Project Number JAG-8006

Teaching Practicum

A Student Teaching Practicum Portfolio

An Interactive Qualifying Project Report

Submitted to the Faculty

of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by

Elizabeth Ellis

Date: 29 April 2009

Approved by:

Professor John Goulet, Advisor

Table of Contents

Table of Figures

Table of Tables

Abstract

In partial fulfillment of the requirements for Massachusetts Educator Licensure, the author spent over 100 hours of observation and 150 hours of practical teaching experience in an eighth grade science classroom at Gardner Middle School in Gardner, Massachusetts. Demographical information for Gardner Middle School and for each community that contributes students to Gardner Middle School was researched and analyzed. The current Massachusetts Curriculum Frameworks as well as MCAS requirements for the eighth grade science test were likewise examined, and relevant, functional lesson plans and course materials were generated and compiled for use in an eighth grade science classroom.

Chapter 1: Gardner Middle School

Community Profiles

Gardner Middle School is located in the City of Gardner, in North Central Massachusetts. The vast majority of students, around 94.9%, that attend Gardner Middle School live in Gardner, while 5.1% of the students attend from the surrounding communities by utilizing the school choice program available to students in Massachusetts. The communities represented at Gardner Middle School include Ashburnham, Athol, Fitchburg, Hubbardston, Leominster, Petersham, Philips ton, and Winchendon [1].

Gardner has an area of 23.0 square miles and a population of 20,770 [2]. In the 2000 Census, the per capita income in Gardner was $18,624, compared to the national average of $21,587 [3]. Figures 1 to 3 below compare Gardner's demographics to those of the other communities that contribute students to Gardner Middle School.

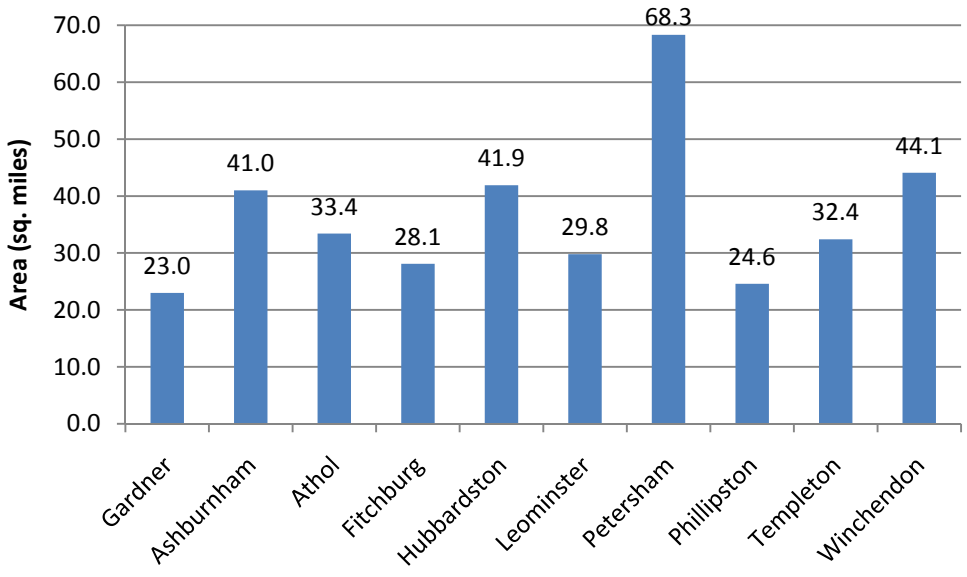


Figure 1: Community Profiles - Area.

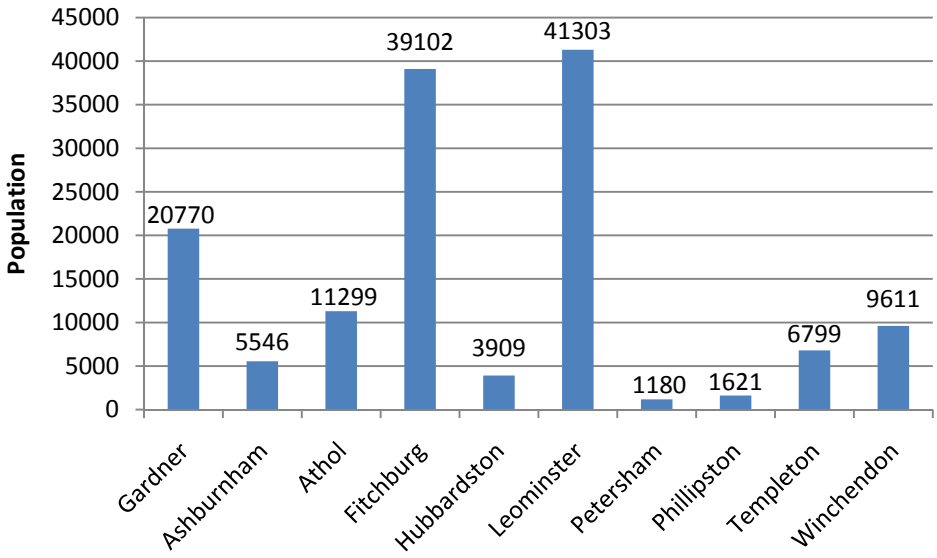


Figure 2: Community Profiles - Population.

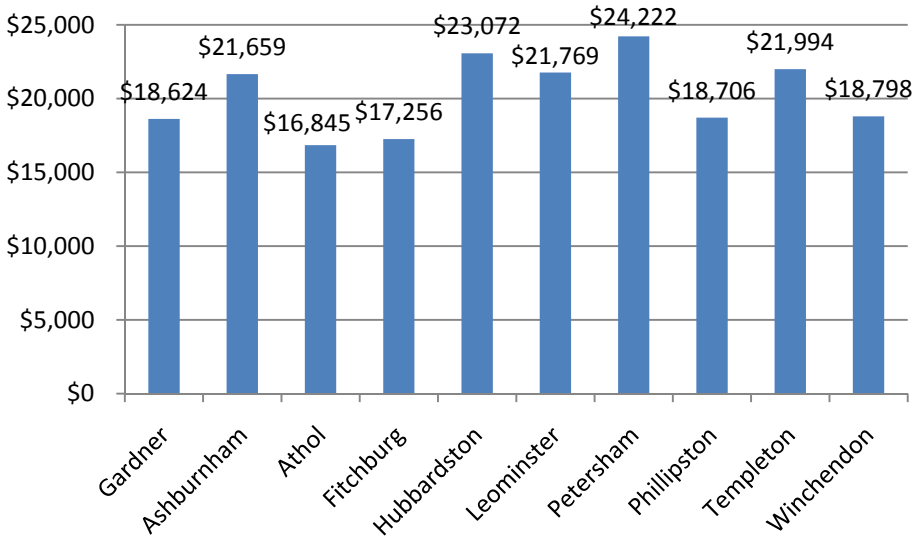


Figure 3: Community Profiles - Per Capita Income.

Gardner Middle School

Gardner Middle School services 613 sixth, seventh, and eighth grade students in the Gardner Public School system. Students from Gardner may choose to attend another available school,

including Sacred Heart School and Holy Rosary School, both private schools in Gardner, and North Central Charter School in Fitchburg, through the school choice program.

The student population is approximately 50.2% female and 49.8% male, with 3.9% African-American, non-Hispanic students, 2.4% Asian/Pacific Islander, 9.7% Hispanic, 0.8% Native American, 81.9% White, and 1.3% multi-race, non-Hispanic students [4]. Figure 4 compares the student population breakdown to the state averages.

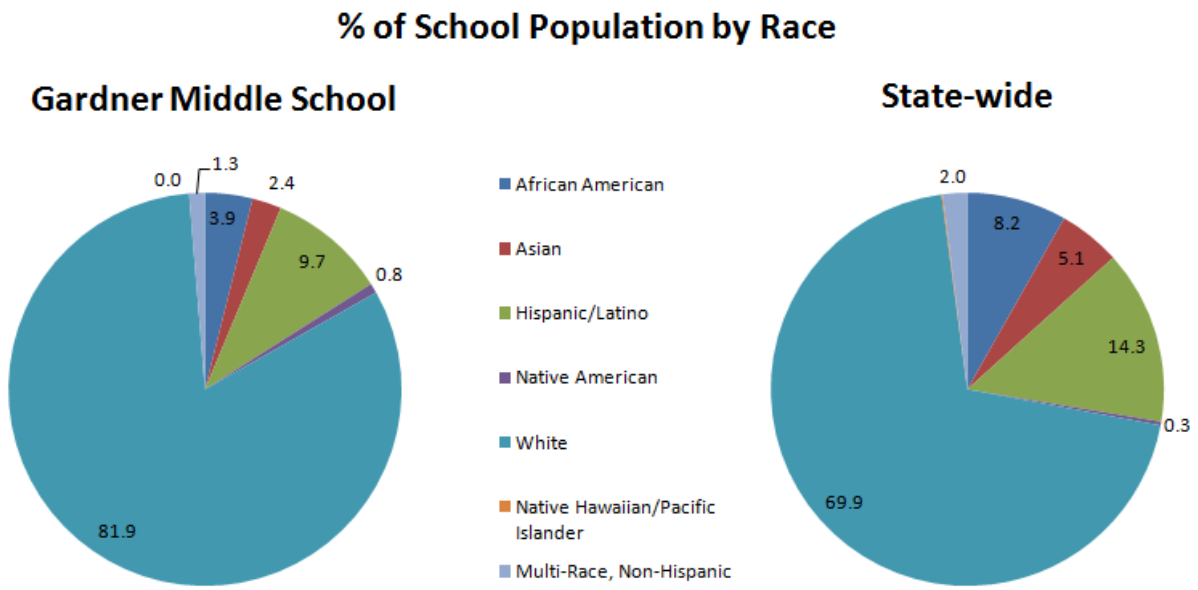


Figure 4: Ethnic Diversity Comparison.

Pie charts compare ethnic diversity at Gardner Middle School with state-wide percentages. [4]

Gardner Middle School employs 46 full-time teachers, giving a student/teacher ratio of 14:1. This value is only slightly higher than the state ratio of 13.6:1. In 2007, the average per pupil expenditure was $9,532, approximately 80% of the state average, which was $11,858 [4].

On the eighth grade floor, the 230-member class is divided into two teams, A and B. These teams determine which teachers a student will have, as each team has a unique set of teachers for the core subjects. This practicum was completed in Team 8B.

Massachusetts Comprehensive Assessment System

The Commonwealth of Massachusetts developed the Massachusetts Comprehensive Assessment System (MCAS) as a statewide exam based on the learning standards in the Massachusetts Curriculum Frameworks. It was implemented to fulfill the requirements of the Education Reform Law of 1993. This assessment tests all students throughout their educational career, primarily in English/Language Arts and Mathematics, with supplemental tests in Science and Technology/Engineering and History and Social Science [5]. Table 1 shows the percent of eighth students at each performance level in Gardner compared to state-wide, for MCAS tests administered in Spring 2008. In this table, we can see that only 1% of eighth graders achieved an advanced score on the Science and Technology test in 2008. CPI is a percent value, similar to a report-card grade, scored out of 100.

Table 1: MCAS Performance Level Comparison.

