

The BPP program itself goes so far as to describe the process of going from science fiction to real-world invention in terms of five reliable steps. Beginning with the steps of 'Conjecture' and 'Speculation' characteristic of science fiction novels, 'Science' develops an understanding of nature which later translates into 'Technology' and finally 'Application'. While this may only be a conceptual tool for understanding the influence of science fiction, it is no doubt suggestive of a solid connection that many scientists, even those at government-based organisations such as NASA, take seriously.

With an audience of young adults already captivated by the world of science fiction stories and movies, the stage is already set for drawing the crucial connection between these ideas and science. However, many attempts to inspire children through inventions have fallen short.

Some of the more contemporary initiatives to reach out to children with science through invention take the form of websites and organisations similar to the 'Kid's Café' portion of 'PatentCafe.Com'. The site offers creative activities centred on all aspects of the invention process, from conceiving an original product, to building it with materials, to marketing it to consumers. 'Kid's Café' successfully points out the progression of a creative idea for an invention into a final product but gets too bogged down in the technical aspects of having children specify their invention descriptions, materials, and test results in concrete terms. As a result, the activities could become tedious or too elaborate for young adults, and without the base of interest in popular science fiction they may not be motivated to continue.

Examining the work of creative writers and the realisations of their ideas in the form of invention offers a new and distinct direction for connecting children to science through invention. The science fiction novels and movies that are often dismissed by parents or teachers as 'only fantasy' can take shape in the realm of science, and as they do children will no doubt pay close attention. Just as Franco writes within his lesson plan, "Our students, too, may develop bizarre and strange goals for themselves, but if they are cultivated to examine the basis for their thinking…they will learn to adjust their future goals in a more responsible and carefully executed manner" (1979).

5.2.4 National Curriculum

An effective and enjoyable science-based web game will need to incorporate scientific information that the player will have some prior background knowledge of. The National Curriculum is the set of general requirements set forth by the British Government that outlines which subjects students must learn in each year. This guideline will allow us to understand what scientific topics will be appropriate for each age group.

The National Curriculum was set up in order to have a clear set of goals for all students in each level of their general education. This set of requirements allows teachers, parents, pupils and members of society to know what students learn at each level of their education. The National Curriculum Requirements are composed of four Key Stages: stage one is between ages 5-7, stage two is between ages 7-11, stage three is between ages 11-14, and stage four is between ages 14-16. These requirements state what subjects are to be taught during those stages. The schools are allowed to use their discretion as to when the subjects are taught but they must be started during the stage stated. Figure 5-A represents a chart that shows the subjects and the stages in which they are required to be taught (National Curriculum Online, 2001).

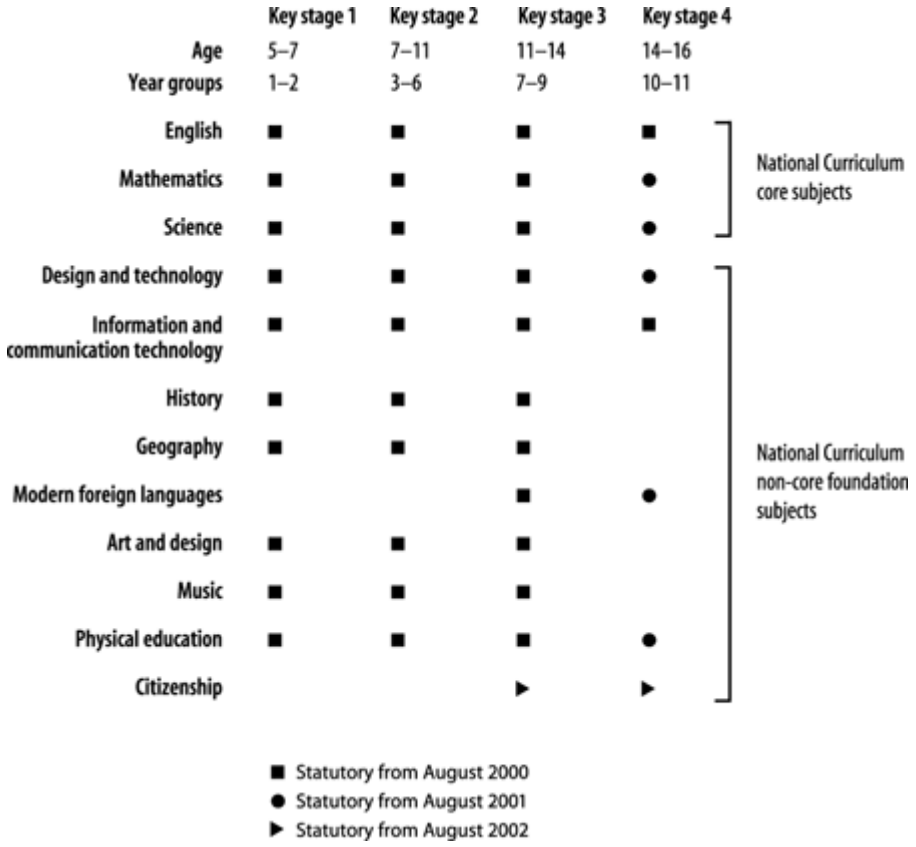

Figure 5.1: National Curriculum Outline

(National Curriculum Online, 2001)

When trying to re-write the National Curriculum, the British were trying to incorporate a new section into it called Information and Communication Technology (ICT). This new section works to unify each subject taught in schools so students can see the connections between them. However, taking that information into account, it almost seems as though this task would be impossible. Many primary school teachers and some secondary school teachers have few science qualifications, and therefore lack the confidence needed to teach these subjects effectively (Dowling, 2001). Teaching science needs to be approached differently than most other subjects such as History or English. Teaching needs to guarantee that science comes to life and students have the opportunity to challenge accepted facts and ask many questions.

When designing a game for young adults it is important that they have the knowledge to reinforce the new concepts that they are learning. In order to have a successful game that is fun as well as educational our group will have to ensure that the scientific concepts in our game match up with those learned in either Key Stage three or four. In Key Stage three there are a slew of different topics that are covered with these students in years seven, eight and nine. Some of these topics are Variation and Classification, Acids and Alkalis, Particle Model of solids, liquids and gases, Solutions, Energy Resources, Electrical Circuits, Forces and their Effects, The Solar System and Beyond, Cells, Reproduction, Food and Digestion, Respiration, Ecological Relationships, Atoms and Elements, and others. The topics covered in Key Stage four include Cell Activity, Nutrition, Circulation, Nervous System, Hormones, Homeostasis, Health, Variation, Inheritance, Evolution, Adaptation and competition, Atomic Structures, The Periodic Table, Chemical Reactions, and others.

The National Curriculum is a guideline that gives Science Year a way to further integrate its resources into the classroom through the development of their academic resources. Science Year is providing resources that can be used to make the connection between the National Curriculum's core subject of science and ICT. According to the National Curriculum Online: "Pupils should be given opportunities to apply and develop their ICT capability through the use of ICT tools to support their learning in all subjects" (National Curriculum Online, 2001). That statement defines what Science Year is out to do and allows a clear way to integrate Science Year's resources into schools through the National Curriculum.

5.3 Current Attempts to Present Science to Young Adults

5.3.1 Overview/Sampling of Various Programs

Many programs and initiatives have been developed to reach out to young adults in response to their perceived loss of interest in science. Hoping to present science in a manner that is exciting, challenging, and ultimately relevant to today's youth, these programs are numerous and unique in their own styles and contexts. Fortunately, their numbers are already large and continuing to grow- so much so that the best way to survey them is to present a few examples.

US FIRST, highlighted in the preceding discussion of inventions, is one of these programs; its mission is "to excite more young people about the fun, accessibility, and importance of science and engineering" (FIRST Homepage, 2001). FIRST is best known for its robotics competitions, in which teams from high schools and colleges all over the US build their own robots and pit them against each other in completing different objectives. In the production of these robots, students not only learn first-hand about scientific and engineering methods and principles, but they have a lot of fun as well! Aside from these competitions, FIRST provides a number of resources for schools looking to energise their presentation of science through the 'FIRST Place Science and Technology Centre'. Such resources come mainly in the form of programs and field trips centred on scientific design, interaction, and application. Overall, FIRST is one of the best examples of the programs geared towards getting children interested in science, and one of the most popular.

Other programs oriented towards getting children interested in science target particular groups, such as the 'Girls in Science: Museum, University, School and Community Connections' program (1996). This program works at educating teachers about the inherent gender discrimination evident in today's schools as well as developing science programs specifically targeted at girls. Admittedly, this particular program seems more geared towards studying the present state of science-based programs rather than necessarily changing them, as the abstract of the program reads, "It seeks to measure science club and other informal science experiences for girls as vehicles for changing classroom climates" (2001).

These two programs offer only a small view of the international push to present science to young adults in new and dynamic ways. Perhaps more important than exploring a list of such programs is developing an understanding of what factors contribute to their success or failure. In general, it seems that programs that mirror the objective and stale nature of science education have less success in student participation and expansion than programs that take a subjective route. The previous example of the 'Girls in Science: Museum, University, School and Community Connections' program, with its focus on aptitude assessments concerning the scientific abilities and opportunities of girls, is perhaps one such program that has gathered information concerning interest in science, but failed to push itself beyond presenting science in a traditional manner. US FIRST, on the other hand, is hugely popular among children of all ages, largely due to its innovative method of presenting science by applying it to the design of robots. The interest of any young adult is easily hooked by any mention of building robots, and consequently the US FIRST program is crowded despite its basis on scientific principles that children may previously have considered boring and irrelevant. Just as new attempts to develop interest in science among young adults have sought to place it in the context of their own hobbies and imagination,

popular science programs such as US FIRST have been successful in facilitating creative and unique activities anchored on scientific principles. Many programs relevant to the WPI Science Year IQP that match these descriptions reside on the World Wide Web and deserve further study and review.

5.3.2 Focus on Web-Based Efforts

The Internet is an often-overlooked teaching resource, even though part of its origins lie in the academic world. This new medium is just beginning to evolve in terms of its educational potential. With the ability to deliver interactive content and various educational media, the Internet also provides a unique learning interface.

Web-based learning provides for a non-traditional type of instruction that allows students to partake in instruction from anywhere at anytime, be it at school or at home. Learning in school is done in a specified time frame and there is only as much time to learn as there is time in the class period (Relan & Gillani, 1997). Web-based learning, however, allows children to learn at their own pace from home and gives them the time to delve in depth into the topic they are studying. They are less bound by structure as well, and they are free to roam when their interest wanes. This keeps them from being put off by what they are studying due to frustration. Web-based learning also has the added effect that a child has control over their learning (Relan & Gillani, 1997). They are guided by what the website offers but are free to choose the direction of their learning.

Currently available web-based teaching efforts provide children with information in many different forms such as audio, video, text, games, published data, expert interviews and more. This allows the student to get a broader range of input and therefore a firmer grasp on a topic than the singular point of view that something like a textbook gives (Relan & Gillani, 1997). Current web-based teaching efforts take advantage of the fact that their medium is dynamic and can be changed as often as necessary, as opposed to the relatively static nature of a textbook. New content as well as new methods for delivering that content can be added with ease. It is significantly cheaper to update and maintain a website than a textbook, and the fact that the website is usually offered up for free increases its usefulness as a teaching tool for all social classes, at least those with access to computers.

Perhaps one of the best science-related teaching websites is BrainPOP.com. BrainPOP contains numerous activities that are designed to teach children about science and technology in a way that makes them want to learn on their own outside of the classroom. The site also contains experiments and activities that teachers could use in their classrooms or students could do on their own. The site is split up into three sections: Health, Science and Technology. From there, individual topics can be chosen such as rainbows or the brain. Each subtopic features an animated movie, quiz, history timeline, experiment, and an activity section. The site is particularly effective because the animated movies condense a lot of information down into a fun and useful form.

Designing and creating websites such as BrainPOP is not a simple task, even setting aside concerns of relevant content and focus. The design of such websites is an important area to study, and one that has grown with the contributions of web and game designers over

the last decade. Understanding their work and its relation to that of the WPI Science Year IQP is vitally important to the success of its final web-based games.

5.4 Creating Content to Reach Today's Youth

Employees at the London Science Museum employees have spent a lot of time documenting the interactions of visitors with interactive displays and more specifically, computers. The Museum has many different computer exhibits, some of which involve touch screen displays. The Museum has done intensive research on designing computer exhibits based on the observed interactions between visitors and the exhibits. Even though the Internet and computers are a relatively new medium of interaction and communication, there seems to be no 'evidence of techno-phobia' (Ben Gammon) from people that attend the Science Museum. Visitors and viewers of these computer exhibits and games obviously prefer something that is colourful and exciting; a simple exhibit does not impress them.

5.4.1 Web-Based Design: Creating Content Geared Towards Children

Children grow up today with the Internet just as their parents grew up with television. It is pervasive and, unlike television, it is interactive. The Internet is an information pool that can be accessed at any time from almost any computer. It was recognised as an abundant information source early in its development by many universities. It can deliver pictures, text, video and audio -- thereby virtually replacing books and television with a single medium

(Crossman, 1997). One of the key aspects of web-based learning is that it can be self-directed (Romiszowski, 1997). More and more this skill of learning how to learn is being emphasised because there is so much information to be picked up that it cannot all be taught in school. Websites that contain information directed towards children are usually designed to capture their interest and make them want to learn. In order to facilitate self-directed learning a website must consolidate as much information into as little space as possible (Romiszowski, 1997). This keeps the user interested because they do not have to weed through irrelevant or seemingly boring information. One of the best aspects of a website is that anyone can access it from home if they have a computer. Children will be encouraged to learn outside of school and will actually seek out the website if it contains interesting topics.

Young children have a very inquisitive nature and are always asking questions related to science – such as "why is the sky blue?" Or, "why is a dog's nose wet?" Children observe something that interests them and then want to find an answer to explain what they see. This is why there is perhaps no better tool than web-based games to bring out a child's naturally inquisitive nature. Most children are interested in computer games, and by wrapping lessons or information in a game a child learns and has fun at the same time, which is ideal. Allowing student to explore and learn at their own pace and of their own will is most conducive to learning. The website's role is simply to provide a structured direction.

Another aspect of learning that Internet-based content can provide is discovery learning. Discovery learning provides a framework in which a student can work in and allows the student to 'discover' a scientific phenomenon (Linn, 1986). This is opposed to direct learning where an authority figure directly tells the student about the phenomena. Discovery learning has a distinct advantage over direct learning in that a student may be put

off if what they are being told contradicts their own information (Linn, 1986). Direct learning may also seem like nothing but a gathering of stale information that has already been discovered (Linn, 1986).

Children in particular interact differently with varying interfaces and therefore a game needs have an interface that is simplified and usable by everyone. Studies in the Science Museum show that most people tend to ignore text and graphics in the top third of the screen, which means that if text must be put at the top of the screen it needs to stand out in some way (Ben Gammon). Another observation shows that people tend not to read anything on the screen that contains more than 100 words so it is important to keep the text as brief and simplified as possible (Ben Gammon). Instructions are quite often skipped over and so any that are particularly complicated need to have some incentive in exchange for reading them; such as forcing the player to wait briefly before continuing.

5.4.2 Game Design: Strategies and Concerns in Creating Educational Games

Central to the WPI Science Year IQP is not only the production of educational web-based games, but the creation of dynamic and innovative web content as well. Just as web content geared towards children requires careful and conscientious design, so too do computer games targeting younger audiences. Too often game designers seem to take this for granted, and the result of such negligence is evident in how the educational game market has yet to live up to its full potential.

As a medium of communication, computer entertainment and games offer a level of interactivity unparalleled by conventional books or movies. They have the potential to allow a player to fly a jet fighter plane through an enemy landscape, manage an entire city and its population, or even just co-ordinate puzzle pieces to accumulate points – all from the comfort of their living rooms or computer desks. Having this ability to allow interaction with imaginative environments and simulate real-life situations, computer games are capable of a wide range of both entertaining and educational opportunities. However, creating games that adequately harness these capabilities is far from easy, especially in regards to gearing them towards educational goals.

Game design is a difficult and developing discipline by itself, setting aside the challenging matter of incorporating educational elements. After all, what makes a game fun? Are there inherent qualities in popular games that explain their success? A wealth of literature exists searching for answers to these questions, and from it a number of theories have emerged. Without delving too deep, a number of core principles seem to fuel the most popular games. The predominant idea is that the medium provides for unparalleled interaction and immersion, so games have to be interactive. Restricting players with linear, step-by-step game play, long-winded cinematic sequences, or heavy reading squanders interactive capacities. At the same time, burdening them with complicated interfaces or difficult controls gets in the way of their experience. Educational games in particular have difficulty in following these guidelines, due to the instructional, step-by-step game play they usually involve. However, innovative and experienced educational game designers have forged methods and tools for creating interactive environments for learning without burdening them with lengthy lesson plans or instructions.

Margo Nanny, the Senior Designer/Producer at Interactive Learning, is one such game designer. In a 1998 interview she remarked that if "…we really want computers to help children enter the 21st century we need to use them for higher level thinking activities in which the child is creating, designing, building and representing ideas, not simply becoming a correct answer machine herself" (Stern, 1998). Believing many contemporary forms of educational software to be dull, flat, and based on older technology, Nanny sees real possibilities in the ability of software to foster interaction and creativity in the player. As an example she discusses Maxis' SimCity, a computer game based around all the important aspects of managing a real-life community. In terms of education, such a game offers unparalleled visualisation of concepts such as the management of resources, the relative happiness of a population, the purpose of government, and more (Stern, 1998). However, Nanny believes that "simulation doesn't "teach" those ideas, they just create rich environments in which children encounter them" (Stern, 1998).

Tzvi Freeman, a teacher of game design at DigiPen School of Computer Gaming, voices similar thoughts in a more objective vein. Freeman sees the key to "empowering" children through educational software as keeping two main ideas in mind: versatility and comfort. Versatility is what allows a child player "… the freedom and power to explore" (Freeman, 1997). It involves creating environments where everything has a use and function, as well as one where control is constantly left in the hands of the child. Comfort concerns the "confidence" with which a child plays a game. It involves creating consistent, intuitive, and responsive worlds that the player has an easy time understanding. In describing how these two ideas should manifest themselves in educational software, Freeman issues some striking ultimatums. For example, educational games should never have built-in "wrong" responses in Freeman's eyes. As he writes, "The last thing any child wants to hear is a machine telling

her she's wrong" (Freeman, 1997). Whereas educational entertainment is capable of empowering children through interaction and creativity, "wrong" answers stifle the confidence and power of children who previously thought they were in control of the environment.

The thoughts of both designers seem revolutionary within the context of the educational software industry over the last ten years. While surely there have been exceptions, many attempts at "edutainment" have resulted in what Margo Nanny calls "meat and potatoes" type instructional games, involving "reading and math with a licensed character" (Nanny, 1998). Such games may keep children interested for a short while, but will not captivate them in the way that the non-educational games they play at home will. What will grab their interest and enthusiasm for learning are games that engage them with interesting environments, versatile interfaces, and dynamic content.

As Jerry Wellington wrote in the conclusion of a 1999 study of the use of multimedia in chemistry classes, "The difficulty of integrating multimedia with subject teaching…should never be underestimated" (1999). Any amateur game designer can conceive of creating a game to teach a subject, with reading sections followed by questions and answers along with bright coloured pictures and characters. However, the key to real success and teaching lies in much more creative games, as well as in understanding what children really enjoy. As Freeman writes, "When you design an object, a tool, or an environment, don't just think about what you intend the child to do, think about what the child may attempt to do. And then make that possible" (1997).

While creating this learning environment it is also important to keep in mind that we are building on foundations of science education, to which the students have already been exposed. Students can build on their knowledge and gain confidence in themselves as learners, thinkers and scientists (Ben Gammon).

Within the scope of the WPI Science Year IQP, these principles take on a special meaning. After all, what lies at the core of renewing interest in science is creating representations of it without the objective and restricted qualities that children dislike. Throughout this discussion the technical demands of game design have been taken largely for granted. Clearly before a game is even ready for full production there are tools and methods necessary in its formal design and elaboration.

5.4.3 Tools of Game Design: Generating and Building Game Ideas

Having come up with an original and innovative game idea, designers are quickly faced with a difficult problem – namely, how to best communicate and detail those ideas so that they can be accurately presented to fellow designers and more importantly, to game programmers and producers. While some may be content in roughly communicating their ideas through sketches or crib sheets of listed ideas, others have developed methods for developing game designs in formal and comprehensive forms.

Some experienced game designers, such as Ben Sawyer, Alex Dunne, and Tor Berg, authors of The Game Developer's Marketplace, have designated an entire process for fledgling game ideas to mature into full-fledged formal designs. Their process begins with

brainstorming, where the ideas are initially generated in an open and creative environment. Design team members gather and focus on the objectives their design must fulfil, throwing out ideas and recording them down for further discussion and elaboration. From here the process moves on to the creation of formal designs in two stages. The first stage involves 'Design Treatments' – short two-page summaries of the proposed game's basic story line, visual representation, gameplay, and technical demands. As these treatments are written the game idea grows in detail, and reaches a stage where it can be proposed to fellow designers or team management. If the treatment is received well and warrants further elaboration, it is fully-designed in a 'Design Document'. Speculating to exceed twenty pages in length, these documents specify in precise detail all the crucial aspects of a game design, from its explicit story line and character scripting, to its visual elements and characters, to its audio elements and technical specifications. The Design Document is intended to be the final realisation of a game idea that can be confidently handed off to a programmer for final production. (Sawyer, Dunne, and Berg, 1998).

Involved with creating design documents is no doubt the creation of storyboards, vital tools to any game design process. A storyboard is a visual representation of how the final game will look and operate, drawn by hand or with imaging software. The Game Developer's Marketplace describes the role of storyboarding as being, "to document, sequence by sequence, exactly how games will look" (Sawyer, Dunne, and Berg, 1998). The drawings detail several visual aspects of the game design, including the appearance of characters and objects and their arrangement on the screen, along with the animations they perform within a given level or scene. They "can range from rough sketches to very detailed drawings," indicating that the importance lies more in the communication of the game design visually rather than in artistic production value (Sawyer, Dunne, and Berg, 1998). However,

depending on the complexity of the design, storyboards may need to be significantly detailed in order to capture the proposed game's visual elements in their entirety. Overall, they are an invaluable tool for illustrating and developing a designer's vision for a game before it begins its production stages.

Using the tools of design documents and storyboards, game designers can work to better define their proposed game concepts and communicate them in a complete manner. More than just committing an idea to paper, producing these documents forces a designer to consider all the different aspects of a game design. In doing so, the programming and production process can begin with solid footing, having all the major details and programming demands already laid out.

5.4.4 Game Production and Programming

Having generated an innovative game idea and formally detailed it within a design document, the programming and production portion of game development can begin. Initial design work is of great value in preparing for this stage, communicating to all members of a development team the proposed game in its entirety. However, in many ways the task of design is still only a beginning; the rigorous and difficult task of programming and developing a web-based computer game still lays ahead, and should not to be taken lightly.

In the same way that experienced game designers have developed methods of generating game ideas and expanding upon design concepts, experienced game programmers have developed strategies for carrying out a game programming project in a structured and

efficient manner. Many of these ideas focus on filtering out the programming and graphical demands of a game design and examining it through the eyes of a computer scientist. It is important to point out that these methods are devised primarily for projects of a larger scale than most web-based computer games. Nonetheless, their study provides a game programmer with a good starting block for managing the unwieldy and intimidating task of making a game design into programmed reality.

One primary principle of producing a computer game involves understanding the technical restraints of both the available tools and the medium itself. In The Art of Computer Game Design, Chris Crawford touches upon this precept to some length, writing that a game developer must, "thoroughly understand the medium with which she works. The computer offers special possibilities and imposes special constraints." (1997). While a degree of this understanding needs to be employed earlier in the stages of design, it becomes vitally important in the process of programming. By examining a design and getting a sense of its technical demands, programmers and designers can sort out discrepancies early and begin development fully-conscious of the challenges before them. As Crawford writes, "Our goal is to extract maximum performance from the computer, to make it work its best. We can only do this by making it perform functions which it performs well." (1997) In looking at a game design with the more pragmatic eyes of a programmer, the necessary tasks become clear and development schedules can be adjusted accordingly.

Another important principle involves deriving the base rules, objects, and relationships that a game design will involve by examining their proposed gameplay. In looking at any produced game or game design, a computer scientist or technically-minded individual can begin to visualise the coded elements it will involve. For example, by looking

at a classic game like Super Mario Brothers a programmer can understand that Mario himself is an elaborate coded element that will require a fair amount of work. All the behaviours that Mario involves, such as jumping, running, growing when he eats a mushroom, or shrinking when hit by an enemy need to be organised and managed within the code in a structured and efficient manner. By looking at these behaviours a programmer or team can begin to understand and list the tasks before them. At the same time, they can make implementation and programming strategy decisions by examining the designed elements in reference to the particular software or programming language they plan to use. Getting deeper into this discussion may involve too technical a focus, so suffice to say that experienced game programmers devote a certain amount of initial time to digesting the game design and discussing its coded possibilities before they sit down at a computer.

Overall, programming and producing a computer game can be just as creative and difficult an activity as designing it in the first place. With the details of a proposed game in front of them, programmers work towards creating structured and efficient realisations of the design. Strategically, this task is best approached by first developing a sort of consciousness of what the coding process will entail. By actively working through the design and creatively visualising its technical demands programmers can sculpt an image of the overall game system; an image that will allow them to program the game through an educated and aware perspective.

Finally, it is important to keep in mind that design doesn't end with the completion of a design document. During the course of a programming project, designs often change and develop as imagined game concepts are realised in a limited technical world. As a result, programmers and designers need to work closely throughout the production period to account

for changes, subtractions, or additions to the original design. As Crawford writes**,** "the designer/programmer team is bound to fail because the designer will ignorantly make unrealistic demands on the programmer while failing to recognise the golden opportunities arising during the programming." (1997). Communication, planning, and visualisation are all keys to creating computer games on whatever scale. In actively working together a designer and programmer can combine their expertise to create games that are not only imaginative and fun but take full advantage of the technical resources available as well.

Particular to the WPI Science Year IQP, each member of the team has the responsibility of both design and programming. At the same time, the tools of use in programming the final web-based computer games are slightly different from those of more traditional game development. Getting a sense of their capabilities is vital to conceiving of the proposed game designs in the sort of programmer mentality discussed.

5.4.5 Production Tools: Flash Software

In creating a web-based game or piece of interactive software, the tools and physical resources involved in its production can play as central a role as its core design. The limits of technology always keep the visionaries of game and web design in check and work as the voice of pragmatism to counter the abstract nature of ideal designs and creations. However, tools and new technology for getting closer and closer to these ideals are created and developed every day and each new advance quickly transitions into the further development of game and web-based mediums. Due to the central role these tools and their developing nature play in design, it is important to survey some of the current tools we expect to be use

in the WPI Science Year IQP for their overall capabilities. In doing so, Macromedia's Flash software quickly becomes the primary focus.

Macromedia's Flash is a very useful tool for designing an interactive presentation or game. It provides many powerful tools for creating graphics and animations. Animations consist of a series of frames that can be played through to create a motion picture. Flash allows for 'motion, scale and shape tweening' which are simple ways to move a graphic around on the screen as well as change its size, shape, colour and orientation.

Flash also has its own scripting language called Action Script, which is much like Java. This language allows developers to create more powerful functionality than the simple actions that take place when using buttons or menus. Variables can be used to record information and facilitate more complex interactions such as game physics. Action Script is essential for any sort of game that needs more functionality than an interactive presentation. A score counter is an example of a function that requires Action Script to create.

Creating a Flash game or presentation is very similar to creating a movie strip. Flash contains a series of frames and layers. The layers allow the developer to reuse graphics so as to keep file size down. A layer can be thought of as a single frame or series of frames making up an animation that can be placed in the movie or game wherever necessary.

Overall there is no other tool quite like Macromedia's Flash for creating a web-based game. Flash provides complex functionality with a simple design interface. It provides added functionality through its scripting language, which is based off the well-known language of Java. Flash is what most small web-based games are created in and thus it has

been adopted by many and installed on millions of computers around the world. Flash is the best tool for developing a web-based game given both our time to learn and implement as well as its enormous install base.

Linked to discussing Flash and its role in the design and production of web-based content is an understanding of the more socio-economic concerns inherent of producing such content. Some children and even some schools may be without the computing resources at home to use or play a game that is too technologically demanding. As a result, an understanding of the level of technology possessed by these schools and households is needed as a concern in the final design of web-based content geared toward them, along with recognition of other possible barriers to the implementation of a well-conceived game design.

5.5 Potential Barriers and Issues

Aside from concerns regarding how to present science and technology as relevant and interesting to children, there are certain other issues and potential barriers that need to be addressed in the creation of an academic web-based game. These barriers represent social issues and outside factors that could have significant effects on the success or failure of our project. As a result, they are necessary to keep in mind throughout the design and development cycles of our work. They include concerns involving socio-economics and the presence of technology in the schools of the users, as well as thoughts of allowable and appropriate content.

5.5.1 Socio-economic Concerns

According to Edelson (2001) "computational technologies have become increasingly important to the practice of science. Computers now play a central role in data collection, data analysis, modeling, and the communication of results in scientific research." This technology is becoming important in order to achieve what Science Year is hoping to accomplish in the classroom with their multimedia resources. After all, software that presents science in a manner that is relevant to young adults is useless if insufficient computer resources are all that is available for accessing them. As a result, keeping in mind the technological status of British schools is necessary to creating software resources that will match their performance to the computer resources of their target users.

Prior to the start of Science Year there were other organisations working to increase the amount of technology present in schools such as Tools for Schools (Tools for Schools, 2001). Tools for Schools is an organisation that takes computers that are no longer being used in industry and gives them to schools. The basis for Tools for schools is as follows: “What makes more sense than giving pupils access to the technology that industry no longer needs, but which remains of considerable value to schools?” (Tools for Schools, 2001) By giving schools better access to computers they are increasing the chance of success for all students.

According the Survey of Information and Communication Technology in Schools 2001 (2001) the proposed ratio of computers to students in secondary schools for the year 2002 is 1:7. This proposed ratio would be good, allowing students ample use of computers during school hours (roughly an hour depending on the length of the school day). But

according to Tools for Schools there are still some government maintained schools where there are classes of 30 students that have access to only a single computer (Tools for Schools, 2001). Despite the average number of computers, 37.5 per school, said by the Survey of Information and Communication Technology, this is an average number and most schools do not have this technology available to them (Department for Education and Skills, 2001). Although Tools for Schools focuses on the less encouraging statistics, it is important to understand that not all schools have ample technology available and that needs to be taken into consideration as a potential problem in the design of our project. Without this kind of technology present, students are incapable of accessing the technology that is out there for them. In order for a large scale success of work that is being done by organisations such as Science Year, appropriate technology much be available to all pupils and teachers so that it can be used appropriately.

5.5.2 Allowable Content

Another potential issue that our project could face is allowable and appropriate content. In order to produce a game that children will want to use it is imperative to use themes that children will want to interact with, but at the same time parents have to approve of what their children are playing. A game would probably be received poorly by parents and the educational community if it were designed without thinking about what sorts of themes parents find inappropriate for their children. Therefore, it is necessary to look at what types of material parents deem acceptable and unacceptable for their children.

Most children think that they should be allowed to see certain things that their parents don't approve of, such as R-rated movies and those with excessive violence, but inevitably parents have the final say about what they see. While studying the topics and themes that students will enjoy interacting with it is essential to keep in mind what their parents will allow them to see.

In the United States there is a rating system called the Entertainment Software Ratings Board (ESRB). This allows parents to know what type of material their children will see before they see it. There are five main categories that all entertainment software falls into: 'Early Childhood', 'Everyone', 'Teen', 'Mature' and 'Adults Only'. According to our research there doesn't appear to be a rating system such as the ESRB in the United Kingdom. The games developed by Science Year are very obviously not 'Early Childhood', 'Mature' or 'Adults Only'. A game that is marked 'Everyone' would contain content acceptable for anyone ages six and up, containing minimal violence and perhaps some comic mischief or crude language (Electronic Software Ratings Board, 2001). A game that is marked 'Teen' would contain content suitable for children ages thirteen and up, and may include violence, mild or strong language and suggestive themes (Electronic Software Ratings Board, 2001).

In accordance with the age group (10-19 years old) of interest to this project, it is in the best interest of the Science Year team to develop a game that would be rated 'Everyone' even though a ratings system such as this does not exist in the United Kingdom. If the project were to be rated 'Teen' it would most likely be too suggestive to use in a school, and parents would not allow their children to play it. The matter of what constitutes acceptable content will be one of the most difficult issues we grapple with as we attempt to find themes that children will enjoy without making them more than what parents will want them to see.

6. Methodology

In tackling the challenge of creating educational media for students, it was important that we employ a collection of methods, some technical and some more qualitative. To completely understand our project we began by talking to students in our target age range in the United States. This knowledge of what gets children interested in games, be they educational or simply entertaining in nature, was essential for designing and creating a game that they would enjoy. Also, we interviewed members of the Science Year team about numerous topics ranging from what already exists on the web site to what types of things they would like to see our game entail. Once the team had a good grasp of our project we dove right into brainstorming and the creation of our actual games.

6.1 Science Year

Each member of the Science Year team contributes different background knowledge to the team, and all of them have the same goal of creating science content for students. Since the Science Year team had such a vast range of knowledge to share with us, Science Year was our primary source of general information and answers. During the first few weeks we were in London, we interviewed members of the Science Year staff familiar with our project and involved with developing content for the Science Year website.

An initial goal was to gather suggestions from Science Year about the educational topics that they wished to see in our games. The Science Year website contains a good

variety of games from different areas of science such as biology (‘Planet 10’) and physics (‘Rail Slide’). It was possible that they already had games made for a specific area of science and would have liked our efforts to focus on a different area. Secondly, we were interested in what materials Science Year might have used in determining, for their website, what students like in interactive media. In speaking previously with Sophie Duncan at Science Year, we had learned that, since Science Year is only in operation for one calendar year, they have not done any research of their own on the subject of interactive media but have instead relied on what others have already discovered. However, Ms. Duncan informed us of three documents developed and used by the London Science Museum in designing their exhibits. Each of these documents dealt with how people (mainly visitors to the Science Museum) interact with interactive computer exhibits. These three documents were entitled “Assessing Learning in Museum Environment”, “Advice on How to Develop Visitor-Friendly Computer Exhibits” (subtitled Seven Gruelling Years of Watching Angry Visitors), and “Learning in Museums”. We read these documents thoroughly and extracted pertinent information from each of them (see Literature Review). The information contained in the documents helped to provide a clearer picture of some of the user interface and design decisions we would make in creation of our games.

We also interviewed Anne McNaught, the Web Co-ordinator for Science Year, with a view towards learning about formatting rules and guidelines we needed to follow to integrate our games into Science Year’s website. Aside from this guideline information, we also asked Ms. McNaught her suggestions and strategies for web-based multimedia development. We were generally looking to garner any tips or insights she could provide us based on her many years of experience in this line of work.

Ms. McNaught also served as our contact with Telepathy, the company that currently designs the games for the Science Year website. Through Ms. McNaught we maintained correspondence with Telepathy concerning their general game design strategies and process. As our project progressed we gained a better sense of the type of information we needed from Telepathy. Ms. McNaught facilitated the communication with Telepathy and set up a meeting between our team and Telepathy representatives for early in week three.

6.2 Children's Interests

Finding out what interests children and what makes them excited to learn was a large part of our project. Without an understanding of what children like, we would have had difficulty creating games that are both fun and stimulating to them. In order to determine what it is that interests children, we went directly to them.

A great deal of our background research is devoted to this topic, but in order to gather our own information we interviewed a small cohort of six students at the Sage School in Foxboro, Massachusetts. At the Sage School we interviewed six students in an hour-long session that was divided into two different sections of questioning. During the first half-hour we allowed the students to navigate the Internet on their own, showing us their favourite games and websites. Each member of our project team observed a different student; we asked them what they liked about the sites and worked to develop an understanding of what they enjoyed in web-based activities. The second portion of the session involved directing the students to the Science Year website, which they were allowed to explore in our company. As the students interacted with the website through its games and resources, team

members asked them what they thought of the site's interactive activities and content. Focusing on the games, we asked them which games they found the most fun and how they would change the games if they could. The questionnaires used can be found in Appendix B.

After completion of the interviews we analysed the data for common responses and reoccurring themes. The data gathered from the Sage School cohort and the conclusions drawn from it can be found in the "Results and Analysis" section of this report. These served as key points of reference for us when designing our own games.

6.3 Telepathy

Telepathy is the company that builds Science Year's games. We found out from them what factors they considered when designing games for children ages ten to nineteen. Maters such as appropriateness, interest to the target age group, and feasibility were main points on which they advised us. It was also instructive to learn what criteria they use to judge educational games. We also received recommendations and pointers from them that cut down on research and development time. Telepathy also provided insight into the scale and time involved with each aspect of a typical project. We asked some of our questions in a questionnaire that was sent ahead to Telepathy before we arrived in London (see Appendix B).

Our questionnaire, completed by Sarah Street of Telepathy, was waiting for us upon our arrival in London on our first day of work. A summary of the advice received from Telepathy can be found in the "Results and Analysis" section of this report. In addition, after

getting Telepathy's responses we developed a contingency plan in case we were unable to finish our games or felt that they could benefit from professional-grade art and sound. Our plan was to have good documentation and a clear model for Telepathy so that we could hand off our work to them if necessary and thereby improve the chance for our game design to be completed.

6.4 Brainstorming

Brainstorming was the first major task on our path to creating science-based games involving the themes of sports and inventions. Having researched and evaluated what types of games interest children and what content they are mature enough to grasp within their particular key stage, we devised a list of objectives and constraints related to the design of our final game. Brainstorming sessions and techniques were critical for creating the initial concepts of science-related games that later grew into full-fledged designs. Our team was committed to holding these sessions every day for the first two weeks of the project, because we saw them as key components in exercising our creativity in both developing new ideas and elaborating on old ones.

The brainstorming sessions, which typically lasted a half-hour, were relaxed and open but at the same time focused on the task at hand. The format was one in which each group member was able to offer suggestions and ideas without criticism from fellow members. Staying on task and keeping tangential discussion to a minimum were also important, as was recording the results and products of each design session in a useful and complete form.

With the goals in mind of staying on task and focusing on sports and inventions, we utilised a number of techniques during the sessions to both provide open space for creativity and focus our attention on realistic objectives. During each session, we designated a moderator and note-taker. The moderator was assigned the task of helping us visualise concepts, and the note-taker recorded our concepts for future review. While trying to come up with ideas, we constantly reminded ourselves of a number of objectives involving realistic game design goals, as well as the need to focus on at least one of the themes of sports or inventions. We also considered more general game design points such as the need to incorporate creative gameplay and maximise replay value.

In addition, our brainstorming sessions had three different stages of concept development. Each of these stages was a part of every brainstorming session and worked on developing our new and old game ideas. The first part of our brainstorming session focused on coming up with *brand new* ideas. The intent here was to keep generating new ways of looking at our objectives, while developing new directions that our more elaborate designs might take. The second part of the brainstorming sessions involved developing previously introduced ideas, by adding creative detail to their imaginative concepts and helping them to grow towards designable and concrete final ideas. Finally, the third part of the brainstorming session pertained to eliminating ideas generated in that brainstorming session that might have been unrealistic or poorly connected to the themes of sports or inventions. After eliminating game ideas, we produced a list of games that we intended to develop into design treatments from that brainstorming session. Appendix C contains various resources pertinent to brainstorming sessions, including a list of objectives and operational guidelines, and Appendix D contains the log from our brainstorming sessions. The brainstorming log was

written up following the brainstorming session; this involved putting ideas initially noted in list form into a paragraph form detailing what each idea entailed.

(*Brainstorming techniques were adapted in large part from those detailed in Game Developer's Marketplace by Ben Sawyer, Alex Dunne, and Tor Berg)

6.5 Game Design

One of the most crucial aspects of our project involved finalising our game designs, this involved creating detailed conceptions of the interactive games that we hoped would inspire scientific interest in children. We produced our game designs from creative raw materials that we produced daily in our brainstorming sessions.

To achieve this end, game designs progressed from their brainstormed beginnings to their final incarnations in a three-step process. First, we elaborated on the ideas at some length in multiple brainstorming sessions. Next, we reached a consensus as to which ideas we felt had the most potential, and we attempted to build on their imaginative bases with further detail and focus. Finally, game design candidates emerged from these brainstorming sessions, and they were elaborated on and made more concrete in design treatments.

Design treatments are relatively short but concrete summaries conceptualizing a game. They describe, in general terms, the characters and story of the game, its basic gameplay, and its core interactive elements and presentation. Appendix E contains a sample breakdown of the design treatment template we utilised. At a length of approximately one to

two pages, they are “adolescent” designs that have potential for more elaboration. We produced twenty-five of these treatments within the first two weeks of our project, these design treatments can be found in Appendix F. By raising our game concepts to this level and further developing them, we had a number of quality possibilities from which to choose our final designs. Once our two final designs were selected from this group of twenty five treatments, they were moved on to the next stage, where they were elaborated by full-scale design documents and storyboards.

In order to gather feedback on our game ideas, we showed them to several different groups. We began by showing four of our game ideas to our peers in the other WPI project groups that were in London with us. We presented our game ideas to twenty-seven students, each of whom was given a sheet of paper on which to organise their comments. At the end of the presentation we fielded questions and collected the students’ comments. A summary of these comments can be found in the “Results and Analysis” section of this report. Next we took five game ideas to the Science Year team and presented each one-by-one, allowing for questions and discussion after each presentation. Although we gave comment sheets to each Science Year team member, many did not use them, opting to give their comments verbally. A summary of their comments can be found in our “Results and Analysis”.

In order to select the two final design treatments for further elaboration and final production, we developed a set of criteria by which the games could be judged. Our criteria consisted of a set of "required" filters and a set of "desired" filters; successful games needed to pass through a minimum number of the filters. If a game did not pass through the required filters, then it was automatically eliminated. The filters were organised into three groups: science, entertainment and feasibility. The science filter’s purpose was to ensure that there

was educational value to be garnered from the game. There were six criteria within this filter four of which were mandatory, and the game idea had to meet a minimum of five out of six to pass. A specific list of the criteria that comprised this filter can be found in Appendix G.

The next filter was the entertainment filter, the purpose of which was to establish whether or not our idea was "fun." This filter comprised ten different criteria. None of the ten criteria were deemed mandatory, but a game idea needed to satisfy at least seven of the ten criteria to qualify. A specific list of the criteria found in this filter can be found in Appendix G.

Our final filter concerned feasibility, or the relative difficulty of producing and programming the potential game. We did not establish a set of specific, formal criteria for this filter because each game was different; instead, we opted to rely on the more subjective feasibility analysis of our own group members. Within this filter, however, we specified that "Should a game that the group is very excited about pass through the first two filters with very high scores, but involve overly complex programming, a full design treatment will be created to give to Telepathy for execution at the end of the Science Year IQP." Once our criteria had been created, we subjected each of our twenty-five game ideas to our criteria; of the twenty-five, eight passed and were retained as our final ideas.

With our eight game ideas in hand, we met with Telepathy early in week three. Each of the game ideas was presented to Telepathy, and they commented on which games were feasible for coding in our limited time frame. They also contributed new ideas for possible incorporation into each game. A summary of their comments can be found in the "Results and Analysis" section of this report. After the meeting with Telepathy we were left with four

game ideas that were each deemed feasible given our timeframe, and our team came to a consensus on two that were regarded as most exciting.

Final elaboration began with the construction of design documents -- this being the next step beyond design treatments and involving a detailed and explicit description of all aspects of the final game product. These documents served as templates and central resources for the final game design and were crucial in outlining the final production process. They detailed the game's plot line, gameplay, objects and characters, environments, visual/audio presentation, and a host of other details. Appendix E contains a sample breakdown of the design document template we utilised. Design documents ranged in size from five to twenty pages (and beyond) and were the formal and final representation of the game designs we contributed to Science Year at the end of our project (along with their programmed counterparts).

Accompanying these final design documents were sets of storyboards illustrating our game concepts and animation. We drew a number of storyboards by hand on paper. The storyboards cover the most essential, visual aspects of our final designs and accompany the printed versions of the final design documents created at the end of the three-week design period.

Our primary goal in this design process was to produce a body of work that generated multiple options and ideas for our final designs, while also allowing time and energy for describing them in sufficient written and visual detail. By the end of the three- week design

period, we had two detailed and complete design documents along with the alternative design treatments.

(**Design techniques were adapted in large part from those detailed in Game Developer's Marketplace by Ben Sawyer, Alex Dunne, and Tor Berg)

6.6 Programming

The final aspect of the project was programming and production of our final games. Before delving into the methods we planned to utilise for producing our games, it is important to emphasise that design work continued throughout the programming phase. On reading about our methodology, it might seem as though design work ended where programming began, but in practice it was more of an iterative process. As we worked to design the art and configure the game mechanics, our designs continually changed, and new ideas needed to be generated. Although the core of our project's design phase had been completed, the same sort of creative processes and strategies were utilised throughout the programming phase as well.

Programming was carried out using the Flash software introduced in our Literature Review. Early on, we needed to spend a considerable amount of time familiarising ourselves with the software, learning from built-in tutorials and lessons available on the web. Some degree of learning and practice with Flash had to be carried out as we turned to actual game production, but getting an early impression of its general use was a vital step in preparation.

An unfortunate effect of having little initial knowledge of Flash to begin with was that we did not have a good sense of how plausible completing the games within a three to four-week period would be. As such, our programming plan was to begin by working out the core functionality behind the game without getting too involved in the production of graphics or sound effects. For example, in producing a game involving football we were inclined to work out the physics and game play nuances of kicking the ball before we concerned ourselves with the quality of the graphics or the sound produced when the player's foot makes contact. This was important due to the aggressiveness of our timetable and the need to produce some sort of final prototype, however rough, by the end of the term.

During the programming period the primary coding duties were left to the more technically-oriented members of the group, while the others worked on both researching and scripting the text that was built into the game to explain directions or relevant scientific information. The design documents created in the previous weeks were invaluable guides for directing the production process and setting out a programming schedule. As new ideas were added to the game, the design documents were developed alongside their coded realisations. By the end of the programming period, we created two dynamic and creative games that were ready for immediate integration into the Science Year web site.

6.7 Final Focus Group

We conducted a shot testing period with a focus group after completion of the beta version of our games. We had planned to use the same Sage School cohort and Science Year representatives in our focus group. However, due to the strained production schedules and

delays, the results from the Sage School group in particular were not ready by the end of the project term. Nonetheless, the Science Year team and a pair of willing child players were able to aid us in identifying bugs and making suggestions for the final versions of the two games. Their input was vital to producing the finishing touches and preparing the finished products for submittal as well as for posting later this year on the web for the general public. We knew that it was important to find out what children thought about our games, because the games were targeted toward their age group. It was also important to have Science Year professionals involved in the critique, because they could provide feedback on the content and themes in our games and how they relate to their vision and goals.

Our focus group was able to access our games through a secure section of the Science Year website. Through this website, our Sage School group and Science Year representatives were able to test the games that we created. We e-mailed the Sage School group to inform them where they could find our games and to ask them to give us feedback similar to that received from them when we last met with them. We analysed this feedback on our games for any common themes or concepts in the comments. Comments or suggestions that occurred frequently were taken into consideration before we finalised our games.

7. Result s and Analysis

This section presents our project's results, which includes both the process we utilised to produce our web-based computer games as well as the games themselves. The process of production began with our background research on education and online games and at the Sage School in Massachusetts where we evaluated children's interest in online games. Arriving in London a few weeks later, we began our project period by brainstorming potential game ideas. These ideas were further developed into short design treatments, which we used to present our game ideas to different groups for feedback. In order to select two designs for final implementation among the final 22 design treatments, we devised a list of objective criteria that we thought our potential games should meet in order to be one of the final games. Utilising these criteria we were left with eight potential games from the original set, which we reviewed with Telepathy before making our final decisions. We chose 'Climbin' High' and 'Feed the Mind' as our two final games, and began a three-week research and production period. Finally, having completed our games we presented them to a number of test players, including members of both Science Year and the group of children we originally worked with at the Sage School, collecting their thoughts and suggestions before making final revisions to our game products.

7.1 Sage School

Since a large part of our project was focused on finding out what gets children interested in science and technology, we needed to have a good knowledge base concerning what children are interested in so we could create a game that they are drawn to. To determine those interests we went to the Sage School in Foxboro, Massachusetts and

interviewed children ages 10-14 concerning their interests in gaming and the Science Year website.

We conducted a focus group with six young boys for about one hour. The first half-hour was spent letting the students browse the internet looking for web-based games that interested them. We observed most of the students going to the same gaming website: shockwave.com. Despite difficulties concerning getting permission to install the Flash plug-in, the students did all eventually play a game of some kind. We found that none of the students actually played web-based games at school and therefore, unless they played games at home they did not have much knowledge concerning where to find games to play.

Each member of our team observed one or two different children, and despite each child's personal preference we did notice a few consistencies. We found that in general the students liked games with plots, storylines and adventure themes. Scoring and competition among classmates seemed to be very high motivators for continued play. A few of the boys seemed to get more involved with the games that used violence as the main theme. Finally, each of the students said that graphics are very important in a game because graphics are what the player sees and visuals account for most of their interaction with the game. However, this is most likely a generalisation that may only be a factor with younger children.

After the first half-hour, we directed the students to the Science Year website. Under our guidance the students browsed around the Science Year website and we recorded our observations of how the children interacted with the website. Generally, we noticed that the children did not read the instructions before playing a game and therefore became easily frustrated with it. If the controls were intuitive then instructions could be skipped without

consequence. In the game Buzzin', the students did not read the questions at the beginning of the levels and therefore did not get much out of the game, educationally. This possibly could have been due to the fact that there were no consequences or bonuses in answering a question wrong. One of the students did read the questions for that game and he commented that they were 'too easy' for his age, which was 14. In addition, one of the students played the 'Blood Bug' game and enjoyed it a lot because it was goal oriented, as was the game that he chose to play in the previous half hour.

Overall, the Sage School trip was invaluable for us because we came out of the focus group with a whole new perspective on gameplay and game creation for young children. We realised that questions required some sort of bonus for correctly answering them in order to get the player to read and answer them. In addition, we observed some of the children passing over games that took a long time to load. The children quickly got bored waiting, even if the game sounded interesting to play. In the end the children found the Science Year website and its games interesting and exciting.

7.2 Brainstorming Sessions

Our project period in London began with brainstorming sessions, which we held everyday throughout the first two to three weeks. Each session lasted for approximately thirty minutes, and during this time everyone remained focused and contributed any ideas that would better our games. The ideas were all generally based either on the themes of sports or inventions or involved attempts to combine the two. When all the ideas were down on paper and the half hour was up, we went through the list of ideas and assessed each for further development. We expanded upon ideas that warranted a design treatment to give us a detailed description of the game and its scientific aspects.

Reflecting upon the two weeks that we spent generating the pool of ideas from which we choose our final two, it is easy to see what led to the ideas we came up with. By the end of the second brainstorming session our team had come to the harsh reality that brainstorming was not going to be easy and would involve some sort of starting place from which to generate ideas. From that point on we used different methods to stimulate our thinking. We started off thinking of how we could make every sport we could think of into a game. Many sports could be easily swapped with the same science like in games such as tennis and football shootouts where the science is physics. The act of swinging a tennis racket to hit a ball is very similar to the swing of a leg kicking a ball. From the first person point of view these games were nearly interchangeable and this led to ideas from one game extending to other more promising game ideas. The invention themed game required thinking about different types of sciences such as mechanics and chemistry to see what we could develop in that subject area related to invention. This led to games that were more of an experimentation process than an invention process. We moved on from there to thinking about what types of games we each liked in order to spawn ideas based around gameplay rather than the other way around. We needed to extract the basic gameplay from 'full' games in order to apply it to a simpler web-based game. After each explaining why we enjoyed a particular game, we identified some underlying gameplay concepts that we could apply a science theme to in some way. For example, 'Feed the Mind' is based on a form of gameplay that requires simply bouncing items on a trampoline. In addition, a moderator for our brainstorming sessions was helpful because team members would tend to get distracted by thinking about an idea that they were particularly excited about instead of continuing to generate new ideas. Full documentation for each brainstorming session can be found in Appendix E.

Another method that worked well for generating ideas was observing some existing web-based games. After a few hours of playing Flash games online, each team member had thought up new ways of looking at sports that were used in these games. Also, we took a trip to the London Science Museum to help stimulate ideas as well as observe the interactive computer exhibits on display. We each recorded different aspects that could be applied to a game from the interactive exhibits at the museum.

Brainstorming is a hard thing to give structure to. It is difficult to outline the methods for a successful brainstorm since it depends on mood among other seemingly random events. One thing that saves time and frustration is cutting an unproductive session short. It became a bit frustrating for us on days when team members were at a loss for ideas. We should have worked on another activity for awhile to gain some inspiration rather than sit and try to think.

In our brainstorming sessions it was easy to identify the ideas that the team was most excited about, because we tended to come back to them during future sessions and embellish them. In looking at how our 22 design treatments came to be, it is evident that they are not the same as they started off as. For example when the idea of 'Climbin High' was initially developed, it was intended to be a game that looked at the geology of different rock types and how having knowledge of them could aid in mountain climbing. However, the final product looks at different mountain types and what a climber could find on them -- and how that relates to their location and rock type. After a design treatment had been drawn up it was looked at by each team member and converted to a form that everyone could visualize and agree on.

During the early brainstorming sessions, the team tended to propose ideas that were similar to games that we had seen somewhere else but with scientific aspects added. These ideas were good, but did not have the originality that we were looking for in our final games. Also, during the early brainstorming sessions our ideas tended to be more one-dimensional and very simplistic. These simplistic ideas could have been due to our lack of knowledge as to the capabilities that Flash provided as well as our ability to use the software. As the team became more confident in its programming abilities and began to appreciate that the ideas we were generating could actually be implemented in Flash, our ideas became more detailed and complicated. This in turn pushed us to figure out more of Flash's features to add to our games.

7.3 Game Design Treatments

Design treatments were quite useful for bringing together everyone's thoughts concerning a game idea. Each group member had a different mental picture of each game when it was proposed, and the design treatments allowed us to unify our vision. This was done by requiring some detail to be provided about the look of the game, the story behind it, and how gameplay would work. There was some disagreement over how the game should look and play but we tried to reach a consensus on these details through group discussion. If that did not work then the decision was left up to the person who came up with the idea in the first place. This system worked well, allowing everyone to add in his or her particular gameplay ideas.

Upon working up the design treatments, we were able to see that many of the gameplay elements we had come up with could be combined into a single game. An example

of this is an idea we came up with about nutrition and how the player could choose what food to eat in the game before they started. Depending on what they chose they were awarded a certain value based on the nutritional value of that particular food. The higher the value the more it would benefit their character during gameplay, i.e. increased stamina. Due to the central importance of nutrition in sports and its applicability to the variety of sports-related games we had generated, this particular element became something that could easily be added to any final sports game that was selected to be produced.

Though some of our different designs shared such similar gameplay elements, others had core gameplay or functionality in common. For example, a game involving football and the calculation of what angle to hit the ball also worked as a tennis game. In this way core game mechanics which seemed simple and engaging were also used and applied to other themes or sports to create new game designs.

Looking back we can now make a few observations about the design treatment's general format and sectional divisions. Determining the 'Development Specification' was really an estimate at that stage of the game. We based our estimate on our prior programming experience and what we thought Flash could do for us. As it turns out, we were not too far off in our estimates. The 'Science Involved' section was more critical than the 'Development Specification'. Looking back, a more thoroughly thought out game idea provided a better platform for adding science content. Some game ideas contained a lot of science concepts but did not fully describe how each could be added to the game. This was a problem when it came time to narrow down our view and choose two final game ideas to create.

7.4 Design Treatment Reactions

In designing a game it is easy to get wrapped up in a particular idea and fail to see the potential flaws in it. Therefore our team took several of the game ideas that we developed to different groups in order to get feedback. We started with the other WPI students at the London Project Centre, presenting six of our ideas and then asking for feedback. We knew that our peers would be naturally averse to telling us that one of our ideas was particularly bad, but they could point out potential areas for concern that we might not have noticed. We then went to the Science Year Team to look for their input on five more of the games for which we had developed design treatments. During this session we hoped to receive input on the science aspects of the games as well as general gameplay. Finally, we took our eight design treatments that passed through our selection criteria to a meeting with Telepathy. From this meeting we hoped to determine the feasibility of each of our games. Each meeting and the feedback that we received allowed to us further narrow down our selections until we had finally chosen two games we were pleased with.

7.4.1 Presentation to WPI Team

On January 22, 2002 our team presented six potential game ideas to the other WPI IQP students working at the London Project Centre. These six game ideas were 'Jumpin' Beans', 'Don't Mix That', 'Surfs' Up', 'Inventor Duel', 'Marathonology', and 'Writers' Invention Workshop'. It was apparent from the discussion that ensued after our presentation that certain games were more popular than others. Much of the class was very interested in the 'Inventor Duel' game. But, it mainly seemed to be the male portion of the class and, as noted on some of the student's comment sheets, 'Inventor Duel' seemed to be a very "boyish" game. This made us realise that we needed to be sure that each of our games was

not biased in favour of one gender's play styles over another. This was something that we were aware of beforehand but we were now reminded of it.

Another game that seemed to get most of the class excited was the 'Don't Mix That' game. There seemed to be a great deal of positive feedback until it was pointed out that it may not be a good idea to show children how to mix specific household items because they might then do so at home. Though this is not a great concern for most items around the house, save perhaps for certain cleaners that can produce lethal gases upon mixing, it became a central issue for us to be conscious of as we continued our design work. Our group felt that 'Don't Mix That' still had the potential to be good game, but we realized that producing it may have required us to be more general or perhaps unrealistic in our descriptions of chemicals and reactions.

While discussing 'Surfs' Up' the class informed us that the concepts the game involved might be a bit over the heads of Key Stage Three students. The class suggested toning down the science to make it slightly more applicable to the age group (i.e. not teaching about Bernoulli effect but explaining wind currents instead). Another question that was brought up here was whether this game was culturally applicable – i.e. whether or not students in the UK would be able to identify with a windsurfing game.

The 'Writers' Invention Workshop' was the final game about which the class had strong opinions. This game was intended to get children who are mainly interested in reading and writing to look at scientific inventions. The class did not feel as though this game offered enough interaction to be fun enough to play. Some of the points made in regard to this game applied to a few of our games that were more in the nature of educational exhibits than games

per se. It was difficult to determine whether or not this was in fact a poor game idea, or whether it just did not appeal to the age group. The other two games, 'Jumpin' Beans' and 'Marathonology', did not elicit the same kind of strong reactions that the others did. Nevertheless, the class did seem to be in consensus on their comment forms that they liked both games.

From this session our team was able to refocus on aspects of our designs that we had neglected to notice in some of our favourite game ideas. An example of this was 'Inventor Duel' where the idea was very exciting, but we forgot to make it appealing to both genders. Focusing our attention on these details allowed us to take a more critical look at our other game ideas. It was also reaffirming to hear that our peers were enthusiastic about our ideas.

7.4.2 Science Year Meeting

On January 29, 2002 our team met with the Science Year team and presented five of our game ideas to them. The game possibilities that were presented to the team were 'Row Row Row Your Boat', 'Surf's Up', 'Don't Mix That', 'Feed the Mind', and 'Writers' Inventions.' In choosing these five games to present we wanted to choose a few games that were typical of other games that we had. This allowed us to apply feedback to more than that single game which we presented. An example of this was 'Row Row Row Your Boat', which was similar in its scientific aspects and theories to 'Marathonology.' We hoped that the comments that Science Year gave us would be general comments that we could apply to the other game ideas that we had developed.

Each of the games received good feedback from the team, but the two games that the team seemed particularly enthusiastic with were 'Row Row Row Your Boat' and 'Feed the

Mind'. Generally the team wanted us to focus our efforts on a game that would get players hooked. They wanted us to choose games that were going to get children to come back and play the game again and again and hopefully look at the other parts of the website while they were there. For that reason, games such as 'Writers' Inventions' and the other exhibit type games that we had thought of in our brainstorming sessions did not seem to be the type of game that the team would be most excited about.

We found that the team liked one concept in particular. That was of allowing the player to choose the meal that the competitor ate before they competed in the sporting activity and having their results be dependent on what was eaten. This would teach some things about energy and nutrition on top of whatever else the game was teaching. After choosing 'Climbin' High' as one of our final games, we added a 'Shop' into the game with this original concept in mind, allowing the player to buy different foods to keep stamina up as he or she climbed. We also expanded on the shop idea and allowed the player to also buy equipment for the climber to use as they scale the sides of mountains all over the world.

In this meeting as in the meeting with our classmates it was pointed out by our liaison that the scientific material in 'Surf's Up' may be too advanced for our target age group. While being too advanced for the age group, the team was apprehensive about teaching the children more about windsurfing than science. This made us scrutinise the scientific content in our games before making a final decision to ensure that our games were appropriate for our target audience.

Another point that was brought up in our meeting, which applied to all of our game ideas, was the concern over stereotypes. The original design for the 'Feed the Mind' game

had a young niece helping her struggling inventor uncle by bouncing books up to him in his attic. The team really liked the game concept but there were a couple of stereotypes within the game that the team was reluctant to perpetuate. The first was that of the typical male scientist. The team hoped that we could change this somewhat so that it was not perpetuating the same stereotype portraying all inventors this way.

The team was also hesitant in 'Feed the Mind' about the idea of only using books as inspirational elements. As our liaison pointed out, there are many things that can inspire someone to create an invention. Both of these points have been carefully looked at and integrated into our final product. Overall, the comments that we received on our game ideas from the Science Year team were very helpful when it came time to choose our final game concepts.

7.5 Selection Criteria

With 22 design treatments completed our team needed to narrow down the choices for games. As stated in the "Methodology" section of the report, the games were narrowed down using filters of three main categories: science, entertainment and programming. Only if the game passed through all three filters could it be considered for implementation into a final game.

We used this set of criteria along with a set of objective questions to narrow down our potential games. This process was very successful narrowing down 22 games to only eight. The criteria were developed in response to a need to define what made a game 'fun'. We designed a series of yes/no questions making up an objective list of criteria that anyone could use to evaluate a potential game.

To begin with, the science filter was the first and most important filter in our game selection process. This explanation can be found previously in this report in the 'Methodology' section. We included mandatory traits that were very critical to our game and two traits that were not as important yet still quite vital to the overall game and its scientific impact. The entertainment filter, otherwise referred to as the 'fun' filter, integrated various categories from simple graphics to continuous non repetitive gameplay. In this category we used a lot of the advice we gathered from the Sage School to help narrow down the ambiguity of the word fun. Therefore, we included different traits that we found to be very important to games that children would play and a list of these can be found in Appendix E. Finally, we wanted to keep the feasibility section completely subjective for a few reasons. This was important to us mainly because of our time restraints and the only people that can gauge how well the game can be programmed and played are the programmers themselves.

From this criteria sheet, the group eliminated 17 game selections and was left with only eight. The chart figure below shows the differences on the selection sheet of one game that passed through the filters and one that did not.

FIGURE 7.1. Chart comparing selection criteria results for two game designs

Criteria	'Science Goals'	'Locker Room'
Science [Need to pass 5 out of 6 requirements & all the *]		
*Does it fall within the National Curriculum? KS 3&4	YES YES	
*Is the game directly science-based and is there a direct science interaction?	YES YES	
*Is it based on sports or inventions?	YES – sport	YES – sport
*Is the game focused on one science discipline?	YES YES	
Are there any secondary science explanations	YES NO	
Are there no 'wrong' answers?	YES YES	
Entertainment [Need to pass 7 out of 10 requirements]		
Is there graphical simplicity?	YES NO	
Does the game offer a reward?	YES NO	
Does the gameplay involve simple intuitive controls?	YES YES	
Are there increasing levels of difficulty?	YES NO	
Can the player replay the game without the exact same content every time?	NO	NO – Here, this game idea failed because the maximum number that it can pass is 6 out of 10. Therefore this game was eliminated.
Is there a story involved?	YES	
Is the interface intuitive?	YES	
Is there potential for creative gameplay?	NO	
Is there limited text?	YES	
Is the activity culturally prevalent?	YES	
Feasibility [Completely subjective]		
Programming YES		
Graphics/Sound YES		
Performance YES		
FINAL RESULTS	**PASS**	**FAIL**

* denotes a mandatory requirement

‘Locker Room’, whose design treatment can be found in Appendix F, was filtered out of our potential game design pool through the use of our selection criteria. This game met five out of the six necessary scientific requirements and therefore passed into the entertainment filter of the selection process. However, as it was tested in the entertainment filter we realised that the graphics were going to be difficult to design and that there was no reward offered to the player once the activity in the game was completed. The game offered simple intuitive controls and therefore it stayed alive until it hit the next two criteria: those involving the potential for increasing levels of difficulty and the capability for dynamically altering the gameplay so that the player could have a slightly different experience of the game each time they played. Having missed both these requirements along with the previous two, ‘Locker Room’ would not be able to recover enough requirements to satisfy the entertainment filter and therefore fell out of the running for final selection.

‘Science Goals’, whose design treatment can also be found in Appendix F, was a very different story. This game passed all six out of six of the science requirements including those that were mandatory as well as the two that were not. Next, the game passed eight out of ten of the requirement for the entertainment filter. It passed this level because of graphical simplicity, its potential for providing rewards at the end of the game, the simple intuitive controls of the mouse and the capability of easily managing increasing levels of difficulty. However, ‘Science Goals!’ success was challenged by its failure of certain entertainment requirements, such as its presenting the same content each game play session and its limited potential for creative gameplay. These requirements in particular were very important given the attitudes of the experts revealed in our Literature Review about game design geared towards younger audiences, but ‘Science Goals!’ was able to clear the entertainment filter regardless. The only filter left to pass concerned its feasibility and programming demands,

which were assessed as being relatively simple due to the basic graphics and performance required by the potential game. Therefore, having passed through all three filters, the game was considered one of the eight finalists along with 'Feed the Mind', 'Climbin' High', 'Row Row Row Your Boat', 'Create a Human', 'Marathonology', and 'Don't Mix That'. From here we went to meet with the game designing team for Science Year, Telepathy.

7.6 Final Decisions

After applying our selection criteria to each of our 22 potential game ideas we were left with eight. Before deciding on which ideas we thought were the two best to go ahead with, we met with Telepathy to discuss which of these they thought were best and most feasible.

7.6.1 Telepathy

On January 30, 2002 the WPI Science Year IQP team met with two members, Nigel and Sarah, of Telepathy, the web and game design firm that produces the Science Year website. Members of Science Year were present as well for support and discussion. The main purpose of the meeting was to evaluate eight final design treatments, previously selected from the original 22 through selection criteria, in terms of the feasibility of their production within our time and software constraints.

The meeting began with a presentation of each of the eight design treatments, made with the intention of familiarising Telepathy and Science Year with the basic gameplay and science-related elements involved in each game. These game explanations were made fairly quickly, and for the most part comments and questions were held until the presentation had been completed. However, at this point it also became very evident that presenting the games properly was very important for discussing them in terms of their technical demands.

Particularly with designs such as ‘Feed the Mind’ and ‘Create A Human’, the weakness of their early explanations resulted in a fair amount of confusion later on. While the design treatments communicated the game concepts in a fairly detailed manner, explaining them verbally became a challenging and a vitally important undertaking.

After the initial descriptions were made, Nigel and Sarah moved on to discussing the development process in general. Their advice involved a number of points and precepts. One such piece of advice was that as developers, Telepathy never develops anything that they themselves do not believe to be exciting or fun. While focusing on the target audience is important and may involve differences in interest and taste, they were very insistent that the excitement of developers is key - both to producing the game and understanding whether or not players will enjoy it. Another precept involved the design process, concerning the need for members of a development team to ‘stick’ to the agreed design. In Telepathy’s eyes, laying out all the different aspects of the game design beforehand is vital to making sure everyone involved has an understanding of the game in its entirety, and this helps limit the confusion that may result from some aspects being poorly explained. Finally, Telepathy placed particular emphasis on being realistic as a design team about what can be achieved within the constraints of time, skill, and equipment. They were concerned about our short production schedule and lack of experience with Flash in their feedback on our game ideas. They wanted to be sure that in selecting our final design candidates we would actually be able to produce them within our timeframe.

To help us figure out what was feasible we discussed some of Flash’s capabilities and drawbacks in producing games. Telepathy was very clear from the beginning that Flash was originally a program for managing animation, but had since grown to incorporate various

elements that are useful for game production. As such, it can be really easy to create amazing visual elements and animation components within a game, but realistically represented physical behaviour and reactions can be much more difficult. In other words, animating a bouncing ball would be very easy to do in Flash, while as might be expected, but calculating the physical interactions between the ball and the environment would be quite a bit more difficult. We then reviewed the eight games presented in terms of their technical demands in order to pick two to produce.

Presenting the eight designs a second time, the emphasis was on discussing the gameplay in particular and analysing how well its proposed representations could match up to Flash's capabilities. At this point, a few of the games quickly emerged as less feasible than the others. Due to large demands in terms of animation of the different cars and race results in 'Vrooom', it was dropped out of candidacy almost immediately. At the same time, 'Don't Mix That' and 'Create A Human', which caused a considerable amount of confusion in their explanation, were dropped out due to the simplicity of their gameplay and the decision that they were more suited as on-line 'activities' than games. Initially, 'Feed the Mind' was dropped out of candidacy due to what Telepathy perceived as the difficulty of accurately representing the physics of the bouncing actions. However, after Sophie Duncan from Science Year explained the design again from her point of view these concerns were assuaged and both Telepathy and our team agreed that it might make a good candidate. 'MARATHONology' and 'Row Row Row Your Boat', both fairly similar in gameplay, were also deemed feasible but only after they were modified in our discussion with Telepathy into versions they felt could be better created through Flash.

By the end of the meeting, five designs remained as plausible and exciting, though each to varying degrees. The first was 'Climbin' High,' kept for the simplicity of its rock climbing activity and the potential for various scientific explanations including both mountain geology and archaeological excavation and collection. The second was 'Feed the Mind', with the simplicity of its bouncing item gameplay and its merits as a fun method of presenting the process of invention. The third and fourth were the two previously grouped together, 'MARATHONology' and 'Row Row Row Your Boat', and we were encouraged to choose these games due to the ease of creating top-down versions of their gameplay and their illustration of health and nutrition concepts. Finally, 'Science Goals!' was the fifth remaining design, kept for the simplicity of its gameplay and the innovative use of different planets for different levels and gravitational effects.

Overall, the meeting with Telepathy was extremely valuable and was a crucial turning point for our project. While prior to the meeting the decision process had been difficult and the technical potentials of Flash largely unknown, the team left that afternoon more confident and knowledgeable about the work and challenges ahead of them. The game design selection process was nearly finished and all that remained was a team decision about the remaining five potential designs.

7.6.2 Team Decision

Towards the end of week three, the decision concerning the final selected game designs had to be made – a decision which would irrevocably shape the remainder of the project term as well as the team's success. Having developed comprehensive design treatments and a set of objective game criteria, as well as having presented and discussed the different game designs with the staff of both Science Year and Telepathy, the time for the

final decisions had arrived. After much discussion, two games remained as the most feasible, entertaining, and educational games possible given the time period and with our skill constraints.

As detailed during the preceding section, eight designs emerged from the selection criteria process as successfully meeting its varied objective requirements. These eight coincidentally included four sports-themed games and four focused on the theme of inventions. Each was presented to Telepathy, as described in the last section, in order to gain a better understanding of their technical demands and feasibility. Given that these different results have already been described, the focus here shifts primarily on defending the final two game designs that we selected.

The first of these two game designs was 'Climbin' High', a sports game involving the links between mountain climbing and the scientific disciplines of archaeology and geology. Taking on the role of a geological explorer searching famous mountains all over the world for noted fossils and cultural artefacts, the player encounters the varied scientific aspects involved in the sport of rock climbing. In terms of gameplay, the game was originally designed as involving the simple movement of a rock climber along a steep rock face, picking up fossils and avoiding obstacles.

During the design selection process, 'Climbin' High' made it through all three of the different filter screens (Science, Entertainment, and Feasibility), though within the 'Entertainment' filter it only scored seven out of the ten requirements - the minimum possible score for acceptance. It failed to meet the entertainment requirements centred on the need for creative gameplay, due to the linear and invariable nature of the game detailed in its original

design. Furthermore, there was some concern that rock climbing was a fairly uncommon sport in the United Kingdom, and that as a result UK players may have some trouble identifying with the game's characters and activity.

These concerns posed a formidable threat to the potential of 'Climbin' High' for final selection. Creative gameplay was a goal originally put forward by the Literature Review, where it was considered one of the most critical elements to designing educational software for children. No matter how well it may have done in the other categories, the failure of 'Climbin' High' to meet this particular requirement became a central stumbling block as preparations were made for discussing the eight candidate final designs with Telepathy.

It was during this discussion that 'Climbin' High' became one of the most feasible and well-received of all the designs presented. Primarily due to the simplistic gameplay, involving simple up/down/left/right player movements and fossil-collecting action, Telepathy appraised it as being among the easiest to program. At the same time, they had a number of suggestions to make concerning ways in which the original design could be detailed with additional game elements, creative twists, and other details. Witnessing this response, the original concerns about its restrictive gameplay were assuaged and it went on to rank one of the final two game designs selected for production.

The second of the two final games was 'Feed the Mind', an inventions-themed game involving the need to transport different invention-related items to a stumped inventor via a trampoline. The gameplay action is fairly simplistic, with the player navigating the trampoline carrier across a two-dimensional area in order to bounce the different items back into the air before they hit the ground. When each level is completed the new invention that

the inventor was able to come up with is displayed. Also on this page is an explanation of its different inspirations and component parts as well as its real-world incarnations. Having this explanation aims to solidify the connection of the activity and science to the world of invention.

In the course of the design selection process, 'Feed The Mind' was able to pass through all three filters fairly easily. It received a perfect score within the 'Science' filter, while within the filter for 'Entertainment' its original design fulfilled eight out of the ten requirements. The two that it failed concerned its seemingly uncreative and restrictive gameplay. However, much like 'Climbin' High', the meeting with Telepathy managed to elevate the design to be one of the final two. This elevation was due to the encouraging response from Telepathy concerning the game's feasibility as well as its opportunities for expansion and detail. The simple left/right movements of the player, along with the basic physics involved in the bouncing objects, were considered fairly simple and certainly possible within our timeframe. At the same time, the potential for building in twists on the gameplay such as inspiration quotients that need to be filled, the need for a player to strategise which items to bounce and which to drop, and the prospect of a time limit or opponent inventors all emerged during the Telepathy discussion and assuaged our earlier concerns.

Though the two games that were finally selected did receive crucial support from Telepathy, there were a number of alternative games that had also successfully met the requirements of the selection criteria as well as Telepathy's feasibility appraisal. Among the eight original games five remained plausible and encouraging after the meeting with Telepathy, and the final two were selected from this subset. 'Feed the Mind' was the only

remaining inventions-based game, which made it a fairly obvious decision, though it was selected based more on its own entertainment and feasibility merits. The sports title was a more difficult decision, as 'Climbin' High' was up against games involving rowing, football, and marathon running. In the end it won out due not only to the simplicity of its programming demands, but for the potential that this simplicity bore for expansion and for the multitude of different details that could be built into its gameplay and presentation within the short time period.

Perhaps also important to add is the notion that the team was really excited about both games in particular – something which Telepathy had advised us not to take lightly. They admitted that they are resistant to developing any games that they themselves do not feel excited about, no matter how much market research or statistics may prove otherwise. This may seem to be a bold statement for us to make in particular, especially within the space of our project's social goals and directives. However, the group was enthusiastic about the majority of the eight final game candidates, so personal choice and excitement overall played a relatively minor role in the final decisions.

Thus, as the third week of project work ended and the fourth began, the final games had been selected and production work could move into full swing. As the designs were elaborated and the programming began, the games quickly grew to incorporate new gameplay elements and modifications – many with the direct intention of fulfilling the design selection requirements their designs had previously failed. The final games, produced over the span of the following two and a half-weeks, would come to be much more than their original designs had specified, and consequently closer to the goals of our entire project.

The last two sections describe the two final games in their final forms, along with explaining the experience of their production. Though the production and research period lasted a duration of three weeks, the main emphasis on these sections remains on the final products and the different aspects of their gameplay and presentation.

7.7 Final Game Product 1 – Climbin' High

'Climbin' High' is a rock climbing exploration game involving the movement of a rock climber by the player across different rock crags collecting fossils and geological treasures. The player travels all over the world looking for different fossils on different rock types while learning about different kinds of rock and various natural phenomena such as volcanic eruptions and plate tectonics. The player is faced with missions that specify particular fossils that need to be collected along with clues concerning which mountainous locales they may be found at. Cratcliffe Tor in England, Frog Buttress in Australia, Nyiragongo Volcano in the Democratic Republic of Congo, Khumbu Glacier on Mount Everest in Nepal and El Potrero Chico in Mexico are all the different mountains that the player has the opportunity to climb while on the missions. By completing missions and collecting fossils, the player is awarded with points that can be exchanged in a 'Shop' area for food or equipment, which enhance the player's climbing performance and alter the game experience. The ultimate goal is for the player to complete all of the assigned missions, though secret level tricks and even a complete secret level, accessible after the purchase of a key from the 'Shop', remain as catalysts for continued gameplay long after the original missions have been completed.

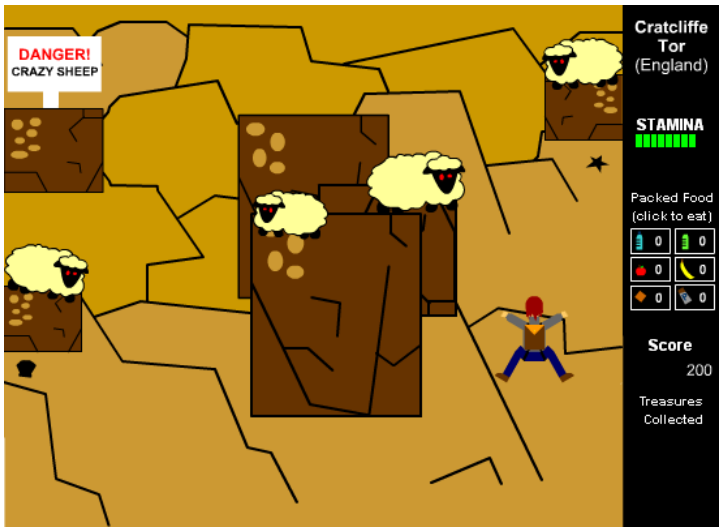

Figure7. 1 : A player navigates the climber along Cratcliffe Tor, a popular climbing spot in the UK. The 'crazy' sheep positioned about the screen knock down the climber on contact, and both shell and starfish fossils can be seen in the surrounding area.

The idea for 'Climbin' High' was prompted during a brainstorming session as the team discussed different sports and their potential computer game incarnations. Moving on from the more traditional choices of football or rowing, rock climbing was brought up and enthusiastically received. The original idea was that the science of geology could be explored through the game, which would involve the player controlling a climber as they scaled the sheer cliffs of different famous mountains and geological locales.

Figure 7.2 : At the end of each climb the player is presented with a screen detailing the fossils and geological treasures they managed to recover.

Later on, during the design selection process, ‘Climbin’ High’ was able to make it through all three of the different filter screens (Science, Entertainment, and Feasibility). However, within the ‘Entertainment’ filter the game only scored seven out of the ten requirements, which was the minimum possible score for acceptance, leaving us wary about implementing this into a final game. Furthermore, there was some concern that rock climbing was a fairly uncommon sport in the United Kingdom, and that as a result UK players may have some trouble identifying with the game’s characters and activity. However, after researching rock climbing and beginning work on the game itself, these cultural concerns as well as those raised by the game design’s performance within the ‘Entertainment’ filter were quickly assuaged.

Figure 7. 3 : At the 'Shop' players are able to purchase supplies and equipment for their climber using points accumulated from finding fossils, answering questions, and completing missions.

There is a wealth of science involved with this rock climbing game, mainly involving geological subjects such as rock formations, geological processes, and fossils. The player is faced with different rock types at every site including igneous, sedimentary and metamorphic. Also, the player encounters geological events such as avalanches and volcanic eruptions. While learning about all this geology the student gets to partake in a fun sports-related game

involving an activity they may want to learn more about or explore on their own. In addition to the geological elements, a stamina meter that must be replenished during the player's climb with food and water provides additional educational value on the subject of nutrition and the demands of physical performance.

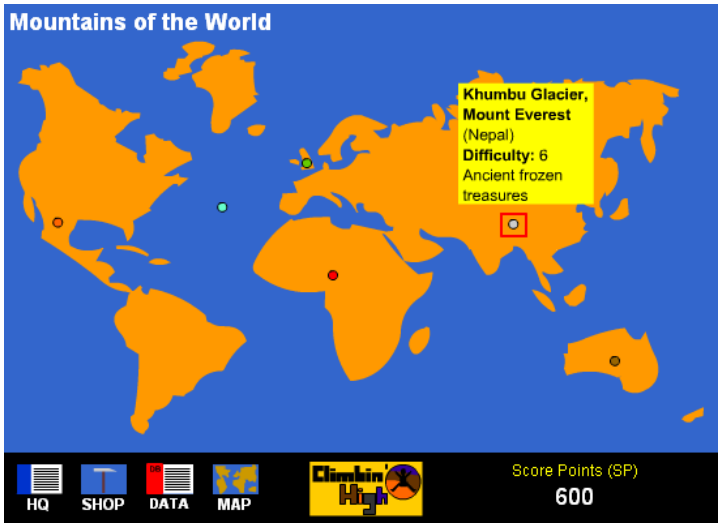

Figure 7. 4 : The 'Map' screen displays the different geographical locales that the player can choose to explore to find the fossils specified by their current mission.

The game's educational elements are still further developed with different questions that the player needs to answer in order to advance to the next level or mountain area. The transcripts of these questions can all be found in the 'Design Document' (Appendix H) section of this report, each of them relating to the basic geological elements or obstacles of their particular mountain level. Furthermore, if the player wants more information about the questions or their subject matter, a 'Databank' section provides easy access to the player to a variety of geological topics. In this section the player can learn about things like glaciers, plate tectonics, as well as the differences in air pressure at high elevations and their effect on the supply of oxygen.