Percent of students at each performance level for Gardner compared to state-wide data. [4]

Subject	Advanced		Proficient		Needs Improvement		Warning/ Failing		Students Included (GMS)	CPI
	District	State	District	State	District	State	District	State		
English/Language Arts	7%	12%	63%	63%	25%	18%	5%	7%	230	87.7
Mathematics	14%	19%	21%	30%	36%	27%	29%	24%	228	65
Science and Technology	1%	3%	31%	36%	46%	39%	23%	22%	225	66.1

The MCAS is also used to judge the progress of schools and districts toward fulfilling the No Child Left Behind Law objective. This federal act requires every school and district meet (or surpass) standards of performance. It states that all students should be proficient in Reading and Mathematics by 2014, and the AYP monitors the progress of each school and district toward this goal [1]. MCAS scores are collected and analyzed by the state to ascertain the progress of each particular school toward the Adequate Yearly Progress (AYP) standards. This AYP evaluation is used to rate each school based on test performance and the rate at which performance improves in both English/Language Arts and Mathematics. Guidelines are also in place on the AYP for schools to meet, including participation, performance, improvement, and graduation rate. Table 2 illustrates AYP ratings for Gardner following the Spring 2008 MCAS exam, and Table 3 displays Gardner's performance according to these AYP guidelines.

Table 2: AYP Ratings for English/Language Arts and Mathematics [4]

Subject	Performance Rating	Improvement Rating
English/Language Arts	High	Declined
Mathematics	Moderate	Declined

Table 3: Gardner Performance against AYP Guidelines [4]

	Participation			Performance			Improvement			Attendance Rate		
Subject	Req.	Actual	Met?	Req.	Actual	Met?	Req.	Actual	Met?	Req.	Actual	Met?
English/Language Arts	95%	99%	Yes	85.4	87.0	Yes	90.6	87.0	No	+1%	94.5%	Yes
Mathematics	95%	100%	Yes	76.5	67.2	No	69.0	67.3	No	+1%	94.5%	Yes

As Table 1 shows, MCAS administers a Science and Technology/Engineering test in eighth grade, and the generated eighth grade science syllabus should include opportunities to practice for this important assessment.

Chapter 2: Course of Interest

Organization of Class Schedule

Gardner Middle School operates on a rotating block schedule, where every block meets each day. For eighth grade, the school day is divided into eight blocks, which are given letter names. Two of these blocks, C and G in this case, are set as “Unified Arts”, such as gym, band, and art. One block, E block, has been designated as “Skill Center”, and is the block that falls directly around lunch. The interpretation of this block varies from grade to grade, and even from team to team. Team 8B used Skill Center as extra class time for longer blocks. The remaining blocks (A, B, D, F, H) rotate through the daily schedule. This timetable is represented below in Figure 5: A Rotating Block Schedule.Figure 5, and has been color-coded for distinction.

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
1st Block	A	H	F	D	B
2nd Block	B	A	H	F	D
3rd Block	C	C	C	C	C
4th Block	D	B	A	H	F
4th Block	E	E	E	E	E
	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
5th Block	E	E	E	E	E
5th Block	F	D	B	A	H
6th Block	G	G	G	G	G
7th Block	H	F	D	B	A

Figure 5: A Rotating Block Schedule.

At Gardner Middle School, scheduling for all subjects excluding mathematics follows a heterogeneous grouping; that is, only the math classes are organized by ability. As such, every class will generally have approximately the same timeline and structure. Detailed content and

assessments will vary between the teams, but within each team, classes follow almost identical schedules regardless of block.

Curriculum

In recent years, curriculum organization throughout the school system has been subject to many changes. Most of the schools in the Gardner Public School system, including Gardner Middle School, have faced multiple administrative changes in recent years as positions become available to new candidates. In spite of these upheavals, a new structure was set for the science department two years ago at Gardner Middle School, which rearranged the order in which material is presented. This new structure creates a more sequential progression of topics, and allows for additional review of the material for eighth graders before MCAS in the spring.

Sixth grade begins with an introduction to general science, the scientific method, and basic biology, focusing on microorganisms and plants. In the second half of the year, sixth grade covers geology and environmental science. Seventh grade begins with basic physics principles, such as Newton's Laws of Motion, properties of fluids, and energy, work, and heat. The second half of the year begins with astronomy, then returns to geology but goes into more detail by applying the physics principles introduced in the first half of the year. As the year ends, seventh grade again covers biology, this time with a focus on the animal kingdom. Eighth grade focuses on chemistry, from an introduction to matter to types of chemical reactions, which was the subject the author taught. The second half of the year covers cellular biology and functions, an introduction to meteorology, and review of MCAS material.

It is easy to see a pattern emerging in the structure of the courses. Several fields of study repeat in future years, such as biology and geology, with each year increasing the complexity of the studied material. In addition, each year has at least one unique unit of study. It can be said that the scientific method unit in sixth grade will carry through all years, and that the physics principles discussed in seventh grade will have applications in eighth grade chemistry, especially concerning physical properties of materials and heat and energy applications.

High school science courses begin with biology in ninth grade before moving to chemistry and physics, with environmental science as an additional elective. The middle school structure is organized such that every high school course is introduced as a unit at least once in the three years. This is beneficial both to the students and to the high school teachers. Students have some background information on the subject and are better able to anticipate the material in the course, at least in the first weeks. High school teachers benefit from the fact that their classes will not be the first time students are faced with these topics, facilitating transitions and allowing for a more rapid development from basics to essential course topics.

The curriculum has been carefully planned to address the standards proposed by the Curriculum Frameworks. In addition, the Holt Science & Technology series carefully monitors the NSF Curriculum standards throughout their materials. Finally, topics which frequently appear on MCAS tests are often reinforced throughout the department, to assist the students achieve a more thorough understanding of these subjects.

Chapter 3: Course Materials

A teaching practicum involves planning and material development from the student teacher. Because many different learning styles exist in the classroom, it is important to vary teaching methods and activities to allow each student the opportunity to work to their strengths. Throughout the semester, lectures, demonstrations, labs, and group projects were used in an attempt to maximize these opportunities. A sample of these materials is provided in this section, as well as the rationale behind each lesson and the relevant frameworks associated with the material.

Chapter Overview

An overview of each of chapters 3, 4, and 5 were created to put individual lesson plans in perspective with the entire unit. These overviews provide unit objectives, relevant frameworks, and the basic plan for each lesson within the unit. This kept each unit more organized, and made it easier to follow the structure of the course.

I. Chapter 3: Elements, Compounds, and Mixtures
   A. Unit Objectives
      1. Describe pure substances.
      2. Describe the characteristics of elements, and give examples.
      3. Explain how elements can be identified.
      4. Classify elements according to their properties.
      5. Explain how compounds are made of elements.
      6. Describe the properties of compounds.
      7. Explain how a compound can be broken down into its elements.
      8. Give examples of common compounds.
      9. Describe three properties of mixtures.
      10. Describe four methods of separating the parts of a mixture.
      11. Analyze a solution in terms of its solute and solvent.
      12. Explain how concentration affects a solution.
      13. Describe the particles in a suspension.
      14. Explain how a colloid differs from a solution and a suspension
   B. Learning Standards
      1. **PS5:** Recognize that there are more than 100 elements that combine in a multitude of ways to produce compounds that make up all of the living and nonliving things that we encounter.
      2. **PS6:** Differentiate between an atom (the smallest unit of an element that maintains the characteristics of that element and a molecule (the smallest unit of a compound that maintains the characteristics of that compound).
      3. **PS7:** Give basic examples of elements and compounds.
      4. **PS8:** Differentiate between mixtures and pure substances.
      5. **PS9:** Recognize that a substance (element or compound) has a melting point and a boiling point, both of which are independent of the amount of the sample.
   C. Resources
      1. Massachusetts Science and Technology/Engineering Curriculum Frameworks. Massachusetts Department of Education, 2006. *http://www.doe.mass.edu/frameworks/scitech/1006.pdf*
   D. Chapter Overview
      1. Lesson 1: Elements
         a. The teacher introduces relevant concepts: pure substance, element, metal, metalloid, nonmetal.
         b. The teacher illustrates unique properties of elements by displaying various materials.
         c. The teacher leads a discussion on elements, and the lesson assessment is distributed.
      2. Lesson 2: Compounds
         a. The teacher introduces relevant concepts: compound, properties of compounds, breaking down compounds.
         b. The teacher demonstrates basic principles of compounds by illustrating molecules using Legos and/or a molecular model kit.

    c. The teacher leads a discussion on compounds, and the lesson assessment is distributed.
3. Lesson 3: Mixtures
    a. The teacher introduces the relevant concepts: mixture, solution, solute, solvent, concentration, solubility, suspension, colloid.
    b. The teacher illustrates mixtures, solutions, suspensions, and colloids using examples.
    c. The teacher leads a discussion on mixtures, and the lesson assessment is distributed.

II. Chapter 4: Introduction to Atoms
   A. Unit Objectives
      1. Describe some of the experiments that led to the current atomic theory.
      2. Compare the different models of the atom.
      3. Explain how the atomic theory has changed as scientists have discovered new information about the atom.
      4. Describe the size of an atom.
      5. Name the parts of an atom.
      6. Describe the relationship between numbers of protons and neutrons and atomic number.
      7. State how isotopes differ.
      8. Calculate atomic masses.
      9. Describe the forces within an atom.
   B. Learning Standards
      1. **HNS1:** Science as a human endeavor.
      2. **HNS2:** Nature of science.
      3. **HNS3:** History of science.
      4. **PS1c:** Chemical elements do not break down during normal laboratory reactions involving such treatments as heating, exposure to electric current, or reaction with acids. There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances we encounter.
   C. Resources
      1. National Science Education Standards. *National Science Foundation*.
   D. Chapter Overview
      1. Lesson 1: Development of the Atomic Theory
         a. The teacher introduces relevant concepts: atom, electron, nucleus, electron cloud.
         b. The teacher uses overhead projection of images to more clearly visualize relevant concepts. The students, with direction from the teacher, illustrate experiments using the “Cathode Ray” activity. The teacher illustrates various theories using props as appropriate.
         c. The teacher leads a discussion on atomic theory, and the lesson assessment is distributed.
      2. Lesson 2: The Atom
         a. The teacher introduces relevant concepts: proton, atomic mass unit, neutron, atomic number, isotope, mass number, atomic mass.
         b. The teacher uses overhead projection of images to more clearly visualize relevant concepts.
         c. The teacher leads a discussion on atoms, and the lesson assessment is distributed.

III. Chapter 5: The Periodic Table
   A. Unit Objectives
      1. Describe how Mendeleev arranged elements in the first periodic table.
      2. Explain how elements are arranged in the modern periodic table.
      3. Compare metals, nonmetals, and metalloids based on their properties and on their location in the periodic table.
      4. Describe the difference between a period and a group.
      5. Explain why elements in a group often have similar properties.
      6. Describe the properties of the elements in the groups of the periodic table.
   B. Learning Standards
      1. **SAI1:** Understandings about scientific inquiry.
      3. **SPSP5:** Science and technology in society.
      3. **HNS1:** Science as a human endeavor.
      4. **HNS2:** Nature of science.
      5. **HNS3:** History of science.
      6. **PS1b:** Substances are often placed in categories or groups if they react in similar ways; "metals" is an example of such a group.
   C. Resources
      1. National Science Education Standards. *National Science Foundation*.
   D. Chapter Overview
      1. Lesson 1: Arranging the Elements
         a. The teacher introduces relevant concepts: periodic, period, periodic law, group.
         b. The teacher illustrates similar properties through examples and molecular models.
         c. The teacher leads a discussion on the Periodic Table, and the lesson assessment is distributed.
      2. Lesson 2: Grouping the Elements
         a. The teacher introduces relevant concepts: alkali metal, alkaline-earth metal, halogen, noble gas.
         b. The teacher illustrates similar properties through examples.
         c. The teacher leads a discussion on atoms, and the lesson assessment is distributed.

Traditional Lectures and Activities

Traditional lectures, in which the teacher presented the relevant concepts and the students took notes on the content, were used in this class. While this method may not be the most interesting for the students, it is the most convenient way to format the delivery of some topics, such as the history of atomic theory. However, that is not to say that these lectures cannot also benefit from activities. In this lecture, the students reenacted Thomson's Cathode Ray experiment, and were better able to understand the methods, and the significance of his discoveries.

Atomic Theory

The material in the Development of the Atomic Theory chapter was presented as a traditional lecture, supplemented with two student activities to demonstrate the results of two important experiments.

Lesson: The Development of the Atomic Theory

A. Objectives:
    1. Describe some of the experiments that led to the current atomic theory.
    2. Compare the different models of the atom.
    3. Explain how the atomic theory has changed as scientists have discovered new information about the atom.
B. Opening Activity
    1. The teacher reviews what the students know about atom by asking questions associated with the information learned in Chapter 3. For example:
        a. What is an atom? *The smallest unit of an element that retains the properties of that element*
C. Developmental Activity
    1. The teacher introduces the history of atomic theory.
        a. The teacher describes historical atomic models.
        b. The teacher describes experiments that led to new atomic models.
            i. Thomson's Cathode-Ray Tube experiment
    2. The teacher leads the "Cathode-Ray" activity.
        a. Students get out of their seats and line up at the front of the classroom. About a third of the students are kept aside.
        b. The students walk in a straight line to the back of the classroom.
            i. This demonstrates the flow of electrons through the cathode ray tube while the plates are not charged.
        c. The students designated as plates line up on either side of the classroom. One side of the room is given cards with + signs on them, and candy is placed on that side of the room (positive), while the other holds – sign cards and has no candy (negative). (If candy is unavailable as a prop, an analogy can be made to aid in students' understanding, such as two stores, but one has a sale, or friends walking down the street.)
            i. This time, when the students walk through the classroom, they will veer toward the side of the room with the candy.
            ii. This demonstrates the flow of electrons when the metal plates are charged.
D. Closing Activity
    1. The teacher reviews the concept of the atomic model.
        a. Historical models began extremely simplified, but have been modified by experimentation.
        b. Thomson discovered that atoms contain electrons, and that electrons are negatively charged.
        c. Rutherford discovered that atoms are made primarily of empty space, with a small, densely packed, positively-charged nucleus and an electron cloud around it.
        d. Bohr discovered that electrons have distinct spheres in which they can be found, called levels, instead of a general cloud of electrons.
    2. The teacher leads a discussion on atomic theory.

Demonstrations

Chemistry, by its very nature, lends itself well to experimentation and lab work. However, lab guidelines are very strict with regards to the equipment available to students, and the kinds of activities students can perform. Even if these guidelines were not in place, resources, such as Bunsen burners, chemicals, glassware, and other equipment, are difficult and expensive to procure. It is unfair to deny students this entire experience for these reasons, and so demonstrations come to take a prominent role in classroom activities. Three demonstrations were performed for the students as an introduction to chemical bonds and chemical reactions.

Demonstration: Introduction to Chemical Reactions

A. Objectives:
    1. Provide context for types of reactions.
    2. Demonstrate single-displacement and double-displacement reactions.
    3. Explain the relationship between surface area and reaction rate.
    4. Stimulate students' interest in chemistry by providing a kick-ass demonstration.
B. Opening Activity
    1. The teacher introduces or reviews relevant topics. For example:
        a. What is a chemical reaction? *Materials interacting and reorganizing to create new things*
        b. What is a reactant? *A material that goes into a chemical reaction*
        c. What is a product? *A material that comes out of a chemical reaction*
        d. What is surface area? *The amount of the material that is able to react*
        e. What is combustion? *A reaction in which reactant and oxygen create a product, carbon dioxide, and water (burning)*
        f. What is glucose? *Sugar*
        g. What is a solution? *Homogenous mixture of 2+ substances uniform in a single phase*
C. Developmental Activity
    1. The teacher distributes lab sheets to each student
    2. The teacher introduces the Thermite demonstration.
        a. The teacher describes thermite powder, single-displacement reactions, and exothermic reactions, and explains the demonstration set-up.
        b. The teacher performs the demonstration.
        c. The teacher leads a discussion in which the demonstration is analyzed.
            i. Emphasis is laid on the importance of safety in science, as established by the demonstration.
    3. The teacher introduces the Dragon's Breath demonstration.
        a. The teacher describes lycopodium powder, and explains the demonstration set-up.
        b. The teacher performs the demonstration.
        c. The teacher leads a discussion in which the demonstration is analyzed.
    4. The teacher introduces the Traffic Light Solution demonstration.
        a. The teacher reviews solutions, describes indigo carmine indicator and double-displacement reactions, and explains the demonstration set-up.
        b. The teacher performs the demonstration.
        c. The teacher leads a discussion in which the demonstration is analyzed.
D. Closing Activity
    1. The teacher leads a discussion on chemical reactions.
    2. The students complete lab analysis questions.

Thermite Reaction Demonstration

Purpose: To emphasize the importance of safety in science
To demonstrate an exothermic reaction
To demonstrate a single-replacement reaction

Materials:

- Aluminum powder
- Iron (III) oxide
- Magnesium ribbon
- Torch lighter
- 4-in.Clay flower pot (2)
- Ring stand
- Goggles
- Lab apron
- Heat-proof gloves
- Fire extinguisher
- Bucket filled ½ to ¾ with sand

PreLab:

a. What does exothermic mean?
b. What are aluminum, iron, and magnesium? What is their classification?
c. What safety issues exist in this demonstration?

Procedure:

1. Clear the demonstration area of any unnecessary materials.
2. Create the thermite powder by mixing 15g of aluminum powder with 50g of iron oxide powder.
3. In one of the clay pots, plug the bottom drain hole with a piece of wadded paper towel. Place the thermite powder in this pot.
4. Nest the pot with the thermite powder inside the second pot, and suspend these pots above the sand bucket using a ring stand.
5. Place a strip of magnesium ribbon into the thermite powder. Be sure to leave enough out of the powder to act as a fuse.
6. Ignite the strip of magnesium with the torch lighter.
7. Wait at least 15 minutes after the reaction has completed before approaching the equipment as it will be extremely hot. Use heat-safe gloves to disassemble the equipment. Place the products in cold water to assure full cooling. Clean the demonstration area and put all materials away properly.

Analysis Questions: *(Answer in complete sentences.)*

1. Draw a diagram of our lab equipment and setup.
2. Compare iron, iron oxide, and thermite powder. How are they different?
3. Why is this reaction difficult to start? Describe what happened during this reaction.
4. What happened to the sand when the iron touched it?
5. Explain how this demonstration is an exothermic reaction.

Dragon's Breath Demonstration

Purpose: To demonstrate how surface area affects chemical reactions

Materials:
- Lycopodium powder
- Candle with drip tray
- Syringe
- Matches
- Goggles
- Lab apron

PreLab:

a. Make a hypothesis: Will the lycopodium powder burn better in a pile on the desk, or dispersed in the air?
b. What is flammability?
c. What safety issues exist in this demonstration?

Procedure:

1. Clear the desk of any unnecessary materials.
2. Place a small pile of lycopodium powder on the lab table.
3. Use a match to ignite the pile of lycopodium powder.
4. Draw a small amount of lycopodium powder into the syringe (5-10 mL).
5. Light the candle, and place it in the drip tray on the lab table.
6. Inject some of the lycopodium powder out of the syringe into the air over the candle, approximately 1-2 cm above the flame.
7. When the demonstration is over, blow out the candle. Clean the lab bench and put all materials away properly.

Analysis Questions: *(Answer in complete sentences.)*

1. Draw a diagram of our lab equipment and setup.
2. Describe what happened when we used the match on the pile of lycopodium powder.
3. Describe what happened when we injected the lycopodium powder into the air above the candle.
4. Was your hypothesis correct or incorrect? Explain.
5. How can we relate this lab to solutions and dissolving?

Traffic Light Solution Demonstration

Purpose: To demonstrate solutions
To demonstrate an oxidation reaction

Materials:

- Glucose
- Potassium hydroxide
- Distilled water
- Indigo carmine indicator
- Plastic bottle
- Goggles
- Lab apron
- Gloves

PreLab:

a. Make a hypothesis: Why do you think the liquid in the bottle changes color?
b. What is a solution? How is it different from a suspension?
c. What safety issues exist in this demonstration?

Procedure:

1. Clear the desk of any unnecessary materials.
2. Fill the plastic bottle approximately $^2/_3$ full with distilled water.
3. Add 10g of glucose and 5g of potassium hydroxide to the bottle. Close the cap on the bottle tightly, to be sure the liquid does not spill.
4. Shake until both powders are dissolved.
5. Add the indigo carmine indicator. Shake the bottle until the color is uniform.
6. Let the bottle rest. Observe the liquid.
7. When the liquid returns to its original color, shake the bottle slightly. Observe the liquid.
8. Shake the solution harder, and observe the liquid change color again.
9. When the demonstration is over, flush the liquids down the drain with excess water. Clean the lab bench and put all materials away properly.

Analysis Questions: *(Answer in complete sentences.)*

1. Explain what we do to get our powders to dissolve faster.
2. What happens when we let the solution sit without shaking it?
3. What happens when we shake the bottle slightly?
4. Describe what happened when we shook the bottle harder.
5. What do you think is happening in this reaction?

Homework

If you ask any student what their least favorite part of school is, they will most likely say homework. Nevertheless, homework remains an important method of assessment, by allowing the instructor to evaluate how well the students understand the material. Often, homework would consist of a set of questions, in the book or in a worksheet, which reviewed the lesson from that day. The textbook contains well-organized section reviews that were very helpful for students. One set of worksheets, the Directed Reading series, was particularly effective in judging the students' understanding of the sub-chapters, as they contained many types of questions, including open-response questions similar to those on the MCAS. Reinforcement activities that focused on topics covered in the past were also used. In addition, it was observed that students are more likely to finish their homework if it is interesting in some way, for example if it is a puzzle rather than a straight list of question. Additionally, if the assignment related the lesson to "real life" it was further accepted by the students as a legitimate assignment. For example, early in the year the students were introduced to the scientific method. The activity that corresponded to this lesson involved the students finding a situation in which they would use the scientific method in "real life". When the assignment was complete, most students expressed surprise that they use the scientific method, even simply, in their lives all the time.

9/19

Name _____ Class _____ Date _____

Skills Worksheet

Directed Reading A

Section: Physical Properties

PHYSICAL PROPERTIES

_____ **1.** A characteristic of matter that can be observed or measured without changing the identity of the matter is a
a. matter property. **c.** chemical property.
b. physical property. **d.** volume property.