Figure 7.5 : Navigating around the Nyiragongo Volcano level can be very challenging, with streams of lava and stamina-reducing lava bombs falling from the upper levels.

During the production stages, ‘Climbin’ High’ became an elaborate programming undertaking as well as a challenge in research and design. The basic functionality of moving the climber in the cardinal directions through the keyboard was fairly simple to program, but background elements such as rock obstacles and enemy characters proved more complicated. In terms of scheduling, this core functionality and the basic environments for the different mountain locales were created first, while the finer points of the particular level’s fossil treasures and obstacles were developed later on. Parallel to this programming work, research was carried out on subjects ranging from general geology and plate tectonics to the particular species of snakes in Australia or the types of fossils common in the United Kingdom. At the same time, text for the game’s questions and informative blocks was produced and edited in several iterations before being placed into the game during the final week. Much of this particular research and text work can be seen in the design document located in Appendix H. Overall, the production of ‘Climbin’ High’ was a challenging and demanding task, but was completed successfully during the final week of the project term.

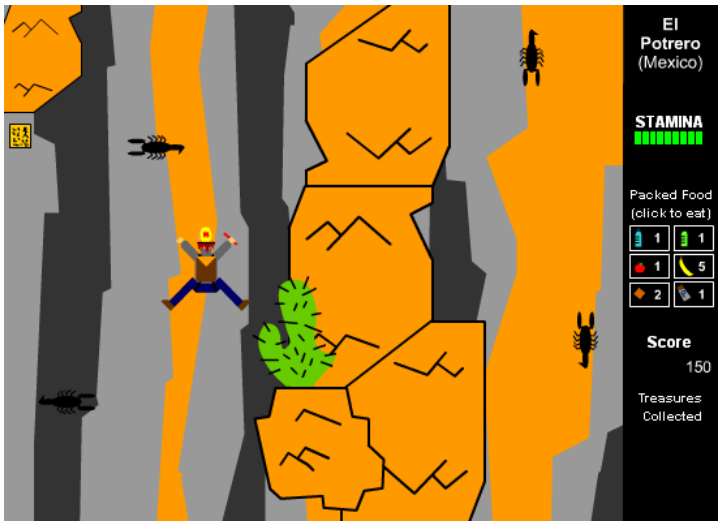

Figure 7.6 : Searching for Aztec relics in Mexico, the player must avoid poisonous scorpions and gnarled cacti.

The final game itself, which will be fully reviewed and discussed within the next section, incorporates a solid range of scientific subject matter along with gameplay that easily provides for creative exploration and dynamic gameplay experiences. The variety of game environments and the potential of the equipment and food systems provide for a wealth of gameplay possibilities, each backed by the scientific focus. Its design document, mentioned several times within this section, is available within Appendix H and fully outlines all aspects of the game in an elaborate and detailed manner.

7.8 Final Game Product 2 – Feed the Mind

'Feed the Mind' is a bouncing action game that illustrates both the products and the process of invention as well as the theme of science fiction writing. The player is part of a team of inventors who are racing against the clock and the evil Mr. Trift to produce an invention for the science fair. The player moves left and right with a trampoline above their head trying to bounce parts and inspirational items, that are thrown out of the window on the left of the screen by Simon, over to the window on the right side of the screen where Jane collects them and creates an invention. The inspirational items that are being bounced

represent: a book, a movie, a walk in the park, and a trip to a museum. When these items are bounced into Jane's window she will gain a random amount of inspiration which is displayed on the inspiration meter in the bottom right corner of the screen. Once Jane has full inspiration and all the parts, the player wins the level and is taken to a screen with a picture and description of the invention. As the levels progress, the evil Mr. Trift attempts to foil the player by stealing items from the safety of his car in the background. In the final level, wrenches are dropped from a plane and when they hit the player they suffer a 10 second penalty.

Figure 7.7 : Level 1 main gameplay screen.

Science and science fiction writing are presented both through gameplay and through text screens. Before each level there is a description of a science fiction book that relates to the item that will be invented. This ties in the science fiction writing aspect of the game. If the player knows what the book is about they can guess at what will be invented at the end of the level.

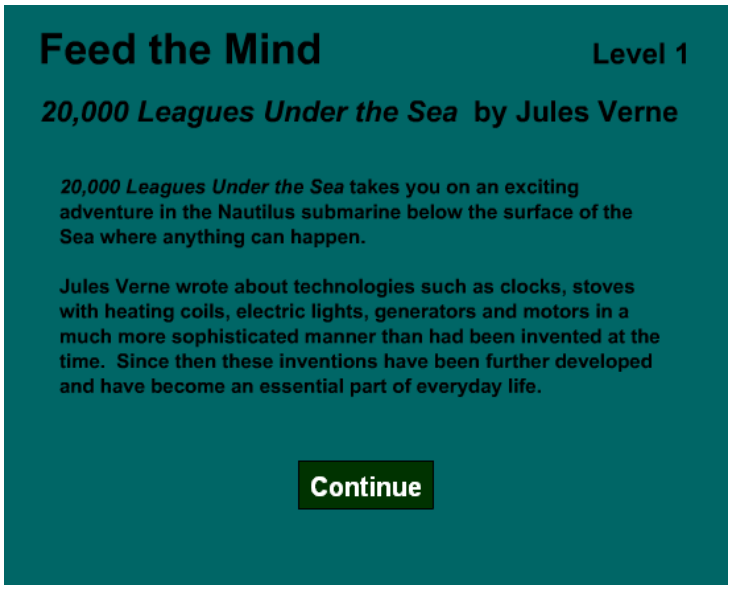

Figure 7. 8 : Science fiction book information screen.

The book for the first level is *20,000 Leagues Under the Sea* by Jules Verne and the invention at the end of the level is a seawater filtering submarine. The real life science behind this invention is seawater filtering through reverse osmosis and distillation. The book associated with level two is *Fahrenheit 451* by Ray Bradbury and the invention at the end of the level is a fully interactive television. The merging of different medias into one is very close at hand and the science behind this invention involves playing *Who Wants to Be A Millionaire* online as the show is playing on television. Level three is *1984* by George Orwell and the invention at the end of the level is a mind reading hat. Brainwaves are currently being harnessed to play a form of soccer where the player concentrates to move a ball into the opponent's goal. Level four's book is *The Past Through Tomorrow* by Robert Heinlein and the invention at the end of the level is a weather control machine. Current efforts to control the weather involve cloud seeding and drying up clouds with the use of an absorbent powder. The fifth and final level's book is *The Time Machine* by H.G. Wells and the invention is obviously a time machine. Current scientific efforts do not come very close

to time travel but there is a virtual reality tour of the past that takes place in Cedar Rapids Michigan in the United States.

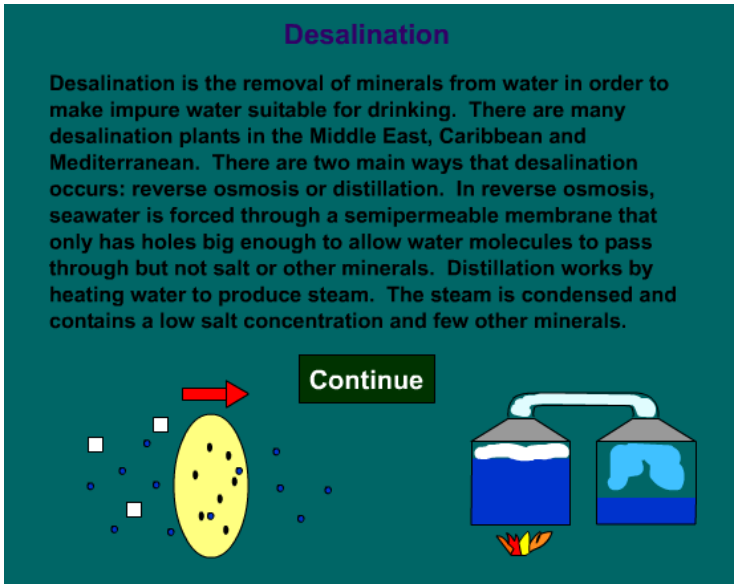

Figure 7.9 : The science behind the invention screen. Level 1, the seawater filtering submarine and desalination

Creating a game centred on the link between science and inventions can be very difficult, primarily due to the creative nature of inventing. Whereas inventions can be envisioned or built from an unlimited number of sources and materials, games need to be created in structured and reasonably bounded environments. By stepping outside of the actual invention process and focusing on the factors such as inspiration and education, opportunities for more feasible game-based explorations of invention become possible. Among them is 'Feed the Mind', an action-based game requiring the player to work with their team of inventors to create an invention to win the Science Fair.

Feed the Mind was chosen as our invention based game because of its original game play and the "fun" way that it looked at and described the invention process. The idea from the game came from wanting to expose children to the invention process and show them that

even the silly ideas for inventions (ones that they may think of on a daily basis) are similar to those that appear in media such as Science Fiction novels. Although the inventions that they may think of and those that appear in Science Fiction novels are not realistic and probably could never be made there are still aspects of them that scientists are working to create all the time.

In 'Feed the Mind' the player is working as Vikki, one of three kid inventors working against an evil opposing team of inventors to create a series of inventions based on Science Fiction novels. The game is based in an alleyway where the player moves Vikki laterally, bouncing different parts to and from windows to build the invention. However, to demonstrate that the player needs more than just parts to invent something, objects that inspire Jane, one of Vikki's lab partners (who is in the upstairs window on the right hand side of the screen), will also be thrown out the window. Simon, who is Vikki and Jane's other lab partner, is throwing the parts out of the abandoned warehouse to Vikki on the ground. The player must successfully inspire and provide the needed building parts to Jane in five fun-filled levels in order to win the game.

'Feed the Mind' passed through most of the filter screens except for replay value and creative gameplay. We feel that despite these shortcomings 'Feed the Mind' presents the process of invention in a very creative and fun way. After meeting with Telepathy, it was decided that 'Feed the Mind' is also quite feasible to create, which would allowed us more time to focus on the background information by requiring less research into programming.

'Feed the Mind' was determined to be feasible after talking to Telepathy because of the simplicity of making objects fall out of a "window" and having to bounce them across an

"alley way." By giving the objects imaginary trajectories and not making the way the objects fall and bounce true to physics, the gameplay and programming were fairly simple. Although the gameplay is relatively simple, having a set group of objects and a certain amount of inspiration that the player must get to the inventor makes for interesting gameplay.

The science behind 'Feed the Mind' has to do with conveying the invention process to the player. In 'Feed the Mind' the player must be sure to inspire Jane as well as provide her with the necessary items to create the invention. 'Feed the Mind' intends to present the invention process as a multidimensional procedure in which the inspiration portion is equally as important has having all the necessary parts. Also, 'Feed the Mind' will expose children to Science Fiction novels such as Jules Verne's *20,000 Leagues Under the Sea* which they may not already be familiar with. Overall, 'Feed the Mind' will demonstrate to students that the invention process goes on all around them and perhaps unknowingly they have been part of it by thinking about how to improve a pre-existing object. By making the connection with the plot of the game and their own lives and the invention process they will be more likely to view it in a less stereotypical manner and perhaps find it of some interest to themselves.

The basic functionality of making the items fall was accomplished during the first week while we were learning to use Flash. From there, adding the levels and then adding more elements to the game became the focus. During the first half of the programming schedule, research was carried out on classic science fiction books, inventions related to them and then the real life science behind those made up inventions. The text for the game's information screens was also created during this period. Over the next few weeks it was edited and reworked quite a few times. Much of this particular research and text work can be seen in the design document located in Appendix H.

One of the challenges that popped up during the production of 'Feed the Mind' was that players were not reading the text. The first thing we did to combat this was to give a reward to the player in terms of a time bonus when the text was read. We then added a transition to the text to make it scroll in slowly to force the player to wait and read it before they could get the bonus. In the end we trimmed the text as much as possible to make it appear is if there was not that much to read. Overall, the production of 'Feed the Mind' was a challenge in design, optimisation and schedule, but was complete by the end of the production schedule.

The general goal of 'Feed the Mind' is to allow the player to get interested in the material by playing a fun game. By introducing children to Science Fiction novels and different inventions that could arise from reading them, it provides direct links to explaining what real world Science Fiction inventions are being created. Here, the player will create a fictional item and then have the link to learn about a real-world invention that parallels that fictional one. 'Feed the Mind' exposes children to different Science Fiction novels while giving them an overview of the invention process.

7.9 Final Focus Testing

Once the games were initially complete it was necessary to get feedback on them prior to submitting them as our final product. We began gathering reactions at our final presentation to the Science Year team and Telepathy on 25 February 2002. The Friday prior to our final presentation, we submitted our games to the Science Year team and Telepathy asking them to play them before our presentation. Upon completion of our formal presentation we sat down with Telepathy and asked them for their opinions of the games and

what recommendations they would make. Also, we put the games on a password protected website so our Sage School cohort could access the game. On the site, we attached a suggestion and feedback form for the students to fill out to give us more feedback.

7.9.1 Telepathy

When talking to Nigel and Sarah from Telepathy we began by going over 'Climbin' High'. They pointed out that with the missions system in 'Climbin' High' it was possible to go to the wrong mountain, and therefore we should have a back button so that if a player goes to the wrong mountain it is possible for them to leave and go to another mountain. This was an excellent point and one that our team chose to add in to our final games. Additionally, they suggested that we incorporate 'roll-over' states, or buttons that change when the mouse pointer hovers over them, to 'Climbin' High'. The use of 'roll-over' states was another idea that we had not thought of, but was easy to implement and therefore was added in to our final product. Also, they suggested that on the loading screen we include bulleted information that the player would want to know prior to starting the game. Having the information on the loading screen would make for less confusion upon the start of the game and since this was something that our team had been struggling with we decided that it would be an excellent use of the loading screen.

'Feed the Mind' received similar comments. On the loading screen for 'Feed the Mind' it was recommended that we use bulleted text and in this text highlight the importance of reading the text in the game. For the same reason as 'Climbin' High' we decided that using the loading screen in this manner would be an excellent idea. Concerning the text in the game, it was suggested that the text is revealed as the player is on the screen and that the continue button only be present after the text has been completely revealed. It was not

possible for us to delay the appearance of the continue button, but we did utilise the idea of having the text reveal little at a time. With the text slowly revealing the game player will not be overwhelmed by the amount of text on the screen and he or she will be more likely to read it. Also, this would allow the player time to read the text and it would be eye-catching having the text slowly revealed.

Nigel and Sarah also emphasised the need to get feedback from people other than us. They pointed out that since we are so familiar with our games it is enormously beneficial to talk to other about what they think of our games. Also, having others play our games will alert us to potential bugs in our games that we wanted to work out before the end of our project. Overall Nigel and Sarah said that they were extremely impressed with what we had accomplished in such a short period of time with our limited resources.

7.9.2 Science Year Team

After meeting with Telepathy, we talked with the Science Year team in order to get their feedback on our games. They too were very impressed with our games and excited to have them as new additions to their website. The Science Year team had similar comments for our games, but some of the additions that they suggested to see in the game were too technically complicated to complete in our remaining time.

In talking about 'Climbin' High' they pointed out that our 'Candle Mint Cake' was really supposed to be Kendal Mint Cake, but due to copyright issues they suggested that we should leave it as it was. They suggested that there be a screen early on just highlighting the main points such as you need to click the food to eat, explaining the equipment and the fog. This suggestion was similar to the suggestion for the bulleted text on the loading screen from

Telepathy and it gave us a better idea of what sort of text to put in the loading screen. They also thought that they snakes should disappear after they bite you in the Australia level. This was a good idea since they were difficult to manoeuvre around once they had popped out but they player could avoid the cracks the next time if the snakes disappeared. Finally, they suggested that at the end of the game the climber go up to the top of one of the mountains and put a Science Year flag on top of it as a conclusion. This too was added in by creating a short movie that plays once the player has won the game showing the climber reaching the top of a mountain and putting his flag there then the Yeti comes and knocks him down to the bottom.

For 'Feed the Mind' the Science Year team pointed out a wording error that we hadn't noticed before. They informed us that in the United Kingdom they call gasoline 'petrol' and we had used the word gas on one of our screens. This was changed immediately to ensure that our game was appropriate for the British culture. They also suggested highlighting key words that would help the player focus in on what they needed to read on a screen if they weren't going to or didn't have time to read everything. Since the inspiration items were the most confusing piece of the game without reading the text a few words were highlighted on the page drawing the players' eyes to those words so even if they only read those phrases they would understand enough. The team suggested adding in a pause button, but we didn't know how to build this function into our games using flash and therefore it wasn't possible. They suggested switching levels one and two because in playing they thought that level one was a bit easier than level two. We decided that we wanted level one to be a bit harder so that the player might not win on the first try and they would be more likely to play again out of determination to win. Also, it was thought that we should change the game so that if they player lost one level they could just go back and play that one again without having to go all the way back to level one. We determined that this was something that only the adults

playing wanted so that they could win faster and since in most games when you loose one level you go all the way back to the beginning we left our game as it was.

7.9.3 Final Focus Group

Before actually submitting the games to Telepathy and the Science Year team, we took the beta versions of our games and tested them on two boys, ages seven and ten. As Sophie Duncan of Science Year had advised us that the best feedback is gathered by observation, we had wanted to observe the two boys play our games instead of merely sending them the game versions and learning of their reactions through e-mail. This event was structured by allowing each of the boys to play the games while under the observation of two group members.

At the beginning of the session, the boys were really excited to play the games and jumped right into them. However, the first observation we made was that the team members were prompting the boys with ideas or hints on how to play. This meant the boys did not read the instructions and when they did, they still did not understand them. This was a very important observation for our team because it suggested that the instruction or 'How To Play' pages needed to either be part of the loading screen or otherwise incorporated clearly into the game. For example, in 'Climbin' High', the older boy did not understand the whole idea of the missions. He just jumped right to the map and started playing, unknowingly beginning on the most challenging level. After a few minutes, and some quick hints, he jumped right back in and played through the missions. Also, in 'Feed the Mind' neither of the boys understood the idea of inspiration until prompted to go back and read about it from a group member. This problem was remedied in 'Climbin' High' by adding a 'help' button that sends the player back to the information screen and in 'Feed the Mind' there are a series of screens at

the beginning of the game that show all of the important elements of the game. Another similar observation that we made about the two games was that neither of the boys read the text either at the end or beginning of levels. We noticed that in 'Climbin' High' the boys would try to answer the question but would not read the explanations at the end. Also, in 'Feed the Mind' the boys found the ideas for the inventions "interesting" however, they did not read the explanations of the inventions at the end of the levels nor did they read the information about the books. To remedy this problem, the team shortened the length of the reading material leaving only especially pertinent material. Also, we incorporated incentives to reading extra text: in 'Feed the Mind', the player gets extra time for the next level if they read the scrolling information on the screen and in 'Climbin' High' the player gets hints for the missions mixed in with the data.

In 'Climbin' High' the boys were really quick to understand the stamina system in this game. This was very encouraging for us because we thought it was a difficult part of the game to get across. The boys did not only understand the importance of the stamina and food, they also grasped the importance of not losing stamina. Another important observation that we noted was that neither of the boys quite understood the mission system at first. Since the missions are an essential part of the game, we made them easier to understand and we had them be the first screen that shows up after pressing start. A final observation that we noted was that one of the boys spent all of his score points (which can be redeemed for food and equipment within the game) right after he got them – choosing not to save any of them for the future or for more expensive items. This is neither a negative nor a positive observation, just an interesting point to note.

The observations from ‘Feed the Mind’ proved to the group that the inspiration idea was a difficult one to grasp. The first boy to play the game, despite his young age of seven, did not initially understand the importance of inspiration in the game. However, after a few of the levels and some help from a group member, he did understand that the ‘Jane’ inventor character in the side window required 100% inspiration to build her invention. Nevertheless, that was one part of the game that we needed to focus on before it was finalised. Another observation was that despite the increased difficulty provided by the evil Mr. Trift in the later levels and the boys were not deterred or discouraged, just surprised.

Overall, the comments we got from the boys were positive and very helpful. Aside from observing their gameplay, we were able to note different glitches in the game that needed to be worked out. A lot of the glitches we found were the same ones that we got from the feedback from Telepathy and the Science Year group.

As we did post our game on an internal Science Year website, our Sage School cohort had access to the games as well. However, the Sage School students did not have adequate time to view and report on our games. The results that we do receive will be passed on to the Science Year team for their own review and benefit. Going on the observations from the two young boys and the reactions from Science Year and Telepathy, the WPI IQP team is confident, however, that despite not receiving this input from the Sage School students our games are in fine operating condition and at the same time both entertaining and educational.

8. Conclusions and Recommendations

8.1 Evaluation of Brainstorming Procedure

This section is an evaluation of the brainstorming procedure we used to develop our games. Our first observation is that we were idealistic about using brainstorming. When our team initially planned out our methodology for brainstorming, we decided to simply write down ideas and expand on them later or at the end of each session. Our reasoning for this was to keep us on track of creating broad new game ideas by not delving too deeply into specifics. This was probably not the best way to go about this because we would have to abandon our train of thought to pursue a different idea rather than expand on the idea that we had just come up with.

Another observation was that our note taker ended up taking on the role of moderator as well, due to the need to keep ideas flowing from speech to paper. A separate moderator would change topics before the note taker was ready to move on. Also, it is good to have a moderator who is good at keeping the group on task and knowing when tangential conversation may lead to more ideas or just is off topic. Where the initial method became a bit more difficult to carry out was in the revisiting of the ideas. The note taker played a key role in storing an idea on paper as they were being bombarded with ideas, which meant they only had time to write just a brief overview. This caused a loss of detail and when the game idea was taken to the design treatment stage some of the more elaborate and exciting details were lost.

Our original procedure stated that there would be two clearly separate portions to our brainstorming sessions: the first was developing new ideas and the second was expanding on those ideas. In practice, we found that it is easier to develop an idea when it is fresh in your head then waiting until later. It was more helpful to talk about an idea as soon as it was brought up because it allowed everyone to better visualise the game as well as spawn more ideas for other games.

Next we observed that outside stimulation was very important for inspiring our creativity during our brainstorming process. Our team used methods such as visiting the London Science Museum, asking each other questions about what games we liked as kids, playing existing web-based games and trying to spawn ideas by discussing each area of science that we could think of. These were all excellent ways of get us to think creatively, but a more beneficial approach would have been to generate a list of techniques we intended to use when we were at a loss for creative ideas. One brainstorming technique that our team would recommend to others, who are doing a creative project such as ours, is taking one day off from brainstorming for every two. It was easy to go into the brainstorming session on the first day due to the fact that we had many exciting ideas that we had been thinking about for a long time. Each further day's brainstorming sessions resulted in fewer and fewer ideas and therefore more frustration. In order to calm our frustrations, our team visited the London Science Museum and observed the interactive exhibits to see what made them enjoyable. This was a great way to take a day off from brainstorming while gathering new ideas at the same time. We also developed some more ideas for games due to the great number of inventions that were there.

When we were running on empty for new ideas we found that if our moderator asked us questions about various interactive activities that we had done when we were younger, we could come up with new ideas. An example of this is the idea for our mousetrap racing game, this was an invention-based game that was related to a former school project. We also tried to think about what made our favourite computer games fun. Although we could not create such rich games as *Where in the World is Carmen Sandiego?*, we could extract the aspects of that game that intrigued us as kids. One example of our use of this was in our game 'Climbin' High' where the idea of having a map and different places that the player can visit. Similar to *Where in the World is Carmen Sandiego?*, the player could choose to climb different mountains around the world which made the game less linear in that they could climb any mountain they wanted at any point. We would strongly recommend having a list of questions such as ours that would stimulate ideas. An additional recommendation on brainstorming is to be sure that the note taker writes down as much as possible during the sessions and to allow for the growth of an idea. It is important for the note taker to take impartial notes. That is, record the ideas in a way that is not biased to his or her point of view.

8.2 Design Documentation

Once we proposed a game idea within the basic guidelines of feasibility we developed it into a design treatment. The design treatment documented the idea and helped to solidify it as well as add on to it. We thought out ideas in detail, and examined games, which had seemed science-based and feasible, under a bright light. This process left us with a clearer view of each game and what would be involved in developing it. Design treatments had an additional benefit in that we could present them to anyone whose input we were looking to

get concerning a particular game idea and they would be able to read the treatment and envision how the game would look and play.

Each design treatment contained a general overview of the game, the story behind the game, a description of how the game would look and play, the science involved, and a development specification that described what it would take in terms of programming and background research to develop the game. This information allowed us to compare game ideas in each of these areas to select the ones that had the most potential.

Overall, design documents were not only helpful for production, but also essential. The design documents contained storyboards that acted as a framework for designing the graphics and gameplay. This freed the programmer from the need to think up each piece of art for the game and allowed him/her to work faster and more efficiently. When the production period is tight there is nothing more useful than preplanning. Game production is an ongoing process in that as the implementation proceeds there will always be new ideas of things to add to the game or realisations that some things cannot be carried out as planned. Having a well-planned design can limit the sort of obstacles and pitfalls that can arise as a designed concept is being implemented.

In the end, we added onto the design documents and developed them as we proceeded with programming. We did this because we wanted to spend as much time as possible familiarising ourselves with Flash to judge our abilities to produce our games, rather than plan something out without knowing whether or not it would be possible. We worked out basic gameplay and from there we added more details such as levels. This allowed the design documents to follow a similar route of development, with more aspects of gameplay being

added as production progressed and time allowed. Given more time, or a prior knowledge of the workings of Flash, we would have completed the design documents as fully as possible before starting work on the games.

8.3 Design Selection

The idea of formulating a design selection process was something that the team toyed around with for two weeks, unable to formalise an actual game selection sheet that would express all of our desires. There needed to be a way to objectively choose one game over another. We attempted to establish what made a game fun multiple times. Finally we sat down and read through the portion of the Literature Review that focused on design and picked a few key items and worked with these. However, this process of formalising objective game criteria was not easy nor was it a definitive list that would work for any game. Formalising objective criteria for a game is a very subjective process: the designers are the ones that choose the criteria. Therefore, it is up to the designers to add or remove criteria based on their personal preferences.

We tried to formalise our ideas in an objective manner thinking primarily about what we found the Sage School children enjoyed, what our research proved and finally our personal gameplay experience. Despite the fact that the final list we composed was very objective, there were many criteria that should have been included to make the process progress smoothly. One such criterion is the element of 'learning,' which was very important for us because it was what Science Year wanted kids to get out of the game. If the student cannot learn something from the game, especially something that gets them excited about science, then there is no reason to consider the game science-oriented or educational.

The final game choices, ‘Climbin’ High’ and ‘Feed the Mind’ left the team weary after looking back at how they fared in the game selection process. Both games passed all of the six science requirements leaving the team very confident however, in the entertainment filter the games neither of the games allowed for creative gameplay or the ability to replay the game differently. Another grave concern related to the cultural prevalence of rock climbing in the United Kingdom – do children in the UK actually partake in rock climbing? Is rock climbing something that interests them? Despite all of these shortcomings for the games, we were very confident that Telepathy had steered us in the correct direction for game creation.

Overall, ‘Climbin’ High’ overcame the concerns of a lack in creative gameplay many ways. For example, the player has different missions that the climber needs to complete, however, if the player does not want to partake in those missions, there is the possibility to explore the mountains independently. Another way ‘Climbin’ High’ allows for creative game play is through the equipment system. The mountain shop, giving players the choice of food, drink and climbing equipment, and allows for a lot of flexibility while playing the game. Each time the player visits the shop they can choose different items to benefit the climbing of their climber allowing for the creative gameplay aspect that was not in the Design Treatment. We also discovered that rock climbing is a very popular sport in the UK, much to our surprise. In conclusion, this game wound up doing very well in relation to our selection criteria despite our concern at the beginning of production.

‘Feed the Mind’ remedied its own lack of creative gameplay and dynamic game experiences by adding some creative elements that were not included in the Design Treatment. As the Design Treatment stated, the only thing thrown from the window was going to be books, but the team later decided that was not the most proper way to

demonstrate the invention process. Therefore, we added the different items and creative inspiration that led to an imaginary invention. The creative gameplay in this game comes from the actual items thrown from the window – they will not come of the window in the same order each time the game is played. Sometimes, the player will be able to get all of the parts immediately when other times the player will needed to wait for a long time before getting that last necessary part. While this allows for creative gameplay, this also is a critical part in the actual invention process because an inventor does not always have all of the parts readily available for use – sometimes it takes a while to get the right pieces.

After the games were chosen, the team went through the criteria again looking at the weak elements in the two games. That is how we decided to add those different parts to the games, that allowed for creative gameplay and the ability to replay the game differently each time. This was a very helpful process for the team because this way we were allowed to incorporate all of the elements that we deemed important, into our final games.

Once we had the criteria in place, our game selection went quite smoothly, though there were still some ambiguities and repetitions between the different requirements. One example of the repetition (that we worked out) was with the original idea of having the player be able to replay the game and play it differently each time. Since both the ability to replay the game creatively and the potential for creative gameplay involved the game being non-linear we decided unanimously to remove that criterion from the game selection sheet. We realised that if a game did not have one of these features, then there was no way that it could have the other. Also, the team faced an immediate problem with some of the games. It seemed as though the topic of invention was very broad and therefore not everyone agreed on what qualified as an invention. How different does something have to be to be considered a

new invention rather than just a creation? Something that the group should have done before sitting down with design treatments and discussing them was to define all ambiguous words that appeared in the selection document. However, for the most part, this was a quite successful process for our team because we filtered out many of the impossible, irrelevant and wacky ideas that might not have made a good game.

8.4 Production Period

The production period ended up being split fairly evenly. Half of our group worked on researching information for the games and working on the design documents while the other half worked on implementing the games in Flash. We found it easier to have one person work on each game due to the fact that it takes time to understand someone else's code and we did not have that luxury. The background research was similarly divided so only one person was assigned to each game. There was the occasional crossover between the two groups that allowed us to keep tabs on how production was progressing and to help address any difficulties that may have required a new perspective to address.

Programming in Flash using Action Script turned out to be very similar to programming in Java. Anyone with experience in any high-level programming language should be able to pick up Action Script fairly quickly. The learning curve for basic Flash functionality was about one week given that none of us had used the software before. This included working with the tutorials that came with Flash as well as online tutorials and practice while creating our games.

It should be said that our games were producible given the month of programming time that we had. Familiarisation with the software and then creating the basic functionality

of the games took about half of our time and creating more dynamic content and more levels took the remainder of the time. Based on the length of time that we had and our level of programming aptitude, we should say that prior programming experience was a necessity for creating a Flash-based game. Learning the basics of how Flash works also requires some aptitude with Windows or Macintosh-based software packages. In the end, if a game is selected that is not overly complicated and the basic functionality can be implemented rather quickly, then there is a far better chance of completion on time, as well as a higher level of quality.

8.5 Final Game Reviews

Having discussed our conclusions concerning the design and production periods of our project, the focus now turns to our final game products. How well do they meet the goals originally set out for creative gameplay and engaging scientific connections? How did they evolve during the project term and what sacrifices, if any, did we make due to the time and skill constraints of the team?

To begin this discussion it is important to review the original goals made for our final game products, established both by our introductory sections and our Literature Review. The most central, but perhaps most elusive evaluation is to appraise our games in terms of how well they work to increase child/player interest in science. While this particular sort of assessment will be among the main topics of the next section, here it becomes something of an aloof higher goal. Looking at our games in particular, we can best assess their power to express science by looking at a number of more tangible factors.

The first of these factors involves examining the two final games in terms of the specifications made in the Literature Review for creating interactive educational media for children. To review, the general consensus among the voices of the game design industry is that educational games need to involve creative and unrestrictive gameplay, avoiding the right/wrong answer exercise games that have plagued educational media in the past. The point is not so much that the player is forced to read lengthy textual segments or slave through boring scientific presentations. Rather, the intent is for children to be interested and engaged with educational topics *through* playing the game. The topics they encounter in trying to play the game better, or the ideas that they walk away from the computer with are where the real opportunities for increasing scientific interest lie. In addition, the interfaces and controls of an educational game product need to be simple and intuitive – granting players complete control over their character or environment.

The rock climbing game, 'Climbin' High,' meets these specifications with its creative, exploration-oriented gameplay. First off, players are provided with a map highlighting five different geological locations to explore, each of which is directly playable at the beginning of the game. Though a mission-based system directs players to particular locations and equipment is often needed to progress anywhere along certain mountains, the possibility for exploration is open to the player and encouraged. Equipment poses a second potential for creative gameplay, with a number of items available that provide for the climber's protection, increased speed, or access to certain portions of the locales. By strategically selecting from the different types of available equipment, different areas of the game can be opened, or gameplay in some areas can be changed. Linked to the equipment system is the food inventory, which inspires creative gameplay in a similar manner. The player must strategize about which kinds of food they should carry with them and in what amounts based on the

amount of spending points they have to pay for food. Finally, the very locations themselves are fairly open, allowing for interesting areas that players are free to explore and manoeuvre. Each area has a number of potential paths that can be taken in order to find the treasures, and in a number of cases treasures are completely hidden behind foreground scenery so that players may have to return and search again. Taking it a step further, a secret area also exists which is 'unlocked' when a player receives enough points to purchase a key from the equipment shop. This sort of added feature ensures that long after a player has mastered each of the five normal locations, there is still an incentive to play on.

However, 'Climbin' High' does have a few shortcomings in respect to the Literature Review's specifications, though they are each fairly minor. It did become necessary to provide blocks of textual information explaining different fossils or geological points, though often times it was scripted as containing hints and clues to treasure locations or equipment needs. At the same time, the varied menu choices that need to be made by the player could be fairly overwhelming for younger or inexperienced players, though the actual climbing gameplay is very straightforward. Despite these minor difficulties in interface and control, the great variety of gameplay elements and creative opportunities meets the Literature Review's demands.

The bouncing invention game, 'Feed the Mind,' satisfies these demands as well through the use of random events and modifications that 'spice-up' its fairly straightforward gameplay. Though the prospect of bouncing a set of objects from one screen to the other may seem rather stale, 'Feed the Mind' has grown to become much more. Players must strategize which items to bounce and which to drop, by virtue of the need to fulfil a sort of inventor 'shopping list' posted on the game screen. A time limit invokes a sense of immediacy for the

player, and an inspiration meter needs to be filled within each level by items that give random amounts of inspiration. Finally, the competing inventor drives by in the background and sometimes steals bouncing items that fall in his path. All of these different elements create an environment that is constantly changing and engaging, with a potential for allowing players to creatively strategize and react to the requirements each new level places on them.

The shortcomings of 'Feed the Mind' in respect to the requirements of the Literature Review are also fairly minor, linked once again to the need for some sort of textual explanations and the somewhat unorthodox gameplay. The text between sections explains many of the real-world scientific applications of the invention created during the level. Aside from hoping to gain a reward for reading the text, players may not spend the time reading it and learning from it. Meanwhile, the basic action of bouncing the different necessary items across a courtyard may seem strange and confusing to some players, as well as perhaps unrelated to invention altogether.

A second tangible factor of use in evaluating our final games is to examine them relative to the games and icons popular among children in the contemporary video games and media industry. Clues to deciphering what kind of games will interest kids can be unearthed from studying the things that are popular among them, though sometimes marketing and other outside factors can play more of a role in their popular status than any inherent traits. However, looking beyond these outside factors and into the basic gameplay of popular games can work to support our final products in terms of their success at engaging today's children. It is important to add that examining only these basic gameplay similarities is important, due to the obvious differences evident in a multi-million dollar product and one coded in Flash over the span of two weeks. At the same time, much of this particular factor is oriented

towards the gameplay aspects of the produced media and less towards its educational elements and effectiveness.

'Climbin' High' possesses adventurous elements that are extremely popular among children today. The concept of controlling a character through varied terrain, the need to purchase new equipment and supplies, and even the presence of secret locations and levels are all common to some of the most famous video and computer games of all time. Games like Nintendo's classic 'Zelda' and Blizzard's 'Diablo' have been wildly popular among children all over the world, and contain elements of this sort of gameplay, though to a much more detailed and refined degree. At the same time popular icons such as 'Harry Potter' or 'Pokemon' embody some elements of this idea, particularly in their video game incarnations: the collection of magical relics or wild monsters, the exploration of new areas, and the adventurous spirit.

Perhaps a bit more elusive but still prominent are the relations between the puzzle-oriented bouncing of 'Feed the Mind' and popular relatives within the games industry. Puzzle games such as the Nintendo's 'Tetris' or Tecmo's 'Bust A Move' incorporate fairly repetitive gameplay but still manage to hook players of all ages and tastes. The common thread between them and 'Feed the Mind' is this concept of a repetitive action that can require some skill, along with a number of random elements that add to making each gameplay experience unique and interesting. As different objects are thrown at different speeds, managing the movement of the 'Feed the Mind' character can be a difficult undertaking that requires some skill, much like the management of a set of Tetris blocks into the completion of a high-scoring arrangement.

However, much of this discussion still borders on speculation and research, side-stepping the core issue: Will kids like the two games? Answering this issue in a direct fashion is an assessment of the two final games made by testing them with a set of kids in a focus group setting, which is our third and final factor in evaluating our final products. By posting the two nearly-completed versions of 'Feed the Mind' and 'Climbin' High' on a restricted portion of the Science Year website, we were able to garner some initial responses directly from children themselves.

Unfortunately, time restraints limited the number of results we could harvest from posting the game on-line, but we managed to present the games to two child players in person and make a number of key observations nonetheless. On 21 February 2002, our team sat down with two of our professor's children from the Sage school to test our games. We were looking to determine if the games were too difficult or too easy, if there was too much text, or if the children had trouble understanding the controls or what they were supposed to be doing in the game. The data that we collected was excellent. The first thing that we noted with 'Feed the Mind' was that the first level was too hard so we increased the time limit by 30 seconds. The next obvious shortcoming of 'Feed the Mind' was that the children did not read the text. In response we shortened the text as much as possible and gave a bonus in terms of time for reading the text. Adding transitions to make the text appear to scroll in presented a visual hook to entice the player to read what was being revealed. A humorous text message was added to further stall the player in case they wanted to continue on without reading the text. One of the fundamental issues that we noticed with both games was that the kids did not understand the point of what they were doing. We addressed this by highlighting the objectives of the game on the first few screens that the player is presented with.

Some of the things that we worked out in ‘Climbin’ High’ were that some obstacles were too hard. For instance, the glacier level has an avalanche that is triggered when the player touches a rock. We were looking for advice as to what to do after the avalanche came down because the way it was, the character moved around under the snow with no way of the player knowing where he was. To rectify this we added a bump in the snowdrift that identifies the player’s location. Another aspect of gameplay that we needed to test was the prices in the shop. The player can buy various items depending on the points gathered or lost in each level. If the player falls off the mountain enough times they would be left with no spending points and so it was necessary to determine the average amount of points to award and subtract so that gameplay would not be too hard to too easy.

The information that we gathered during the play testing was extremely valuable for balancing the games and working out bugs. It was also critical for testing whether the player knew what the objective of the game was as well as gathering information about what the player was learning as they played. It should be noted that as each play tester continues to test the game they progress in their playing skills and so fresh play testers should be brought in as the testing cycle progresses.

Reflecting back on the final games once again, testing the games with a set of child players further cemented their promise as entertaining and educational pieces of interactive media. Though the games were still relatively rough, with several components missing and yet to be implemented, the children enjoyed them both and freely offered their own suggestions and enthusiasm for making changes. We were able to learn a number of the crucial limiting aspects of our games were, concerning such things as placing text or properly

explaining the game mechanics. Overall, the experience solidified our confidence in the potential for our games to reach out to children and engage them.

8.6 Final Thoughts

Expanding from our own attempts, what does it mean to design and develop web-based media to get kids interested in science? Having spent an intensive fourteen weeks researching, discussing, and finally engaging in the actual project process, what have we learned about it? What contributions can we make to future projects with similar goals or directives?

These questions may be extremely broad and almost rhetorical, but certainly there are aspects of our work that can extend outside of our short project period. In working with children, designing games, and working through a production schedule there are certain lessons that we came upon which future projects involving game design could employ to save time and effort. More than that, our work does have something to offer the educational game community at large, albeit if nothing more than confirmation of the principles they wisely ascribe to.

To begin, one of the most important, if not central, factors in our project and our game production turned out to be feasibility. Seven weeks is a very short amount of time to produce a polished and tested piece of interactive media, let alone with the added demands of project reports, elaborate design work, and software familiarisation. At the same time Flash itself, as a game producing tool and coding program, has many strengths and benefits that helped us to produce the originally envisioned games more easily than expected. Understanding these different factors was a key to making our project a success. Just as

Telepathy had advised us during our meeting with them mid-term, being realistic about our time, resources, and skill was very important. In the end, the final games selected were chosen in large part due to the simplicity of their design. As described in the different selection criteria sections and in the section concerning our final decisions, the two games were actually somewhat lacking in terms of the creative gameplay we were hoping to incorporate. However, many of the elements that made the games creative and engaging were successfully worked in after they were selected. Thus, in the hopes of producing something deliverable in seven weeks, even the most central educational goals were forced into second place behind the feasibility of the game design.

However, the success with which creative elements were added to our original game designs offers another important lesson. Knowing that the two selected games were the most feasible, their originally basic gameplay elements were refined and fleshed out in a manner which allowed for new creative possibilities. The comments and suggestions of not only Science Year and Telepathy, but our peers and project advisors in part inspired this process as well. Understanding this in a broad context does not necessarily indicate that any game concept can be easily adapted into an interactive and innovative form; just that opportunities for adding creative value to game designs can exist in a great variety of places.