_____ **2.** Some examples of physical properties are
a. color, odor, and age. **c.** color, odor, and magnetism.
b. color, odor, and speed. **d.** color, odor, and anger.

Match the correct example with the correct physical property. Write the letter in the space provided.

_____ **3.** Aluminum can be flattened into sheets of foil.

_____ **4.** An ice cube floats in a glass of water.

_____ **5.** Copper can be pulled into thin wires.

_____ **6.** Plastic foam protects you from hot liquid.

_____ **7.** Flavored drink mix dissolves in water.

_____ **8.** An onion gives off a very distinctive smell.

_____ **9.** A golf ball has more mass than a table tennis ball.

a. state
b. solubility
c. thermal conductivity
d. malleability
e. odor
f. ductility
g. density

10. Density is the _____ that describes the relationship between mass and volume.

11. Objects such as a cotton ball and a small tomato can occupy similar volumes but vary greatly in _____.

12. If you pour different liquids into a graduated cylinder, the liquids will form layers based upon differences in the _____ of each liquid.

13. Which layer of liquid would settle on the bottom?

_____

9/19

Name _____ Class _____ Date _____

Directed Reading A *continued*

14. Where will the least dense liquid be found?

_____

15. Why would 1 kg of lead be less awkward to carry around than 1 kg of feathers?

_____

_____

_____

16. What will happen to a solid object made from matter with a greater density than water when it is dropped into water?

_____

_____

_____

17. How will knowing the density of a substance help you determine whether an object made from that material will float in water.

_____

_____

_____

18. What is the equation for density?

_____

19. What do D, V, and m stand for in the equation for density?

_____

_____

_____

20. The units for density take the form of a mass unit divided by a(n)

_____ unit.

21. What are two reasons why density is a useful property for identifying substances?

_____

_____

9/19

Name _____ Class _____ Date _____

Directed Reading A *continued*

PHYSICAL CHANGES DO NOT FORM NEW SUBSTANCES

22. A change that only affects the physical properties of a substance is known as a(n) _____.

23. What kind of changes are melting and freezing?

_____

_____

_____

Identify which of the following activities represent physical changes by writing PC in the space provided, if they cause only physical changes. Put an X beside any that do not.

_____**24.** sanding a piece of wood

_____**25.** baking bread

_____**26.** crushing an aluminum can

_____**27.** melting an ice cube

_____**28.** dissolving sugar in water

_____**29.** molding a piece of silver

MATTER AND PHYSICAL CHANGES

30. When a substance undergoes a physical change, its _____ does not change.

31. What is changed when matter undergoes a physical change? Give an example to explain your answer.

_____

_____

_____

_____

_____

10/20

Name _____ Class _____ Date _____

Skills Worksheet

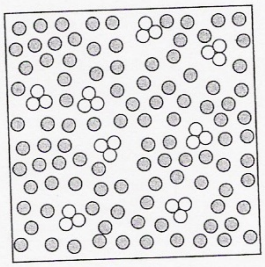
Reinforcement

It's All Mixed Up

Complete this worksheet after you finish reading the section "Mixtures."

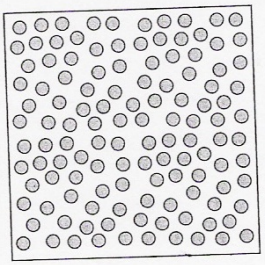
Label each figure below with the type of substance it BEST models: colloid, compound, element, solution, or suspension.

1.



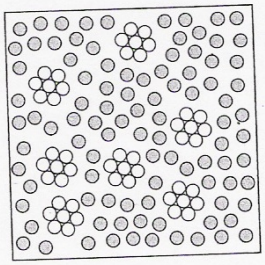
_____

2.



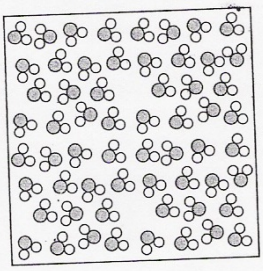
_____

3.



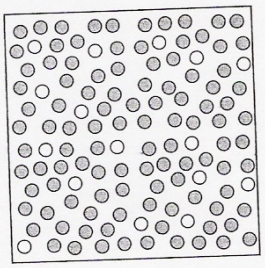
_____

4.



_____

5.



_____

10/20

Name _____ Class _____ Date _____

Reinforcement *continued*

6. Why did you label the figures on the previous page as you did?

_____

_____

_____

_____

_____

_____

PROFESSOR JUMBLE'S CONFUSION

In her lab, Professor Jumble has four shelves labeled "Suspensions," "Solutions," "Compounds," and "Colloids," respectively. Last night, the professor set one beaker of clear liquid on each of the four shelves. When the professor walked into her lab this morning, all four beakers were on the same shelf, and she didn't know which was which. She tested each beaker, and the results are below.

7. Use the test results to help Professor Jumble unjumble the beakers, and write the identity of each liquid in the blanks.

Beaker A: _____ • Light passes right through. • Particles do not separate in a centrifuge or a filter. • Upon heating, the liquid evaporates, and a crystal powder remains.	Beaker C: _____ • Liquid scatters light. • Liquid centrifuged into two different-colored layers. • Particles were left behind in the filter.
Beaker B: _____ • Light passes right through. • Particles do not separate in a centrifuge or a filter. • Upon heating, the liquid evaporates, but no residue remains. • The particles could not be separated by any other physical changes.	Beaker D: _____ • Liquid scatters light. • Liquid passes through a filter without leaving a residue.

10/8

Name _____ Class _____ Date _____

Activity

Vocabulary Activity

Know Your States

After you finish reading the chapter, try the crossword puzzle using the clues provided.

ACROSS

1. He said that as the volume of a gas increases, its pressure decreases.
5. change of state from a gas to a liquid
6. If a substance pours very slowly, it has a high _____.
7. change of state from a solid to a gas
11. this property is affected by the number of times particles of gas hit the inside of a container
13. changes shape and volume to fit container
14. changes shape but doesn't change volume
15. the law that describes the relationship between volume and temperature of a gas when pressure is constant

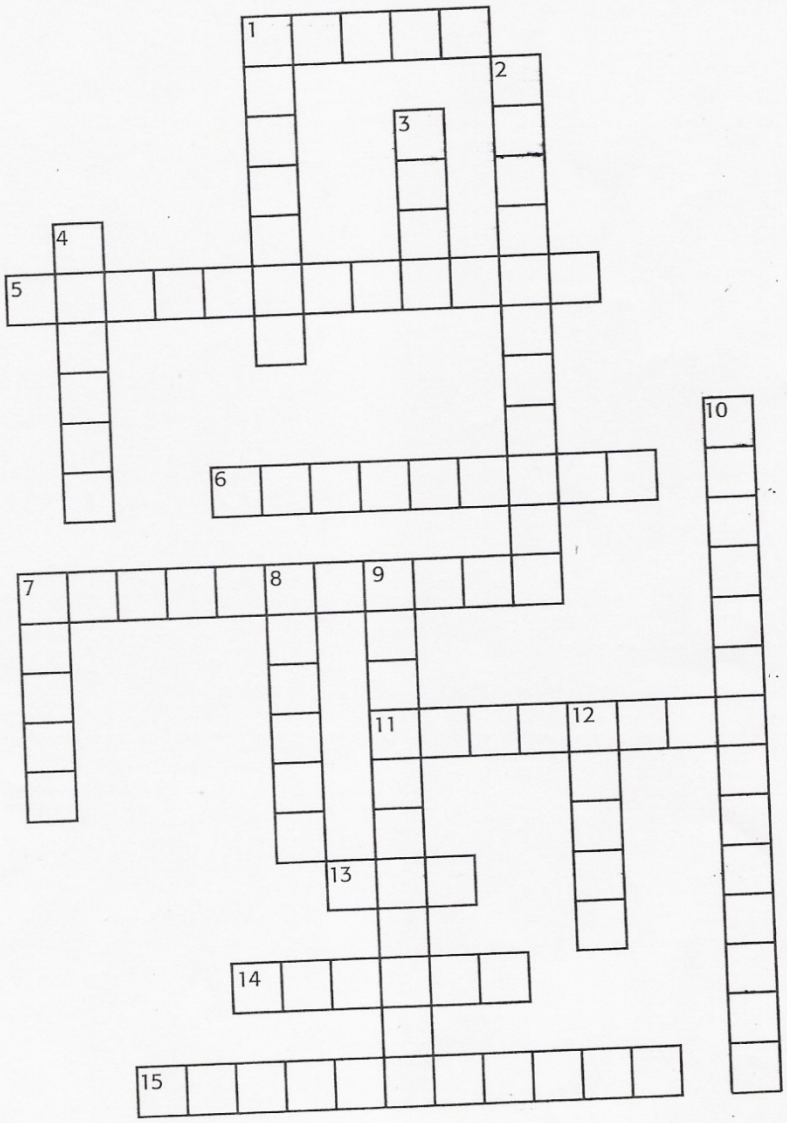
DOWN

1. during this process hot water changes to steam
2. how your body is cooled when you perspire
3. to change state from a solid to a liquid
4. can only be measured in three dimensions
7. a change of _____ occurs during both freezing and melting
8. exists in three physical states
9. a measure of the movement of particles in a substance
10. Liquids form spherical drops because of this property.
12. does not change shape when placed in a different container

10/8

Name _____ Class _____ Date _____

Vocabulary Activity *continued*



Chapter 4: Classroom Dynamics

Students

There are five blocks of eighth grade science, which, as was previously discussed, have been labeled with letters: A, B, D, F, and H. These classes range in size from 18 to 25 students with varying backgrounds, learning strengths, and behavioral tendencies. With the heterogeneous grouping in class scheduling, each block has a fairly even distribution of ability and discipline level. This mixture greatly influences the classroom dynamics, both positively and negatively as the following examples will show.

A-Block

This group of students was the largest class. With only 28 seats in the classroom, 25 students occasionally seemed crowded. This class contained a good balance of differing learning styles. On several occasions, it was observed that while some students might be struggling with a particular topic, others in the class were able to grasp the concepts easily. In most situations, the students who understood were able to help the students who did not. It was further observed that the "teachers" among the students were not always the same, and that this assistance was offered and accepted regardless of who understood. In this class, because of the dynamics among the students, lectures or demonstrations were delivered, and work was assigned. Students were often allowed to complete the work in pairs or small groups.

B-Block

B-block was the most attentive class. The majority of this class seemed to learn best through a lecture and/or discussion, followed by review questions. This group also had very few behavioral issues. As such, the atmosphere in this block tended to be much more relaxed and informal than the other classes. More leniency was possible with respect to group work and projects, since these students could usually be trusted to finish their work and to minimize disruptions.

D-Block

This class was characterized most definitively by their friendships. All of the students in this block were friendly with each other, and it made for a generally pleasant atmosphere. Incentives such as extra points or a break from homework were offered if certain conditions were met within the class, and in most cases, this class encouraged each other to meet the objective. Unfortunately, these friendships led to chattiness that on occasion lost them privileges. For example, this class was unable to attend one of the planned demonstrations and was instead assigned book work because they could not keep the noise level down in the hallway. Instead of the informal discussions that were possible in B-block, D-block required a more rigid structure, and responded best to lectures in which pointed questions were asked at random. In this way, students were given motivation to stay focused and not get caught talking. Group projects were much more closely monitored as well, as the students could not reliably stay on task.

F-Block

F-block was the class with the most severe behavioral problems. There were a few students in this class that had multiple behavior concerns, and this is the only class from which a student was sent to the office. This class was frustrating, since many of the other students were willing to learn, and the disruptions necessary for disciplinary reasons detracted from that learning experience. After the first few difficulties, it was much easier to, if not avoid then at least mitigate the effects of the disciplinary disturbances. Most often, the students would read the material from the book, and points were given for participation. This allowed for easier mobility to forestall any behavioral outbursts, and for the ability to get the students involved in their education.

H-Block

As the one notable exception to the previously observed even distribution of ability and discipline levels, H-block had the misfortune to fall during the same block as the highest-level math class. Further, the majority of the students were from low-income families, and it was observed that the students seemed to have no real motivation to do well in school, or in fact even to attend regularly. It was sometimes difficult to convince the students to do anything in the class, though this problem was more evident at the beginning of the practicum and faded as the students became more comfortable in the class. It was found to be helpful, especially in the case of this class, to establish definite boundaries within which the students could behave, whether in their interactions with each other, their interactions with the faculty, or the work ethic they showed regarding assignments. After an initial period of testing these boundaries, the students seemed to settle down, and privileges, such as the option to work in groups for bookwork, were

reinstated. Absences were also a definite issue with this block. Usually, if a student is out, the work must be made up the next day they return. This method worked in most cases, but occasionally a student would be absent for an extended period of time. One student missed an entire chapter of material before returning to the class. In these cases, a schedule was drawn up to assist the student with the make-up work, and tutoring sessions were offered to allow the student to catch up to the class.

Chapter 5: Assessments

As with learning, assessment can be done in several ways and different students will respond differently to each type. Several assessments were utilized over the course of the practicum, including tests and quizzes, and projects.

Tests and Quizzes

Though not a favorite among the students, traditional tests do have merit. These tests provide a straightforward evaluation of a student's understanding of a particular topic. These tests were generated by the Holt textbooks. Always, open-ended questions were included in the test, and wherever possible, questions based on tables, graphs or figures were included as well. It has been shown that students have the most difficulties with the open-ended MCAS questions. By including them in the tests throughout the year, the students have many more chances to improve their ability to answer these types of questions.

Some quizzes were also given. Quizzes were counted as two homework grades. Usually, quizzes were given shortly after a topic was covered to ensure understanding in the students. Quizzes tended to be personally-generated documents, or oral questions that translated to a short problem.

10/7

Name _____ Class _____ Date _____

Assessment

Chapter Test A

States of Matter

MULTIPLE CHOICE

Write the letter of the correct answer in the space provided.

_____ **1.** Boyle's law explains the relationship between volume and pressure for a fixed amount of
- **a.** a solid.
- **b.** a liquid.
- **c.** a gas.
- **d.** any type of matter.

_____ **2.** Which of these factors could affect the temperature at which water boils?
- **a.** the volume of water in the pot
- **b.** the atmospheric pressure at which the water is heated
- **c.** the amount of energy added to the water
- **d.** the type of fuel used to heat the water

_____ **3.** How do the particles of water that evaporate from an open container differ from the particles that remain?
- **a.** The evaporated particles only have more speed.
- **b.** The evaporated particles have greater order.
- **c.** The evaporated particles only have higher energy.
- **d.** The evaporated particles have more speed and higher energy.

_____ **4.** Which of the following occurs when a liquid becomes a gas?
- **a.** The particles give off energy.
- **b.** The particles break away from one another.
- **c.** The particles move closer together.
- **d.** The particles slow down.

_____ **5.** According to Charles's law,
- **a.** heating a balloon will cause it to expand.
- **b.** crushing a closed container of gas will increase the pressure.
- **c.** pumping more air into a basketball will increase the pressure.
- **d.** filling a balloon with helium will cause it to rise.

Name _____ Class _____ Date _____

_____ **6.** If you open a bottle of perfume, after a period of time, the people on the opposite side of the room will be able to smell it due to the process of
a. condensation.
b. evaporation.
c. sublimation.
d. vapor pressure.

_____ **7.** A drop of vinegar will flow and spread out but a drop of vegetable oil will form a bead. This is evidence that
a. vegetable oil has a lower surface tension and lower viscosity than vinegar.
b. vinegar has a lower surface tension and lower viscosity than vegetable oil.
c. vegetable oil has a lower surface tension and higher viscosity than vinegar.
d. vinegar has a lower surface tension and higher viscosity than vegetable oil.

_____ **8.** The melting point of salt is the same as its
a. boiling point.
b. condensation point.
c. freezing point.
d. sublimation point.

_____ **9.** A liter of gasoline will boil at
a. a higher temperature than a milliliter of gasoline.
b. a lower temperature than a milliliter of gasoline.
c. the same temperature as a milliliter of gasoline.
d. the same temperature as a milliliter of water.

_____ **10.** In order for carbon dioxide gas to enter the air from dry ice, the dry ice must
a. gain energy.
b. boil.
c. increase in pressure.
d. undergo an exothermic change.

_____ **11.** Which of the following statements is NOT true of all different types of matter?
a. They are made up of atoms and molecules.
b. The particles that make them up are always in motion.
c. They are made up of extremely small particles.
d. The particles that make them up move at the same speed.

Name _____ Class _____ Date _____

Chapter Test A *continued*

_____ **12.** A graph that shows the change in temperature of a substance as it is heated will show
- **a.** a straight line as the substance melts.
- **b.** a straight line as the substance freezes.
- **c.** a rising line as the substance melts.
- **d.** a falling line as the substance melts.

_____ **13.** The reverse of condensation is
- **a.** boiling.
- **b.** evaporation.
- **c.** freezing.
- **d.** sublimation.

MATCHING

Match the correct description with the correct term. Write the letter in the space provided.

_____ **14.** It can be determined by measuring the speed of molecules.

_____ **15.** This happens when tomato soup boils.

_____ **16.** Ice, water, and steam are all examples.

_____ **17.** This is a state of matter in which atoms and molecules are close together but can slide past each other.

_____ **18.** It has no definite volume.

_____ **19.** It may be either crystalline or amorphous.

_____ **20.** It increases when the amount of force per unit area increases.

_____ **21.** This force acts on the particles of milk at the surface of a glass of milk.

_____ **22.** This can only be measured in three dimensions.

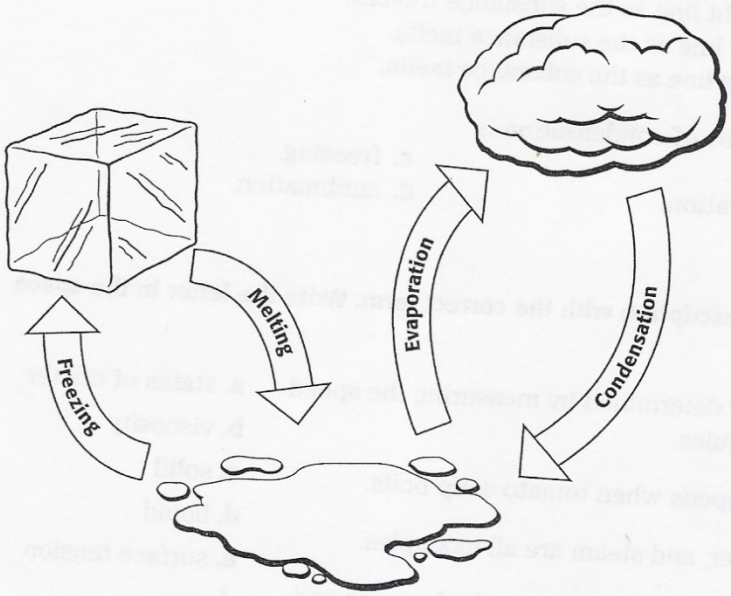
_____ **23.** This property of liquids is affected by the strength of the attraction between the molecules.

- **a.** states of matter
- **b.** viscosity
- **c.** solid
- **d.** liquid
- **e.** surface tension
- **f.** gas
- **g.** temperature
- **h.** volume
- **i.** pressure
- **j.** change of state

Name _____ Class _____ Date _____

Chapter Test A *continued*

Use the figure below to answer questions 24 and 25. Write the letter of the correct answer in the space provided.



_____**24.** Which of the changes of state shown in the drawing are endothermic changes?

a. freezing and evaporation
b. freezing and condensation
c. evaporation and melting
d. condensation and melting

_____**25.** Which of the changes of state shown in the drawing are exothermic changes?

a. freezing and evaporation
b. condensation and freezing
c. evaporation and condensation
d. melting and evaporation

Name _____ Class _____ Date _____

CRITICAL THINKING

17. Explain why more time is required to boil pasta in Denver, Colorado, than in New Orleans, Louisiana.

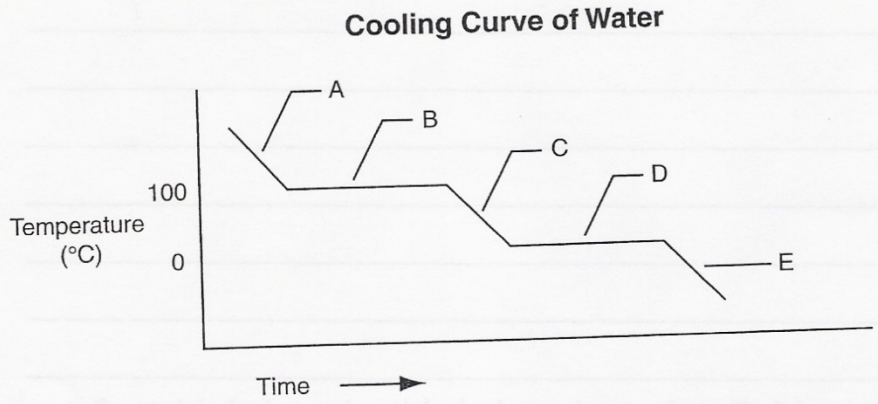
18. To create special effects for movies and television shows, technicians often pour water over solid carbon dioxide, also called dry ice. What effect does this produce? Explain your answer.

19. On Thanksgiving Day a big parade is held in New York City with many giant helium-filled balloons. How will the weather affect the inflating of the balloons? Explain your answer.

Name _____ Class _____ Date _____

INTERPRETING GRAPHICS

The following graph shows the different states of water as it is cooled. Examine the graph, and answer the questions that follow.



20. Which letters on the graph represent the three states of matter gas, solid, and liquid?

_____

_____

_____

21. Which letters on the graph represent the changes of state of condensation and freezing?

_____

_____

Name _____ Class _____ Date _____

Assessment

Chapter Test A

The Properties of Matter

MULTIPLE CHOICE

Write the letter of the correct answer in the space provided.

_____ **1.** Which property of matter is a measure of the gravitational force?
- **a.** density
- **b.** mass
- **c.** volume
- **d.** weight

_____ **2.** In a graduated cylinder containing several liquid layers, the least dense liquid is found
- **a.** floating at the top.
- **b.** in the middle layer.
- **c.** in the lightest colored layer.
- **d.** settled on the bottom.