This point is also related to the question of whether or not the time we spent coming up with our designs and selecting our final games was warranted. Spending half of our time on this portion of the process alone placed a serious strain on our eventual production period, and its value may be a subject for debate. Especially given that our final designs developed their creative elements after their selection, spending so much time focused primarily on producing fledgling designs may not seem important.

However, as a group we felt that this design period was invaluable. Generating our different ideas and discussing them with Science Year and our advisors was vitally important to our understanding of their own expectations, thoughts, and ideas. At the same time, one of our two final designs was actually conceived the day before our presentations to Science Year and Telepathy, so in some ways the very process of design lead to better ideas. Though our time schedule may have been cramped by the three- week focus on this process, the three weeks were a central exercise in understanding different aspects of game design in practice, as well as delineating what sort of elements needed to be evident in our final produced games.

Another important factor in our project came to be our own enthusiasm and excitement towards each of our games. When our final decisions were made, it was very important but also very clear that as a group we felt excited more about some designs than others. Spending an intensive two to three weeks programming and designing a web-based game would be very difficult if we thought the concept to be boring or lame. Telepathy had hinted at this during our discussion with them, highlighting the importance of personal enthusiasm for creating a piece of interactive media over the results from market research and inquiry. While we do feel confident that kids will enjoy our final products and that they were designed with their interests in mind, our personal excitement went a long way towards fuelling their production.

Speaking of the interests of children, how can we be so sure that our games will engage them, or even that they will find them to be any fun? We spoke with a number of them and did our best to research the types of media that they enjoy, but is that enough?

As described in the last section, there are a few different techniques that we can use to assess our games in reference to kids' interests. They include looking at our final products in terms of the game criteria set forth by our Literature Review, comparing our games to popular and successful mainstream computer games, and actually testing our games with kids and responding to their criticism. Provided with these sorts of assessments and critiques, we can confidently say that our games do achieve the sort of gameplay that kids enjoy – that is, that we have managed to produce media that will interest and engage them.

However, is this even enough? We can perhaps be sure that kids will play and enjoy the games, but will they walk away from the computer interested and avid students of science? Is this too much to ask?

Ultimately, our project in particular has indirectly examined two different theories involved in presenting science or any subject matter in a context that children can understand and enjoy. On one hand is the more logical theory, which submits that taking the core scientific knowledge and adding in a set of objective game components that kids enjoy will result in scientific knowledge that kids enjoy. On the other hand is a more artistic theory, which speculates that taking that same scientific knowledge and presenting it in a creative, enthusiastic, and innovative light is enough to engage kids.

Coming from a technical background at WPI, it is perhaps our first inclination to break down this project using our logical theory. It seems as though all we need to do is unearth the core principles behind the most popular children's games and apply them to a scientific area of study. Add in some bright graphics and entertaining sounds, and every kid

in the neighbourhood should be hooked, right? By that same token, we can tell if our game has succeeded by merely looking at whether or not it has met our checklist of popular game elements.

However, the challenge is obviously much more complicated. Approaching our project from a logical perspective certainly provides some important insight and strategy, but it has its limits. Our science-based games may incorporate all the elements of a hundred different popular games and still fail to make the connection for kids between the gameplay and scientific study. This is because the level with which kids are interested by our games and their scientific topics is still fairly subjective, determined by thousands of factors involving current interests, backgrounds, social situations, and more. Merely transplanting elements from popular games is not enough; personal creativity and enthusiasm are equally necessary. Thus our more artistic theory comes into play, and in the process our project becomes just as much a creative and artistic creation as an objective attempt to reach out to children. Evaluating it therefore becomes much more complicated, just as it is hard to say that Beethoven is better than Britney Spears without succumbing to some subjective opinion or objective system of musical analysis.

The best we can hope then is that our games will reach out to children, and that somewhere within their young minds they may inspire a question about science or its connection to the things they already enjoy. We can evaluate and test our games forever and still not get a clear sense of how well they are able to achieve this end. We do not think that we would be so pretentious as to say that if our games inspire one future scientist they will have been worth the effort, but the cliché does seem to apply. Then again, one inspired child would certainly be enough to make us proud.

9. Appendices

9.1 Appendix A – Science Year

9.1.1 General Information

Science Year is a year of packed calendars that includes projects and resources that aim to stimulate interest in science and technology. It aims to alert people of all backgrounds, but especially students' ages ten to nineteen, about the importance of science in an increasingly growing field. Science Year is about raising awareness of the scientific world and different careers that involve technology in fields that range from music, computers, health and the environment. Since primary schooling ends at age sixteen, the Science Year initiative is based on encouraging post-sixteen interests in science (Science Year, 2001).

Science Year is funded through many government operations and through private companies. The Department for Education and Skills, which is government run, seeks students to create opportunities, release potential, and achieve excellence. The National Endowment for Science, Technology and the Arts (NESTA) is the United Kingdom's first national endowment that is set up to £200 million. NESTA, created in 1998, is an independent organisation, made of 35 members that work primarily through their website to encourage invention, innovation and education. NESTA invests in excellence by helping individuals to release their individual talent in science and the arts. They see creativity as a very vital factor in science and technology and therefore strive to combine science, technology and art. Also the Association for Science Education, ASE, is a key partner in the

Science Year initiative. The ASE is a charity that provides resources to teachers and advisors and helps them to develop science education through KS3. The British Association for the Advancement of Science (BA) is also dedicated to the communication and appreciation of science. In addition, Science Year receives numerous corporate donations from companies like Intel, Pfizer, Oracle and New Media (Science Year, 2001).

9.1.2 Projects

For the 2001-02 year, there are nine projects that have been fully-funded. Science Club Networks is one of the projects. This project focuses on the hundreds of after-school science clubs and is trying to link these groups together to maximise their strengths and activities. Another project is "Johnny Ball's 'Tales of Blooming Science'", a musical show featuring Isaac Newton and Charles Darwin. This show takes children through the history of science from electricity to the telephone. Since this show travels throughout the UK, all children have the opportunity to see it! Also, 'Science in Libraries' is a project where libraries will be activated to promote science. Another project that interests all children is 'How Scientists Make Money', which demonstrates to children the importance of science and scientists in the moneymaking process. The next project is a series of photographs that features today's scientists and is called 'Faces of Modern Science Year'. Cheltenham Science Festival 'Science Theatre' is another project that involves five schools that have been given full-funding to produce their own science plays. These students perform their plays in front of parents and other viewers at the Cheltenham Science Festival. 'Pondlife' is a special needs project that is done through the Chalton Park School in London. The school has access to a pond and the students will track life in the pond for eighteen months. This makes science

available and fun for students have previously been excluded from this field. ‘Science Where you Least Expect It’ is another project that illustrates typical school subjects and how science plays an integral part in each of them. And finally, ‘Poster Power’ is a poster campaign that aims to raise the profile of science in schools (Science Year, 2001).

Recently, one of Science Year’s most successful projects entitled ‘Free Science Kits for Young People’ has provided kits that contain "information on how to perform science experiments in schools and at home" (Department for Education and Skills, 2001). The kit, which is the second in a series, includes home experiment cards on topics such as gravity, chemical attraction, movement and sound for students ages ten to fifteen or KS 3 and 4. The kit meant for young adults ages sixteen to nineteen provides information on scientific careers and experiments on heat transfer, chemical attraction, sound and movement (Department for Education and Skills, 2001). These kits allow children to have the opportunity to see science interacting in many different things and to try many different experiments. As Science Year Director, Nigel Paine, explains, "The kits are an excellent way to demonstrate how the things that we take for granted such as gravity, sound, and movement, unlock the door to the exploration of scientific concepts and ideas…the kit also links to some great websites so that the ideas can be taken further" (Department for Education and Skills, 2001). To date there have been more than 75,000 requests for the Science Year Kits showing a huge success for the program (Department for Education and Skills, 2001).

9.1.3 Science Year and Teachers

Also on the Science Year website is a whole section dedicated just to teachers. Science Year aims to help teachers and other such educators to do their job effectively and enthusiastically. There are multimedia materials and free high-tech lab equipment distributed to teachers around the UK. Some of the multimedia materials include a set of five CD-ROMs that are distributed evenly throughout the year to teachers, including topics that range from diet, to the earth, ethics, mobile phones, communicating science and science & truth. The lab equipment is available through a program called Kit Pot, a fund that is offered to teachers to give them the lab equipment they need most. Some pieces of equipment include Digital Microscopes, used to capture mini-beasts or plant life, and Interactive Whiteboards (Science Year, 2001).

9.1.4 Web Site and Children

There are things on this website designed not just for corporate sponsors and teachers; there are a lot of fun activities just for children as well! One game is 'Planet 10', a game with two interactive sections. The first section explores the universe, planets, asteroids and more. It allows you to take a closer look at the planets -- a view that textbooks could not offer. The second section is a 'world builder'. It allows you to choose your own physics, chemistry, plant life, and more to see if your planet will survive in this universe. Along with this game there are activities that can be downloaded along with a quiz about the solar system (Science Year, 2001).

Another interactive section is the ‘Science Room’ that looks just like a very messy room. However, when you click on the lava lamp, a text box pops up. The text box explains how a lava lamp works. Other items that students could click on include a smelly sock, a mixing table, a computer and many more. A lot of those items have more involved that just a text box. For example the mixing table leads to a whole different part of the website. There is an interactive section that allows students to mix their own music through previously recorded templates. Students learn how the music is created, through vibrations in the air that hit your eardrum and make noise, and they have the opportunity to create their own music (Science Year, 2001).

Another game called ‘Buzzin’ shows how some insects harm the plants on earth while others help them to grow and reproduce. It tells a story about how bees feed on pollen and therefore need enough pollen to help other plants grow. This game uses the forces of nature to control the bees, the slugs, and the growth of new plants. However, to get to each level there are questions that require some knowledge of plant life and ecology. Another similar game is ‘BloodBug’, which uses antibodies and viruses to create a general learning base for the immune system. Students need to create a good defence system for the body using their knowledge of antibodies and the immune system. A third fun game is ‘Rail Slide’. This game takes the popular sport of skateboarding and shows children the science behind it. There is a lot of physics that goes into completing jumps. The initial velocity, the incline of the ramp, as well as how far away the rail is are all very important aspects of skateboarding (with tricks). In this game the student can change the initial velocity of the skateboarder and can alter the degree of inclination, both of which result in whether or not the boarder will land on the ramp (Science Year, 2001).

Science Year also dedicates a section of their website to amazing science facts and within that site there are six subsections including 'Time Warp', 'Alive', 'Superhuman', 'Raging Planet', 'Rush' and 'Extremes'. Time warp includes facts dealing with space. Some facts are "The sun loses up to a billion kilograms every second because of the solar wind that blasts out from its surface", "the moon is gradually moving away from the Earth and the tides are to blame. Every year the moon moves 3.82 cm away from the Earth" and about the Hubble Telescope saying that "The wide field and planetary camera on the Hubble Space Telescope could resolve the fine print on a newspaper one mile away." The 'Alive' section talks about nature, humans, animals and plants. "A giraffe has the same number of bones in its neck as a human. They also clean their ears with their half metre long tongue", "if all the blood vessels in the adult human body were laid end to end they would stretch 160,000 kilometres, that's four times around the earth!" and "starfish have no brain – they're just a bag of nerves." 'Superhuman' section has facts that have to do with everything human such as "In a lifetime we spend the same amount of time eating as we do blinking. We spend about five years eating, and about five years with our eyes shut because we are blinking". The next section, raging planet, deals with the weather and different things Mother Nature does to the earth. In that section students can learn that "the energy in a hurricane is equal to about 500,000 atomic bombs" and "in the middle of the Atlantic (Ocean) the two (tectonic) plates, the African plate and the American plate, are moving apart at about the same speed as your fingernails grow". The rush category has to do with everything fast (i.e. colour) and fun such as "Sapphires and rubies are both made of the mineral corundum. They are identical in every way except for their colour. Rubies are the red variety while sapphires can be any other colour, blue, green, yellow, orange or even black." The final section, extreme, deals with feeling the forces around you. One interesting thing that students can learn in this section is that "Paper money is made from cotton rather than from wood pulp which means it

doesn't disintegrate as easily as ordinary paper if you leave it in your laundry." These facts are all random; however, they're aimed at young students and since they're so random, children will be more ready to remember the facts. This is a section that teachers can use and that children can go to on their own (Science Year, 2001).

9.1.5 Conclusion

From Science Year's resources students can learn a great deal about the importance of science while having fun playing games and doing experiments. The teachers can also find new ways to incorporate science into their lessons and curriculum. Science Year has found new interactive ways for teachers to present relatively difficult scientific topics and they have made it easy for students to learn.

9.2 Appendix B – Sample Questionnaires

9.2.1 Questionnaire for Children: Self-Directed

Name of Student: _____
Observer's Name: _____
Interviewer's name: _____
Key Stage: _____

I. Observations:

II. Interviews:

1. What game is this that you are playing?

2. Why is this your favourite game to play while you're at school?

3. What about the game is it that you like so much? (* Here if needed say such things as is it to score points, or kill the insects etc. in order to get information from student)

4. Do you like any of the other themes in a game such as:

   i. Mystery?

   ii. Science Fiction?

   iii. Action?

9.2.1 Questionnaire for Children: Science Year

Name of Student: _____
Observer's Name: _____
Interviewer's name: _____
Key Stage: _____

I. Observations:

II. Interviews:

a. What do you think of the Science Year website?

b. Do you think you would visit the site on your own in the future?

c. Which of the games was your favourite? Why?

d. Which of the games did you like the least? Why?

e. If you could change the Science Year website or its games, how would you change them?

f. What kind of science game would you like to play?

9.2.2 Telepathy Questionnaire

Name of Contact: _____
Interviewer's name: _____

1. When a client has a game for you to build, what design information do you need from them to make the build process as clear as possible?

2. How long does it take (on average) to design the sort of games that are on the Science Year website?

3. How do you go about designing games for children ages 10-19? What, if any, factors do you have to consider due to the age of the target audience?

4. How much of the game is made up by you and how much is made up by your client? Does the client give you the storyboard and you simply execute it or do you add your own ideas to it?

5. What are your technical constraints when building a web-based game? Is the game created using strictly Shockwave? We know the general capabilities of this software package and the limits of a web-based game but are there any specific limits we should be aware of?

9.3 Appendix C – Brainstorming Resources

Objectives
(to be posted during Brainstorming sessions as focus points)

- The games must involve the themes of inventions (related to science fiction and creative writing) or sports
- The games must be appropriate for ten to nineteen year olds
- The games must be web-based and technically plausible as well as modest in their use of computer resources
- The games must be completely playable in a one-hour game play session.

Operational Guidelines
(for running Brainstorming sessions)

(1) Each session a moderator will be appointed to direct the meeting and write out ideas and suggestions on the whiteboard

(2) Each session a note-taker will be appointed to transcribe the contents of the whiteboard into a more manageable form.

(3) All members of the group will be able to contribute to the brainstorming process without criticism or argument from fellow team members.

(4) At all times the group will remain focused on the brainstorming session at hand and will avoid discussing other unrelated topics, even those involved in other aspects of the project.

(Brainstorming techniques adapted in large part from those detailed in Game Developer's Marketplace by Ben Sawyer, Alex Dunne, and Tor Berg)

9.4 Appendix D – Brainstorming Log

9.4.1 15 January 2002

Today was our first brainstorming session. During this session, everyone contributed their ideas and had plenty, leading to seventeen potential games. We had ideas for invention games that included 'Writers' Invention Workshop', which would be a game where the student can choose an invention and write about it, and another idea we called 'Simple Machines'. In the 'Simple Machines' game there would be a lot of little parts that would connect together to create a labyrinth and then, when the student is done putting the parts together he needs to navigate a ball through it without having it drop. Another invention game was 'Inventor Duel' where multiple famous inventors would compete using their inventions for weapons. And a final idea for inventions was a 'How Things Work' room where we could choose several previous inventions and show how they work. The children would then click on the invention and get a brief overview of the item and a description of how it works. We came up with more ideas for sports and those ideas included three football games. The first one was very basic and just included kicking the ball into the goal but to do that the student would need to pick the angle and velocity of the ball. Another football game we came up with was similar to the first one however in order to kick the ball the player needs to answer a simple biology and physics question correctly. The final football game involved a second and third level to the first game however eliminating gravity and adding more gravity to the game. A 'Ski Jump' game, where there was a moving ramp and incline for the skier to jump off of, was another potential idea that idea was followed by the idea for a tennis game. Also, with different swimming equipment and different biological conditions presented in the games we could create a swimming game. We thought of creating a darts type game and a sports room with just different sports shown. Then we thought of having a sports locker room that displayed different athletes and profiled their anatomy and physiology. An idea for a race car game evolved where the student could build up the car using different advances (e.g. a better engine) as the driver progressed though the course. We thought of researching the Commonwealth Games, which are being held in the UK this year, and that spawned the idea for a running game and a hurdling game.

After we finish brainstorming that day, we went through the list and tried to expand on some ideas and wound up expanding on a few and combining a few more. The ideas that we did expand on can be found as Design Treatments. We did not totally eliminate the possibilities for the games that did not get expended upon; those games only need to be thought through more.

9.4.2 16 January 2002

Today it was a bit more difficult to come up with more creative ideas after having come up with so many yesterday. We decided that because of this we would discuss with Sophie how Science Year goes about brainstorming to help give us ideas. There were a total of sixteen game ideas developed today and we have chosen to elaborate five of them into design treatments. The first of these game ideas was an Inventor room where there would be a display of different science fiction books and the scientific inventions that were in them.

But we decided that since there was a lack of interactivity we would save that one as a backup in case we can not come up with better invention ideas. Next we thought of having a clay pigeon shooting game in which the player would have to use angles in order to break the clay pigeons, but we thought that since we were against violence in our games we should not use guns no matter what. Another idea we had was a chemistry game in which the player could mix different compounds together in a lab in order to create new things. We also had the idea for an Antarctica game where the player would go through and discover new plants and animals, but we could not really see this fitting in too well with the inventions then so it was put aside to come back to later. We thought that we could build an oil drilling game where the player could design a new way to dig deeper but we thought that would be too complicated and could not really see where to go with it so that was also put aside for now. The second idea that we decided to elaborate on was a rock climbing game, which could incorporate geology and different types of rock that the player could learn about as they climbed a mountain. The next idea we had was one for inventing different ways to trap animals, but we decided that that was not a good topic to be discussing with children so we put that idea off. Another idea we had was for and animal fighting game but we also thought this was a bit violent and did not want to encourage harming animals so we decided not to go ahead with this idea either. We also thought of having an animal racing game but did not like the idea of racing animals, though we did consider working the idea into our marathon racing game somehow. Next we thought of having an "Invent Your own Animal Game" where you could put together different parts of different animals in order to create your own. Another idea we decided to elaborate was one where the player would design a tooth pick tower to see how much weight it could hold. Our next idea was to have a mouse trap car game in which the player would choose from common household items to build a car powered by a mouse trap and then would race the car to see how far it went. We also came up with the idea for two games that we decided were too female-specific. The first being a gymnastics game in which the player would choose to do a gymnastic move and then would be shown the physics behind it, and the second being an ice skating game involving the same sort of explanations. Another idea we had was to have a long jump game where the runner would do tricks in the air but it wasn't clear how this would work so the idea was put off. Finally, an idea about using one of Dean Camen's inventions in a game was brought up but could not be firmly put into a game idea so it too was put off for now.

9.4.3 17 January 2002

After our meeting with Sophie yesterday the team was ready to start fresh with some great new ideas. We came up with nine different ideas and decided to elaborate six of them into design treatments. Our first idea was to have a Bunjee jumping game, which we decided, would use vegetables so that real people wouldn't be hitting the ground if the player made a wrong decision. Also with this game we did not want to make any children feel insecure about their weight or cause them to think that they should be skinny and therefore decided that vegetables were going to be our best bet. Also we thought about a Humpty Dumpty game somehow incorporating Bunjee jumping into that, but we thought it might be too childish for our age range. Our next game was a Tennis game; we thought we could work in Wimbledon and have equations on the screen so that the player thought about the science behind it and use it to help them play better. Another game idea was one for an Inventor/Adventure game in which the inventor would be on a mission to gather certain pieces to a puzzle or invention. One of the games we decided not to elaborate on was the idea for a dancing game the idea came up just as one that would interest girls, but really it

was not very gender neutral. We also had the idea for a wind surfing game in which you would see the wind and have to manoeuvre the boat in order to get to the end of the race. Another game we decided not to elaborate on was the idea of a fencing game. We also had the idea of a game where the player would be a detective and would have to look back at science fiction writing in order to solve the mystery in some way. Our final game idea for today was one for a "Life" inventor game where the player would follow the life of a famous inventor.

9.4.4 18 January 2002

Today in order to excite ourselves with more scientific idea we went to the Science Museum instead of Brainstorming. Hopefully, our experiences today will be reflected in our ideas on Monday.

9.4.5 21 January 2002

Today, our Brainstorming session occurred with Sophie at our regularly scheduled Monday morning meeting. Our meeting was very productive and we came up with a total of seven game ideas and five of those we are going to elaborate in to design treatments. The first idea that we came up with was one about a rowing game because it is a very popular sport in Britain currently. Our next idea was one with Archaeology where the player would go around and collect different parts that he/she found and them use them to put together a new invention. Another idea that we had that we decided not to elaborate on though was one where students could design their own wacky inventions that would never work though. Our next idea was to have a game where the student could design their own car and then race it against other cars that the computer already had in it is memory bank. We also had the idea of having an interactive activity involving a modern day kitchen, which players could navigate through clicking on different appliances and both learning about their history as well as inventing their own futuristic versions. Next we had the idea of having another interactive activity that would just show inventions through time but we decided it was too much like the kitchen idea and therefore decided not to pursue it further. Our final game idea for today was one about genetics and allowing students to design their own human by choosing the genes that their fictitious person would be made of.

9.4.6 22 January 2002

Today due to the demands of multiple meetings and having just received the background research from Sophie from the Science Museum we did not brainstorm. However, we are bringing some of our potential ideas to the class today in our presentation so for tomorrow we hope to have even more new ideas.

9.4.7 23 January 2002

Today was more focused on research for what criteria our games will have to meet in order to be chosen as one of our final game designs.

9.4.8 24 January 2002

Today will be our last brainstorming session, due to our not working tomorrow on account of our four-day weekend. We feel as though we have a good base of game ideas and that we are very prepared to choose our two games after next weeks meeting with Science Year and Telepathy. Today we had a total of eleven game ideas and we decided to elaborate on only one of them. The idea we decided to elaborate on was one based on 'Survivor' where the player would be stranded on an island and in order to get off would have to create certain inventions. The others where ones such as a moon obstacle course where players would have to manoeuvre certain courses on the moon in order to win. Another idea was to have a microscope game somehow relating to biology. We also had the idea of having a game where the player could create their own catapult and then launch certain items. Our next idea was to have a game about lasers some how incorporating inventions into it. Another idea was to have a different set of inventions that the player would be able to work with in some way. Our next two ideas were very similar, the first was to have a game in which the player could put together their own electric circuits, and the second was to have a game involving electricity and inventions. We also came up with the idea to have a "Mother May I" type game where the player would advance when answering certain scientific questions correctly. Our last game idea was to have a game where the player could make the tube system in London better in some way by using inventions.

9.5 Appendix E – Game Design Document Templates

Design Treatment

<design name> **Design Treatment**
WPI Science Year IQP, C Term 2002
Last Modified Date:

Introduction (What prompted this idea for a game? Why does it warrant a design treatment? How did the idea for it arise?)

Game Story (What is the plot of the game? Who are the main characters? What are the goals of the characters/player? What is the opposition?)

Science Involved (How does this game relate to one of the scientific themes, either sports or inventions? What elements of scientific instruction will be involved in it? What scientific concepts will it help children to interact with in its environments?)

Game Play and Look (Describe the game play and visual/audio elements of the game: How will a player interact with the game? What basic actions and strategy are involved in playing the game well? What will the game look like? What will it sound like?)

Development Spec (What programming languages or technical methods may this game involve? How will it be deployed to the public? How long will it take to develop? What computational resources will it require from users?)

Design Document

<design name> **Design Document**
WPI Science Year IQP, C Term 2002
Last Modified Date:

Introduction (What prompted this idea for a game? Why does it warrant a design document? How did the idea for it arise?)

Plot Line Description (Detailed narrative of the story's plot line, with enough detail to prepare the reader for understanding the components of the game described throughout the document. What is the game about? What are the goals of the player? What are the minor and major achievements that a player completes in the course of the game?)

Science Involved (How does this game, in detail, relate to one of the scientific themes, either sports or inventions? What elements of scientific instruction will be involved in it? What scientific concepts will it help children to interact with in its environments?)

Detailed Description of Core Game Elements (Describe the elements of the game that are universal to all of its different sections. What does the main character look like? How do they interact with their environment? How does a player control this character? How do they accumulate points? How do they achieve basic goals or defeat opponents?

Detailed Description of Every Game Section (Whether it be levels, scenes, or varied adventures, describe all of the different portions of the game. Establish conventions for naming and organising objects, characters, and environment elements. Describe the visual and audio presentation of these sections, along with animations, scripting, background, and other important miscellaneous details)

Name of Section/Level/Scene:

Detail (including presence of Science in Section):

Physical and Audio Appearance:

Background:

Foreground Objects and Characters:

Animation:

Music and Sound Effects:

Scripts for Characters:

Scenes and Transitions:

Miscellaneous Elements:

Storyboards (Illustrate your design concept in reference to its different sections or universal elements? How do you visualise the character or their actions? How do you visualise scene transitions or animations? What do you imagine to be the results of performing certain actions in the game's various environments?)

Development Spec (In more detail, what programming languages or technical methods may this game involve? How will it be deployed to the public? How long will it take to develop? What computational resources will it require from users?)

(Design techniques adapted in large part from those detailed in Game Developer's Marketplace by Ben Sawyer, Alex Dunne, and Tor Berg)

9.6 Appendix F – Game Design Treatments

9.6.1 Climbin' High

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: January 16, 2002

Introduction

The idea for this game was prompted by an attempt to incorporate different scientific aspects of science into one of our games. This game warrants a design treatment because it's unlike any of the other games that Science Year already has. The idea arose because of an increasing interest over the sport of rock climbing and its relationship to such science as geology.

Game Story

In 'Climbin' High' the player assumes the roll of a mountain climber who is racing to the top of a mountain in a race to be the first to inhabit the mountain top by putting Britain's flag atop the mountain. This is a race against time where the fastest climber will win, but the terrain is difficult and must be kept in mind in order to have a successful climb. The climber will have to pay attention to the condition advisories telling them exactly what type of rock they are climbing in order to successfully win the race.

Game Play and Look

'Climbin' High' begins with the climber getting a briefing of his/her mission from the British government to be the first person to reach the top of a newly discovered mountain. The player begins his/her mission at the bottom of the mountain that he/she must climb. The race starts and the climber will be seen from behind heading up a mountain.

There will be notches in the mountain for the climbers' hands and feet some will be too far away to reach and others will be close enough to get too. If the player gets over ambitious the consequences will be that he/she will fall off the mountain. Our adventurer once conquering the mountain will receive another mission from the British government sending him/her to the next mountain. Again there will be another terrain advisory explaining some sort of geological fact.

Points will be gained for our adventurer for the shortest amount of time that it takes to climb to the top of the mountain. The players with the highest score after completion of all the levels will have their name added to our list of "Great British Adventurers."

Science Involved

This game relates to the theme of geology while relating it to sports. This game would clearly relate different rock types to how ones climbing would have to be different. This game would be interesting because the kids might not normally relate geology to that of sports ever while they may tend to realise that there are angles involved in the other sports they play and just don't bother to learn about them. The climbing advisory that the player will be given at the beginning of each level will allow them to learn about different types of rocks.

Development Spec

Flash will need to be supplemented by Action Script in order to keep the high scores recorded for each player.

9.6.2 Create a Human

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/17/02

Introduction

This game is inspired by how genes control every characteristic of who we are. We wanted to allow the player the maximum freedom to experiment with their creation. Instead of asking the player "What colour eyes do you want?" we left it open to them by choosing a blank slate for them to start with. They can add skin colour, hair length etc. With no way to win or loose it is up to the player to determine their level of interactivity. This game allows the player to experiment with creating a new type of animal and learn about the function of genes at the same time.

Game Story

The player is a very old scientist in the 22nd century who is working on designing a body to replace his own worn out one. Each characteristic of the body is left up to the user to decide. This allows each player to have a unique experience and learn about how genes control aspects such as height and skin colour at their own pace.

Science Involved

This is an invention based game where the player invents a person they would like to be. Descriptions of various characteristics that genes control will be provided to the player so they can decide what they would like to add to their person.

Game Play and Look

Players select from a graphical list of chromosomes that allow them to modify many aspects of their creation including eye, skin, and hair colour, height, sex, etc. Upon selecting one of the chromosomes a blurb is presented to the player describing what each gene does and then they can choose from a menu the various choices they can apply to their body.

Development Spec

This game is straightforward and could be done rather easily using Flash and a bit of Action Script.

9.6.3 Don't Mix That!

New Chemical Compounds Design Treatment
WPI Science Year IQP, C Term 2002

Last Modified Date: 16/01/02

Introduction

The idea for this chemical compound idea was spawned from the general idea of chemistry and inventions. The idea of this game is to have the player look at different items and try to combine them for a possible effect. This chemical mixing warrants a design treatment for a few reasons. Primarily we were trying to incorporate different areas of science into our potential game designs and this seems to be a good way to get chemistry into a game. Also this helps kids learn about different chemical aspects in everyday life.

Game Story

When the chemist, the player for this game, enters the laboratory he is faced with several different possible scenarios all involving different coloured compounds found in beakers around the room. The chemist is in the lab to figure out a possible way to save the universe without knowing what chemicals he has to work with. Once the chemist deciphers the compounds from each other he has the chance to save the world by combining two of them.

Science Involved

The science involved in the chemical compounds game would be more in the chemistry side, as mentioned before. There would be the chance for students to learn the basics of chemistry. For example, when the student chooses to mix sodium and chloride, they get salt. Then, if they mix hydrogen with chloride the player gets a very dangerous acid, hydrochloric acid. This might give the player both safety lessons and a lesson on mixing different compounds. This game relates to inventions because the child gets the chance to mix things together that he or she had never thought of even though it has been done before.

Game Play and Look

Since the object of this game is to use inventions and chemistry to save the world, the chemist is faced with various takes prior to taking on this mission. And another twist is that the beakers that contain the compounds are not labelled; it seems as though the labels wore off over the years. Therefore, the chemist needs to start combining the compounds together to figure out which is which. Some of the compounds that will be there will be sulphur, bleach, sodium, chloride, hydrogen, oxygen and ammonium. There will be more however they have not been decided upon yet.

Once the chemist ammonium and bleach. After the chemists learns about the mixture there will be a memory bank where the chemist can insert his guesses for the compounds. That way the chemist will be able to keep a running tally about what occurred in the experiments.

After the chemist thinks he knows the answer of all the compounds he will insert them into an answer bank and then he will be either allowed or denied entrance to save the world. Therefore it is important for the chemist to make accurate guesses about the compounds he creates. For another twist to this game, every time someone plays this game they will be faced with different colours for the compounds so that way this game can be played over and over. Select up to three of the compounds a new screen will pop up and show the effect of the mixing – either a safe mixing, where there will be a little blurb about what was created and what creates that, or a blow up. The blow up will have a blurb about the dangerous effects of mixing the two compounds.

Development Spec

The Flash aspect of this game is fairly straight foreword. Simple animations only.

9.6.4 Dr. Ravine

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/28/01

Introduction

In looking at inventions and working to connect them to the interests of kids, the tendency seems to be to look forward to the future. By envisioning the world to come the creativity of kids can be unleashed and drawn towards the process of invention. But surely there is something to be gained by looking to the past as well! Popular movies such as *Indiana Jones and the Last Crusade* and *The Mummy* have successfully presented archaeology and its study as being full of adventure and fascinating discovery. 'Dr. Ravine' looks to capture a similar spirit while drawing towards a mystery involving history of invention and the secret scientific foundations hidden behind the greatest inventors of our time.

Game Story

Dr. Alex Ravine was once an accomplished archaeologist, having unearthed a number of priceless artefacts and used them to make huge discoveries about ancient civilisations over ten years ago. Since then he has fallen on ill times, and has yet to find any leads as to where to look next.

However, he recently received an anonymous tip urging him to arrive at an ancient conservatory buried deep within a nearby mountain range. Once there, he is drawn up into a web of discovery and intrigue, faced with a mystery linked to famous inventors and the science that inspired them. At the same time, Alex slowly comes to realize the reason why he was summoned to the ancient locale, and is faced with the responsibility of assuring the discoveries he makes remain in the right hands!

Game Play and Look

Players undertake the role of Dr. Ravine as he works to study the ancient conservatory and unravel its ancient puzzles. They are allowed to move Alex about the different areas of the conservatory with a number of remedial verb-oriented actions such as 'Look', 'Examine', 'Push', and so forth. By selecting one of these actions and then clicking on an on-screen object Alex will obey and different objects will react in different ways. At the same time, Alex will be able to pick up different objects and use them in other locales. All of these different abilities will allow him to decipher hidden clues and operate ancient machinery to unravel some of the mystery involved in science and invention.

For example, Alex may enter into a dark cave area with an un-lit torch nearby and an inscription on a nearby wall. Using a set of matches the player had Alex pick up earlier on, the player clicks on the matches and then the nearby torch to watch Alex light it. The room is now illuminated and Alex is able to read the inscription which may reveal a hint pertaining to another puzzle.

The puzzles will be rather intricate and will draw from real-life historical events and anecdotes. Players will have to combine different items within their inventory, find keys to unlock new areas, and sometimes communicate with other characters or enemies along the way.

Visually Alex and his surroundings will be represented from a side-view, with the different verbs and inventory items displayed along the bottom of the screen. All gameplay will be managed a point-and-click interface.

The game will end when Alex has resolved the final puzzle and defeated the evil forces involved. The main reward will be the solution of the involved mystery and perhaps the possibility of a screen saver or other downloadable reward at the conclusion of the game.

Science Involved

'Dr. Ravine' connects the world of inventions to science by presenting the history of invention and its scientific foundations as intriguing and adventurous. By working real-life historical anecdotes involving inventions into the complex puzzles and plot the player will be naturally drawn into an interest of invention and its link to science. Also, the portrayal of Dr. Ravine as a 'cool' character that kids enjoy playing will work to change the typical representation of scientists that they encounter in their studies.

Development Spec

'Dr. Ravine' will be produced using Flash software and action scripting. Originally the idea behind the game was thought to be more feasible, but as Flash was studied further the scope of this particular design was better understood. It will require significant art and research/scripting work along with a fair amount of game play logic programming. At this point, it seems fairly ambitious given the time and skill constraints of the project.

9.6.5 Feed the Mind

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/28/01

Introduction

Creating a game centred around the link between science and inventions can be very difficult, primarily due to the creative nature of inventing. Whereas inventions can be envisioned or built from an unlimited number of sources and materials, games need to be created in structured and reasonably-bounded environments. However, in stepping outside of the actual inventions process and focusing on its outside factors, such as inspiration and education, opportunities for more feasible game-based explorations of invention become possible. Among them is 'Feed the Mind', an action-based game requiring the player to inspire an inventor who is having a substantial creative block.

Game Story

Dr. McPhee is a young inventor who has freshly completed his studies and is looking to come up with a new invention that will change the world. However, he is having a lot of trouble coming up with an idea. Racking his brain for inspiration, he is depressed and spends most of his time sitting alone in his third-floor apartment.

Anna McPhee, the good doctor's niece, has been witnessing her uncle's trouble and wishes to help him out. She resolves to bring him some different books to inspire him, and luckily the library is just next door. As books are tossed out the library's back window, Anna must bounce them off of her trampoline and into her uncle's study room. As he reads enough of them, hopefully a great invention will come to his mind!

Game Play and Look

'Feed the Mind' involves six levels of book-bouncing fun. Controlling Anna, the player must bounce books from the lofty library window to her uncle's study on the third floor next door. As the books tumble through the air, the player is able to move Anna left and right in order to bounce the books back into the air before they hit the ground. This process gets much more complicated as multiple books must be bounced at one time, each of them with different weights and trajectories. At the same time, Dr. McPhee must be provided with enough time to read each of the books he receives, requiring Anna to provide the books at a slow and timed rate.

At the end of a level, with Anna having successfully bounced a majority of the books, Dr. McPhee will have invented something new! The reward for each level will be a display of this wacky invention along with some of the inspirations that led to its conception. At the same time, in between levels players will be presented with a short little story or statement involving the strange inspirations that have led to real life inventions (such as the melting chocolate in the pocket of the person who invented the microwave, et cetera).

Science Involved

'Feed the Mind' is an action-based game that illustrates the inspiration process of inventors. By presenting the links between strange life events and the real-life inventions they inspired, a connection is linked between the human aspect of inventing and its more popular incarnations. At the same time, the books being bounced can be detailed as science fiction as well as science fact, revealing to kids that the sorts of stories they know and enjoy are very applicable to the nature of scientific invention. Finally, the anecdotes between levels concerning real inventors will grant players some sense of the truth of the inspiration process and perhaps allow them to wonder what sorts of inventions the questions and thoughts they have may someday inspire.

Development Spec

'Feed the Mind' was conceived with the constraints of Flash-based game production in mind. The gameplay is based on a simple but challenging activity that will require a fair amount of logic programming (mostly involved in gravitational effects) but will not be overwhelming. At the same time, the art constraints will be reasonable and the difficulty easily scaled with simple artificial intelligence as the player progresses.

9.6.6 Gum Shoe

Design Treatment (Detective Game)
WPI Science Year IQP, C Term 2002
Last Modified Date:

Introduction

This game was influenced by the detective game: Where in the World is Carmen Sandiago. Carmen Sandiago is a game that gives players clues and requires them to figure out the rest. The game even includes an almanac for the player to use to track the thief, Carmen Sandiago, around the world in an attempt to apprehend her. Carmen Sandiago was a popular game with kids and we want to use that model as a proven concept.

Game Story

The player takes the role of a gum shoe who is trying to solve the mystery of how and why famous inventions are being moved around in the 'Antic' museum. The mystery joker is playing a prank on the detective. The player must track the joker and find each invention, returning them to their rightful locations.

Science Involved

This game directly relates to inventions. It will teach the player about various inventions as he or she plays through the game. Problem solving is a key aspect of this game.

Game Play and Look

A blurb describing what invention has been moved as well as a clue to where the joker and the invention is, will be displayed. The blurb will include the story behind the invention and who the inventor was. This is the optimal time to explain this information because if it were done during gameplay the player would be likely to skip it in order to keep playing. When the player has determined the joker's location he will escape. This will happen automatically for the first three locations the player goes to. For each incorrect location the player goes to the trail of the joker gets colder and the clues for finding him harder to figure out. There is a fifty-fifty chance that the joker left an invention behind as he fled. The chance to find an invention goes down as the trail gets colder. When an invention is found the next invention that has gone missing will be introduced.

In order to find the joker in the minimum amount of time the player must select the location of the joker on the first try five times in a row. The joker will get away if the player selects the wrong location five times in a row and the game will end.

The game will be a first person view of each room in a museum. The player can choose what room to go to from a menu. Interacting with inventions in the room will be point and click and upon clicking a popup box will explain the invention or give a clue.

Development Spec

This game may be too similar to 'Where in the World is Carmen Sandiago.' This game will require a system for keeping track of the number of correct and incorrect selected locations. It will also need to be able to randomly select where the joker travels to as well as what inventions are moved and where they are hidden.

9.6.7 Inventia

Design Treatment

WPI Science Year IQP, C Term 2002

Last Modified Date: 1/18/02

Introduction

Role-playing games are among the most popular in the video games industry, incorporating epic story lines, likeable player characters, and even drama into the interactive medium. Ask any avid game player about console games like *Final Fantasy* and *Metal Gear* or computer games like *Diablo* and *Baldur's Gate* and they will do doubt respond with praise and discussion. So what would it take to create a role-playing game centred on inventions and science, unique enough to stand out among its mainstream counterparts? 'Inventia' is the answer, an epic (within limits) adventure game that follows the vagabond Ashley Brandt in her mission to save the world of Inventia by recovering the works of the world's greatest inventors and their scientific bases.

Game Story

The evil nemesis Xavier Stone has cast a dark cloud over the island world of Inventia, capturing the power of the six great inventors, revered throughout the country, and twisting it to his own fanatical ends. The national council has dispatched Ashley Brandt, a vagabond with a dark past, to recover each of the different inventors' powers and use them to put an end to Xavier's evil. By travelling across the dangerous landscape of Inventia and defeating Xavier's evil inventions along the way she is the only hope for the people of her world!

Game Play and Look

In 'Inventia' the player takes control of Ashley Brandt, the battle-hardened vagabond of Inventia. She is represented as a fairly small animated character on the screen, who freely navigates about the landscape of Inventia in all four cardinal directions (using the four arrow keys). Other characters navigate in a similar manner, and can interact with Ashley giving advice, selling items, or battling.