_____ **3.** How does a physical change differ from a chemical change?
- **a.** New volumes are created in a physical change.
- **b.** New materials are produced in a physical change.
- **c.** The composition is unchanged in a physical change.
- **d.** The change is reversible in a physical change.

_____ **4.** Melting crayons is an example of a
- **a.** physical property.
- **b.** physical change.
- **c.** chemical property.
- **d.** chemical change.

_____ **5.** Which of the following units would be best for describing the volume of mercury (liquid) used in an experiment?
- **a.** grams or kilograms
- **b.** meters or centimeters
- **c.** liters or milliliters
- **d.** newtons

_____ **6.** Which of the following events is NOT a common sign that a chemical change has taken place?
- **a.** change in color or odor
- **b.** change in state
- **c.** foaming or bubbling
- **d.** production of heat or light

Name _____ Class _____ Date _____

_____ **7.** What chemical property is responsible for iron rusting?
- **a.** flammability
- **b.** conductivity
- **c.** nonflammability
- **d.** reactivity with oxygen

_____ **8.** The motion of a 150 g ball is more difficult to change than the motion of a 50 g ball because the 150 g ball has
- **a.** less weight than the 50 g ball has.
- **b.** greater density than the 50 g ball has.
- **c.** more mass than the 50 g ball has.
- **d.** larger volume than the 50 g ball has.

_____ **9.** What unit of density would be appropriate to describe a solid bar of silver?
- **a.** g/mL
- **b.** g/cm^3
- **c.** oz/ft^3
- **d.** kg/L

_____ **10.** Which physical property of matter describes the relationship between mass and volume?
- **a.** density
- **b.** ductility
- **c.** reactivity
- **d.** weight

_____ **11.** Souring milk is an example of a
- **a.** physical property.
- **b.** physical change.
- **c.** chemical property.
- **d.** chemical change.

_____ **12.** Malleability is an example of a
- **a.** physical property.
- **b.** physical change.
- **c.** chemical property.
- **d.** chemical change.

Name _____ Class _____ Date _____

MATCHING

Match the correct description with the correct term. Write the letter in the space provided. Some terms will not be used.

_____ **13.** The saltiness of seawater is the result of this property.

_____ **14.** Objects float or sink as a result of this property.

_____ **15.** This is the physical form in which a substance exists.

_____ **16.** This type of matter makes up an object and the way it is arranged.

_____ **17.** The breakdown of water to form two gases is the result of this process.

_____ **18.** This is the ability of a substance to resist burning.

_____ **19.** This is the tendency of a substance to resist changes in its motion.

_____ **20.** This is the rate at which a substance conducts heat.

a. thermal conductivity
b. composition
c. nonflammability
d. inertia
e. state of matter
f. solubility
g. reactivity
h. electrolysis
i. ductility
j. density

Name _____ Class _____ Date _____

Chapter Test A *continued*

MULTIPLE CHOICE

The table below shows the density of some common substances. Use the table to answer questions 21 through 25.

SUBSTANCE	DENSITY (g/cm^3)	SUBSTANCE	DENSITY (g/cm^3)
Aluminum (solid)	2.7	Ice (solid)	0.93
Pyrite (solid)	5.02	Water (liquid)	1.00
Mercury (liquid)	13.55	Zinc (solid)	7.13
Silver (solid)	10.50	Wood (oak)	0.85

_____**21.** A cube has a density of 2.7 g/cm^3. What substance is the cube made of?
- **a.** aluminum
- **b.** ice
- **c.** pyrite
- **d.** wood

_____**22.** What substance has a density more than 13 times greater than water?
- **a.** ice
- **b.** silver
- **c.** aluminum
- **d.** mercury

_____**23.** Why will ice float on top of liquid water?
- **a.** Ice has a lower density than water.
- **b.** Ice has a higher density than water.
- **c.** Ice is a solid.
- **d.** Ice is colder than water.

_____**24.** What is the density of oak wood?
- **a.** 85 g/cm^3
- **b.** 5.02 g/cm^3
- **c.** 0.85 g/cm^3
- **d.** 0.93 g/cm^3

_____**25.** What is the densest solid shown in the table?
- **a.** mercury
- **b.** silver
- **c.** zinc
- **d.** pyrite

Name _____ Class _____ Date _____

CRITICAL THINKING

15. After a tree is cut with a chain saw, it is impossible to put the tiny wood chips back together. The process cannot be reversed. Does this mean that cutting trees with a chain saw causes a chemical change in the wood? Explain why or why not.

16. Summarize the differences between mass and weight. Why do you think people tend to confuse these terms?

17. A glass cylinder contains four liquids in four separate layers. One liquid is water. The purple liquid has a density 1.62 g/cm^3. The yellow liquid has a density of 0.46 g/cm^3. The red has a density of 0.91 g/cm^3. What is the order of the liquids in the cylinder? Explain your answer. What will happen if you slip a small, flat chip of wood (density 0.85 g/cm^3) into the cylinder?

Name _____ Class _____ Date _____

Standardized Test Preparation *continued*

Passage 2 Blimps and dirigibles are types of airships. An airship consists of an engine, a large balloon that contains gas, and a gondola that carries passengers and crew. Airships float in air because the gases that the airships contain are less dense than air. In the early 1900s, airships were commonly used for travel, including transatlantic flights. Airships were less frequently used after the 1937 explosion and crash of the *Hindenburg* in New Jersey. The *Hindenburg* was filled with flammable hydrogen gas instead of helium gas, which is nonflammable.

_____ **1.** In this passage, what does *flammable* mean?
- **A** able to burn
- **B** able to float
- **C** able to sink
- **D** not able to burn

_____ **2.** Which of the following statements is true according to the passage?
- **F** Hydrogen gas is nonflammable.
- **G** Airships float because they contain gases that are less dense than air.
- **H** Helium gas was used in the *Hindenburg*.
- **I** The gondola contains gas.

_____ **3.** Which of the following statements about airships is true?
- **A** Airships are still a major mode of transportation.
- **B** Airships now contain nonflammable, hydrogen gas.
- **C** Airships consist of an engine, a gondola, and a large balloon.
- **D** Airships traveled only in the United States.

2: Key

tch the correct theory with the correct diagram.
e the correct letter on the line next to the diagram.

A Very Brief History of Atomic Theory

A

c. 460 B.C.E.: Democritus (Greek philosopher)
Proposed that matter cannot be broken down indefinitely. At some point you end up with a piece that can't be divided. That smallest piece he called an atom, from the Greek word *atomos,* which means "indivisible."

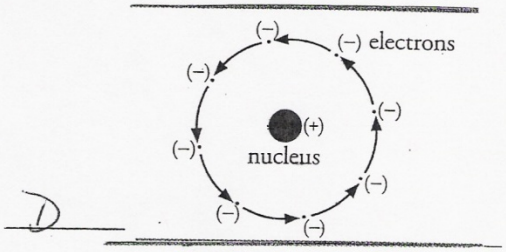
1807: John Dalton (British chemist)
B The first modern scientist to propose the existence of atoms. He described an atom as an invisible, indestructible, solid sphere, like a billiard ball.

1898: Sir Joseph John (J.J.) Thomson (British physicist)
C Proposed the "plum-pudding" model: An atom is a solid mass of positively charged material with negative charges (electrons) scattered through it like pieces of plum in pudding. He is credited with discovering the electron.

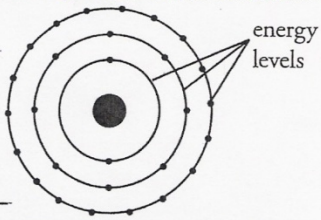
1911: Ernest Rutherford (British physicist)
D His experiments proved that atoms are mostly empty space. Discovered the nucleus, which contains positively charged particles. Was the first to suggest that electrons circle the dense nucleus.

1913: Niels Bohr (Danish physicist)
E Proposed that electrons move in different orbits, or energy levels, around the nucleus like planets orbit the sun. Each energy level is located a specific distance from the nucleus and contains a certain number of electrons.

Current Atomic Model
F Based on the Bohr model, except that electrons orbit the nucleus in random paths. The regions where they are most likely to be found are called electron clouds.

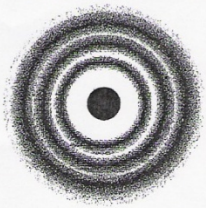


D



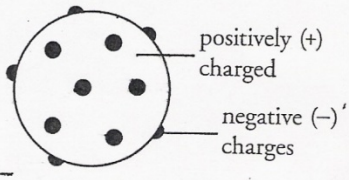
E

B



F

A



C

Projects

In-class projects tended to be activities that could be too difficult for individual work. While this was not always the case, these assignments provided students with the opportunity to work in groups. Especially in the more difficult chapters, such as Introduction to the Atom and the Periodic Table, these activities were key in promoting understanding by allowing the students to collaborate and learn from each other, as well as providing them the opportunity to ask questions on the work. The two examples shown are from the Period Table chapter. One is a crossword puzzle in which students were required to use their knowledge of the periodic table to obtain the names of elements. The second is a logic puzzle that involves the discovery of a new planet that was adapted from the Virginia Department of Education Science Outreach Program. In this project, the people on this planet have developed a periodic table, but the names of their elements do not match ours. Students were asked to figure out which elements correspond based on properties given in the clues.

The culminating project for this unit used knowledge gained in every chapter. This project was designed to incorporate the idea of learning through design, which has been gaining momentum in many educational circles. In this project the students were asked to present their element like an infomercial. The goal was to catch the interest the consumers (the other students in the class) so that they want to buy the element. Groups of 3-4 students were assigned their element and were asked to research it.

Guidelines were set to ensure maximum impact of this project. Students were given a minimum requirement regarding the information that needed to be presented in their infomercial. They were also required to generate a poster for their element, and a storyboard and script for their presentation. In any project that involves presenting in front of people, there will always be students that are uncomfortable. By including these preliminary requirements, the project plays

to a greater range of strengths in the students. Students were then given ample in-class time to design and prepare for their infomercial.

Since this project was so time-intensive, and because there were so many aspects to it, the grading form had several parts. Students were required to turn in their research sheet, a poster, a finished script, and a storyboard with role designation for group members. Additionally, the presentations themselves were graded by the teacher using a rubric. The rubric focused on both the technical research and the creative application of the presentation. Peer evaluations were distributed for each project, where students discussed their reaction to each project and the marketing strategy used by each group.

With peer evaluations, there is always the risk that some students won't take the evaluation seriously or will use the opportunity to sabotage the project. In some classes, there were certain biases evident in the peer evaluations, but overall there were much fewer issues than were anticipated. Students tended to be less critical of their peers' work, but they were also honest in their responses.

10/24

Name _____ Date _____ Class _____

SCIENCE PUZZLERS, TWISTERS & TEASERS

Introduction to Atoms

Mystery Guests

1. The three particles of an atom appeared recently on a talk show, and they stood behind a screen to hide their identities. (Not that you could see them anyway.) Identify their statements below, based on what you know about their characteristics.

   a. I don't mean to be negative all the time, but, well, I'm always on the go.

   _____

   b. Me? I stay positive. It's the only way I know how to be.

   _____

   c. I have almost no mass—no weight to throw around. And just once I'd like to be at the center of things.

   _____

   d. I stay neutral on most nuclear issues.

   _____

   e. When we (other particles just like me) outnumber the electrons, the whole atom has a more positive energy.

   _____

Sound Alikes

2. Each clue below will lead you to one or two short words. Combine the syllables to find the hidden terms, which are used in the study of atoms.

   a. Frozen water | A breakfast grain | A famous comedian named Bob; A TV hospital show: Chicago _____

   _____

   b. A long skinny fish; one is electric | When the teacher speaks in class | The opposite of "offs"

   _____

Name _____ Date _____ Class _____

Double Puzzle

3. Use the clues below to fill in the blanks and boxes provided. Then arrange the letters from the boxes to answer the final riddle.

a. Thompson's negative discovery

☐ _ _ ☐ _ _ ☐ _

b. a model English dessert

_ _ _ ☐ _ _ ☐ _ ☐ _ _

c. Dalton knew oxygen and hydrogen were both these.

_ ☐ _ ☐ _ _ _ _

d. Protons and electrons have this.

_ _ ☐ _ _ _

e. a well tested, unifying explanation

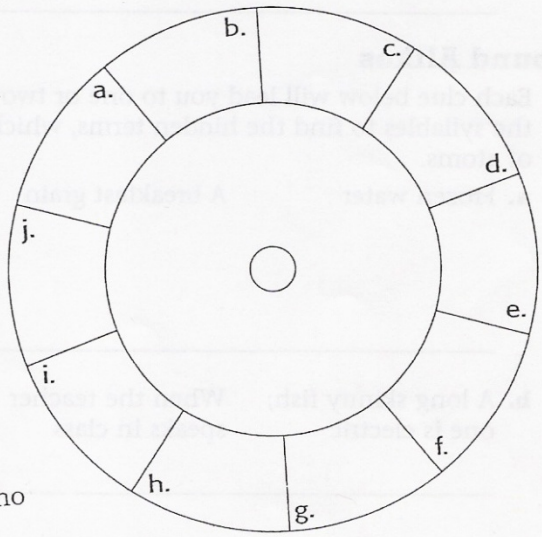
☐ _ _ ☐ _ _

It's a central theme of this chapter:

_ _ _ _ _ _ _ _ _ _ _ _

Where's the Electron?

4. The exact position of an electron cannot be predicted by modern atomic theory. But you can make a guess. Find three true statements in a row, and you are in the electron's neighborhood! Place your answers (true or false) in the ring and circle the electron's neighborhood.



a. All substances are made of atoms.

b. Aristotle did not believe there was such a thing as an "atom."

c. The idea of an "atom" has been around for only about 200 years.

d. The negatively charged particles within the atom are called electrons.

e. A model is a representation of an object or a system.

f. Rutherford proposed the center of the atom was a negatively charged nucleus.

g. The positively charged particles within the nucleus are called protons.

h. The particles in the nucleus that have no charge are called neutrons.

i. The electrons contain most of the atom's mass.

j. The diameter of the nucleus is about 1/100,000 the diameter of the atom.

Name _____ Date _____ Class _____

SCIENCE PUZZLERS, TWISTERS & TEASERS

The Periodic Table

Periodic Crime

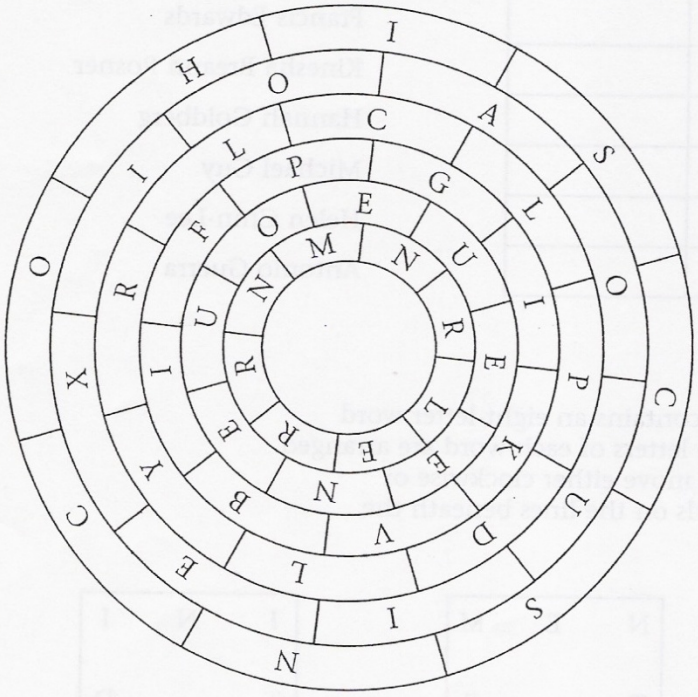
1. This is an eyewitness account of a crime recently committed. Which element committed the crime?

   "He was definitely a metal, but really soft, like you could cut him with a knife. As he ran past us, we squirted him with a water gun. He burst into flame! It was unbelievable. We almost had him cornered, but he pulled out a vial of chlorine gas and in the blink of an eye, he disappeared. All that was left was a pile of table salt."

   _____

Elements in the Round

2. Moving from the outside of the circle to the center of the circle, choose one letter from each ring to find the names of eight common elements. Write the names of the elements on the lines provided. Each letter will be used only once.



_____ _____

_____ _____

_____ _____

_____ _____

Name _____ Date _____ Class _____

Elemental E-mail

3. A secret society of chemists has formed in order to discuss controversial chemistry issues over the Internet. To conceal their identities, the members use code names in their e-mail addresses. In the example below, Dr. Nancy Ann Fisher, who has the initials NAF, uses sodium fluoride, or NaF, for her e-mail address. (NOTE: When compounds are formed between two elements, the usual ending of the second element is replaced with "-ide.") For each e-mail address in the left column, write the appropriate chemical symbol in the right column. Then draw a line from the chemical symbol to the name of the person who would have that e-mail address.

Email address	Chemical symbol
Ex: sodiumfluoride@chem.net	NaF
a. silver@beaker.edu	
b. magnesium@univ.edu	
c. hydrogenchloride@bohr.org	
d. tin@kimistree.com	
e. iron@science.net	
f. potassiumbromide@lab.edu	
g. lead@bunsen.edu	
h. mercury@atom.org	

Name

Salina Neruda
Nancy Ann Fisher
Pradesh Babu
Francis Edwards
Kinesha Breann Rosner
Hannah Goldberg
Michael Guy
Helen Chin-Lee
Antonio Guerra

Ordered Squares

4. Each of the three squares below contains an eight-letter word related to the periodic table. The letters of each word are arranged in order in the square when you move either clockwise or counterclockwise. Write the words on the lines beneath the squares.

A	L	N
T		O
E	M	N

N	E	M
T		E
S	E	L

I	N	I
T		D
C	A	E

a. _____ **b.** _____ **c.** _____

Alien Elements Project

Name: _____

Materials: Periodic Table
Textbook, Chapter 5
Pencil

Intro: You are part of a collection of scientists who have been chosen to assist a group of alien scientists. In order to be able to converse scientifically, you must learn their language, and most importantly, you must arrange their elements according to the trends that exist in the periodic table. Below are clues for the aliens' elements. So far, the aliens have only discovered elements in groups 1, 2, and 13-18, and periods 1-5. Although the names of the elements are different, they must correspond to our elements if our belief of universal elements holds true.

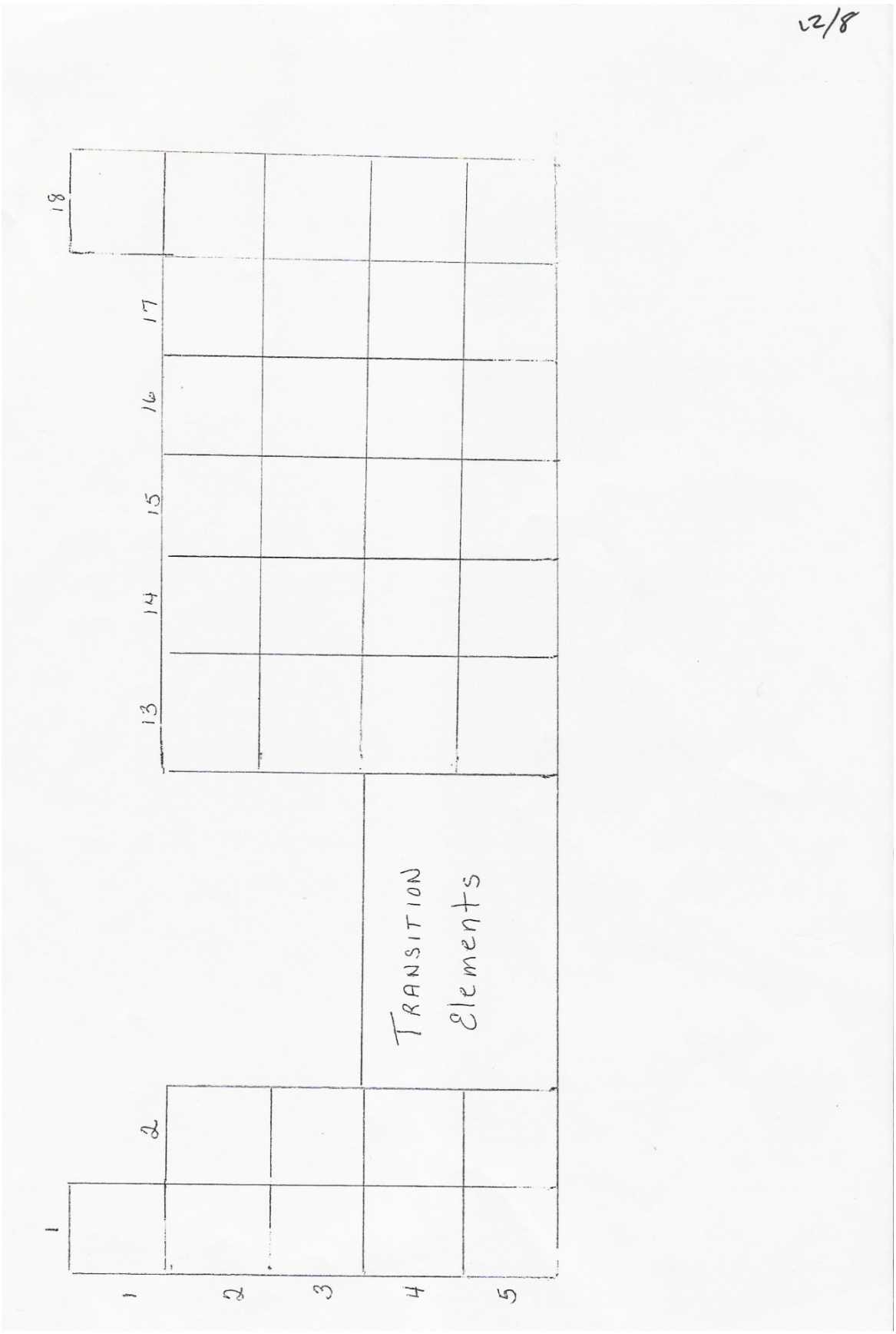
Procedure:

1. Read each of the clues about the aliens' elements.
2. Use the information given in the clues to determine which of our elements matches the properties of the aliens' element.
3. On the given periodic table, place the aliens' element symbol in the location that corresponds to the group and period of our matching element. For example, from the clue we can determine that **Livium** corresponds to **carbon**, so we put **Lv** in the box that is Group 14, Period 2.