The objective of the game is to navigate the Inventia world, defeating evil aggressors when necessary and recovering the powers of the six great inventors. Powers can be recovered by directing Ashley to different regions of the world and using her abilities to defeat Xavier's minions who stand guard. When Ashley receives a power she interacts with the spirit of the great inventor and learns something about the relation between science and inventions. Once she has recovered all six of the powers she will face off against Xavier in the final battle to save her world.

Battle is managed with a menu set that will pop up when an enemy is engaged. Within the menu will be a set of options detailing actions such as 'Attack', 'Use Item', and 'Use Inventor Power' which will result in different animations and damage results. Such options will be selected using a 'point-and-click' interface.

Ashley's own health during battle will be managed using a number-based system displayed on a similar menu. When attacked she will be damaged by a certain point value that will be deducted from her health total. By the same token she will inflict point-valued damage upon opponents, and can be healed with items that result in point-valued increases of her own health total.

When Ashley approaches allies and innocent civilians she will be able to speak with them. This communication will be managed through text boxes that will represent what the different characters are saying. During battle these text boxes can also appear, as evil minions

make comments before attacks or at the time of their defeat. Merchants will also be available for interaction, with items and weapon advancements available in return for money Ashley receives from defeating monsters.

Science Involved

'Inventia' involves science in the exploration of inventions by presenting the work of our own great inventors (in the form of the six powers Ashley must recover) and in the process explaining the science that they utilised. The secret revealed through the story at the game's climax will be that the powers Ashley has recovered were actually forces of science which must be moulded by her to defeat Xavier's evil. At the same time, the evil of Xavier's inventions will allow a form of invention ethics to be presented to the player. Overall, the fantasy setting and imaginative characters will all be playing out a presentation of the links between science and invention in a manner that is very popular and well-received among kids.

Development Spec

'Inventia' will be developed utilising Flash software and action scripting. Coding the game play logic may be fairly straightforward, with the exception of the storage demands involved in remembering the different aspects of Ashley's health and equipment throughout the game. Despite how elaborate the game may seem, it will be fairly short and playable within a one-hour session. The art demands are also fairly low. The main difficulty and effort will be involved in the creation of the 'Inventia' world and its various locales.

9.6.8 Inventor Duel

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/17/02

Introduction

'Inventor Duel' is a conflict-based video game where players assume the role of a historical inventor character and face-off against opponents. Possible characters include cartoon versions of inventors and creative writers such as Thomas Edison, Jules Verne, and even Steve Jobs. Their attacks are indicative of their expertise or involving the things they have invented during their lives. For instance Thomas Edison may wield light bulbs in battle while Jules Verne may attack using the *Nautilus* submarine from his famous work *Twenty-Thousand Leagues Under the Sea*. This idea was mainly prompted by the popularity of such games in the mainstream video game market, hoping to simulate a similar sort of game play while drawing it toward the work of real inventors and the relation of their work to science. At this point it has warranted a design treatment because of its potential as a popular and creative game.

Game Story

The plot of 'Inventor Duel' involves an evil mad scientist using a time machine to capture the greatest inventors and creative writers of human history. By capturing them and forcing them to battle one another, he hopes to ultimately steal their inventions and return to their times to reap the benefits of their work himself. The main characters are a set of 6-8

inventors and creative writers from the last two centuries, with the potential for 'secret' characters to become available upon defeating the entire game. The main goal for a player will be to take control over one of these inventors and utilise their own special skills to defeat the other inventors in a one-on-one melee. Once the player's inventor has completed this task he/she will face the evil scientist, and if they successfully defeat him they will complete the game.

Game Play and Look

Battles will take place on a level battleground viewed from the side with opponents placed at opposite ends, with attacks/movement managed by 'point-and-click' selection menus. The melee will commence in a turn-based manner, with each of the two opponents having a chance to select their attack and witness its animated results. Within the battle players will be allowed to charge their attacks to increase their power or effectiveness. At the same time they will be able to use healing or protective attacks to increase their own defences or recover from wounds. Each character/player will have their own life bar and the battle will end when either of them is completely diminished.

After defeating an opponent the player will advance to the next battle and face a new opponent. This will continue until they reach the final boss whose defeat will complete the game.

Science Involved

Relating to science, 'Inventor Duel' hopes to connect inventions and science by making historical inventors into formidable and 'cool' characters that kids will enjoy controlling. Before attacks are made the science involved in them will be highlighted. For example, when the player is about to play as Thomas Edison (who throws a light bulb) some sort of message may appear on-screen describing how he invented the light bulb and the scientific elements of its conception. At the same time, the evil mad scientist at the game's climax will fight back using inventions that have caused destruction in the world, illustrating to kids some degree of the ethics behind the act of inventing. Overall, the link to science is made to children through a sort of glamorisation of invention in a game form that kids are familiar with and enjoy.

Development Spec

'Inventor Duel' will be developed utilising Flash software and action scripting. The user interface will be fairly simple and manageable, providing basic menu options. The most daunting aspect of the production of 'Inventor Duel' is thus the art and animation, which will be very involved and could 'make or break' the entire game.

9.6.9 Animal Creator

Design Treatment (Invent Your Own Animal)
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/17/02

Introduction

Evolution and its effect on the diversity of animal life are the inspiration behind 'Animal Creator'. The player can invent a new animal using various parts of other animals such as the torso, legs, and head, among others. The design has warranted this treatment due to the creative fun that creating an animal involves and its applicability to concepts of invention and related science.

Game Story

The player is able to create new animals and the goal is open-ended. The player may create any animal they like using the parts provided and print out the results along with their own name for the new form of life. The parts will be chosen from a list of animal types such as mammal or reptile so they will fit together more easily.

Game Play and Look

'Animal Creator' is an invention-based game where the player invents a new type of animal. Players will have to match body parts using a set of available pieces for each part of their animal. Each animal 'template' will require parts such as a head and torso, with the possibility of multiple templates relevant to different species.

The player will be presented with a picture of an animal template viewed from the front or the side and they will have arrows on the left and right of the various parts of the body for scrolling other animal's body parts in. When finished, a blurb will be displayed describing how the animal that was created hunts and where it lives based on the features of the animals it is made up of. At completion players will be able to name their animal and describe it through some sort of text-based form.

Some combinations may not be possible given the involved physiognomy. For example, an ostrich's legs cannot be attached to a lion's body because the bone structure of the ostrich is not compatible with the lion. Thus, in some cases, the animals must at least be of a similar structure/template.

Science Involved

'Animal Creator' explores scientific subjects such as anatomy and biology while relating in some degree to the concept of invention. As players configure their animals and read the resulting explanation of their hunting habits and behaviours, they will grasp some sense of the biological relations between the way an animal lives and its invented physical makeup.

Development Spec

'Animal Creator' will be developed using Flash software and some form of action scripting. Coding the game play logic will be very basic, while the main focus of production work will be on the graphics involved with the different body parts and templates. In terms of research a fair amount of time will have to be devoted to studying the anatomy of various types of animals as well as their hunting behaviours and habitats.

9.6.10 Jumpin' Beans!

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 17/01/02

Introduction

After talking with our liaison, who told us that 'extreme sports' have a huge following in the United Kingdom, we started to think more on those lines. Therefore we thought of a game with bungee jumping around England that could be an invaluable idea for our group. This sport is the subject of this design treatment and it is a warranted idea because students will enjoy playing it more despite the educational elements. Therefore, the student will be more likely to become aware of his or her interest in science through sports.

Game Story

In 'Jumpin' Beans' the player is faced with several vegetables that want to jump off a huge bridge in England however, the player wants to eat all these vegetables for dinner. Therefore, as a final request all the vegetables requested that they bungee jump. The player needs to realise that different vegetables are different sizes however and needs to have different length elastic chord. The player needs to keep in mind the idea that if one of his vegetables falls and splatters on the ground he will not be able to eat it.

Science Involved

This game specifically relates to sports because the player is bungee jumping and that is a very popular extreme sport. The scientific concepts of physics, weight, mass and elasticity are incorporated into the sport. There are different ropes for varying weight classes and since not every vegetable is the same shape or size the player needs to be aware of the differences in elasticity through general physics formulas. Therefore the player will have the choices displayed to him or her and then the player can choose which type of rope they want to use for which type of vegetable.

Game Play and Look

The object of the 'Jumpin Beans' game is to be able to make it home with all the vegetables without any of them smashing on the ground. The different vegetables will include a tomato, a green bean, broccoli, eggplant, pumpkins and carrots. The vegetables will vary in size and shape so the player will need to change the size of the rope. The player will interact with the game in the respect that he or she will be faced with the challenge of not allowing their veggies to become destroyed.

The game will take place at a huge bridge somewhere in England, most likely fictional; the bridge will be about 250 metres high and not very sturdy. There will be little instructions however after the first veggie breaks the reasons will pop up on the screen to give further insight into the game and into the scientific aspects of bungee jumping.

Development Spec

'Jumpin Beans' will require the use of Action Script for creating the spring effect in the bungee cord.

9.6.11 Locker Room

Design Treatment – Sports Room
WPI Science Year IQP, C Term 2002
Last Modified Date: 15-01-2002

Introduction

The Science Year's science room prompted the idea for a sport, locker room. Science Year's room is a room that has all kinds of household objects that involve some part of science whereas ours would be similar but be about sports. This design warrants a design treatment for a few reasons, but primarily that this game is very feasible to create. This sports room would not require much animation and therefore would be a great way to put some ideas onto the website about sports and the biology of athletes. The idea for this spawned from a combination of the Science Year's science room, our want to include some new sports inventions and our desire to incorporate more than just one sport into our sports game. In order to appeal to as many students as possible we felt that it was necessary to have a place where these students can learn about the scientific aspects of many different sports.

Game Story

When in the 'Locker Room' the player assumes the role of a newscaster that is allowed into a multi-sport locker room. The newscaster has the opportunity to see what makes this athlete work and how they can perform so well. They also have pre-asked one question that the athlete can also answer. This interview with the athlete should help the people of the United Kingdom understand more about the sport of the athlete and more about the science behind their sport.

Science Involved

The theme of this game is related solely to science and sports. This game will allow the player to get a closer look at the physiology and anatomy of certain athletes. The facts about certain athletes will be displayed through muscle areas used, what foods to eat for competitions, and a miscellaneous fact. The miscellaneous fact would range anywhere from the material of their uniform to the equipment they use. The scientific instruction that will be included should help the student further understand the sport that he or she plays and it will give them insight into ways that may help them be able to perform better. If one fully understands every aspect of the sport that they are playing they have a far better chance of actually being able to compete at a higher level.

Game Play and Look

The game room will be set up to look like a locker room. At each locker there will be an athlete with the equipment for his/her sport. When the player clicks on that athlete, they are sent to another page that has more instructions/options set up on the left side of the screen while the athlete stands in the middle of the page with the necessary equipment for his/her sport. The options will be about muscles, foods and a miscellaneous category. The muscles category will give the player a chance to find out which muscles the athlete uses in that particular sport. The muscles used will flash in red while the rest of his body will remain natural colour. The food category contains information about various types of foods and how they help the athlete gain energy and other vitals. And finally the miscellaneous category will be an aesthetically pleasing way to show kids a neat aspect of their sport. The athlete's equipment can be selected and a detailed description will be presented to the player to inform them of how various tools of the sport help the athlete perform better.

Development Spec

'Locker Room' is a fairly straight forward game which can be done in Flash without much if any programming in Action Script.

9.6.12 MARATHONology

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/17/02

Introduction

Marathon running is a popular and difficult sport, involving a great number of factors and practices that are necessary for a participant's preparation and success. Aside from training and working out, biological factors including diet and equipment are crucial. These factors have a scientific basis, and as a result offer a unique opportunity for a game that draws connections for kids between the sport and scientific study in a new way. This game warrants a design treatment due to its unique design and its incorporation of a number of varied scientific disciplines such as physics and biology into one game, representing for players the intertwined nature of science in all of our activities.

Game Story

Science Year is holding a nation-wide marathon running tournament over the course of a week. Each day five runners will compete and the contestant with the shortest overall time will be crowned the winner at the end of the week. Running each day is the primary focus of the game play, with players accelerating down the track and successfully jumping over obstacles. However, in- between the days' races crucial decisions must be made by the player concerning what they choose to eat or buy/repair concerning their outfit and footwear; decisions which can significantly effect their performance the next day!

Game Play and Look

The main character of the game is a marathon runner of the players' choice whose unique physiognomy alters their performance during races. For example, a tall racer may have an advantage in their long and powerful strides but be disadvantaged in needing constant hydration and stringent diet constraints. At the same time, a more medium-sized runner may move slower but at a more steady and enduring rate, and may be able to sustain longer intervals without needing to be refreshed. The player is free to strategically choose the runner they wish to control and the choice effects much of the game play throughout the seven days of racing.

Visually, races will be represented with each racer lined up along a horizontal track and running left to right in a stadium-type of setting. Obstacles will appear ahead and players will need to press the spacebar at the right time in order to have their player successfully clear them. If a player is not able to clear an obstacle, their final time will be increased by a set number of seconds. Towards the end of the week and during the harder races, larger hurdles will appear which will require the answering of special physics questions to clear successfully.

In terms of audio, crowd noise will be heard throughout races along with special remarks from each different racer as they jump/miss a hurdle or complete the race in first place.

At the top of the screen a stamina/health meter will be displayed showing how much the runner has left and as a result their physical condition. There will be stations where the runner must go to pick up either sports drink or water during the race to replenish themselves, having to answer a biology-related question in order to receive the chosen refreshment. The players may attempt to avoid stopping for the water or sports drink but they may not be capable of finishing the race with a good time due to their stamina/health sinking too low.

At the same time outside factors will effect the behaviour of the stamina/health meter and the rate of its replenishment. In-between races the players will be presented with a special menu screen and asked to make decisions concerning how their racer will behave during the evening. Decisions will need to be made concerning dinner and the following morning's breakfast, along with evening activities such as taking brief warm-up jogs or going to the pub with friends. Overall, these decisions will have effects on the next day's performance and will help illustrate to kids the scientific aspects of preparing and sustaining performance over a seven-day race period. For example, eating fast food and spending a night watching television may weaken the runner the next day or make them sick during competition. At the same time, eating a healthy meal and getting to bed early may increase stamina and give the runner a better start. It may seem as though players will quickly learn how to play the game effectively using common sense, but the other choices may result in different animations and results that the kids may find enjoyable to watch and sample. Short scientific explanations will also accompany the animations that result the following day explaining why the player's choices the evening prior resulted in this outcome.

When the week of racing is completed the racer with the lowest combined race time will be indicated as the winner. If the player has successfully managed their racer throughout the time period they will be rewarded with a special character to play through the game with again (possibly a robot or animal character).

Science Involved

'MARATHONology' relates to the science involved in sports in a number of ways, though most prominently in its presentation of the biological, physiological, and anatomical factors involved in running a marathon race. By allowing players to make decisions concerning their racer's health and witnessing the consequent results and explanations they will draw a link between scientific study and athletic performance. Combined with a degree of physics understanding from the jumping of the hurdles, the impression that science is involved in the world of sports will be clearly communicated.

Development Spec

'MARATHONology' will be developed utilising Flash software and action scripting. The art and programming logic demands are fairly balanced, and fairly simple. The more difficult computations will be involved in computing/deducing the racer's performance from day-to-day, while the more daunting artistic work will be focused on creating the animations necessary for each playable character.

9.6.13 Row Row Row Your Boat

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 22/01/02

Introduction

This idea was prompted by the popularity of crew in the United Kingdom. Currently Steve Redgrave is enormously popular after having won his fifth Olympic gold medal. This game warrants a design treatment because it is unique and most kids don't think of the scientific aspects of something such as crew.

Game Story

The game is set as an Olympic crew race. The player is set as the racer in a one-man crew boat and must win the race in order to prove that Britain is the best at rowing. The goal of the game is to win the race and see how the muscles in the human body work and feed them to keep them going for the entire race.

Game Play and Look

The player will begin at the start of the race. As the race begins the boat will begin rowing on it's own. As the game progresses the muscles of the rower will be shown. Since different muscles are constantly being used in different ways and therefore will need different things to be delivered to those muscles in order to continue working.

An alert will appear on the screen during the race alerting the player to a certain muscle/muscle group that needs something either more energy or more oxygen. The player will have to click and drag the O_2 and ATP to the needed sites. If the student gives the muscles too much there will be an over load and the muscles will be working too hard to process it instead of working on continuing to work towards winning the race. On the same note should the student not give a certain muscle group enough of one element then that muscle group will get too warn out to continue the race and subsequently the rower will slow down. With the optimal addition of O_2 and ATP the rower will win the race beating the other contestants and upholding Briton's name as the top rowers in the world.

Visually the screen will be laid out on a river with different building and such moving past in the background. There will be other rowers that will move around the screen passing and being passed by the player depending on his/her performance. On the right hand side of the screen there will be two large flashy buttons that will be Oxygen and ATP for the player to click and drag to the muscles.

Science Involved

The Science Involved in this game is anatomy and physiological effects of exercise. The student will put into direct use the knowledge that he/she has about muscles and what they need to work optimally.

Development Spec

The AI for the computer controlled racers will require extensive use of Action Scripting which may not be feasible taking into account or skill level.

9.6.14 Science Goals!

Design Treatment (Football)
WPI Science Year IQP, C Term 2002
Last Modified Date: 17/01/02

Introduction

In wanting to design a game involving the scientific aspects of sports in the United Kingdom, the popular sport of football immediately becomes a likely candidate. Though designing and producing all the varied aspects of the team-based sport may be beyond our abilities, a smaller game focused merely on the physics-based aspects of scoring a goal is more plausible. This abridged version of the sport is the subject of this design treatment, and warrants this stage of development due to the rampant popularity of football in the UK. By using it as the primary focus of our game, students will be less likely to shy away from it due to its educational elements and will therefore also be more likely to recognise and celebrate scientific interest through its relation to the sport.

Game Story

In 'Science Goals!' the player assumes the role of a contestant (male or female) in a nation-wide football tournament. The tournament, which involves fields and goals on multiple planets, has been held to decipher who is the greatest football player in the United Kingdom. However, more than just physical prowess and technique is necessary for success; scientific knowledge and understanding of the different environments for the competition is crucial!

Game Play and Look

The object of 'Science Goals!' is to score as many points as possible with the number of shots that you have, which is initially five but may be increased with bonus shots awarded for answering science questions correctly between the different rounds of the game. These different rounds will be unique in that the player will be rocketed off to a different planet in order to attempt the same scoring techniques in areas with alternate systems of gravity and atmosphere (for example, the moon with its extremely weak gravitational pull).

In terms of scoring, players will be able to navigate their football player up and down in reference to the static goal area. The goal itself will be sectionalised into areas with varied point values, such that the more difficult shots will result in a larger number of points scored. When a player is ready to make a shot, they will be presented with an angular targeting display, which will allow them to set the direction of the shot along with the amount of power they intend to make the shot with. Once they have made their decision the shot will be made and the applicable points will be rewarded.

When the player completes the first 2-3 rounds of football in this manner they will be transported to the moon and later to other planetary areas and asked to continue the tournament under the new gravitational constraints. Visually the player will be represented in a space suit and the surrounding environments will be altered to reflect the new terrain.

Between rounds a screen will pop up with a "Did you know?" about the physics of soccer or those of the current planet, which will be short and directed questions interesting enough to get the player to read them. In answering the question correctly the first time they will rewarded with bonus shots in the next scoring round.

When the player completes the entire game they will be rewarded with a screen detailing their score and its ranking among a set of pre-ranked scores. Also, completing the game may reveal secret player characters or special bonus planetary playing fields.

Science Involved

'Science Goals!' specifically relates to sports in that the player is specifically playing the popular sport of football. The scientific concepts of physics involved in both football and the gravitational differences among planets will be demonstrated by the effect environmental differences, kick direction angles, and kick 'power' have on the football. Also, the "Did you know?" facts in after each level will hopefully get the player thinking about these aspects and how to use them to adjust their kick. A better of understanding of the physics of football will thus allow the player to obtain a higher score.

Development Spec

'Science Goals!' will be developed utilising Flash software and action scripting. The more complicated aspects of its design will be the physics involved in the act of kicking the football as well as the gravitational effects of the different environments. Such physics will be coded using the different equations concerning gravity and trajectories presented in basic physics classes (within the restraints of the action script coding).

9.6.15 Science Racket

Design Treatment (Tennis)
WPI Science Year IQP, C Term 2002
Last Modified Date: 18/01/02

Introduction

Tennis is a very popular sport in the United Kingdom, among both boys and girls. 'Science Racket' hopes to tap into this popularity by allowing players to engage in a tennis match against a simulated opponent while offering explanations linked to the sport's scientific aspects. As a result, 'Science Racket' has emerged as a design treatment candidate due to its presentation of science through an activity that kids already understand and enjoy.

Game Story

Science Year is holding a simulated tennis tournament to decide which player is the greatest tennis player of all time. It has all come down to a few final matches, which it is up to the player to complete successfully. Cunning, speed, and strategy will all be put to the test on the court!

Game Play and Look

'Science Racket' presents the game of tennis as a turn-based game that allows the player to select the type, direction, and power of the shot they wish to make. Visually the player is represented in the forefront of the screen while the opponent is shown relaying the tennis ball in the background. After the initial serve, the player is able to move the player

about in real-time while the ball reaches the opponent and either scores or is returned. When the ball is close enough, the action freezes and the player is able to configure their next shot. The opponent is able to score if the player fumbles their shot by either taking too long to make a shot decision or failing to move close enough to the returning tennis ball to be able to strike it with the racket.

During the shot decision portion of the game, a menu is presented detailing a number of different types of shots which the player may select from using the mouse to 'point and click'. These different types may have creative names such as the 'Power' shot or the 'Curve' shot, as research into tennis strategy may provide. Once a type of shot is selected, the player may in turn select a direction (once again using the mouse), and then indicate the amount of force behind the shot by manipulating a power meter utilised by holding down the mouse button and releasing it at the appropriate power level. Once all of these decisions are made the shot will be made and the game will continue.

As different shots are successfully made, points are scored, or opponents or defeated 'Did You Know?' type information and question blocks will appear detailing scientific aspects of the sport of tennis.

The game ends when the final opponent is defeated and the player is praised as the greatest tennis player of all time. Beating the game may result in bonuses such as new types of shots or new opponents/characters to play the game with a second or third time.

Science Involved

'Science Racket' involves science and sport by detailing the scientific aspects of the game of tennis, mostly those related to physics. In offering message bubbles and presenting the configuring of tennis shots as being composed of different physics-based factors (direction, force, and so forth), sports and science are drawn together within the framework of an enjoyable web-based game.

Development Spec

'Science Racket' will be developed utilising Flash software and action scripting. The more complicated aspects of its design will more than likely be those involved in animation. Creating the effect of the three-dimensional tennis court and the façade of depth on the court between the player and opponent will be difficult, as will orienting the player shot animations to properly present the dynamics of the selected shot as well as the variable position of the ball.

9.6.16 Simple Machines

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 17/01/02

Introduction

This game was inspired by a commercial game entitled The Incredible Machine. The Incredible Machine is a much larger and more complex game but it may be that Simple

Machines is too similar to the commercial product to risk developing. This game has a fairly high replay value because there are different ways of solving the problem at hand. The solution could be as elaborate or as simple as the player wants it to be. We wanted a game with a clear goal, high replay value and gameplay that required the user to invent a complex machine out of many simple machines in order to solve a problem.

Game Story

The idea behind this game is to present the player with various simple machines such as ramps, trampolines, levers, water wheels, magnets, etc so the player can connect them the create a maze for the ball to travel through. The objective is to get a ball from one place to another using the machines. Once the player has set up their machines and is ready to start playing they can hit the start button. This will cause gravity to be turned on but only the ball will be affected by it. The machines stay in the same place and when the ball comes into contact with them they can affect it.

Science Involved

The player observes the laws of physics concerning how different types of machines affect balls of different size and material. The game also involves the ideas of combining simple machines to create a large one to solve a problem. Players must solve the problem of how to position the machines so as to get the ball to go where they want. Also, since the ball can very in size and material the player needs to be familiar with different aspects of gravity and material composition.

Game Play and Look

Players will be presented with a list of the machines available to them and they will be able to drag and drop the machine to where they want them. This game will be viewed from the side so the effect of gravity on the ball can be seen by the player. The levels will become harder and harder by presenting the user with fewer and fewer simple machines to work with and by placing various obstacles and machines around the screen which can either help or hinder the player's task. The player can use these pre-placed machines if they wish. The ball can vary in size and material. It could be metal and be effected by a magnet or it could be rubber and have good bouncing properties. When the player wants to test their layout they can hit start and turn on gravity, putting the ball in motion. When the ball bounces it can make various sounds depending on the material it is made out of and the material it comes in contact with.

Development Spec

This game may require programming in Action Script to create the physics necessary to have the ball fall and react properly when colliding with objects. It may be possible to get the effect of gravity without complex programming by using the power of Flash. The majority of development time will depend on the difficulty of implementing the physics portion of the game.

9.6.17 Surf's Up!

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/22/02

Introduction

'Surf's Up' is a game of survival and sailing. Sailing is a sport that requires the participant to have knowledge of how to use the wind to his or her advantage. Players will learn some sailing techniques as well as how wind propels a boat. Drag and friction due to air and water will be explained. Sailing is a fun and technical sport that can requires a great deal of science, which can be presented in a fun and exciting way.

Game Story

The player is a doctor who starts off on his home island and needs to sail to nearby islands to treat patients as the need arises. He will have a radio with which he can receive calls for help. Before going from one island to the next the player must look at weather maps to see where the low and high pressure systems are and what the wind forecasts are. The player can use this information to plan his or her course or to wait if the conditions are too treacherous.

Game Play and Look

The view of this game will be top down with the wind surfer near the rear centre of the screen. An arrow in the top left of the screen will represent the wind direction. Wind speed will be noted in the top left corner and points will be accumulated in the top right corner. The player can steer the boat using the arrow keys or the mouse. The player must navigate through channels which will be represented as deeper coloured sections of the map. Lighter coloured sections of the water will be too shallow to navigate through.

The player can orient the sail to make the boat go in the direction he or she wants. The boat and the sail are separate so there will be an apparent lag between the time when the sail is moved and when the boat catches up with it so as to make the physics of how the wind is hitting the sail more pronounced.

The game will become harder each level by increasing the wind speed, rapidly changing wind direction and possibly throwing in some obstacles for the player to navigate around such as driftwood.

Science Involved

Between levels pop-up screens will explain the physics of how the boat interacts with its surroundings. These pop-ups will allow the player to gain a better idea of how to play the game more effectively. For example, measuring wind speed from the boat must take into account the apparent wind that is caused from the action of moving forward. The measure of speed could be explained, the history of how the knot came about. The pop-ups can also explain how to orient the sail in order to get the most out of the wind.

Players may be able to choose between different types of boats in order to take advantage of wind speed and conditions. Different types of boats will be better suited for different sea conditions.

The pop-up screens could also be accessed during gameplay so the player could get instant information on how to play better. Players may access them via a button on the screen.

Development Spec

'Surf's Up' will be developed utilising Flash software and Action Scripting. One of the most difficult aspects of this game may involve determining when a player has rounded a buoy. The effect the wind will have on the boat will also a defining factor for feasibility. Beyond that this game would be fairly simple to produce in a Flash environment.

9.6.18 Survival

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 1/28/01

Introduction

Science and the process of invention are surely put to the test when someone is stranded on a desert island. Often provided with meagre equipment and limited tools, survivors are required to make the most of what they have in order to keep alive. 'Survival' attempts to simulate this survival environment while focusing on its invention-oriented aspects. Furthermore, given the recent popularity of survival and reality-based television programs the game may be well-accepted and easily understood.

Game Story

Paul had been spending a leisurely afternoon water skiing with his friends in the South Pacific when a huge wave throw him out into the sea and onto a deserted island. Stranded without any sort of radio or communications equipment, he must survive on his own until rescue services arrive.

Having never read *Robinson Coruso*, Paul doesn't know the slightest thing about surviving in a harsh tropical environment. He has very limited equipment and he needs some help understanding how to put it to good use. If he can't manage to produce the inventions he needs, he may not be able to hold out long enough to be saved!

Game Play and Look

'Survival' presents player with a set of different tropical materials (coconuts, bamboo shoots, rocks, et cetera) and some sort of direction concerning what Paul needs to be built. Using a point-and-click interface players must construct some sort of invention to meet Paul's demands, or else his life may be put at danger!

For example, a player may be asked to construct a lookout mechanism for Paul, and provided with a set of materials. They may construct the mechanism by connecting a set of bamboo shoots to a diamond and a coconut shell. Each puzzle will have a set of possible solutions, each of which will be attributed a certain score.

As players complete the different puzzles and create the different inventions, they will accumulate points which will translate into how well Paul is surviving. If they are able to keep him happy and healthy long enough, he will finally be rescued.

Reward in the game comes from wanting to create the best invention possible for each puzzle. In between levels anecdotes detailing real survival-oriented inventions will be

provided, while during a puzzle session information will be available concerning each of the different materials available.

The invention process will be managed with a sort of material 'warehouse' that the player is able to choose from and place onto their 'workplace'. Each different item will have its own number of connector points that the player will be able to manipulate. Puzzle sessions may be timed, but the player will be allowed to continue producing inventions as long as they wish until the round ends or all of the possible solutions are constructed (thus, if they build one successfully but it receives a low score, they may try again).

Science Involved

The science involved in 'Survival' is primarily involved in studying the different properties of the available materials and then translating them into invention performance. The hope is that by understanding the different physical properties of each item, the player will learn about the invention process as well as the related scientific processes involved. At the same time, the anecdotes concerning real survival provided in-between the different puzzles will attempt to connect the excitement and danger of real-life survival situations to the science of invention.

Development Spec

'Survival' will be produced using Flash software and action scripting. The art constraints may be fairly low, concerned primarily with simple coconuts and different materials. The main development efforts will have to be devoted to organizing the different puzzles and their solutions, as well as successfully creating the free and creative invention-producing environment described.

9.6.19 This is your Life!

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 18/01/02

Introduction

While brainstorming, we started discussing favourite board games and the game of 'Life' came up and what a better game than something like that game. Although we realise that there are physical limitations to this game such as the length of the game and all the different variables we still think that this idea warrants a design treatment.

Game Story

This game is a vague combination of the game of 'Life' and 'This is your Life' (a game show where the contestant is paraded around and shown different aspects of his life). The main character would get to choose from different inventors such as Albert Einstein, Jules Verne, and James Watt to decipher which inventions each inventor created and furthermore learn more about these world-altering inventions.

Science Involved

'This is your Life' relates to inventions because the different inventors talking and sparking interest to the player is a way of grabbing the players attention about inventions and moreover, science. While travelling through time the players are faced with different inventions that their character has worked on. This game could be an integral part in not only teaching kids about previous inventions but also about their creators.

Game Play and Look

This game's main objective is to stimulate the interest of kid in the area of inventions and science through travelling along the life of a famous inventor. The game starts out where the player gets to choose their favourite inventor or an inventor that intrigues them. Then the player rides around in a car along the path of that inventor's life. For example, if the player chooses Jules Verne, the voyage would start on Feb 8, 1828, the year he was born. Then the car would travel through his life stopping at some milestones like when he wrote the book 20,000 Leagues Under the Sea. At the end of his life the player would then have a much deeper understanding of the life of Jules Verne and would possibly desire to either write like him or come up with other inventions in a similar fashion to him. Also, with the other inventors the players will learn similar information including all types of quirky facts that we can uncover. There will be different backgrounds for each different inventor and hopefully inventors from at least every century.

Development Spec

This game may be possible to create without using any Action Script. Flash has many tools for creating animations and moving those animations around the screen.

9.6.20 Toppling Toothpicks

Toothpick Tower Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 17/01/02

Introduction

In general physics, students are occasionally faced with the task of building a toothpick tower. This toothpick tower is made only out of toothpicks and glue and its prime objective is to withstand a certain amount of weight. This game could be done on the Internet with set parameters around it so if the design was not good for holding weight it would crumble. This game warrants a design treatment because it introduces an aspect of science, architecture and building, that does not occur anywhere else in our thoughts.

Game Story

When playing 'Toppling Toothpicks', the player assumes the role of a design architect that needs to have the design for a tower. The architect only has limited materials and the tower needs to fit between other buildings therefore it needs to meet area specifications. However, after the tower is built, the contractors want to make sure that it can

endure anything especially a meteor falling from the sky. Therefore, the contractors want to drop weight on it after it is completed.

This game is set on building a personalised tower that needs to withstand a specific applied weight. When the weight is applied to the tower, the tower needs to have specific qualities about it so it will not crumble (i.e. it needs to have a good triangular base so it can support the weight best). The player is the main character in this game; he competes against himself each time hoping to build a tower that can withstand the maximum weight each time. The only opposition in this game is that there are a limited number of toothpicks that the student can make and there is a mandatory height and width.

Science Involved

By attaching toothpicks and applying a weight to this structure a lot of science is involved. How can a little structure composed of toothpicks weighing 3 kilograms hold up to 100 kilograms? The use of geometry and physics is used primarily in this design. Knowing that a triangular structure can support the most, a student would fix the toothpicks in that order to win the game. This would show the player the advantages of trusses (triangles) in construction and architecture. Also, the student learns basic concepts of equilibrium, stability, forces, centre of gravity and Newton's Third Law of Motion. Finally, the forces of tension and compression play a huge role in this project since tension works on pulling the structure apart while compression works to push the parts together. The player needs to realise that the two forces need to work in unison so the tower doesn't collapse as easily.

Game Play and Look

Keeping in mind that the final goal of this game is to have a fully sustainable tower for this contractor, the architect needs to remember all the constraints that the contractor put into play. The architect will start out at a construction site with different buildings that are in the build process.

The total number of toothpicks allowed to the player will be visibly displayed on the screen at all times so the player knows when he or she is close to running out. On the main background there would be a square that is the same dimensions as those required in the instructions which would be about a 15cm x 15cm square. There would also be a running longitudinal scale so the player knows how tall their structure is getting which would be a minimum of 25 cm. After the player is done using all their toothpicks he can click a button and watch weights accumulate on his structure until it collapses or can support the maximum weight.

If the tower collapses the student will then be taught a little lesson on trusses and compressive and tension forces that could be beneficial to his or her second try of the game. However if the architect creates a tower made of trusses and none of the compressive or tensile forces fail then he or she will be rewarded.

Development Spec

Gravitational physics would need to be created using Action Script which is an unlikely feat given our programming skill.

9.6.21 Vroom

Mouse Trap Car Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date:

Introduction

One experiment that is often performed in schools is the mouse trap car race. Children create a car using a mouse trap as propulsion and race it with their classmate's cars. This game will include multiple options for propulsion other than just a mouse trap. Water, solar, wind and rubber band cars will be available.

Game Story

This is a drag racing game where the objective is to beat the computer controlled cars. When a player wins a race they receive new parts with which to upgrade their car. The parts will be progressively more effective for making the car go faster. The wheels, frame, propulsion and possibly gearing could be upgraded.

Science Involved

Players will be able to experiment with car designs and propulsion methods in their quest to beat the other cars. The inventive process is being explored and at the same time science dictates the speed of the cars. Players need to think about various aspects of their cars in order to make them competitive. Friction and energy are directly related to the car's performance. Rubber tires would be better for grip than wooden tires and rubber tires with inner tubes would be even better. Every part that can be added to a car will be made out of household materials such as CDs and rubber bands. Players learn about how each part of a car helps to make it competitive.

Game Play and Look

The player can choose from a list of parts and options when designing his or her car. The game will start off with only limited resources for use when designing the car and as the player wins more races more options will become available for use. This keeps the competition linear. The parts will include various methods of propulsion, various types and sizes of tires as well as various frames. The speed of the car will depend on its weight, tire size, material properties and propulsion.

When the player has designed his or her car it will be set up on a straight track and raced against computer controlled cars of various random modifications. The car would travel along a straight path so as to replicate the course of a real mouse trap car race. Starting off with cars of a simple design and working up as the levels get harder, the student can learn about different parts that make the car work more efficiently.

Each component will have a corresponding value. The sum of the values will determine how far the car will go. Speed may be determined in a similar manner.

Development Spec

This game requires the use of Action Script for randomizing the racing sequence and keeping track of the car's attributes.

9.6.21 What's Cooking'?

Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date: 21/01/02

Introduction

During a brainstorming session with Sophie, we thought of creating a kitchen type scene that explained different actions that occur in the kitchen. This game would run parallel to the room that Science Year already has on their website: the Science Room. Most children are aware of various appliances that are available in the kitchen however very few of them know the science behind these apparatuses. This idea certainly warrants a design treatment for many reasons including the fact that all of these appliances are fairly recent inventions that have altered everyday life in a huge way.

Game Story

In 'What's Cooking'?' the player get to play the role of a very curious chef that works in the kitchen all day everyday but wants to know how he gets all of his appliances to work. The kitchen which includes various appliances in addition to a toaster oven, a microwave oven, a blender, pots and a refrigerator. In this game, the chef also wants to come up with any idea for a newer model for his or her appliances: what will that look like in the future?

Science Involved

'What's Cooking'?' is a game that relates directly to the application of inventions in science. The appliances that have been created throughout time have had a direct impact on our culture and society. Without these inventions the world would undoubtedly be a lot different and therefore these inventions need to be celebrated and understood by young adults. Also if children are given the opportunity to create/build upon another appliance they might come up with some amazing ideas about a futuristic apparatus. This could spawn a creative interest in science and might make the student more intrigued in science in general.

Game Play and Look

Since the object of this game is to learn more about different kitchen appliances that have been invented throughout time, it will be set in a kitchen that has all of these appliances readily available. The kitchen should be a bright area that displays appliances such as a blender, toaster, microwave oven and other similar machines that are used in a kitchen.

When the student chooses to learn about a certain appliance they can click on it and move to a new screen. On the new screen, the chef will learn about the apparatus including the technical aspects of it and who created it. Then, for each appliance we will try to find at least one interesting and fun fact about it to make the students more interested in why they're learning about it. After learning about how the appliance works the student will then be allowed the opportunity to think of a new way of re-inventing that appliance. This will allow the student to start thinking in a more technical and advanced way therefore helping him or her to create things through inventions.

Development Spec

We intend to use Macromedia's Flash to create the basic animations necessary for this game.

9.6.22 Writer's Inventions

Writer's Invention Workshop: Design Treatment
WPI Science Year IQP, C Term 2002
Last Modified Date:

Introduction

The idea for this game was prompted by the idea of using Science Fiction writing to inspire kids that are interested more in writing than in science. This game will incorporate kids' interest in writing to that of scientific inventions that they probably have not already thought about. This game design is valuable because it is unlike anything else that is on the Science Year website already and it is something for a large age range. The idea arose from trying to think of a way to incorporate the idea of science fiction writing and science inventions without having to have kids come up with their own inventions. If we had wanted kids to come up with their own inventions we would have limited the number of kids that would find our game interesting. Coming up with a new invention can be vary hard to do. It requires a lot of thinking and to keep kids interested we want to do the hard work for them.

Game Story

The plot of the game is as follows: the writer / "player" will be given several different invention ideas created by the game designers. The writer will then be prompted to write a story about the invention(s). The story can be as long or as short as the writer wishes but must include at least one of the inventions that are given. The goal of the game is to come up with the most creative story possible. The stories will be saved and sampled at random by website staff to be posted on the website where others can read them.

Science Involved

This game is directly related to the theme of inventions. This game would allow students that may prefer writing and literature over science and inventions to become involved and exposed to that field of study. It will help kids to see that there are always new things that can be created. It will allow them to see connections between inventions and writing and they might also find one of the inventions particularly interesting and want to elaborate on it or even want to learn if it really could be made. This will also be taking a simple activity that kids could do at home with a parent or friend and spark an interest in science through creative writing.

Game Play and Look

The game will be set up to look like a notebook. On the right hand side of the screen there will be a box in which there will be certain "inventions" that the game designers have come up with. The player will be presented with the inventions and asked to name them and may then click and drag them over to his/her notebook to place the name of the invention in their story. Then will be told to pretend to be the inventor and write a story involving that invention. Multiple inventions may be used and they may be connected to one another to create a more elaborate story. Once the story has been created the author will be asked to give their story a name and submit it. A sample story may be available to give ideas to the writer.

Development Spec

Depending on how busy Telepathy or Science Year are it may not be feasible to have stories posted to the website. In that case we may put more emphasis on having the player print out the story rather than submit it.

9.7 Appendix G – Game Selection Criteria

Game Design:

MESSAGE:

SCIENCE – To pass through this level it needs to meet 5 out of 6 requirements

- **MANDATORY** Does it fall within the criteria of the national curriculum? Especially within KS 3 and 4.
- **MANDATORY** Is the game directly science-based and is there direct science interaction?
- **MANDATORY** Are the games directly theme based on sports or inventions?
- **MANDATORY** Is the game focused on one science discipline (i.e. based on one specific scientific aspect as opposed to a broad range such as both biology and physics)?
- Are there any secondary science explanations? Will learning from them aid the player in performing better within the game?
- Are there no 'wrong' answers? Is the activity structured in a way that is does not involve choosing between a right and wrong answer thus avoiding academic discouragement

ENTERTAINMENT – To pass through this level it needs to meet 7 out of 10 requirements

- Is there graphical simplicity?
- Does the game offer a reward?
- Does the gameplay involve simple intuitive controls?
- Is the game challenging presenting the player with increasing levels of difficulty?
- Can the player replay the game without the exact same content every time?
- Is there a story involved?
- Is the interface intuitive? Is information pertinent to gameplay easily accessible on the screen?
- Is there potential for creative gameplay?
- Is there limited text?
- Is the activity culturally prevalent? Will children in the UK have trouble identifying with it?

FEASIBILITY

- Programming
- Graphics/Sound
- Performance

9.8 Appendix H – Game Design Documents

9.8.1 Feed the Mind

Introduction

Creating a game centred on the link between science and inventions can be very difficult, primarily due to the creative nature of inventing. Whereas inventions can be envisioned or built from an unlimited number of sources and materials, games need to be created in structured and reasonably-bounded environments. By stepping outside of the actual invention process and focusing on the factors such as inspiration and education, opportunities for more feasible game-based explorations of invention become possible. Among them is 'Feed the Mind', an action-based game requiring the player to work with their team of inventors to create and invention to win the Science Fair.

'Feed the Mind' passed through most of the filter screens except for replay value and creative gameplay. We feel that despite these shortcomings 'Feed the Mind' presents the process of invention in a very creative and fun way. After meeting with Telepathy, it has been decided that 'Feed the Mind' is also quite feasible to create, which will allow us more time to focus on the background information by requiring less research into programming.

'Feed the Mind' was determined to be feasible after talking to Telepathy because of the simplicity of making objects fall out of a "window" and have to be bounced across an "alleyway." By giving the objects imaginary trajectories and not making the way the objects fall and bounce true to physics the gameplay and programming become fairly simple. Although the gameplay is relatively simple having a set group of objects and a certain amount of inspiration that the player must get to the inventor makes for interesting game play.

Plot Line Description

Vikki and her lab partners are in a thrilling race against time and the evil Mr. Trift that are trying to create their set of Science Fiction based inventions faster. Vikki and her partners Simon and Jane don't know what to build though in order to defeat the evil group of inventors that they're racing against.

Vikki, Simon and Jane are working as a team to get all the pieces that they need to create each invention. Simon has gone to an old warehouse where there are still plenty of old building supplies and books laying around. Jane has gone to their lab next door to set up and waits for the parts to get to her from Simon across the alleyway. Vikki is waiting down below in the alleyway for Simon to throw the parts down. As Simon throws the parts down Vikki needs to bounce them off of her trampoline that she's holding over to Jane in the lab.

Simon throws certain objects out the window and Vikki needs to get the inspiration up to Jane in the lab. The sources of inspiration that Vikki, Simon and Jane are using are Science Fiction novels, a walk in the park, a visit to the museum, and a movie, but given that there are different things that inspire people there will be an unknown amount of inspiration that is needed to create the invention. Therefore there will be icons that represent different

sources of inspiration and Vikki will have to bounce these over to Jane in the window. Each Science Fiction novel that the levels are based on contains different types of inventions that the author thought up and some of which have even been created into real life machines.

In order to complete the entirety of the game Vikki, Simon and Jane will have to work through five fun filled levels of inspiration and inventing in order to successfully beat the evil Mr. Trift.

(Detailed narrative of the story's plot line, with enough detail to prepare the reader for understanding the components of the game described throughout the document. What is the game about? What are the goals of the player? What are the minor and major achievements that a player completes in the course of the game?)

Science Involved

'Feed the Mind' is conveying the invention process to the player. The common misconception about the invention process is that it is solely slaving away in a laboratory day after day working to come up with something new or it is just by pure inspiration or accident. Neither of these theories is true, the invention process that inventor goes through involves a lot of hard work, inspiration and sometimes it is by accident that he/she comes out with the desired product.

The invention process is generally set into motion by inspiration for some new invention or an improvement to an existing invention. Some of this inspiration comes from Science Fiction writing in which the writers write about inventions which seem so far from reality at the time but later in history become reality because of the interest that they sparked in a young mind. But, once this inspiration has occurred it is important to realise that there is a great deal of work that goes into building these inventions. There is a lot of time that goes into creating something new and sometimes it just doesn't work no matter how hard the inventor may try.

'Feed the Mind' will show the invention process in a fun way that involves both the inspiration and creation processes. By having the student bounce the book before creating anything it shows that the inventor needs some sort of inspiration behind their creation. Also, showing the different Science Fiction books that are the basis of each of the five levels incorporates the aspect of Science Fiction as an integral part of the invention process. But, by also having the students bouncing specific parts that are needed to build each invention they will see that the inspiration part is only a part of the whole process.

Overall, 'Feed the Mind' will demonstrate to students that the invention process goes on all around them and they have probably been a part of it without knowing it by simply thinking about a way of improving a pre-existing object. By making the connection with the player between their own lives and the invention process they will be more likely to view it in a less stereotypical manor and perhaps find it of some interest to themselves.

(How does this game, in detail, relate to one of the scientific themes, either sports or inventions? What elements of scientific instruction will be involved in it? What scientific concepts will it help kids to interact with in its environments?)

Detailed Description of Core Game Elements

Vikki along with her lab partners Simon and Jane are working against the evil Mr. Trift to be the first to create a series of new inventions. Simon, based out of the window of the building located on the left-hand side of the screen, is throwing different parts to Vikki that they may need for the invention they are currently working on. Simon cannot be seen by the player but in the game story at the beginning of the game it will be explained that he is there.

Vikki the main character of the 'Feed the Mind' adventure holds the bouncer above her head while moving between the two buildings. Using the right and left arrow keys on the keyboard the game player can move Vikki right and left between the two buildings. Vikki holds the bouncer over her head so that she can help her two lab partners be sure that they beat the evil inventor team. Vikki receives the pieces from Simon on the left and the player chooses whether or not to bounce the particular parts over to Jane who is based out of the window in the building on the right hand side of the screen. The decisions that the player makes for Vikki are the basis of the game.

Vikki and her team are given a certain amount of time for each level based on the number of parts that are needed for the particular invention. By moving Vikki so that she bounces the needed items that Simon throws, the picture of that item will be removed from the bank of needed items. Once all the needed items have been bounced from Vikki to Jane the level is completed and the player has successfully created that invention which is shown after completion of the level.

Each level of the 'Feed the Mind' adventure involves a different Science Fiction book, different needed parts, and a different end invention. But the three characters and the game play remain consistent through the whole game.

(Describe the elements of the game that are universal to all of its different sections. What does the main character look like? How do they interact with their environment? How does a player control this character? How do they accumulate points? How do they achieve basic goals or defeat opponents?

Detailed Description of Every Game Section (Whether it be levels, scenes, or varied adventures, describe all of the different portions of the game. Establish conventions for naming and organising objects, characters, and environment elements. Describe the visual and audio presentation of these sections, along with animations, scripting, background, and other important miscellaneous details)

Name of Section/Level/Scene:

Introduction/Loading Screen

Detail (including presence of Science in Section):

This screen is what will be used to capture the player and want them to go into the game. Therefore it has been decided that this screen should be the most eye catching while going along with the rest of the game. There will be the name 'Feed the Mind' along the top of the screen while the logo will be below it. The logo will appear as the silhouette of a head that has been split open on the side with a picture of Vikki with her bouncer standing on the

open head. Below the picture of Vikki it will say start and the player will click on Vikki to start.

Physical and Audio Appearance:

The physical appearance of the game will be as it is stated above with the Logo appearing at the top of the page about a quarter of the way down. Then below the title in approximately the middle of the page there will be the 'Feed the Mind' logo. The background will be a light bluish colour similar to that of the buildings and sky in the background of the game. The 'Feed the Mind' title will be in all black. This screen will also have bulleted information on it that the player will read while the game loads.

Background:

The background will be a light bluish colour similar to that of the sky and buildings behind the player in the actual game. It will be all one colour as to not distract the player will other object and directing their focus to the start button.

Foreground Objects and Characters:

- Feed the Mind: All capital letters, black
- Logo: Silhouette of head with top cut open and hinged on right side of screen, put in centre of page minimum ½ inch below title
- Vikki: The picture of Vikki will be the same as she appears in the game. She will be standing on the top of the open head and below here it will say start. Vikki will operate as the start button.

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

Once the player clicks on Vikki he/she will be taken to the game info screen.

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Game Info Screen

Detail (including presence of Science in Section):

On the top of the screen there will be the heading of Feed the Mind. There will be four divisions under it. These buttons will be arranged along the left of the screen in green with white text and as the mouse moves over the buttons the text turns red. The four buttons are:

- Game Story
- Controls
- Credits

When each of the above buttons is clicked on the text associated with it will appear on the right hand side of the screen. There will also be a start button with the same properties as the other buttons.

Physical and Audio Appearance:

- Background will be the same bluish colour as the Intro/Title Screen
- The heading will be in black just as it was on the Intro/Title Screen, but smaller to fit up on the top 1/3 of the page.
- The Text will be set up with a heading and then below it the information about the heading
- The Start button will be purple with the 'Start' written in black

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: Feed the Mind (in all black fitting in the top 1/3 of the screen)
- Vikki will be standing in the upper right hand corner of the screen
- The Text will be as follows:
- Game Story: Take on the role of Vikki and help her two lab partners Simon and Jane beat the evil inventor, Mr. Trift, to create and patent new inventions for the science fair. You will be racing against the clock to beat Mr. Trift to the patent office. Watch out because he may try to interfere with your work. Simon is in the old warehouse throwing you inspirational materials and spare parts that need to get to Jane up in the lab. You need to bounce the items on your trampoline to get them into the window. Jane must create her invention before the clock runs out and Mr. Trift beats her to the patent office.
- Controls:

Use the left and right arrow keys to control your movement.

- Credits:

Programming: Seth Borg and Nicholas Baker
Research and Design: Allyson Barford and Elizabeth Heneberry

Sound effects: William Ryan Baker
Special Thanks to: Gregory Theyel, Steven Matson, Sophie Duncan and the Science Year team.

- The Start button will be the same as all the other buttons

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the Start button he/she will be taken to the 'Feed the Mind' Inspirational items screen.

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Inspirational Items Screen

Detail (including presence of Science in Section):

On the top of the screen there will be the heading of Feed the Mind and under it, it will read say Inspirational Items. Vikki will be in the right hand corner again. There are pictures of all four of the inspiration items and there will be a description of he inspiration process below the items. There will be a continue button at the bottom of the screen.

Physical and Audio Appearance:

- Background will be the same bluish colour as the Intro/Title Screen
- The heading will be in black

- Vikki will the in the upper right hand corner
- There will be pictures of the inspiration items lined up along the middle of the screen with the title below them
- There will be text explaining the inspiration below the pictures

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: Feed the Mind (in all black fitting in the top 1/3 of the screen)
- Vikki will be standing in the upper right hand corner of the screen
- There are pictures of the four inspiration items along the middle of the page
- There is text below the pictures
- The Continue button will be the same as all the other buttons on the previous page

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the Continue Button he/she will be taken to the level 1 info screen.

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Level 1 Intro Screen: *20,000 Leagues Under the Sea* by Jules Verne

Detail (including presence of Science in Section):

The loading screen will be up for as long as the player wishes with the intention of introducing the player to *20,000 Leagues Under the Sea*, the Science Fiction novel that level one is based on.

- Level 1: 20,000 Leagues Under the Sea will be at the top of the screen.
- The text will be a short explanation of the book and the second paragraph will be a short description of the technology found in the book.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in black, and will be placed in the top 1/3 of the page
- The text in all black, the two text boxes will be centred on the remaining portion of the screen.
- There will be no sound affects on this screen.
- There will be a continue button on the screen that will be the same shape and size as those on the Game Info screen

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Level 1: 20,000 Leagues Under the Sea
- Text: in all black centred on the lower part of the page not taken up by the Heading
- 20,000 Leagues Under the Sea takes you on an exciting adventure in the Nautilus submarine below the surface of the Sea where anything can happen.
- Jules Verne wrote about technologies such as clocks, stoves with heating coils, electric lights, generators and motors in a much more sophisticated manner than had been invented at the time. Since then these inventions have been further developed and have become an essential part of everyday life.

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

Once the player clicks on the Continue button he/she will be taken to the beginning of level 1.

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Level 1: 20000 *Leagues Under the Sea*

Detail (including presence of Science in Section):

In this level it will begin with Vikki stationary in the middle of the screen. Simon will also be set stationary with the first object in his hand. Jane will be set up in the right hand window also stationary. The car in the background will be set on timer and will begin running as soon as the game starts. There will be a five-second delay before the first object is thrown to allow students to experiment with the controls prior to the start of the game.

The needed items will be posted in a box under Jane on the right hand side and as items are collected they will disappear from the list. In level one after the player has collected the book he/she will need to collect:

- Book
- Filter
- Glass
- Propeller
- Metal
- Nail
- Hammer
- Legal Document

There will also be different sources of inspiration. There will be one necessary book that the player will have to get and that will in the necessary items list. The other sources of inspiration will be:

- Walk in the park
- A visit to a museum
- Animals
- Movies

All the necessary parts and inspiration items will be randomly generated in a list and two rotations through the whole list will be possible during the time allotted for the first level. Allowing for two rotations through the randomly generated list of items will allow a certain amount of ease in passing the first level. The ease will be generated so should the player miss one of the items the first time through he/she will be able to collect it in the second time and still have time to complete the level.

The science in the first level is the science of the invention process. By showing that Jane must be inspired to builds shows kids a good way to go about their own invention process. The aim of this first level is to introduce kids to the Jules Verne's *2000 Leagues Under the Sea*, and for them to think creatively about their own ideas after seeing the ideas generated in the game. Leading us to the invention generated in the first level, which will be a Pollution Filtering Submarine.

Physical and Audio Appearance:

- The screen will be set up with a building on the right and left of the screen and a silhouette of building in the background and a road in front of the silhouette of buildings.
- There is a car continuously moving on the road in the background of the screen.
- The building on the left is the abandoned warehouse that still has numerous building items and books.
- Vikki is stationary on the ground level (without induced movement from the player)
- There is a list of items that the player needs to collect on the left of the screen.
- As Inspiration items are collected they will cause the inspiration meter on the bottom of the screen to go up
- On the bottom of the screen there is an inspiration meter
  - Due to fact that it's unknown how much inspiration it will take to inspire an inventor we will represent this by having the value that the inspiration icons give on the inspiration meter will be randomly generated. Therefore the player may get all the needed parts to the inventor but even will all the parts and inspiration it still may be not enough.
- The randomly generated list of needed parts and inspiration items will be "thrown" out the window by Simon to Vikki.
- The needed parts and junk parts will be depicted by literal pictures of what they would look like
- The inspiration items will be represented as follows
  - A walk in the Park: A tree
  - A visit to a museum: An old building
  - Animals: A dog
  - Movies: A video cassette
- The Audio content of this level is as follows
  - The car will honk as the go by
  - The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
  - The objects will have a "thud" as they hit the ground
  - There will be a "bling" as the needed objects get up into the window
  - There will be a sound as the inspiration meter goes up
  - There will be a sound for when all the needed items have been successfully collected
  - There will be a sound for as the inspiration meter has reached the needed level of inspiration

Background:

- The background will be set up as an alley way between two building
- The building on the right and left will be very similar in appearance
  - Dark Grey building with two windows on it a lower and upper
- A road behind the buildings that cars will be going down
- Silhouette of buildings behind the road

Foreground Objects and Characters:

- Vikki the main character will be in between the two buildings in front of the road.
- The objects will be thrown out of the window on the left hand side
- Simon will be in the window on the left hand side
- Jane will be in the window on the right hand side
- On the bottom of the screen there will be the inspiration meter
- On the bottom of the screen will show what objects you have collected
- On the building on the left there will be a box showing which object will be thrown next
- On the bottom there will be the list of items that need to be collected and as they are collected the item will disappear.
- On the bottom right corner of the screen there will be a clock with the amount of time that the player has running backwards down to zero

Animation:

- Simon will have his arm moving and forward and backwards motion while each piece is thrown out the window
- Vikki will move side to side determined by the player
- The car in the background will go down the road
- The pieces will bounce as Vikki bounces them on her bouncer
- The inspiration meter will go up as the player bounces different inspiration items over to Jane
- The list of needed parts on the left will remove each item as it has been successfully bounced into the window
- The part in the box below Simon's window will change to show what item is next going to be thrown.

Music and Sound Effects:

- The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
- The objects will have a "thud" as they hit the ground
- There will be a "YAY" as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an "awe"
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected

Scripts for Characters:

None

Scenes and Transitions:

Once the player has completed the first level, if they have won they will be taken to the “Level One Completion Page” or should they loose will be taken to the “Try Again Page.”

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Level One Completion Screen

Detail (including presence of Science in Section):

The completion screen will be up for as long as the player wishes until they click on the continue button or the read more button. This page intends to show the player the invention that they created.

Physical and Audio Appearance:

- Seawater Filtering Submarine, will be in big font in all purple
- The description of the Submarine will be below the picture, it will be in smaller font in all black, the description will be as follows:
- This submarine will solve drought all over the world. It will filter seawater to make it suitable for drinking and the submarine will deliver its cargo of fresh water to poor and drought stricken areas of the world where permanent desalination plants cannot be afforded.
- The drawing of the submarine will be above the description of it, in the centre of the screen
- The background will be blue
- There will be a green continue button on the bottom right hand side of the screen
- There will be a read more button
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- The title will be in large font in purple
- The text above and below the picture of the invention will be in a smaller black font
- The picture of the submarine will be in the centre of the page
- The continue button and read more buttons will be at the bottom of the screen.

Animation:

When the player's cursor passes over the read more button red text will appear above the button saying "+20 seconds for reading more."

Music and Sound Effects:

- There will be a submarine type sonar noise when the player first gets to this screen.

Scripts for Characters:

None

Scenes and Transitions:

- When the player clicks on the read more button the player will be taken to the Level 1 Educational Page
- When the player clicks on the continue button he/she will be taken to the level 2 intro screen

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 1 Educational Information Screen

Detail (including presence of Science in Section):

This screen will give players additional information on what type of science is being developed in the real world. This will allow players to see the connection between the pretend inventions that they see at the end of the level and the real life inventions that scientists are working on.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page
- Congratulations will be at the top of the screen
- The text in all black will be a description will be as follows:

Desalination is the "de-mineralisation" or "purification" of water in order to make impure water usable. There are many desalination plants in the Middle East, Caribbean and Mediterranean. There are two main ways that desalination occurs by reverse osmosis or distillation. In reverse osmosis seawater is forced through a semipermeable membrane that only has holes big enough to allow water molecules to pass through but not salt or other minerals. Distillation works by heating water to produce steam. The steam is condensed and has a low salt concentration and contains few other minerals.
http://www.sciam.com/2001/0201issue/0201how.html

- Below the text will be a picture representing the desalination process
- Continue Button: will be in the bottom right hand corner of the screen same as in the completion screen

- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Text: in all black centred on the lower part of the page not taken up by the Heading
- For specific text see Physical and Audio appearance

Animation:

The text will scroll in as the player is on the screen.

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- The player may continue here to the link to the world wide web for more information
- Also, they can click on the continue button to go back to the game and continue on to the loading screen for the next level.

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Try Again Screen

Detail (including presence of Science in Section):

This screen is what the player is taken to when they have not successfully completed the level they were playing.

Physical and Audio Appearance:

- The screen will have a bluish background
- In the middle of the page it will say
- "Try Again… you failed to help Jane create her next invention"
- On the bottom of the screen there will be Try Again button and it will send the player back to the beginning of the game (the Try Again button will look similar to the continue button on the completion screen)

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Text: all black in large font
- Try Again button: small on the bottom right hand corner of the screen

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- This screen is the end of the game unless the player clicks on the Try Again button which will take them back to the Intro Screen

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 2 Loading Screen

Detail (including presence of Science in Section):

The loading screen will be up for as long as the player chooses with the intention of introducing the player to *Fahrenheit 451*, the Science Fiction novel that level two is based on.

- Level 2: Fahrenheit 451 will be at the top of the screen.
- The text will be a short explanation of the book and the second paragraph will be a short description of the technology found in the book.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page
- The text in all black, the two text boxes will be centred on the remaining portion of the screen
- There will be no sound affects on this screen.
- There will be a continue button in the bottom of the screen

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Level 2: Fahrenheit 451
- Continue Button: bottom right of the screen, purple with black writing
- Text: in all black centred on the lower part of the page not taken up by the Heading
- Guy Montag is a 'fireman' in the future who starts fires all over the city wherever he finds books, because books are illegal. Find out about the rest of Guy's world in this strange place.
- In Fahrenheit 451, technology such as interactive television is everywhere. This society is one of complete virtual reality. There are robots to do everything for people and a mechanical dog that goes around killing people who have broken the law which forbids people to have books. Would you like to live in this world?

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the continue button they will be taken to level 2

Miscellaneous Elements:

None

Name of Section/Level/Scene:

Level 2: *Fahrenheit 451*

Detail (including presence of Science in Section):

In this level it will begin with Vikki stationary in the middle of the screen. The cars in the background will be set on timer and will begin running as soon as the game starts.

The needed items will be posted in a box under Jane on the right hand side and as items are collected they will disappear from the list. In level two after the player has collected the book he/she will need to collect:

- Book
- Television Screen
- Control Box
- Remote control
- Speaker
- Antenna
- Legal document

There will also be different sources of inspiration. There will be one necessary book that the player will have to get and that will in the necessary items list. The other sources of inspiration will be:

- Walk in the park
- A visit to a museum
- Animals
- Movies
- Friends

The science in the second level is the science of the invention process. By showing that Jane must be inspired to builds shows kids a good way to go about their own invention process. The aim of this second level is to introduce kids to the Ray Bradbury's *Fahrenheit 451*, and for them to think creatively about their own ideas after seeing the ideas generated in the game. Leading us to the invention generated in the first level, which will be a Completely Interactive Television.

Physical and Audio Appearance:

- The screen will be set up with a building on the right and left of the screen and a silhouette of building in the background and a road in front of the silhouette of buildings.
- There is a car continuously moving on the road in the background of the screen.
- The building on the left is the abandoned warehouse that still has numerous building items and books.
- Vikki is stationary on the ground level (without induced movement from the player)
- There is a list of items that the player needs to collect on the bottom of the screen.
- On the bottom of the screen there is an inspiration meter
    - Due to fact that it's unknown how much inspiration it will take to inspire an inventor we will represent this by having the value that the inspiration icons give on the inspiration meter will be randomly generated. Therefore the player may get all the needed parts to the inventor but even will all the parts and inspiration it still may be not enough.
- The randomly generated list of needed parts and inspiration items will be "thrown" out the window by Simon to Vikki.
- The needed parts and junk parts will be depicted by literal pictures of what they would look like
- The inspiration items will be represented as follows
    - A walk in the Park: A tree
    - A visit to a museum: An old building
    - Animals: A dog
    - Movies: A video cassette
    - Friends: A person
- The Audio content of this level is as follows
- The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
- The objects will have a "thud" as they hit the ground
- There will be a "YAY" as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an "awe"
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected

Background:

- The background will be set up as an alley way between two building
- The building on the right and left will be very similar in appearance
    - Dark Grey building with two windows on it a lower and upper
- A road behind the buildings that cars will be going down
- Silhouette of buildings behind the road

Foreground Objects and Characters:

- Vikki the main character will be in between the two buildings in front of the road.
- The objects will be thrown out of the window on the left hand side
- Simon will be in the window on the left hand side
- Jane will be in the window on the right hand side
- On the bottom of the screen will be the inspiration meter
- On the building on the left there will be a box showing which object will be thrown next
- On the bottom of the screen there will be the list of items that need to be collected and as they are collected they will disappear from the list
- On the bottom right corner of the screen there will be a clock with the amount of time that the player has running backwards down to zero

Animation:

- Simon will have his arm moving and forward and backwards motion while each piece is thrown out the window
- Vikki will move side to side determined by the player
- The car in the background will go down the road
- The pieces will bounce as Vikki bounces them on her bouncer
- The inspiration meter will go up as the player bounces different inspiration items over to Jane
- The list of needed parts on the bottom will remove each item as it has been successfully bounced into the window
- The part in the box below Simon's window will change to show what item is next going to be thrown.

Music and Sound Effects:

- The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
- The objects will have a "thud" as they hit the ground
- There will be a "YAY" as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an "awe"
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected

Scripts for Characters:

None

Scenes and Transitions:

Once the player has completed the second level, if they have won they will be taken to the "Level Two Completion Page" or should they loose will be taken to the "Try Again Page."

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level Two Completion Screen

Detail (including presence of Science in Section):

The completion screen will be up for as long as the player wishes until the click on the continue or read more buttons. This page intends to show the player the invention that they created.

Physical and Audio Appearance:

- Completely Interactive Television, will be in big font in all purple
- The description of the Television will be below the picture, it will be in smaller font in all black, the description will be as follows:
- This totally interactive television allows the viewer to talk to the characters as the shows are going, and play along with their favourite game show as it's being seen on TV.
- The drawing of the television will be above the description of it, in the centre of the screen
- The background will be blue
- There will be a green continue button on the bottom right hand corner of the screen
- There will be a green read more button on the bottom of the screen
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- The title will be in large font in purple
- The text below the picture of the invention will be in a smaller black font
- The picture of the television will be in the centre of the page
- The continue button will be small and in the bottom right hand corner
- The read more button will be the same as the continue button

Animation:

When the players' mouse goes over the read more button there will be red text that pops up saying "+20 seconds for reading more"

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- When the player clicks on the read more button the player will be taken to the Level 2 Educational Page
- When the player clicks on the continue button the player will be taken to the Level 3 loading screen.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 2 Educational Information Screen

Detail (including presence of Science in Section):

This screen will give players additional information on what type of science is being developed in the real world. This will allow players to see the connection between the pretend inventions that they see at the end of the game and the real life inventions that scientists are working on.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page and will say: Interactive television
- The text in all black will be a description will be as follows:
- It is not currently possible to interact with the characters on a live television program, but scientists are working on merging many different types of media into one unit, for example the internet and television. In conjunction with Go.com, the television show 'Who Wants to

Be a Millionaire' has done something remarkable. Viewers of the show in the United States can log onto the website and play along while watching the show. This is one of the first examples of combining different media, but if you want to read about more to come visit http://www.sciam.com/2000/1100issue/1100stjohn.html

- Continue Button: will be in the bottom of the screen
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Text: in all black centred on the lower part of the page not taken up by the Heading
- For specific text see Physical and Audio appearance

Animation:

The text will scroll in as time passes while the player is on the screen.

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- The player may continue here to the link to the world wide web for more information
- Also, they can click on the continue button to go back to the game and continue on to the loading screen for the next level.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 3 Loading Screen

Detail (including presence of Science in Section):

The loading screen will be up for as long as the player wishes with the intention of introducing the player to *1984*, the Science Fiction novel that level three is based on.

- Level 2: 1984 will be at the top of the screen.
- The text will be a short explanation of the book and the second paragraph will be a short description of the technology found in the book.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page
- The text in all black, the two text boxes will be centred on the remaining portion of the screen
- There will be no sound affects on this screen.
- There will be a continue button on the bottom of the screen

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Level 3: 1984
- Continue Button: Small green button with black text in the bottom right hand corner
- Text: in all black centred on the lower part of the page not taken up by the Heading
- *1984* is the story of a futuristic society where everyone is under constant observation. Winston Smith wants freedom in his life, but the all-knowing Big Brother knows where he is and what he is doing at all times.
- In *1984* George Orwell also predicts future technology. He suggests an all seeing body that even knows what people are thinking which is displayed on screens for people to see (and for it to see them).

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the continue button he/she will be taken to the start of level 3.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 3: *1984*

Detail (including presence of Science in Section):

In this level it will begin with Vikki stationary in the middle of the screen. The car in the background will be set on timer and will begin running as soon as the game starts.

The needed items will be posted in a box under Jane on the right hand side and as items are collected they will disappear from the list. In level three after the player has collected the book he/she will need to collect:

- Book
- Hat
- Light
- Wire
- Brain Wave sensors
- Circuit
- Legal document

There will also be different sources of inspiration. There will be one necessary book that the player will have to get and that will in the necessary items list. The other sources of inspiration will be:

- Walk in the park
- A visit to a museum
- Animals
- Movies
- Friends

All the necessary parts and inspiration items will be randomly generated in a list. In the third level the items will be thrown faster.

Also in this level as the car drives behind on the road the evil Dr. Ravine will reach out and steal parts that are coming out of the window. This will add another level of difficulty to the game as the player is trying to bounce the items across the screen. The player will not be able to stop Dr. Ravine at this point from stealing the items as they come out of the window.

The science in the third level is the science of the invention process. By showing that Jane must be inspired to builds shows kids a good way to go about their own invention process. The aim of this third level is to introduce kids to the George Orwell's 1984, and for them to think creatively about their own ideas after seeing the ideas generated in the game. Leading us to the invention generated in the first level, which will be a Mind Reading Hat.

Physical and Audio Appearance:

- The screen will be set up with a building on the right and left of the screen and a silhouette of building in the background and a road in front of the silhouette of buildings.
- The car is continually moving on the background of the screen while Dr. Ravine is driving. This arm will stretch out and grab items as they are being thrown out the window and a "haha" bubble will come up if he grabs something.
- The building on the left is the abandoned warehouse that still has numerous building items and books.
- Simon is situated in the second story window of the abandoned warehouse.
- Vikki is stationary on the ground level (without induced movement from the player)
- There is a list of items that the player needs to collect on the bottom of the screen.
- On the bottom of the screen there is an inspiration meter
    - Due to fact that it's unknown how much inspiration it will take to inspire an inventor we will represent this by having the value that the inspiration icons give on the inspiration meter will be randomly generated. Therefore the player may get all the needed parts to the inventor but even will all the parts and inspiration it still may be not enough.
- The randomly generated list of needed parts, junk parts and inspiration items will be "thrown" out the window by Simon to Vikki.
- The needed parts and junk parts will be depicted by literal pictures of what they would look like
- The inspiration items will be represented as follows
    - A walk in the Park: A tree
    - A visit to a museum: An old building
    - Animals: A dog
    - Movies: A video cassette
    - Friends: A person
- The Audio content of this level is as follows
    - The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
    - The objects will have a "thud" as they hit the ground
    - There will be a "YAY" as the needed objects get up into the window
    - Should a needed object be tossed up into the window twice there will be an "awe"
    - There will be a sound as the inspiration meter goes up

- There will be a sound for when all the needed items have been successfully collected
- There will be an evil laugh when Mr. Trift steals your items

Background:

- The background will be set up as an alley way between two building
- The building on the right and left will be very similar in appearance
  - Dark Grey building with two windows on it a lower and upper
- A road behind the buildings that the car will be going down
- Silhouette of buildings behind the road

Foreground Objects and Characters:

- Vikki the main character will be in between the two buildings in front of the road.
- The objects will be thrown out of the window on the left hand side
- On the bottom of the screen will be the inspiration meter
- On the building on the left there will be a box showing which object will be thrown next
- On the bottom of the screen will be the list of items that need to be collected and as they are collected they will disappear
- On the bottom right corner of the screen there will be a clock with the amount of time that the player has running backwards down to zero

Animation

- Vikki will move side to side determined by the player
- The car in the background will go down the road
- Dr. Ravine's arm will extend out as he goes by and grabs something
- The pieces will bounce as Vikki bounces them on her bouncer
- The inspiration meter will go up as the player bounces different inspiration items over to Jane
- The list of needed parts on the bottom will remove each item as it has been successfully bounced into the window

Music and Sound Effects:

- The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
- The objects will have a "thud" as they hit the ground
- There will be a "YAY" as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an "awe"
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected
- There will be an evil laugh when Mr. Trift steals your items

Scripts for Characters:

None

Scenes and Transitions:

Once the player has completed the first level, if they have won they will be taken to the “Level Three Completion Page” or should they loose will be taken to the “Try Again Page.”

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level Three Completion Screen

Detail (including presence of Science in Section):

The completion screen will be up for as long as the player wishes until the click on the continue button or the read more button. This page intends to show the player the invention that they created.

Physical and Audio Appearance:

- Mind Reading Hat, will be in big font in all purple
- The description of the Mind Reading Hat will be below the picture, it will be in smaller font in all black, the description will be as follows:
- This new mind reading hat will allow people to read each other's mind just by looking at the person whose mind they want to read.
- The drawing of the hat will be above the description of it, in the centre of the screen
- The background will be blue
- There will be a green continue button on the bottom right hand side of the screen
- There will be a read more screen on the bottom of the screen
- There is a futuristic blinging noise when the player gets to the screen

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- The title will be in large font in purple
- The text below the picture of the invention will be in a smaller black font
- The picture of the hat will be in the centre of the page
- The continue button will be small and green
- The read more button will be identical to the continue button

Animation:

When the player's mouse goes over the read more button red text will appear saying "+20 seconds for reading more"

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- When the player clicks on the continue button they will be taken to the Level 4 Loading Screen
- When the player clicks on the read more button they will be taken to the Level 3 Educational Information page

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 3 Educational Information Screen

Detail (including presence of Science in Section):

This screen will give players additional information on what type of science is being developed in the real world. This will allow players to see the connection between the pretend inventions that they see at the end of the game and the real life inventions that scientists are working on.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page and will say: Interactive Television
- The text in all black will be a description will be as follows:
- Scientists are working to understand the different brainwaves that exist in our minds under different conditions. The brainwaves found in our brains are Beta (alert/working), Alpha (relaxed/reflecting), Theta (drowsy), Delta (sleeping).The Smart Studios at the Interactive Institute in Sweden have developed a new game called Brain Ball. Brain Ball makes use of the different brainwaves to move a ball across a table and the object of the game is to get the ball into your opponent's goal. To do this you need to relax and harness your alpha brainwaves. When people compete it is difficult to relax and win the game. To learn more go to: http://www.bbc.co.uk/science/tw/items/010516_brainball.shtml
- Continue Button: will be in the bottom of the screen There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Text: in all black centred on the lower part of the page not taken up by the Heading
- For specific text see Physical and Audio appearance

Animation:

The text will be scrolled in as the player is on the page. The continue button will appear after the player has been on the page for 15 seconds.

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- The player may continue here to the link to the world wide web for more information
- Also, they can click on the continue button to go back to the game and continue on to the loading screen for the next level.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 4 Loading Screen

Detail (including presence of Science in Section):

The loading screen will be up for as long as the player wishes with the intention of introducing the player to *The Past Through Tomorrow*, the Science Fiction novel that level four is based on.

- Level 2: The Past Through Tomorrow will be at the top of the screen.
- The text will be a short explanation of the book and the second paragraph will be a short description of the technology found in the book.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page
- The text in all black, the two text boxes will be centred on the remaining portion of the screen
- There will be a continue button on the bottom right hand corner of the screen
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Level 4: The Past Through Tomorrow
- Continue Button: small purple with black text on the bottom right of the screen
- Text: in all black centred on the lower part of the page not taken up by the Heading
- The Past Through Tomorrow is a collection of stories about the future. Each story is unique but they are all tied together by predictions of what will happen in the future. Will any of them come true?
- In this book, Robert A. Heinlein predicts such events as petrol shortages causing people to use a system of conveyer roadways instead of cars. Also, humans have figured out how to control the weather and live on other planets in our solar system.

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the continue button he/she will be taken to level 4.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 4: *The Past Through Tomorrow*

Detail (including presence of Science in Section):

In this level it will begin with Vikki stationary in the middle of the screen. The cars in the background will be set on timer and will begin running as soon as the game starts.

The needed items will be posted in a box under Jane on the right hand side and as items are collected they will disappear from the list. In level four after the player has collected the book he/she will need to collect:

- Book
- Display Screen
- Switch
- Laser
- Wire
- Legal document

There will also be different sources of inspiration. There will be one necessary book that the player will have to get and that will in the necessary items list. The other sources of inspiration will be:

- Walk in the park
- A visit to a museum
- Animals
- Movies
- Friends

All the necessary parts and inspiration items parts will be randomly generated in a list. In the forth level the items will be thrown faster.

Also in this level as the car drives behind on the road the evil Mr. Trift will reach out and steal parts that are coming out of the window. This will add another level of difficulty to the game as the player is trying to bounce the items across the screen.

The science in the forth level is the science of the invention process. By showing that Jane must be inspired to builds shows kids a good way to go about their own invention process. The aim of this fourth level is to introduce kids to Robert Heinlein's *The Past Through Tomorrow*, and for them to think creatively about their own ideas after seeing the ideas generated in the game. Leading us to the invention generated in the first level, which will be a Weather Control Machine.

Physical and Audio Appearance:

- The screen will be set up with a building on the right and left of the screen and a silhouette of building in the background and a road in front of the silhouette of buildings.
- The car is continually moving on the background of the screen while Dr. Ravine is driving. This arm will stretch out and grab items as they are being thrown out the window and a "yoink" bubble will come up if he grabs something.
- The building on the left is the abandoned warehouse that still has numerous building items and books.
- Vikki is stationary on the ground level (without induced movement from the player)
- There is a list of items that the player needs to collect on the bottom of the screen.
- On the bottom of the screen there is an inspiration meter
    - Due to fact that it's unknown how much inspiration it will take to inspire an inventor we will represent this by having the value that the inspiration icons give on the inspiration meter will be randomly generated. Therefore the player may get all the needed parts to the inventor but even will all the parts and inspiration it still may be not enough.
- The randomly generated list of needed parts, junk parts and inspiration items will be "thrown" out the window by Simon to Vikki.
- The needed parts and junk parts will be depicted by literal pictures of what they would look like
- The inspiration items will be represented as follows
    - A walk in the Park: A tree
    - A visit to a museum: An old building
    - Animals: A dog
    - Movies: A video cassette
    - Friends: A person
- The Audio content of this level is as follows
- The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
- The objects will have a "thud" as they hit the ground
- There will be a "YAY" as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an "awe"
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected
- There will be an evil laugh when Mr. Trift steals your items

Background:

- The background will be set up as an alley way between two building
- The building on the right and left will be very similar in appearance
    - Dark Grey building with two windows on it a lower and upper
- A road behind the buildings that cars will be going down

- Silhouette of buildings behind the road

Foreground Objects and Characters:

- Vikki the main character will be in between the two buildings in front of the road.
- The objects will be thrown out of the window on the left hand side
- On the bottom of the screen will be the inspiration meter
- On the bottom of the screen there will be the list of items that need to be collected and as the items are collected they will disappear from the list
- On the bottom right corner of the screen there will be a clock with the amount of time that the player has running backwards down to zero

Animation:

- Vikki will move side to side determined by the player, she will also kick at Dr. Ravine's car when he is going by if the player uses the appropriate controls.
- The car in the background will go down the road
- Dr. Ravine's arm will extend out as he goes by and grabs something
- The pieces will bounce as Vikki bounces them on her bouncer
- The inspiration meter will go up as the player bounces different inspiration items over to Jane
- The list of needed parts on the bottom will remove each item as it has been successfully bounced into the window
- The part in the box below Simon's window will change to show what item is next going to be thrown.

Music and Sound Effects:

- The objects will "boing" as they bounce off of the "bouncer" that Vikki is holding
- The objects will have a "thud" as they hit the ground
- There will be a "YAY" as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an "awe"
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected
- There will be an evil laugh when Mr. Trift steals your items

Scripts for Characters:

None

Scenes and Transitions:

Once the player has completed the first level, if they have won they will be taken to the "Level Four Completion Page" or should they loose will be taken to the "Try Again Page."

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level Four Completion Screen

Detail (including presence of Science in Section):

The completion screen will be up for as long as the player wishes until the click on the continue button or the read more button. This page intends to show the player the invention that they created.

Physical and Audio Appearance:

- Weather Control Machine, will be in big font in all purple
- The description of the Mind Reading Hat will be below the picture, it will be in smaller font in all black, the description will be as follows:
- This machine will save lives by controlling the weather, no longer will natural disasters destroy our cities. It will allow the desired weather to be programmed in and the weather ray will shoot the clouds.
- The drawing of the television will be above the description of it, in the centre of the screen
- The background will be blue
- There will be a green continue button on the bottom right hand corner of the screen
- There will be a green read more button on the bottom of the screen.
- There is a zapping noise when the screen comes up.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- The title will be in large font in purple
- The text below the picture of the invention will be in a smaller black font
- The picture of the weather control machine will be in the centre of the page
- The continue button will be small in the bottom of the screen

Animation:

There will be a lightening bolt coming out of the weather control machine. When the player's mouse goes over the read more button red text reading "+20 seconds for reading more" will appear.

Music and Sound Effects:

There will be a zapping noise when the screen comes up

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the continue button they will be taken to the Level 5 loading screen. When the player clicks on the read more button they will be taken to the level 4 educational information screen.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 4 Educational Information Screen

Detail (including presence of Science in Section):

This screen will give players additional information on what type of science is being developed in the real world. This will allow players to see the connection between the pretend inventions that they see at the end of the game and the real life inventions that scientists are working on.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page and will say: Interactive Television

- The text in all black will be a description will be as follows:
- Two ways that have been developed to control our weather are: cloud seeding and cloud absorption. Cloud seeding involves sprinkling dry ice, silver iodide and other chemicals into clouds causing rain to be produced. Scientists have developed a powder that can absorb up to 2000 times its weight in moisture from clouds. Once it has absorbed the moisture it becomes a gel and falls to earth much like snow. The gel is biodegradable and dissolves in salt water, making it perfect for absorbing storms at sea. The chemicals used in weather control are currently added to the clouds by some sort of aircraft. To learn more go to: http://www.rams.atmos.colostate.edu/gkss.html and http://www.newscientist.com/blahblahblah
- Continue Button: will be in the bottom of the screen same as in the completion screen
- There will be an airplane noise on the screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Text: in all black centred on the lower part of the page not taken up by the Heading
- For specific text see Physical and Audio appearance

Animation:

There will be an airplane pouring white chemicals out of the bottom as it flies above the text. The text will scroll in on the screen.

Music and Sound Effects:

There will be an airplane noise on this screen.

Scripts for Characters:

None

Scenes and Transitions:

- The player may continue here to the link to the world wide web for more information
- Also, they can click on the continue button to go back to the game and continue on to the loading screen for the next level.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 5 Loading Screen

Detail (including presence of Science in Section):

The loading screen will be up for as long as the player wishes with the intention of introducing the player to *The Time Machine*, the Science Fiction novel that level five is based on.

- Level 5: The Time Machine will be at the top of the screen.
- The text will be a short explanation of the book and the second paragraph will be a short description of the technology found in the book.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page
- The text in all black, the two text boxes will be centred on the remaining portion of the screen
- There will be a continue button on the bottom of the screen
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Level 5: The Time Machine
- Continue Button: small green with white text on the bottom right hand side of the screen
- Text: in all black centred on the lower part of the page not taken up by the Heading
- Follow a Victorian time traveller 800,000 years into the future. When he arrives in a futuristic world he finds it divided in two: innocence (Eloi) and knowledge (Morlocks). The Eloi are the group of happy innocent humanoid people that live above ground, but there's another group called the Morlocks who live below ground and only come up at night to prey on the Eloi.
- In The Time Machine HG Wells predicted what the future will look like. In some of Well's other novels he predicted technology such as air conditioning, video recordings, automatic doors, and portable televisions.

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

When the player clicks on the continue button he/she will be taken to level 5.

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 5: *The Time Machine*

Detail (including presence of Science in Section):

In this level it will begin with Vikki stationary in the middle of the screen. The car in the background will be set on timer and will begin running as soon as the game starts.

The needed items will be posted in a box under Jane on the right hand side and as items are collected they will disappear from the list. In level five after the player has collected the book he/she will need to collect:

- Book
- Circuit
- Controller
- Metal
- Clock
- Legal document

There will also be different sources of inspiration. There will be one necessary book that the player will have to get and that will in the necessary items list. The other sources of inspiration will be:

- Walk in the park

- A visit to a museum
- Animals
- Movies
- Friends

All the necessary parts and inspiration items will be randomly generated in a list. In the fifth level the items will be thrown faster and the ratio of junk items to needed items will be 2:1 so it will be essential to get the needed items the firs time around.

In this level the car will return to solely driving in the background and not steal things. But, on the top of the screen there will be an aeroplane flown by the evil Dr. Ravine that flies along the top of the screen and he drops wrenches out from. The player must successfully avoid the wrenches because should they bounce one of them they will have time deducted from the allotted time.

The science in the third level is the science of the invention process. By showing that Jane must be inspired to builds shows kids a good way to go about their own invention process. The aim of this fifth level is to introduce children to H.G. Well's *The Time Machine*, and for them to think creatively about their own ideas after seeing the ideas generated in the game. Leading us to the invention generated in the fifth level, which will be a Time Machine.

Physical and Audio Appearance:

- The screen will be set up with a building on the right and left of the screen and a silhouette of building in the background and a road in front of the silhouette of buildings.
- The car is continually moving on the background of the screen.
- There will be an aeroplane that flies along the top of the screen and it will drop wrenches that the player will have to avoid
- The building on the left is the abandoned warehouse that still has numerous building items and books.
- Vikki is stationary on the ground level (without induced movement from the player)
- There is a list of items that the player needs to collect on the bottom of the screen.
- On the bottom of the screen there is an inspiration meter
    - Due to fact that it's unknown how much inspiration it will take to inspire an inventor we will represent this by having the value that the inspiration icons give on the inspiration meter will be randomly generated. Therefore the player may get all the needed parts to the inventor but even will all the parts and inspiration it still may be not enough.
- The randomly generated list of needed parts, junk parts and inspiration items will be "thrown" out the window by Simon to Vikki.
- The needed parts and junk parts will be depicted by literal pictures of what they would look like
- The inspiration items will be represented as follows
    - A walk in the Park: A tree
    - A visit to a museum: An old building
    - Animals: A dog
    - Movies: A video cassette
    - Friends: A person

- The Audio content of this level is as follows
- The objects will “boing” as they bounce off of the “bouncer” that Vikki is holding
- The objects will have a “thud” as they hit the ground
- There will be a “YAY” as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an “awe”
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected
- There will be an evil laugh when Mr. Trift steals your items
- There will be aeroplane noise as it flies above the screen

Background:

- The background will be set up as an alley way between two building
- The building on the right and left will be very similar in appearance
    - Dark Grey building with two windows on it a lower and upper
- A road behind the buildings that cars will be going down
- Silhouette of buildings behind the road

Foreground Objects and Characters:

- Vikki the main character will be in between the two buildings in front of the road.
- The objects will be thrown out of the window on the left hand side
- On the bottom of the screen will be the inspiration meter
- On the bottom of the screen will show what objects you have collected
- On the building on the left there will be a box showing which object will be thrown next
- On the bottom of the screen will be the list of items that need to be collected and as the items have been collected they will disappear from the list
- On the bottom right corner of the screen there will be a clock with the amount of time that the player has running backwards down to zero

Animation:

- Vikki will move side to side determined by the player
- The car in the background will go down the road
- Mr. Trift’s arm will extend out as he goes by and grabs something
- The pieces will bounce as Vikki bounces them on her bouncer
- The inspiration meter will go up as the player bounces different inspiration items over to Jane
- The list of needed parts on the bottom will remove each item as it has been successfully bounced into the window
- The aeroplane will fly across the top of the screen and drop wrenches out that will fall down the screen

Music and Sound Effects:

- The objects will “boing” as they bounce off of the “bouncer” that Vikki is holding

- The objects will have a “thud” as they hit the ground
- There will be a “YAY” as the needed objects get up into the window
- Should a needed object be tossed up into the window twice there will be an “awe”
- There will be a sound as the inspiration meter goes up
- There will be a sound for when all the needed items have been successfully collected
- There will be an evil laugh when Mr. Trift steals your items

Scripts for Characters:

None

Scenes and Transitions:

Once the player has completed the first level, if they have won they will be taken to the “Level Five Completion Page” or should they loose will be taken to the “Try Again Page.”

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level Five Completion Screen

Detail (including presence of Science in Section):

The completion screen will be up for as long as the player wishes until the click on the continue button. This page intends to show the player the invention that they created.

Physical and Audio Appearance:

- Time Machine, will be in big font in all purple
- The description of the Time Machine will be below the picture, it will be in smaller font in all black, the description will be as follows:
- This machine will allow anyone who enters it to be transported anywhere in time.
- The drawing of the television will be above the description of it, in the centre of the screen
- The background will be blue
- There will be a green continue button on the bottom right hand side of the screen
- There will be a green read more button on the bottom of the screen
- There will be a futuristic noise on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- The title will be in large font in purple
- The text above and below the picture of the invention will be in a smaller black font
- The picture of the time machine will be in the centre of the page
- The continue and the read more buttons will be small on the bottom of the screen

Animation:

The colours will change as in the middle of the time machine.

Music and Sound Effects:

There will be a futuristic noise

Scripts for Characters:

None

Scenes and Transitions:

- When the player clicks on the read more button they will be taken to the Level 5 Educational Page
- When the player clicks on the continue button they will be taken to the game completion page

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Level 5 Educational Information Screen

Detail (including presence of Science in Section):

This screen will give players additional information on what type of science is being developed in the real world. This will allow players to see the connection between the pretend inventions that they see at the end of the game and the real life inventions that scientists are working on.

Physical and Audio Appearance:

- The screen will have a bluish background
- The heading in purple, and will be placed in the top 1/3 of the page and will say: Time Machine
- The text in all black will be a description will be as follows:
- People obviously can't travel through time. But did you ever wonder what the United Sates looked like in 1900? It's now possible to "travel back in time" to 1900 Cedar Rapids, Michigan. There a completely interactive buggy ride that takes you into the digital recreation of this city. The visitor can interact with their surroundings and get a real impression of what this part of America looked like in 1900.
For more information go to: http://www.digitalartefacts.com/samples/todc.html
- Continue Button: will be in the bottom right hand corner of the screen same as in the completion screen
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Heading: in all purple
- Text: in all black centred on the lower part of the page not taken up by the Heading
- For specific text see Physical and Audio appearance

Animation:

The text will scroll in.

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- The player may continue here to the link to the world wide web for more information
- Also, they can click on the continue button to go Game Completion Screen

Miscellaneous Elements:

None

Storyboards

Name of Section/Level/Scene:

Game Completion Screen

Detail (including presence of Science in Section):

This screen will be shown once the player has completed all five levels of the game. It will simply conclude the game.

Physical and Audio Appearance:

- The screen will have a bluish background
- The text in purple, and will be placed in the middle of the screen and will say: Congratulations
- The text in all black will be smaller and below and will say: You have won the Science Fair and stopped the evil Mr. Trift
- There will be a picture of Vikki holding the evil Mr. Trift in his car above her head
- Play Again Button: will be in the lower middle part of the screen
- There will be no sound affects on this screen.

Background:

- Bluish colour (same as Intro/Title Screen)

Foreground Objects and Characters:

- Congratulations: in all purple
- Text: in all black centred below the congratulations
- For specific text see Physical and Audio appearance

Animation:

None

Music and Sound Effects:

None

Scripts for Characters:

None

Scenes and Transitions:

- Also, they can click on the Play Again button to go back to the beginning of the game.

Miscellaneous Elements:

None

Storyboards

Development Spec

Component	*Description*
User Input	**2 keys** : Left and Right arrow keys
Boundaries Screen	**Boundaries** - The player moves left and right on the screen between the building on the left and the building on the right of the screen.

Items Pseudo-Code	When an item is thrown out of the window on the left of the screen {
	If item is **needed** {
	Player must bounce it into the window on the right
	} else if item is **not needed** {
	Player must not bounce it into the window on the right but if it is then it is detrimental to progress
	}
	}

Items needed	The next item that is needed will be displayed in a box below the window on the right. As the items that are needed are bounced into the window on the right a progress bar there will be incremented. The next item that is to be thrown out of the window on the left is shown in a box below the window on the left.
Animation Demands	1. Player motion (left and right) 2. On-screen effects (bouncing books) 3. Progress meters 4. Displaying items in the windows and the final invention

9.8.2 Climbin' High

Introduction

The idea for 'Climbin' High' was prompted during a brainstorming session as the team discussed different sports and their potential computer game incarnations. Moving on from the more traditional choices of football or rowing, rock climbing was brought up and enthusiastically received. The original idea was that the science of geology could be explored through the game, which would involve the player controlling a climber as they scaled the sheer cliffs of a newly discovered mountain.

Later on, during the design selection process, 'Climbin' High' was able to make it through all three of the different filter screens (Science, Entertainment, and Feasibility), though within the 'Entertainment' filter it only scored seven out of the ten requirements, which was the minimum possible score for acceptance. The requirements it failed to meet were mainly centred on the invariable nature of its gameplay and its limited provisions for creative gameplay and problem-solving skills on the part of players. Furthermore, there was some concern that rock climbing was a fairly uncommon sport in the United Kingdom, and that as a result UK players may have some trouble identifying with the game's characters and activity.

However, during the meeting with Telepathy 'Climbin' High' became one of the most well-received and feasible of all the designs presented. It was deemed very feasible by virtue of the simple up/down, left/right movement of the main character and the relative ease with which collecting items and creating pitfalls and dangers could be implemented. This encouraging response was perhaps the primary factor in its final selection for elaboration and production. Given that the team's production period is limited to approximately two weeks, feasibility was a key factor and to a degree took precedent over the concerns about gameplay made earlier in the selection process.

Now that the decision has been made to fully-produce 'Climbin' High', efforts have been made to build in creative and variable elements into the game to alleviate the potential problems with its entertainment value among children. At the same time, concerns about its cultural prevalence have been assuaged by reassurance from Telepathy and Science Year. This design document reflects those changes and contains the complete layout of the game, from the different components of its programming to its visual and audio elements. It will be used as a direct blueprint for coding and production.

Plot Line Description

In 'Climbin'High' the player assumes the role of a secret archaeological agent who needs to follow missions around the world in order to pick up valuable fossils for the team. The player needs to climb up mountains, using vast knowledge of different terrain and equipment, in order to get all the necessary fossils for headquarters. Therefore, the player climbs up the mountain using the arrow keys, collects the fossils and treasures, and then needs to climb back down the mountain.

This game consists of five public levels and one secret level. The different locations are all around the world and are all different types of mountains. There is a gritstone crag in England, a rhyolite cliff in Australia, a volcano in the Democratic Republic of Congo, a limestone cliff in Mexico and finally a glacier at the bottom of Mount Everest. Through each of these locations the player needs to find the necessary fossils while climbing up and down the mountain. In each location there are different pieces of equipment that will be of particular help. For example, on the glacier, the crampons will help the player battle the icy terrain by giving the player a better grip on the ice. Also, in the volcano scene, the player will benefit from the helmet because of the falling lava bombs. Edging shoes, when worn by the player, create a little plateau of ease while climbing. They allow the player to move much more quickly around the terrain and there is less chance of losing footing, in real life.

Also, the player is faced with a stamina meter. This will give the player some experience in actually helping the climber climb better by supplying it with more food and water. The player has the choice, in the mountain shop, to gather different food such as apples, bananas, protien bars, and kendal mint cake. Also, there are two different beverages that the player can choose from: water and sports drink. There are different food and drink that will increase stamina more however, those foods are more expensive so the player might not have enough spending points for those foods.

As the player completes each level, he or she is rewarded with spending points for the number of fossils collected. Also, there is an optional bonus questions at the end of each mountain that gives the player more opportunity for spending points. There is no maximum number of spending points that the player can get however, the more points the player gets the better. That is the overall goal of the student: to get the most points and learn about geology and archaeology.

Science Involved

Climbin' High relates the theme of geology to sports to teach science in a game. There are many topics within the discipline of geology including plate tectonics, rocks and minerals, fossils and water sources. However in this game there would be only a few focused areas such as plate tectonics, rocks, mountainous environment and glaciers. During the actual gameplay there would not be much science introduced however to pass levels the students will need to read questions and show that their knowledge on geology is good enough to pass to the next level. Within the game there will be areas that the student can go to learn about different aspects of geology. For example, there will be one section about the tallest mountain on each continent and why those mountains are so big (and why some of them are getting bigger!). The fact box will be present at the beginning of the game and it will be available for the student to use in between the different levels. Also, there will be tips, hidden within the mission statements for different equipment to use. For example, how to climb up a mountain in such slippery conditions especially taking into account the friction on ice is very small.

At the beginning of each level there will be an information box which will tell the player various important aspects of the level. Some of the features include the type of rock the climber will encounter, the climate, the level of difficulty, and the type of fossils found at that section of the mountain. There will be three different rock types: igneous, sedimentary and metamorphic. Igneous rock is formed when molten rock cools and crystallises. This

molten rock is often referred to as lava however that is when it is underground and then erupted. From igneous rock there are two categories: one that is formed underground and one that is formed on the Earth's surface. We will be focusing on rhyolittle, a rock very similar to granite, in the igneous section of this game and that is an intrusive igneous rock (http://www.infoplease.com). In the England level, there will be gritstone, a sedimentary rock. Sedimentary rocks are ones that form from one of three ways: deposition by water or ice, precipitation or growth in position for example sandstone. Gritstone, similar to sandstone is a very challenging rock to climb because it is very slippery and since it is just made of a sand composite, it falls apart with relative ease. There is a level with limestone which is another sedimentary rock that is composed of decaying seashells and particles found at the bottom of evaporated lakes. Another level will be volcanic rock – from an erupting volcano, Nyiragongo in Congo, Africa. The rock that comes out of this volcano is basalt – an extrusive igneous rock that cools quickly leaving behind few crystals. And the final level will be a glacier – the most challenging form of climbing. Khumbu glacier, which a climber encounters en route to the summit of Everest, is a glacier that forms from snowflakes that are not given the opportunity to melt because of the harsh temperatures. More snow continually compresses the snowflakes and as more snow falls, the air is squeezed out leading to glacial ice (http://www.pbs.org/wgbh/nova/everest).

The different natural objects that the player encounters in each level, vegetation and wild life, are different signs of the mountainous environment. In each level there are different elements that are significant to that climate and help the player learn about different areas of the world and different worldly phenomena. For example, in the volcano level, there are lava bombs that fall from the crater of lava and at the very top of the volcano, there is a huge lava pit that is typical to that particular mountain. Also, in England, there are sheep that cover the mountain and very thick fog towards the top of the mountain. The sheep and other such animals will not likely be seen on the side of a vertical crag however, at Cratcliffe Tor there are a lot of sheep that are often found in the surrounding areas. The player will see different things like this for each mountain: they will all be explained in more detail later in this document.

The player is also faced with a stamina problem. There will be different items throughout the levels that with help the player has the opportunity to gain more stamina. The stamina will be decided by the amount of food the player gets as he or she climbs up the mountain. The climber has the opportunity to purchase food and water at the mountain store before leaving for each different level and the player can choose when to use the food throughout the level. The player needs to realise that as he or she moves up the mountain they lose energy therefore need more food to keep going. The player needs to realise this before starting the game or else he or she will not be able to finish the first level. Food and water are very important parts of climbing because if the player does not get the proper amounts, disaster could strike on the mountainside.

Detailed Description of Core Game Elements

There are many aspects of the game that are universal to all the sections, primarily the character. The character, a person, not gender specific, is a medium sized person who wears blue jeans and a red shirt. He carries a backpack on his back so he can collect the fossils and dump them there for later observation. The player interacts with the environment by climbing the mountain and his arms and legs move as though climbing up the mountain. The up/down/left/right keys control the player so he can collect fossils and food for points.

Also, there are fossils/treasures present in each level. The fossils are spread throughout the levels and are different in each level. However, the idea of gathering fossils while on an archaeological adventure is present in each level. Since the player is working for someone who wants these different treasures and fossils the player needs to diligently collect them in each level. In the meantime, the player also needs to remember to bring the correct equipment and enough food to be able to sustain the voyage.

Detailed Description of Every Game Section

Introduction Screen

The introduction screen is an optional screen where the player can go in order to learn how to play the game. The button is on the loading screen and it will take the player to a screen that says the following:

> How to Play:
>
> Navigate your climber up mountains collecting treasures and avoiding obstacles using the 4 arrow keys (up,down,left,right)
>
> Be careful not to allow your stamina meter to deplete, and replenish it using food and refreshments from the Shop.
>
> Accumulate SP points from finding treasures and completing missions, and use them to purchase food and helpful equipment
>
> Complete missions by collecting the specified treasures from the different mountains and see how high you can climb!

This screen gives the player just enough instruction to play the game while still leaving enough room for creative gameplay.

Map Screen

This screen is a map of the world that shows all the different mountains that the player will climb. The continents are coloured in a tan/brown colour while the oceans are blue. When the mouse points to the dot indicating a mountain to climb, a few facts come up the name of the mountain, the location and difficulty. This should help the player if he or she does not know where different mountains are located.

Mountain Shop

This screen shows the different items that the player can purchase. The top part is food and drinks while the bottom half is climbing necessities. The different foods the player can purchase are as follows with the attached point value:

- Apples – 30 sp
- Bananas – 20 sp
- Protein Bar – 40 sp
- Candle Mint Cake – 50 sp

And the drinks (with attached prices) are as follows:

- Water – 10 sp
- Sports drink – 30 sp

The equipment that the player can choose from include:

- Edging shoes – 100 sp
- Crampons – 50 sp
- Helmet – 200 sp
- Support hooks – 300 sp
- Oxygen tanks – 200 sp
- Pick axe – 300 sp
- Rope – 100 sp
- Secret Key – 900 sp

The player needs to know which mountain needs which equipment because the choice of equipment is detrimental whether the player finishes the level or not.

Data Bank

Nyiragongo –

- Nyiragongo is one of Africa's most active volcanoes
- The crater at the top of the mountain was 800 metres in diameter in 1977
- In 1977, when it erupted, the lava flowed at speeds up to 60 km/hr down the volcano
- Nyiragongo is part of the Virunga Volcanic Chain and is located on the East African Rift
- Since this is a very active volcano, a helmet will help protect you from lava bombs.
- www.volcano.und.nodak.edu/vwdocs/volc_images/africa/nyiragongo.html

Cratcliffe Tor –

- Cratcliffe Tor is made of natural gritstone
- At Cratcliffe Tor there are more than 50 possible routes to the top
- Within the 'Peak District', it has some of the best climbing routes
- In 1400 AD, a hermit carved a sitting spot here and a place for a candle (www.derbyshireuk.net/birchover.html))
- Occasionally, young children are found kicking their football around here. Sometimes the football gets lost in the bushes.

Frog Buttress –

- There are over 400 routes to climb on the Frog Buttress crag
- This crag is known for its crack climbing, as the cracks can go upwards for 40 metres
- The best time to climb this crag is in the winter because of the extremely hot summers in this part of Australia
- The snakes found in this level are poisonous and your climber with become disoriented if you hit the snakes.
- www.araplies.com/guide-frog.html

Khumbu Glacier –

- This glacier needs to be attacked by a climber before actually reaching base camp - the start of the actual hike to the summit of Everest
- There are massive ice peaks on this glacier that are more than 10 metres high

- Through numerous icefalls, this glacier is slowly sliding down Mount Everest
- I don't remember…..
- www.pbs.org/wgbh/nova/everest

El Potero Chico -

- In Spanish, this means 'The Little Corral' which is ironic because it is not little in the least (standing 700 metres tall)
- The cliffs are made of limestone which creates for a challenging climb
- El Potrero Chico belongs to the Sierra Madre Occidental - which is about 500 km wide and runs parallel with the Pacific Ocean.
- www.planetfear.com/climbing/travel/mexico

Mid-Atlantic Ridge -

- The Mid-Atlantic Ridge is a ridge that runs right down the centre of the Atlantic Ocean - it forms a 'C' between Africa and South America
- This ridge is part of a larger series of underwater mountains: The Mid-Ocean Ridge
- Iceland, which straddles the Mid-Atlantic Ridge and lies on the North American and Eurasian plates, is actually splitting down the middle while those plates move further apart.
- The Mid-Atlantic Ridge is actually causing the Atlantic Ocean to move apart at the rate of 2.5 centimetres every year!
- http://pubs.usgs.gov/publications/text/understanding.html

IGNEOUS ROCK

Igneous rocks are called fire rocks and are formed either underground or above ground. Underground, they are formed when the melted rock, called magma, deep within the Earth becomes trapped in small pockets. As these pockets of magma cools slowly underground, the magma becomes igneous rock. Igneous rocks are also formed when volcanoes erupt, causing the magma to rise about the Earth's surface. Some common types of igneous rock are granite and obsidian. Granite rocks are formed by slowly cooling magma that was trapped underneath the surface of the Earth. The large sized crystals in granite are evidence of how slowly the rock cooled. A rock that is similar to granite is rhyolite - this rock is commonly found in Australia. Obsidian rocks, similar to other quickly cooling lava, are shiny, black and look like glass.

METAMORPHIC ROCK

Metamorphic rocks are rocks that have transformed from either igneous or sedimentary rock to another type of rock. These changing rocks are subjected to a lot of pressure, which allows an increase of heat and then, the rocks change due to the changing temperatures. Some examples of metamorphic rock are schist and gneiss. Schist rock is very coarsely grained and its individual minerals can be seen by the naked eye. Gneiss is a rock that has been subjected to much heat and pressure - it is composed of the same materials as granite because it has alternating banded layers in it.

PLATE TECTONICS

Over 200 million years ago, the continents were all connected as one big land mass in the centre of the planet. To get the world to look the way it does today, the continents needed to go through an incredible series of movements - they're still moving to this very day! Most of the continents rest on their own continental plate and it seems pretty unbelievable to think that these plates are still moving. How can you believe this? This geological activity takes place at the edges of the plates where they either collided (and form mountains) or move away (causing earthquakes). The Atlantic Ocean is coming about 5 centimetres wider every year while the Himalayas are growing from 1-20 centimetres every year. For more information on plate tectonics and continental drift visit
http://www.bbc.co.uk/education/rocks

SEDIMENTARY ROCK

Sedimentary rocks are the result of millions of year of the Earth's erosion - the surface that has been broken down by wind and water. These little sediments of Earth have been washed away from their original location to a place where they can settle at the bottom of rivers and oceans. With time, layers of this eroded material builds up and these layers become compressed more and more until the bottom layers solidify and turn to rock. Some examples of sedimentary rock are sandstone and limestone. Sandstone rocks are made from small grains of quartz and feldspar (minerals) and they often form in layers. Gritstone, commonly found in central England, is a rock that is quick similar to sandstone. Limestone is made from calcite, which originated from evaporated seas, lakes and shells of sea animals. Limestone, which can be found world wide, is quite abundant in Mexico.

Missions:

Mission 1

Your first mission is to recover a starfish and shellfish fossil from a gritstone mountainside. If you consult the data bank you can find out where gritstone rock is commonly found and then you can head towards that mountain.

Climb up the crag to recover the fossil but beware of the crazy sheep; catching them off guard can be very dangerous! Watch out for fog towards the top of the cliff.

To begin with your archaeological field work, I have arranged for you to be provided with 200 spending points for food and equipment. Also, climbing rope is one of those items that could be used on any mountain and it could save you from a dangerous fall. Use your points sparingly at the shop and be conscious of which items in particular may be helpful for gritstone.

Once you are ready, head to the map area and select your destination.

Heads up!

Your second mission is to find a piece of obsidian left over from the volcanic eruption on Mt. Nyiragongo in Africa.

Be careful while climbing this volcano because there are still volcano bombs that fly around from time to time so keep your head up. Watch out for the lava stream because it is scalding hot and if you walk over or through it you won't be able to finish your mission.

Make sure you pack plenty of food and water because food is scarce on this mountain because of the recent eruptions. But use your points carefully and be conscious of which items in particular may be helpful for Nyiragongo.

AVALANCHE!
Your next mission is to pick up a fossilised flower and the bone of a mountain goat from Khumbu glacier on Mount Everest.

Make sure you are prepared for all types of weather including lots of ice. Use different items from the shop to help with traction on the ice. On another note, watch out for avalanches – if you bump into certain things an avalanche could tumble down the glacier and you would be swept away to the bottom of the mountain.

Again, make sure you pack enough supplies to last for your whole trip – it's a long, hard trek out there. Best of luck!

¡Buenos Dias!
Your next mission is to retrieve all the Aztec artefacts on El Potrero Chico in Mexico. I have heard there are two different artefacts there: an medical log and a piece of the ancient Aztec temple.

Make sure you are prepared for different climates because one day it could be 30º C and the next day it could hover around 13º C. You need to make sure you have plenty of water with you and enough food to make it up the 700 metre cliff. A harness might be helpful in case you bump into a cactus – without it you might fall off. Beware of the scorpions because they could send you to the hospital.

Make sure you take enough supplies with you and as the Mexican's say – ¡Buenos suerte! (Good Luck!)

Where?
Your next mission is to track down a snake fossil and a piece of coral reef on a cliff made of rhyolite rock. To find out where rhyolite is found, consult the data bank and then head in that direction.

Make sure you prepare yourself with plenty of water because often times the summers here are quite hot and it's important to bring a lot of water to avoid dehydration. Watch out for the snakes that pop out of the cracks. Be careful!

Also, make sure you bring enough supplies and make sure you check out the store!

Bombs Away!
There is a lion's tooth and a gold coin that lie on the volcano in the Democratic Republic of Congo. You need to find these two items to complete this next mission.

You need to make sure you still have some protection from the heat and lava bombs. The lava bombs and the lava streams are very dangerous – be careful!

I got a hint for you from the headquarters: "the lion's tooth might be close to the end, but look close from the beginning" – I think that means you need to go all the way around the lava stream to get to it so keep your head up! Good luck

That mouse is how old?
For this mission you need to backtrack somewhere to find the fossil remains of a mouse that lived thousands of years ago. The mouse is housed in a limestone crag – you can search the data back to find a common area where limestone is found.

Oh yeah, don't forget to stop by the store to refill on food and water and other important items for this climb – word on the street is that edging shoes can help a lot for this level.

Ready for more?
Ready to head back to Cratcliffe Tor? Well, your next mission is to climb that crag and pick up a football and a worm fossil that you might have missed the last time up the mountain.

There are still crazy sheep on the mountainside so be careful! The forecast is for fog so keep your wits about you when you bump into this thick fog – it might become hard to see.

As always, check the store and make sure you have all your important supplies for this trip and best of luck! Cheers!

Aussieland
Heading back to Australia, it looks as though you've forgotten to pick up the Tasmanian Devil and a boomerang. Good thing you have another chance to go there!

Beware of the cracks in the rhyolite rock because the snakes the pop out are not the snakes that you want to collect. Looks like that kangaroos do not want you to take those fossils so be aware when trying to go around them. Other than that, follow the advice from your previous Australian experience and being plenty of water. Good luck this time!

Last but not Least
Your final mission is to go to Khumbu Glacier and collect the final two fossils: a Prayer Flag from the climb to Everest and 'old' ice.

It is important to remember that the glacier is ice and it is easy to slide down without the proper equipment, so be sure to pick up some crampons at the store if you don't already have them. As you near the top of this glacier, a pickaxe **might** be able to protect you from the Yeti. Also, beware of the Yeti at the top of the mountain – if you come in contact with him you could be in serious trouble.

Good luck with this final level – because if you complete this level you have the chance for a great surprise.

Special Key Level Mission

The chief decided to give you this mission because you have completed all the other ten missions before anyone else! The chief knows you are an experienced climber and treasure hunter so, he needs you to head to a secret location in the Atlantic Ocean. We got

word that the remains of a sunken Spanish galleon, from the 15th century, have been located. You need to go underwater to a mountain range that you can climb down to collect all four of the special treasures.

The special key is 900 SP so you can only go to this level if you have enough points. If you do not have enough points for this level, you certainly can go back to other mountains to try to get more points. Good luck, we are counting on you!

Level One – Cratcliffe Tor - England

Detail (including presence of Science in section):

In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature's dangers and picking up the important fossils for points. In this level, the fossils include a football, a seashell fossil, a starfish fossil and a worm fossil. These things are all found on this gritstone crag in Derbyshire England and they help the player learn about the different geological events that happened in central England throughout history.

The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answers it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

This level takes place at a rock climbing crag placed in the green fields and scenic area between Manchester and Sheffield England. The player is immediately faced with the task of climbing this ancient gritstone mountain that has a peaceful and quiet surrounding habitat. There is an initial information box that appears on the screen telling the player the type of rock he or she is about to attack, the level of difficulty, the climate, vegetation and different fossils that are of importance to the player. For example in this level the box would be displayed as such:

Location: Derbyshire, England
Rock Type: Gritstone (sedimentary rock)
Climate: 15° C and fog
Elevation: 30 m
Vegetation: trees and bushes

Wild Life: sheep
Nourishment: Medium
Fossils: Worm, starfish, shellfish and football

The rock type of this level is sedimentary gritstone. Sedimentary rock is a type of recycled rock that is formed when sediments of other rocks or something else in nature sticks together to form a rock. This is not a process that happens over night, this rock forms over hundreds of thousands of years. Since the rock is derived from sand particles it is easy to believe that this rock formation was formed by sand blown by the wind from other places around the United Kingdom (Young, 99).

The climate and the final elevation have little to do with the science behind this game mostly because of intricate programming tactics however, they are still very important to the sport of rock climbing. Also, these items are important because they deal with the different types of equipment that are needed. For example, if the weather is sunny and cool, the rock probably won't be too slippery therefore the player will not need to use special crampons or other climbing shoes. Also, the climate is important because if it is sunny and warm, the rocks are dry whereas if it were rainy and freezing the rocks would be very slippery and dangerous to climb on. Final elevation is also important because the further up the player goes the harder is it to receive oxygen from the atmosphere and the atmospheric pressure increases making it harder to breathe.

Vegetation and wild life play an important part in the ecology of a mountain. At the bottom of a mountain the vegetation and wild life is abundant and thriving especially under ideal conditions. Life is bountiful in many forms at the bottom with deciduous trees, flowers, plants, and animals. The conditions and altitude at the bottom of a mountain are ideal for certain types of wild life and vegetation. For this section we are conveying how important that vegetation is to the surrounding climbing environment. We are trying to convey this by showing how there is a lot of rolling green fields and cows at the base of the rock but as the player climbs up to the summit there is not the same vegetation.

As the player climbs the mountain, the stamina bar will decrease continuously. However, the player also has the opportunity to pack his or her backpack that would contain the nourishment for the level. Depending on the food the player chooses he can either make it through the level or not. The nourishment indication key will tell the player how much food and the importance of food is to that level. For example, in the first level the nourishment level is at medium, despite the fact that it is the easiest level. The player needs to be able to store energy and stamina for future levels therefore his or her choices in the first level will impact the later gameplay. There will also be a water meter where the player can click on it with the mouse to get more water so he will not dehydrate. In fact, few things hinder performance as dramatically as dehydration. Even slight dehydration can impair aerobic endurance, primarily by reducing blood plasma volume and increasing total body temperature. If the player does not use the water continuously throughout the game he or she will encounter terrible physical difficulties while climbing.

Finally, the player will encounter various fossils as he or she climbs through the levels. Each level will have a goal to collect a certain number of fossils however the number of fossils is not enough to pass the level. The fossil type is indicated in the information box at the beginning of the level and only those fossils are counted towards the total. In this level, there would be more animals present than in other levels therefore the animal fossils would

be more pressing to collect. The animal fossils would be like bones and teeth and at the end of the level the player would be given extra points if he or she collected all the fossils. There is a minimum number of fossils that the player needs to collect however, it is important to keep in mind that the player is still racing against the ticking stamina clock.

Post Level Education:

Here the student will read facts about the different fossils and learn what he or she has collected. Then, at the end of the fact bulletin there will be a multiple choice question about either the rock that the player climbed, the fossils he collected or the different things he witnessed in the surrounding environment.

Question 1: The rock you climbed was a sedimentary rock called gritstone – how is gritstone formed?

- A. magma
- B. sand formation
- C. laughter
- D. a chemical reaction

Then, there would be an explanation at the end of that question that told two things: what exactly sedimentary rock is and how it is formed and there would be a clue for the next fossils the player needs to find.

The answer is sand formation. Sedimentary rocks form with the weathering, transportation and deposition of sediments from either igneous or metamorphic rock. Geologists usually consider sedimentary rock a recycled rock. This is a challenging rock to climb because sandstone generally because they are all different and require a combination of balance, agility and finesse.

Question 2: Why did you find the fossils from sea animals?

- A. England was once covered in ice
- B. Sea animals used to live on land
- C. They fell out of the sky
- D. A bear brought them back from the ocean

Then, there would be an explanation at the end of that question that told two things: why fossils from sea animals are on a mountain and there would be a clue on where to climb next.

The answer is that England was once covered in ice. After the last ice age, the whole world was changed when ice pushed its way across the land. The ice that pushed its way south from the North Pole and north from the South Pole brought everything in its path. This brought the frozen sea animals, from the northern oceans, to central England.

Question 3: How are fossils formed?

- A. Mud gets caked to the animal
- B. A change in atmospheric pressure makes the animals become preserved
- C. A quick burial in layers of sediment
- D. None of the above

Then, there would be an explanation at that end of the questions that told two things: how fossils are formed and there would be a clue leading the player to the location of his or her next climb.

The answer is that the animal had a quick burial in the layers of sediment. Shells and bones embedded in sediment in years past, under suitable conditions, left exact replications of both internal and external structures. Sometimes, after the remains were set in the sediment and the rock formed around it, water tricked through the ground and dissolved out the remains, which left a cavity for the shape of the object to be preserved.

Physical and Audio Appearance:

This level takes place at the bottom of the mountain with a lot of green fields and wild life in the background. There are cows and sheep grazing, trees with vibrant green leaves and blooming flowers. As the player climbs the mountain, the fossils and stamina increases are apparent and stand out from the background. There is background sound that is either barking dogs, whistling wind or simple things like the climber shouting out 'Yippee' when he or she finds the correct fossil.

Background:

The background will be green and brown with different obstacles and fossils in the path of the climber. Some of the fossils will be hidden behind rocks or trees. This extra level of difficulty ensures that the player will read the clues provided to him or her during the previous level.

Foreground Objects and Characters:

As this is the first level and the base of the mountain, there are many objects and still only one character. The character is someone, not gender specific, who is trying to climb to the top of a huge rock climbing mountain. The objects presented in this level include:

- Fog (at the top)
- Sheep
- Bushes
- Rocks – Gritstone
- Fossils – There will be 3 fossils on the screen and the player needs to collect all three.

- Fossil 1 – Worm -This worm that crawled around the Earth about 15,000 years ago, has been perfectly preserved in between the layers of sedimentary rock.
- Fossil 2 – Shellfish - This is a shellfish fossil most commonly found in eastern Canada. Millions of years ago, England was connected to Greenland, Iceland and Canada. But, through the theories of plate tectonics and continental drift, they moved apart leaving behind artefacts.
- Fossil 3 – Starfish - This starfish found on a rock in central England is proof that the country used to be submerged or partially covered in water.
- Fossil 4 – Football - Have you ever wondered where football equipment originates from? The goal posts were originally designed in Britain.

Animation:

There will be various amounts of animation throughout this scene.

- Climber – up/down/left/right and diagonal
- Fog is hanging over the mountain
- Sheep are stationary except for head

Music and Sound Effects:

Sound/Music Effects

- Sheep baas – 'baa'

- Pick up a fossil – ‘yippee’
- Pick up food – ‘munch munch’
- Finish the level – ‘congratulations’
- If you lose – ‘game over’

Scripts for Characters:
none

Scenes and Transitions:
After this level is over, there will be a data gathering section. Here the student will be able to analyze the different fossils he collects. And the student will need to learn about the different fossils he or she collected in order to pass a multiple choice question and move on to the next level.

Miscellaneous Elements:
There will be different types of rock in the levels that add to the level of difficulty because the player goes slower during those sections and goes much quicker in other sections of this level.

Level 2 – Volcano - Africa

Name of Section/Level/Scene: Nyiragongo Volcano

Detail (including presence of Science in Section):
In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature’s dangers and picking up the important fossils for points. In this level, the fossils include a gold coin, a lion’s tooth and a shiny piece of obsidian rock. All of these elements are things that could be found at the site of an erupting volcano. The lion was not given the same warning as the humans and therefore could not escape as quickly and therefore perished in the volcanic blast. The gold coin is a symbol of the mass disaster that occurred here and the obsidian is an example of the glorious new happenings that will pop up all over the mountain.

The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answeres it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

This level takes place among the spewing volcano in Congo Africa called Nyiragongo. This is a very active volcano that recently just had a large eruption that killed about 100 people and ruined a small town called Goma that is very close to the Rwandan boarder. In this level, the player is daunted by the task of collecting the fossils that are on this rock however, the player cannot proceed without an essential helmet. There is an initial information box that appears on the screen telling the player the type of rock he or she is about to attack, the level of difficulty, the climate, vegetation and different fossils that are of importance to the player. For example in this level the box would be displayed as such:

Location: Democratic Republic of Congo
Rock Type: Basalt and Magma
Climate: 28° and grey
Elevation: 3,000 m
Vegetation: none (all dead from recent volcanic eruptions)
Wild Life: none
Nourishment: High
Fossils: Lion tooth, Obsidian, child's toy, coin
Warning: There is not a lot of healthy drinking water here

* Just a quick side note to add on the screen: People will never be allowed to climb actively erupting volcanoes nor is it an advisable idea.

The rock type in this game is basalt and liquid magma. Basalt is a fine-grained igneous rock that comes from volcanic magma. This is a rock that has cooled quickly because there are not many crystals present in this rock. There is only a certain type of volcano that disperses this type of rock and it is called a stratavolcano or a composite volcano. This is a steep conical volcano, which is built by thick lava flows of basalt magma. Most composite volcanoes have a crater at the summit that contains a central vent or a clustered group of vents. Lava either flows through breaks in the crater wall or flows from fissures on the flanks of the cone. Lava, solidified within the fissures, forms dikes that act as ribs which greatly strengthen the cone (www.infoplease.com/ipa/A0001758.html).

In this level, temperature is very critical for a few reasons but primarily the fact that it is quite hot and there is no source of clean water. If the player does not have a way to get the proper amount of water then he or she will become dehydrated and not be able to finish the level especially in the hot weather of central Africa. The climate is also important to determine the conditions of the rocks and how easy they would be to climb. Finally, elevation is also important especially while climbing this 3,000-metre rock. The higher up the player climbs the harder it is to breathe because of the changes in atmospheric pressure and there is less oxygen higher up in the air. These two characteristics are important to this game because they deal with different equipment that would be needed in actual rock climbing. If it was snowy or rainy and the climber needed extra grips on the mountain, the climber would use crampons. When the climber was at 3,000 metres in the air he could use a respirator or something to help him receive the sufficient amount of oxygen needed to survive.

Since vegetation plays a large role in the environment surrounding a mountain, the lack of vegetation is very significant in the surrounding area of a volcano. Because of the recent eruptions of this mountain, there would be little vegetation remaining here. The lava tore through this town leaving little standing including vegetation, houses, and animals. In this section we would try to convey how important vegetation is to the surrounding

mountainous environment however, the dark grey and black of the screen might be enough to show the devastation an erupting volcano can cause.

As the player climbs the mountain, the stamina bar will decrease continuously. However, the player also has the opportunity to pack his or her backpack that would contain the nourishment for the level. Depending on the food the player chooses he can either make it through the level or not. The nourishment indication key will tell the player how much food and the importance of food is to that level. For example, in this level there is not much food for the player to grab along his or her way so he needs to pack his backpack sensibly enough to last for the whole climb. There will also be a water meter where the player can click on it with the mouse to get more water so he will not dehydrate. In fact, few things hinder performance as dramatically as dehydration. Even slight dehydration can impair aerobic endurance, primarily by reducing blood plasma volume and increasing total body temperature. If the player does not use the water continuously throughout the game he or she will encounter terrible physical difficulties while climbing. Again, since there is no clean water supply around this mountain, the player needs to be prepared to battle the mountain with the supply of water that he has saved from other levels.

Finally, the player will encounter various fossils as he or she climbs through the levels. The fossil type is indicated in the information box at the beginning of the level and only those fossils are counted towards the total number of points at the end of the game. The fossils in this level aren't typical fossils; they are a lion's tooth, obsidian, a child's toy and a coin. The lion's tooth is used in this level because it is an easy way to give a 'clue' to Africa – the land of the lion. Obsidian is an object to collect in this level because it is the direct product of a volcano that has dried too quickly for the minerals to crystallise at all. Obsidian is a glassy looking rock that is used world-wide because of its sharpness and lovely lustre. Finally, a child's toy and a spoon would be items to be found because this links the severity of this disaster with something children can relate with. These items imply how little time people had to save their belongings before the havoc of an eruption fell upon their lives. Children were not allowed to gather toys, parents were not allowed to gather important memories and some people were not even allowed to save their own lives.

Post Level Education:

Here the student will read facts about the different fossils and learn what he or she has collected. Then, at the end of the fact bulletin there will be a multiple choice question about either the rock that the player climbed, the fossils he collected or the different things he witnessed in the surrounding environment.

Question 1. What kind of rock covered the volcano?

- A. Granite
- B. Slate
- C. Basalt
- D. Pebbles

Then, there would be an explanation at the end of that question that told two things: what kind of rock covered the mountain and how that rock is formed and then, there would be a clue for the next fossils the player needs to find. This would lead the student to the next mountain.

The lava at Nyiragongo was a type of basalt. Basalt is a hard volcanic rock that often has a glassy appearance. Since basalt contains silica (SiO_2) it can flow at speeds greater than 20 km/h. Basalt is also the most common type of rock in the Earth's crust and the ocean floor.

Question 2. How is a volcano formed?

- A. Magma leaks through Earth's crust
- B. Swelling of underground land
- C. It is too hot underground
- D. Tectonic plates shift

Then, there would be an explanation at the end of that question that told the player two things: how a volcano is formed and there would be a clue for the next fossils that the player needs to find. This would lead the student to the next mountain scene.

The answer to this question is that magma leaks through the Earth's crust. However, there is not a mountain surrounding the magma until the cones of solidified magma grow large enough to create an actual volcano: a process that could take millions of years of volcanic activity. The magma, coming from deep in the Earth's crust, gathers in a pool under a weak part of the overlying surface and eventually (but not always) the magma erupts onto the surface.

Question 3. How many volcanoes have erupted in the past 10,000 years?

- A. 1,468
- B. 1,499
- C. 1,511
- D. 1,535

Then, there would be an explanation at the end of that question that told the player two things: how many volcanoes have erupted in the past 10,000 years and there would be a clue for the next fossils that the player needs to find. This would lead the student to the next mountain scene.

The answer is 1,511 but even less than that are still active today. Less than 100 volcanoes are active today including Mount St. Helens in the United States, Mount Etna in Italy and Mount Erebus in Antarctica. To learn more about volcanoes please visit http://volcanoes.usgs.gov/.

Physical and Audio Appearance:

Physical Appearance:

The physical appearance of this level would be the side of a rock climbing mountain but instead of green and brown rock, the rock will be black and dark grey with red lava streams. In the third part of the level, as the player approaches the summit of the mountain; the player will need to watch out for volcano bombs that come from the mouth of the volcano. These are bombs of hot magma that are greater than 64 mm and in order for one to be considered a volcano bomb, it has to have been molten when it got thrown out (although it may solidify before it lands). That adds a little extra challenge to this level.

Audio Appearance:

The audio appearance of this level would be minimal because most everything has perished through the previous eruptions. However, the player needs to be alert because there is still potential for more eruptions. An eruption is signalled by a loud 'boom' and followed by more flowing lava.

Background:

The background for this level will be dismal – black and dark grey. It should appear as a very sad scene with not much to it except flowing lava. There will be different fossils in the background too that include a child's toy truck, a gold coin, and a piece of obsidian.

Foreground Objects and Characters:

Foreground Objects: none because there is nothing to show scale to except the fossils and very minimal food for stamina.

Fossils:

- Fossil 1 – Lion's Tooth – The lion whose tooth you found used to live here. The lion was roaming in this environment when the volcano erupted.
- Fossil 2 – Obsidian - Obsidian is a volcanic rock that looks like glass because of its shiny appearance. It was used years ago for arrowheads and knives.
- Fossil 3 – Gold Coin – This is something that people would not normally leave behind!. In the panic of the eruption people left as quickly as possible, often leaving valuable items behind.

Character:

Same character for all levels

Animation:

The only animation in this scene will be the climber physicially climbing the mountain. Since the only other foreground objects are the fossils and food, there will be no other animation in this morbid scene.

Music and Sound Effects:

- Volcano erupting – 'boom'
- Climber picking up a fossil – 'yippee'
- Climber picking up food – 'munch munch'
- Finish level – 'congratulations'
- Lose level – 'game over'

Scripts for Characters:

none

Scenes and Transitions:

After this level is over, there will be a data gathering section. Here the student will be able to analyse the different fossils he collects. And the student will need to learn about the different fossils he or she collected in order to pass one of the above multiple choice questions and move on to the next level.

Miscellaneous Elements:

Level 3 – Rhyolite - Australia

Name of Section/Level/Scene: Frog Buttress - Australia

Detail (including presence of Science in Section):

In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature's dangers and picking up the important fossils for points. In

this level, the fossils include a boomerang, a Tasmanian devil, a snake and coral. These things are all native to the continent of Australia and help explain different geological aspects in Australia.

The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. In this level, the player needs to get the support hooks from the store to climb the mountain efficiently. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answers it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature's dangers and picking up the important fossils for points. The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answeres it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

This level takes place at Frog Buttress a rock crag in Queensland Australia (about 100-km south west of Brisbane). In this level the player is faced with the task of climbing this challenging rhyolite – a rock very similar to gratine, that is full of daunting cracks and crevices. There is an initial information box in this level that appears on the screen telling the player the type of rock he or she is about to attack, the level of difficulty, the climate, the vegetation, and different fossils that are important to the player. In this level the info box would look like this:

Location: Queensland, Australia
Rock Type: Rhyolite (igneous rock)
Climate: 20° C and sunny

Elevation: 60 m
Vegetation:
Wild Life: Kangaroos and snakes
Nourishment: Medium
Fossils: Tasmanian Devil, boomerang, snake, and coral

The rock type in this level is a type of igneous rock called Rhyolite. Rhyolite is the chemical equivalent to granite however it is composed of different quantities of quartz and feldspar. This is an igneous rock meaning that it comes straight from erupted volcanoes and rhyolite is a type of rock that is exploded fiercely from the volcano. Igneous rocks form when molten rock cools and solidifies. Molten rock trapped underground is called magma. Molten rock erupted at Earth's surface is referred to as lava. The type of rock in this level, rhyolite, is formed from magma that cooled very slowly deep underground in a magma chamber. The larger crystals on this rock lead geologists to believe that the rock cooled very slowly in order to form such large crystals similar to those in granite. Rhyolite lava flows occur in the continental and submarine volcanoes and therefore it could be a rock typical to Australia. Another typical place to find this rock would be in Yellowstone National Park in the U.S.

The climate and final elevation are also quite relevant to this level for a few main reasons. The climate in Australia varies a lot through seasons and the best time to climb generally in Australia is in the spring or fall however at Frog Buttress climbing is possible year round. Climate is also important because the player needs to be aware of the weather – it would be inadvisable to climb in the rain especially without the proper gear. And the final elevation in this level is not that important because at 60 metres the atmosphere is not changing as dramatically as it does at 600 metres. The amount of oxygen intake is also a little different in this level as opposed to a level with a higher final elevation.

Vegetation plays an important part in the ecology of a mountain. At the bottom of a mountain the vegetation and wild life is abundant and thriving especially under ideal conditions. Life is bountiful in many forms at the bottom with deciduous trees, flowers, plants, and animals. In Australia, the climber could encounter a kangaroo at the bottom of the mountain perhaps at the very beginning of the level and also through the cracks of the rock could pop a venomous snake. The most venomous snake in Australia is the King Brown, a brownsnake found in Australia; brownsnakes have caused the more fatalities in Australia than any other snake. In this level, we are trying to convey the difference in environment from England and any of the other levels – all are quite different in their own respects.

As the player climbs the mountain, the stamina bar will decrease continuously. However, the player also has the opportunity to pack his or her backpack that would contain the nourishment for the level. Depending on the food the player chooses he can either make it through the level or not. The nourishment indication key will tell the player how much food and the importance of food is to that level. For example, in the first level the nourishment level is at medium and therefore will be able to save a lot of his money for food in later levels. There will also be a water meter where the player can click on it with the mouse to get more water so he will not dehydrate. In fact, few things hinder performance as dramatically as dehydration. Even slight dehydration can impair aerobic endurance, primarily by reducing blood plasma volume and increasing total body temperature. If the player does not use the water continuously throughout the game he or she will encounter terrible physical difficulties while climbing.

Finally, the player will encounter several fossils as he or she climbs through each level. Each level will have a certain number of fossils necessary to collect for each mission. In this level there are a total of four fossils that the player could collect. The fossil type is indicated in the info box at the beginning of each level. In this level there are fossils from a Tasmanian devil, boomerang, a snake and coral. All the fossils that the player finds are found in Australia and some are unique only to the continent of Australia.

Post Level Education:

Here the student will read facts about the different fossils and learn what he or she has collected. Then, at the end of the fact bulletin there will be a multiple choice question about either the rock that the player climbed, the fossils he collected or the different things he witnessed in the surrounding environment.

Question 1: Rhyolite is what kind of rock?

- A. Sedimentary
- B. Metamorphic
- C. Igneous
- D. None of the above

Then, there would be an explanation at the end of that question that told two things: what exactly type of rock it is and how it is formed and there would be a clue for the next fossils and place the player needs to venture to.

The answer is igneous rock. Igneous rock forms when molten rock cools and solidifies. Molten rock trapped underground is called magma. Molten rock erupted at Earth's surface is referred to as lava. The type of rock in this level, rhyolote, is formed from magma that cooled very slowly, deep underground in a magma chamber. The larger crystals on this rock lead geologists to believe that the rock cooled very slowly in order to form such large crystals, similar to granite.

Question 2: What is coral?

- A. rocks
- B. marine animals
- C. plants
- D.

Then, there would be an explanation at the end of that question that told two things: what exactly coral is and its importance and there would be a clue for the next fossils and place the player needs to venture to.

The answer is marine animal. Sea coral is a small sedentary marine animal that is characterised by its coral skeleton of very hard material. Most coral formations come in colonies however, there are some solitary corals found throught the world. The biggest coral formation is off the Northeastern coast of Australia: the Great Barrier Reef - here there are over 200 different species of coral.

Question 3: What kind of animal is a kangaroo?

- A. rodent
- B. marsupial
- C. insect
- D. amphibian

Then, there would be an explanation at the end of that question that told things: what kind of animal a kangaroo is and a clue for next fossils and the place that the player needs to go to.

The answer is marsupial. A marsupial is a pouched animal and kangaroos are found in Australia, Tasmania and New Guinea. Kangas hop around on their powerful and strong two hind legs. The mother kangaroo nurses her young inside her pouch for about 40 days after their birth.

Physical and Audio Appearance:

Phyisical Appearance

The physical appearance of this level is that of a bright coloured side of a rhyolite crag. As the player climbs the rock there are more and more cracks covering the side of the rock because Frog Buttress has a lot of cracks in it. Also, there will be trees in the background with a lot of green leaves because the areas surrounding some trails at Frog Buttress have a lot of high standing leafy trees.

Audio Appearance

The audio appearance in this level would be at a minimum however; there would be some animals as background noise.

Background:

The background for this level is going to be composed of the colours yellow, white/grey and brown. This is to show the type of rock that rhyolite is and the different colours that it encompasses. At the bottom of this crag there will be different obstacles in the background including a kangaroo, trees and there will be snakes that pop out of the rock as the player moves up the crag. The snakes add a bit of randomness to the game leaving the player constantly wondering when the next snake will emerge from the rock.

Foreground Objects and Characters:

- Trees – with leaves to simulate the actual area at Frog Buttress
- Snakes – to create a level of uncertainty similar to that while actually rock climbing
- Kangaroos – at the bottom of the crag – they are native to Australia and rather easy to imitate on a computer screen
- Fossils
  - Fossil 1 – Tasmanian Devil – This unique animal, native to the continent of Australia, is an extremely greedy marsupial (pouched animal). These devils have very powerful jaws and prey on other, much larger mammals.
  - Fossil 2 – Boomerang - A boomerang is a sporting device that has been used by Australians for years. The physics of the shape allows it to be thrown such that it returns to the original thrower.
  - Fossil 3 – Snake – The fossilised remains of a grey snake, found in the Queensland area, prove that snakes have been in Australia for thousands of years.
  - Fossil 4 – Coral – This piece of coral dates back to about 417 million years ago. Extensive deposits of fossil corals indicate that large coral reefs, similar to the Great Barrier Reef, existed in the past.

Character: same as all levels

Animation:

The animation in this scene consists of the climber physically climbing the mountain, the kangaroo bouncing across the screen and snakes popping out of cracks. The foreground objects will be trees and the fossils.

Music and Sound Effects:

- Snake coming out from crack – 'hiss'
- Climber picking up a fossil – 'yippee'
- Climber picking up food – 'munch munch'
- Finish level – 'congratulations'
- Lose level – 'game over'

Scripts for Characters:

none

Scenes and Transitions:

After this level is over, there will be a data gathering section. Here the student will be able to analyse the different fossils he collects. And the student will need to learn about the different fossils he or she collected in order to pass one of the above multiple choice questions and move on to the next level.

Miscellaneous Elements:

Level 4 – Glacier – Nepal

Name of Section/Level/Scene: Khumbu Glacier on Mount Everest

Detail (including presence of Science in Section):

In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature's dangers and picking up the important fossils for points. In this level, the fossils include a Buddhist Prayer Flag from the climb to Everest, a bone from a mountain goat, 'old' ice and a flower. All of these items give the idea of what it is like to be on a glacier that is thousands of metres above sea level – there isn't much life, but the life that is there thrives.

The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answers it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the

initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature's dangers and picking up the important fossils for points. The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answeres it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

This level, perhaps the most challenging, takes place atop Khumbu Glacier that is en route to Everest's base camp. This is a very high altitude glacier that looks quite harmless and beautiful however occasionally there is an icefall (similar to a landslide but it happens when a large chuck of ice cracks from the glacier and moves slowly down the mountain side) and suddenly there are millions of tons of ice moving downhill. This is a glacier that climbers of Mount Everest have to tackle before they even get started on the mountain and therefore the player in this games needs to know how to climb a glacier. In this level, the player certainly needs a few essential items from the mountain shop: crampons and an ice pick are undoubtedly necessities. There is an initial information box that appears as a loading screen at the beginning of each level. In this glacial level, the box looks like:

Location: Khumbu Glacier on Mt. Everest
Rock Type: Ice
Climate **:** -20° C without wind
Elevation: 3,000 m
Vegetation: none (too cold for plants)
Wild Life: Yeti
Fossils **:** flower, prayer flag, 'old' ice, bone from mountain goat
Warning: Beware of Yeti!

In this level, there really is no rock however the player climbs sheets of ice. Glacial ice is formed from very highly compressed snow. In an atmosphere similar to that on Khumbu, where the temperature is too cold to keep melting the snow, the snow builds up and its structure gradually changes. The snow keeps building up and compressed and therefore the air pockets between the snow decreases also eventually forming glacial ice. This process is repeated several thousand times and then the beginning of a glacier is formed. Most glaciers form over a long period of time where it is cold year round; they must not be able to lose more ice in the summer due to melting. Even in the polar regions, only a minimal amount of snowfall is necessary to sufficiently balance the little amount of melting from the summer.

In this level, the climate and elevation are very important. The climate is very extreme on a glacier often being very cold and with harsh whipping winds. The player will need to know that he or she needs crampons and an ice pick to even start to climb this mountain mostly due to the climate. Since there is such a harsh climate here, the glacier remains in tact however, if the climate changed and it became much warmer, the glacier would melt and flood the surrounding towns in Nepal. Also, the higher up the player climbs the harder it is to breathe because of the changes in atmospheric pressure and there is less oxygen higher up in the air. These two characteristics are important to this game because they deal with different equipment that would be needed in actual rock climbing. When the climber was at 3,000 metres in the air he could use a respirator or something to help him receive the sufficient amount of oxygen needed to survive.

Since vegetation plays a large role in the mountainous environment it is important to state that there really is little to no vegetation on a glacier. At certain low valleys, where some water drains into one of Nepal's rivers, there are a few pine trees but other than that, there is only dirt and rocks that have been carried for hundreds of metres by the glacier. In this section we are trying to convey that there is not much vegetation or wild life because of the harsh/extreme conditions.

As the player climbs the mountain, the stamina bar will decrease continuously. However, the player also has the opportunity to pack his or her backpack that would contain the nourishment for the level. Depending on the food the player chooses he can either make it through the level or not. The nourishment indication key will tell the player how much food and the importance of food is to that level. For example, in this level there is not much food for the player to grab along his or her way so he needs to pack his backpack sensibly enough to last for the whole climb. There will also be a water meter where the player can click on it with the mouse to get more water so he will not dehydrate. In fact, few things hinder performance as dramatically as dehydration. Even slight dehydration can impair aerobic endurance, primarily by reducing blood plasma volume and increasing total body temperature. If the player does not use the water continuously throughout the game he or she will encounter terrible physical difficulties while climbing. There is a way to boil the glacier to obtain fresh drinking water, since glaciers make up about 80% of the world's fresh water supply, however in this game, the player will not have the resources to do that.

The player will encounter several fossils whist on this mountain. Depending on the mission, the fossils are 'old' ice, a flower, prayer flag and the bone from a mountain goat. The fossilised flower, found at the bottom of the glacier, is a sign that there once was life on this mountain. It's difficult for life to survive when temperatures are so that ice stays frozen here for thousands of years. Prayer flags are long strips of coloured cloth printed with prayers that are "said" whenever the flag flaps in the wind. Prayer flags are located along the trekking and climbing routes in the Himalayas. The 'old' ice that the climber encounters is ice that dates back thousands of years to when the glacier first started to form. An icefall that started only a few weeks prior to today uncovered this ice. Finally, mountain goats live in small herds on steep mountain sides and cliffs, feeding on little vegetation above the tree line. They are extremely sure-footed and navigate steep slopes and ledges with ease. This is a typical living environment for these goats.

One final warning is that for a Yeti – a type of snow monster. This creature might pop out from a cave on the glacier.

Post Level Education:

Here the student will read facts about the different fossils and learn what he or she has collected. Then, at the end of the fact bulletin there will be a multiple choice question about either the rock that the player climbed, the fossils he collected or the different things he witnessed in the surrounding environment.

Question 1. What is it called when a large chunk of ice breaks off from a glacier?

- A. icebreak
- B. icecrack
- C. icefall
- D. icespill

Then, there would be an explanation at the end of that question that told two things: what an icefall is and then there would be a clue for the next country that the player needs to travel to.

The answer is icefall. An icefall is a steep, sometimes fast-flowing section of a glacier that has cracked off the original glacier. The Khumbu icefall is very famous because it is included in the most dangerous obstacles climbers face during their climb to the summit of Mount Everest.

Question 2: Glaciers are formed by _____ of snow.

- A. precipitation and melting
- B. burial and compression
- C. melting and refreezing
- D. precipitation and freezing

Then there would be an explanation at the end of that question that told two things: how glaciers are formed and then there would be a clue that states where the player should travel to next.

The answer is burial and compression. As the snow falls in the Himalayas, it keeps building up and compressed and therefore the air pockets between the snow decrease and eventually form glacial ice.

Question 3: What causes an avalanche?

- A. earthquake tremors
- B. man-made disturbances
- C. too much rain
- D. all of the above

Then there would be an explanation at the end of that question that told two things: what causes avalanches and then there would be a clue that states where the player should travel to next.

The answer is all of the above. An avalanche is when snow, ice, rock or soil fall down a mountain side due to either earthquakes, too much rain or human disturbances. The speed of an avalanche can reach up to 300 km/h. Most avalanches start on mountain sides with slopes that are about 30-45 degrees steep and they can be stopped by trees despite all the destruction that occurred beforehand.

Physical and Audio Appearance:

Physical Appearance

The physical appearance of this level is that of a white and grey mountainside with a small snowstorm that covers the screen occasionally. As the player climbs the glacier he or she is faced with difficulties such as avalanches, Yeti's and cracks in the ice. There will be little wildlife or vegetation visible on the screen during gameplay because it is all frozen over or unable to sustain life due to the harsh environment.

Audio Appearance

There will be whipping wind across the glacier.

Background:

- White, grey, and black cracks
  - These colours demonstrate the reality of a glacier; there is not much else there except for ice and snow.

Foreground Objects and Characters:

- Avalanche
- Yeti
- Snow storm
- Fossils
  - Fossil 1 - Flower – This fossilised flower, found towards the bottom of the glacier, is a sign that there once was life on this mountain. It is difficult for life to survive when temperatures are so low.
  - Fossil 2 – Prayer Flag - These are long strips of coloured cloth printed with prayers that are said whenever the flag flaps in the wind. Prayer flags are located along the trekking and climbing routes in the Himalayas.
  - Fossil 3 – 'old' ice - This is ice that dates back thousands of years to when this glacier first started to form. A recent icefall uncovered this ice.
  - Fossil 4 – bone from a mountain goat - Mountain goats live in small herds on steep mountainsides and cliffs, feeding on vegetation above the tree line. They are extremely sure-footed and navigate steep slopes with ease.
- Character – same for whole game

Animation:

- Climber
- Avalanche
- Yeti
- Snow storm moves across the screen

Music and Sound Effects:

- Wind howls
- Avalanche tumbles down the mountain
- Player using the ice pick
- Climber picking up a fossil – 'yippee'
- Climber picking up food – 'munch munch'
- Finish level – 'congratulations'
- Lose level – 'game over'

Scripts for Characters:

none

Scenes and Transitions:

After this level is over, there will be a data gathering section. Here the student will be able to analyse the different fossils he collects. And the student will need to learn about the different fossils he or she collected in order to pass one of the above multiple choice questions and move on to the next level.

Miscellaneous Elements:

none

Level 5 – Limestone - Mexico

Name of Level: El Potrero Chico, Mexico

Detail (including science in section):

In this level, the player needs to complete the mission by climbing up and down the mountain while avoiding nature's dangers and picking up the important fossils for points. In this level, the fossils include various Aztec remains and a fossilised worm. The Aztecs used to roam the northern part of Mexico until they settled down and created a civilisation. In this civilisation they had a very structured way of life that included doctors and worshipping temples – which explains the medical log and piece of the temple that the climber finds. Also, the worm remain is typical in that area from thousands of years ago.

The player moves by using the up, down, left and right buttons and can use food and water by the click of the mouse. Before each level, the player has the opportunity to spend his or her spending points at the base camp store gathering things that are important for that level. The player needs to buy food and water for each level and for certain levels the climber needs different amenities such as crampons for the ice and a helmet in the lava level. All these items are important for climbing however, in this game, the player needs to get enough spending points for these novelties. In order for the player to get spending points, the student needs to collect all of the important fossils for that level and answer the question correctly on the first try – that will give the player the maximum number of points. As far as the questions at the end of the level go, the player gets 50 spending points (sp) if he or she answers it correctly on the first try, 25 sp on the second try, 10 on the third and 1 point if the player gets the answer on the fourth and final try. This will give the students the incentive to answer the questions right on the first try to get more points. The students who read the initial explanation at the beginning of the game will have a clear advantage over the rest of the students and will get more points.

This level takes place on El Potrero Chico near Monterrey Mexico. In this game, the player is faced with a crag of limestone rock that is practically vertical to the ground. There are extremely hard climbs are this cliff; some climbs can even last overnight. There is an initial information box at the beginning of this level. This box explains the terrain, the weather and many other variables. The fact box in this level looks like:

Location: El Potrero Chico – Monterrey, Mexico
Rock Type: Limestone
Climate: 25 C and humid
Elevation: 700 m
Vegetation: cactus
Wild Life: scorpoins
Fossil: Aztec medical log, mouse, piece of Aztec pyramid

The rock type in this level is a sedimentary rock called limestone. Sedimentary rocks form with the weathering, transportation and deposition of sediments from earth's erosion – from sand particles to sea animal's shells. Geologists usually consider sedimentary rock a recycled rock. This is a challenging rock to climb because limestone rocks generally are all different and require a combination of balance, agility and finesse. Limestone originates from a number of different places such as sea shells and calcite (which comes from evaporated seas and lakes).

The climate and final elevation are relatively important in this level too. Often times in Mexico it is very hot outside, especially in the summer and spring. However, there can be many times where it is very hot one day and then the next day the temperature has dropped about twenty degrees. Also, especially when the temperature is hot outside, there is extreme danger for dehydration. No one is immune to dehydration especially in the hot days of summer in Mexico. Slight dehydration can even cause a lot of problems including a decrease in climbing ability. More severe problems include increased heart rate and body temperature. As a general rule of thumb for whatever sport you are playing, it is important to drink water often and especially before and after competition. Also, it is important to use the proper equipment when climbing a crag that is over 700 metres up. Also, it's important to keep in mind that even though the player is not even a mile up, there is still the chance of a change in atmospheric pressure. If the atmospheric pressure changes, the player needs to remember to go slowly and with care or else the climber will fall off the mountain side.

Again, vegetation and wild life play an important part in the mountainous environment. At the bottom of the mountain there is a base camp with many bushes and trees and people. As the climber ascends the crag, there is less vegetation and more signs of extinct life. It is important to beware of the scorpions and cacti that will come out of the crag often. If scorpions bite the climber could die because they are poisonous. In this level we are trying to convey the difference in environments from England and any of the other levels – and all are quite different from each other.

As the player climbs the mountain, the stamina bar will decrease continuously. However, the player also has the opportunity to pack his or her backpack that would contain the nourishment for the level. Depending on the food the player chooses he can either make it through the level or not. The nourishment indication key will tell the player how much food and the importance of food is to that level. For example, in the first level the nourishment level is at medium and therefore will be able to save a lot of his money for food in later levels. There will also be a water meter where the player can click on it with the mouse to get more water so he will not dehydrate. In fact, few things hinder performance as dramatically as dehydration. Even slight dehydration can impair aerobic endurance, primarily by reducing blood plasma volume and increasing total body temperature. If the player does not use the water continuously throughout the game he or she will encounter terrible physical difficulties while climbing.

Finally, the player will encounter several fossils as he or she climbs through each level. Each level will have a certain number of fossils necessary to collect for each mission. In this level there are a total of four fossils that the player could collect. The fossil type is indicated in the info box at the beginning of each level. In this level there are fossils from an Aztec medical bowl, a mouse and an Aztec temple. All of these items are unique to Mexico and some of them have had a huge impact on Mexican culture.

Post Level Education

Here the student will read facts about the different fossils and learn what he or she has collected. The fossils for this level will be explained later. Then, at the end of that fact bulletin, there will be a multiple choice question for the student to answer in order to proceed to the next level. The player cannot get the question wrong however, the fewer tries it takes, the more 'mountain money' the player gets – that way he or she can get more food or mountain climbing items.

Question 1. What kind of rock is limestone?

- A. igneous
- B. sedimentary
- C. metamorphic
- D. its not a rock

Then there would be an explanation at the end of that question that told two things: what limestone is and then there would be a clue for the player about where they need to go to look for their next set of fossils.

The answer is sedimentary. Sedimentary rocks form with the weathering, transportation and deposition of sediments from Earth's erosion - from sand particles to sea animal's shells. Geologists usually consider sedimentary rocks to be recycled rocks. This is a challenging rock to climb because limestone, similarly to gritstone, requires a combination of balance, agility and finesse.

Question 2. When climbing in intense heat, it's a good idea to keep plenty of _____ with you.

- A. soda
- B. rope
- C. gum
- D. water

Then there would be an explanation at the end of that question that told two things: that water is important for a healthy climb and then there would be a clue for the player about where they need to go to look for their next set of fossils.

The answer is water. No one is immune to dehydration especially in the hot days of summer, in Mexico. Slight dehydration can even cause a lot of problems including a decrease in climbing ability. More severe problems include increased heart rate and body temperature. As a general rule of thumb for whatever sport you are playing, drink water often during competition and especially before and after.

Question 3. How can a cactus go days without water?

- A. they can store water
- B. a miracle
- C. they don't need water
- D. none of the above

Then there would be an explanation at the end of that question that told two things: how a cactus can go days without water and there would be a mission that identified the players next climbing location.

The answer is that they can store water. Cacti have an enlarged stem, which is made to store and retain water. This makes the cactus a good candidate for regions with high temperatures and long dry periods.

Physical and Audio Appearance

Physical Appearance

The appearance of this mountain is that of a bright coloured side of a limestone crag in Mexico. As the player climbs the rock the climb becomes more and more challenging.

Audio Appearance

There will be little audio sounds in this level except for the scorpoions coming out of their holes.

Background

The background for this level will be stripes of yellow, brown, red and orange with patches of white moss. This shows the different structure and colours of limestone and how it can vary from patch to patch. On this crag there will be different obstacles such as scorpions and cacti.

Foreground Objects

- Cactus
- Scorpion
- Rock – Limestone
- Fossils
    - Fossil 1 - Aztec medical logs – Aztec doctors used all types of herbal remedies to cure anything from fevers to earaches to broken legs - all in the 14th century.
- Fossil 2 - Lizard – A fossilised lizard was killed by a falling rock and because of that lack of oxygen and the surrounding soft sediments, the lizard's remains were preserved in the rock.
    - Fossil 3 - Piece of Aztec temple – The Aztec empire wanted to make their sacrificial temple better than any others. These temples were built over continuously to make them bigger and better than everyone's.

Character – same for all levels

Animation

- Climber
- Scorpions

Music and Sound Effects

- Climber picking up a fossil – ‘yippee’
- Climber eating food – ‘munch munch’
- Finish level – ‘congratulations’
- Lose level – ‘game over’

Scripts for Characters
None

Scenes and Transitions

After this level is over, there will be a data gathering section. Here the student will be able to analyse the different fossils he collects. And the student will need to learn about the different fossils he or she collected in order to pass one of the above multiple choice questions and move on to the next level.

Miscellaneous Elements:

Secret Level – Underwater – Atlantic Ocean

Name of Level: Underwater – Mid-Atlantic Ocean Rift

Details:

In a final attempt to gain the maximum number of points, a secret level has been set up. Therefore, in this level, the player can complete this mission by climbing or scaling down an underwater mountain. As in other levels, while underwater the player needs to avoid different obstacles such as fish, sharks and litter. However, the ocean is a great place to find deposits of different and unique animals – living and dead. In this level, the player should needs to find the sunken treasures from a Spanish galleon such as gold coins, a sword, a gold chain and a pirate flag. There will also be a final, bonus treasure that will be worth 2,000 spending points. As opposed to the volcano level, each gold coin will be separate and each will give the player 50 sp – and there are 5 gold coins.

As in other levels, the player moves by using the up, down, left and right arrow keys while using the mouse to click on the different desired food. Before the level starts, the player has the opportunity to use his or her spending points at the mountain shop to gather things necessary for this level. In order to gain access to this level, the player needs 1,100 spending points for the oxygen tank and the secret entrance key. That 1,100 points does not include food and water for the level and since underwater climbing is very rigorous, the player should have enough spending points to get food too. The student can collect all the fossils in order to get the maximum amount of spending points. Then the player needs to answer the multiple choice question correctly at the end of the level to continue. If the student get the question right on the first try, they get 50 sp however, if they get it right on the second try its only worth 25 sp and third try is only 10 sp and the last try is only worth one spending point. That is motivation for the player to answer the question correctly on the first try.

Since this level takes place underwater, what better place than the longest mountain range: the Mid-Atlantic Ridge. This ridge runs right down the middle of the Atlantic Ocean in the shape of a ‘C’ between South America and Africa. The Mid-Atlantic Ridge is part of the larger series of underwater mountains that circumnavigate the Earth: the Mid-Ocean Ridge. In this level, the player is faced with the daunting task of climbing down this underwater mountain while avoiding wild life and other such obstacles. There is an initial information box that appears on the screen telling the player about the type of rock he or she

is about to attack and other very important facts. For this level, the information box would look like this:

Location: Mid-Atlantic Ridge
Rock Type: Basalt
Climate at Top: 17° C
Climate at Bottom: 2° C
Elevation: 10,000 km
Vegetation: seaweed, kelp
Wild life: fish, sharks
Fossils : gold coins, baleen, gold chain, pirate flag and the final treasure

The rock type in this game is basalt and liquid magma. Basalt is a fine-grained igneous rock that comes from volcanic magma. This is a rock that has cooled quickly because there are not many crystals present in this rock. These rocks can form basically because the plates move. These plates move by hot rock, that is less dense than other rock, rises to the earth's surface causing convection currents. This hot rock is then forced sideways when it hits the plates. As it is pushed sideways, it drags the plates along. As the magma cools near the surface, it melts again and this occurs over and over again. The result is sea floor spreading. These underwater mountains start off as piles of sediments at the bottom of the ocean, then these sediments are morphed and they form sedimentary rocks. Then, as this process continues and the plates drift farther and farther away, magma flows from the centre of the Earth and the igneous rock forms over the sedimentary.

The climate at the surface of the water generally much warmer than at the bottom of the ocean. The sun hits the water towards the top to warm the water however; the water can only penetrate so car down so the water temperature changes drastically as the depth increases. The sun hits the surface layer of the ocean, heating the water up. Wind and waves mix this layer up from top to bottom, so the heat gets mixed downward too. “The temperature of the surface waters varies mainly with latitude. The polar seas (high latitude) can be as cold as -2 degrees Celsius while the Persian Gulf (low latitude) can be as warm as 36 degrees Celsius” (http://www.windows.ucar.edu/tour/link=/earth/Water/temp.html&fr=t). Also, in this level the depth at which the player will be descending is important. A human being can only hold his or her breath for about four minutes maximum so, if the decent would take more than four minutes in real time then the player needs to have an oxygen tank ready to use.

The wild life and vegetation in this level is very rich and unique. At the top of the water, near the surface, the player will encounter seaweed, sharks and fish. However, as the player dives below 200 metres, the wild life and vegetation becomes less and less but there are still eels to be aware of. There are eels that live towards the bottom of the ocean and emerge from their hiding spots only when potential nourishment is near. The player will need to be very cautious when travelling in the deep waters because of those eels. As mentioned in the gameplay, the player needs to have an oxygen tank to go into the water and especially as the climber descends the mountain.

Finally, the fossils in this level are more like bonus treasures. The site of the climb or dive for that matter, is the alleged site where a Spanish galleon crashed hundreds of years ago and the ship or its contents have not been recovered. It is the job of the player to confirm the site of that crash and pick up a few items along the way. Five gold coins, a gold chain, baleen and a pirate’s flag that are needed to confirm the site of the disaster.

Post Level Education

Here the student will read facts about the different fossils and learn what he or she has collected. The fossils for this level will be explained later. Then, at the end of that fact bulletin, there will be a multiple choice question for the student to answer in order to gain more points for the mountain shop. The player cannot get the question wrong however, the fewer tries it takes, the more 'mountain money' the player gets – that way he or she can get more food or mountain climbing items.

Question 1: How do dolphins and whales 'see' the world with sound?

- A. Osmosis
- B. Echos
- C. Sonar
- D. 3-D goggles

Then there would be an explanation at the end of that question that told two things: that water is important for a healthy climb and then there would be a clue for the player about where they need to go to look for their next set of fossils.

The answer is echos. Echolocation - the location of objects by their echos - is a highly specialised sense that enables dolphins and whales to explore their environment and search out their prey in a watery world where sight is often of little use.

Question 2: What is the freezing point of ocean water?

- A. 4° C
- B. 2° C
- C. 0° C
- D. -2° C

Then there would be an explanation at the end of that question that told two things: that water is important for a healthy climb and then there would be a clue for the player about where they need to go to look for their next set of fossils.

The answer is -2° C. The freezing point of non-salt water is 0 but as the amount of salt increases the temperature at which water freezes decreases. This is why the ocean only freezes in very cold places, land closer to the north and south poles.

Question 3: What is the deepest point on earth?

- A. Death Valley, California
- B. Mount Everest
- C. Marina Trench
- D. Dead Sea

Then there would be an explanation at the end of that question that told two things: where the lowest point on Earth is and where to look for their next mission.

The answer is Marina Trench. The trench lies 11,035 metres down into the Earth - as a comparison; Mount Everest is 8,848 metres high. So, if you flipped Mount Everest upside down, Marina Trench would still be about 2,000 m deeper than Mount Everest. It was formed when 2 huge tectonic plates collided. One plate moved underneath another causing this huge trench in the Earth.

Physical and Audio Appearance

Physical Appearance

This level takes place underwater and therefore it has a light blue background with a darker colour for the rock. The appearance will be as similar as possible to an actual underwater mountain.

Audio Appearance

There will be water flowing around the player that can be heard among other sounds to be explained in the 'sounds' section.

Background

The background will be blue surrounding the black and dark brown mountain. The blue colour of the water will change as the climber goes deeper – the water will get darker and darker. There will be seaweed also in the background.

Foreground Objects and Characters

- Fish
- Sharks
- Eel –
- Seaweed
- Rock – Basalt
- Fossils/Treasures
  - Fossil 1 - Gold Coins - After this Spanish Galleon was sunk, these gold coins were spilled onto the Ocean Floor. Divers have come for years to find them, but they seem to have missed these!
  - Fossil 2 – Baleen - These strips of baleen, found from a gigantic Blue Whale, have been found close to the bottom of the ocean. Baleen is a type of filter that whales use to feed on plankton and shrimp.
  - Fossil 3 - Gold Chain - A gold necklace, probably worn by the Captain of this ship shows the pompous attitude of these big-time captains that sailed in the 15th century.
  - Fossil 4 - Pirate Flag - This flag is proof enough that this Spanish ship was overtaken by Pirates! A big fight might have taken place on this ship and caused it to sink into the Atlantic Ocean.

Character is the same as in all levels however in this level it will have an oxygen tank on its back and scuba gear.

Animation

- Climber
- Fish – swimming around
- Shark – swimming around
- Eel - They look just like a light however, as the player approaches the eel it jumps out and attacks the player.

Music and Sound Effects

- Water
- Climber picking up a fossil – 'yippee'
- Climber eating food – 'munch munch'
- Finish level – 'congratulations'
- Lose level – 'game over'

Scripts for Characters
none
Scenes and Transitions
After this level is over, there will be a data gathering section. Here the student will be able to analyse the different fossils he collects. And the student will need to learn about the different fossils he or she collected in order to pass one of the above multiple choice questions and move on to the next level. Even though this is the special key level, the student can go to this level at any time – not only after they completed all ten missions. Therefore, this level is not necessarily the end of the game even though it very well could be.

Miscellaneous Elements
none

Storyboards

Development Spec

Component	*Description*
User Input	**4 keys** : Up, Down, Left, Right arrow keys 2 key-combinations will be possible, allowing the player to move the climber diagonally
Boundaries Screen	**Boundaries** - Left, right, bottom boundaries set - Reaching the top of the screen will scroll to the next screen, end the level, etc. **Scenery Element Boundaries** - Certain on-screen elements made for background illustration (i.e. rock outcroppings, skeletons) will need to have bounded boxes to keep player from moving over them

Collectable Items	**Pseudo-Code**
	When player moves over item {
	If item is **food** {
	Effect stamina in some way
	} else if item is **equipment** {
	Effect game flag for covering certain areas, certain effects (for example, if player receives crampons, ice areas can be crossed)
	} else if item is **treasure** {
	Add item to player inventory
	Remove item from screen
	Place item into 'backpack' sub-screen
	}
	}

Dangers Pseudo-Code	If player enters **danger area** {

	If player does not have correct **equipment** {
	Player dies
	Game ends
	}
	}

Stamina	Decreases slowly with the **clock** as player moves Increases with **food**
Animation Demands	1. Player Motion (same for up, down, left, right, diagonals) 2. On-screen effects (trees swaying, water dripping) 3. Danger effects (Yeti yelling, avalanche) 4. Player falling (death scene) 5. Intro-Zooming effect 6. Scrolling to next level

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