1. **Livium (LV)**: This element is responsible for life. It has 2 electron energy levels and 4 electrons available for bonding in the outermost energy level.
2. **Computerchipium (Cc)**: This element is important for its use as a semiconductor in computers.
3. **Lightium (L)**: This is the lightest of elements; aliens once used it in their aircraft, until their aircraft caught fire in a horrific accident.
4. **Breathium (Br)**: When combined with **Lightium** (**L**), it makes the aliens' most common liquid, whose formula is **L_2Br**.
5. **Francium (F)**: A metal found in group 13, period 4.
6. **Moonium (Mo):** An element with an atomic number of **34**.
7. **Explodium (Ex)**: This element is the most reactive metal on the aliens' table.

8. **Voiletium (V)**: This element is found as part of a compound in bananas. When burned, it has a violet colored flame.
9. **Sparkium (Sp)** and **Burnium (Bu)**: These elements are members of the alkali metal group, along with **Violetium (V)** and **Explodium (Ex)**. Their reactivity, from least to greatest, is **Sp**, **Bu**, **V**, **Ex**.
10. **Balloonium (Ba)**: A noble gas used to fill balloons.
11. **Toothium (To)**: This element is added to juices to help build strong bones and teeth.
12. **Metalloidium (M)** and **Poisonium (Po)**: Two metalloids found in period 4. **Po** is more massive than **M**.
13. **Lowigium (Lo)**: A period 4 halogen.
14. **Darkbluium (Dk)**: **This element has an atomic mass of 115.**
15. **Hugium (Hu)**: The element on the aliens' periodic table that has the most mass.
16. **Glucinium (Gl)**: The element found in group 2, period 2.
17. **Reactinium (Re)**: The most reactive non-metal on the periodic table.
18. **Balloonium (Ba)**, **Signium (Si), Stableium (Sb), Supermanium (Sm)** and **Hugium (Hu)** are all noble gases. They are arranged from least to most massive.
19. **Cannium (Cn)**: This element helps to preserve foods; it is used in can manufacturing.
20. Period 3 conains: **Burnium (Bu), Blue-whitium (Bw), Bauxitium (Xi), Computerchipium (Cc), Bringer-of-lightium (Bl), Stinkium (Sk), Purium (P),** and **Stableium (Sb)**. **Bu** has 1 electron in its outer energy level; **Bw** has 2, **Xi** has 3, **Cc** has 4, **Bl** has 5, **Sk** has 6, **P** has 7, and **Sb** has 8.
21. **Scottishium (Sc)**: A metal element found in group 2.
22. **Infectium (If)**: This element, missed with alcohol, is used on cuts.
23. **Abundantcium (Ab)**: One of the most abundant gases in the universe. It has 7 protons, 7 neutrons, and 7 electrons.
24. **Notalonium (Na)** has 5 electrons in its outer energy level. **Earthium (E)** has 6, and **Boracium (B)** has 3.

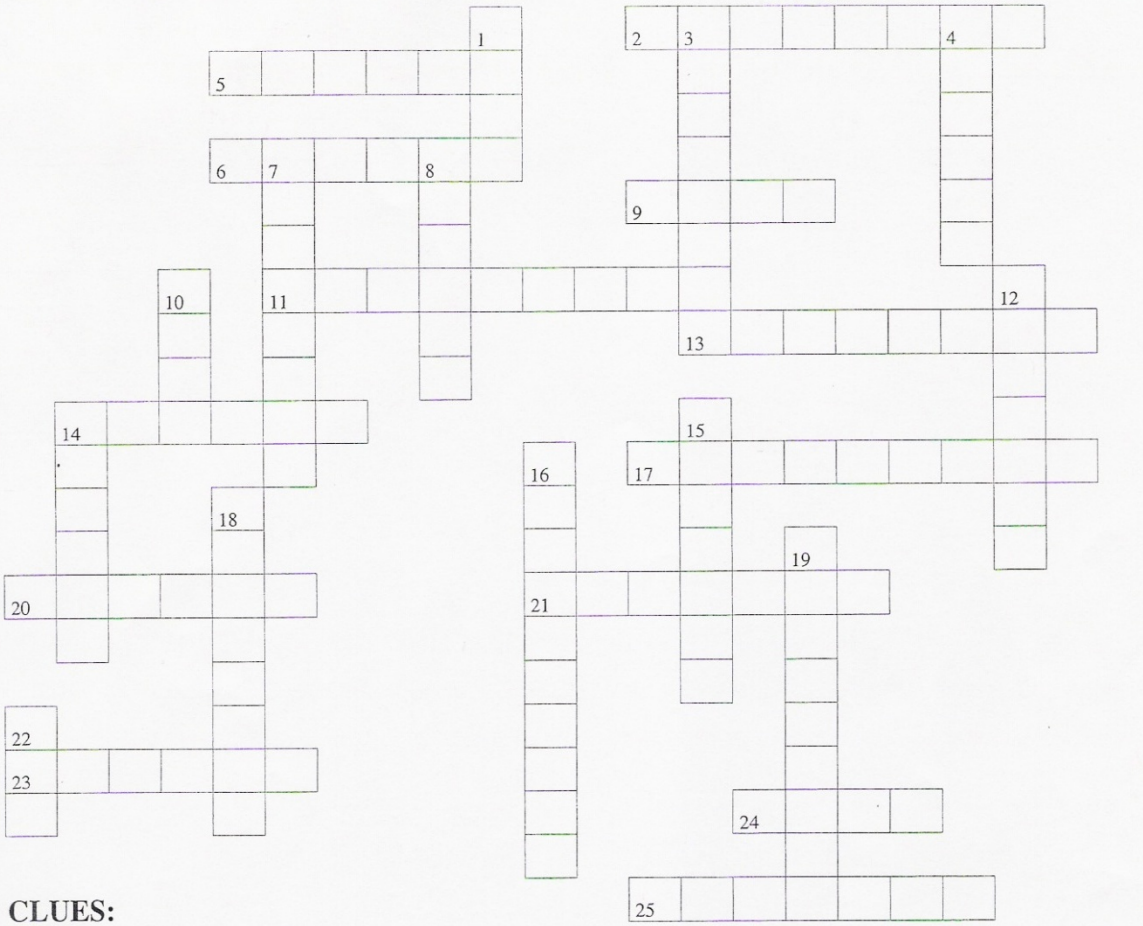
12/18



12/8

Periodic Table Puzzle

Name _____



CLUES:

Down:

1. I have 26 protons.
3. I am not really an alkali metal, but since I have only 1 electron I behave like them.
4. I am a metal with 28 electrons.
7. I am a member of the boron family and am the most abundant metal in the Earth's crust.
8. I am a gas with 8 protons and 8 neutrons.
10. I am a member of the carbon family often mistaken for the end of your pencil.
12. I am a metal that is liquid at room temperature.
14. My atomic number is 47 and I am used to make photographic film.
15. I have 20 neutrons and am found in your teeth and bones.
16. I am a member of the nitrogen family with 16 neutrons.
18. I am a gas with a mass number of 19.
19. I am the first element in the fourth period used in making fertilizer.
22. You can find me in the carbon family in the fifth period.

Across:

2. My atomic mass is 35.453.
5. I have 2 electrons in the first shell, 8 in the second shell, and 6 in the third shell.
6. I am the head of the carbon family known as the "basis of life".
9. My atomic number is 79.
11. I am a transition metal with 25 electrons.
13. I make up 78% of the air and am found in the 15th group.
14. I am a silvery white metal used to make salt.
17. I am a member of the alkaline earth metals used to make fireworks and medicines.
20. I am a noble gas with 2 electrons.
21. I am the 2nd most abundant element in the Earth's crust and have 14 neutrons.
23. I am a member of the halide family with an atomic number of 53.
24. I am a transition metal with 30 electrons useful in making paint.
25. I am the only element in the halide family that is a liquid.

Element for Sale – Infomercial Information

Intro: You and your team of highly motivated artists, designers, writers and salespeople at the Tata Advertising Agency have been hired by the large corporation ElementsRUs to increase their sales of certain elements that have not been selling well.

You will need to do extensive research on your assigned element in order to effectively sell it. An element fact sheet will be provided for you to use, in order to get all of the necessary information.

In our next department meeting, we will view a few infomercials so you can get ideas on how to proceed. You are free to come up with your own format for your infomercial. Be creative, but keep in mind that the goal is to increase sales, so the more information you provide, the better chance you have for selling your element.

Procedure:

1. Conduct research on your element. We will be using the computer lab to do our research. You will find all the information that you need at www.webelements.com.
2. Develop a storyboard. You will show the different parts of your presentation in this storyboard, as well as a list of the roles and responsibilities of each team member. This is a group effort and each group will be meeting with me to discuss what each member will be responsible for contributing in this effort.
3. Provide a script prior to your actual infomercial, so we can discuss and edit it before your final presentation. Your final presentation needs to be a minimum of five minutes in length
4. Colorful sales posters and props, as well as samples of what you are selling, will greatly enhance your presentation. Make sure that you have lots of things for the studio audience to see.

We will be going over the rubrics involved with your presentation, in order to insure that you are totally prepared to wow the clients. Remember, your paycheck (grade) depends on it.

Element for Sale – Research

Name: **Block:** **Date:**

Supply all of the following information for your assigned element. You can go to www.webelements.com and click on your element's symbol on the Periodic Table to find all the required information.

1. **Name:**
2. **Symbol:**
3. **Atomic Number:**
4. **Classification:**
5. **Group Number:**
6. **Group Name:**
7. **Atomic Weight:**
8. **Standard State:**
9. **Color:**
10. **Density:**
11. **Melting Point:**
12. **Boiling Point:**
13. **Critical Temperature:**
14. **Discovered by:**
15. **Discovered at:**
16. **Date Discovered:**
17. **Origin of Name:**
18. **History:**

19. Electron Energy Level Diagram:

20. Uses:

Element for Sale – Research Rubric

Category	4	3	2	1
Quality of Information	Information clearly relates to the main topic. It includes several supporting details and/or examples.	Information clearly relates to the main topic. It provides 1-2 supporting details and/or examples.	Information clearly relates to the main topic. No details and/or examples are given.	Information has little or nothing to do with the main topic.
Amount of Information	All topics are addressed and all questions answered with at least 2 sentences about each.	All topics are addressed and most questions answered with at least 2 sentences about each.	All topics are addressed and most questions are answered with 1 sentence about each.	One or more topics were not addressed.
Diagrams and Illustrations	Diagrams and illustrations are neat, accurate, and add to the reader's understanding of the topic.	Diagrams and illustrations are accurate, and add to the reader's understanding of the topic.	Diagrams and illustrations are neat and accurate, and sometimes add to the reader's understanding of the topic.	Diagrams and illustrations are not accurate OR do not add to the reader's understanding of the topic.
Sources	All sources (information and graphics) are accurately documented in the desired format.	All sources (information and graphics) are accurately documented, but a few are not in the desired format.	All sources (information and graphics) are accurately documented, but many are not in the desired format.	Some sources are not accurately documented.
Internet Use	Successfully uses suggested internet links to find information, and navigates within these sites easily, without assistance.	Usually able to use suggested internet links to find information, and navigates within these sites easily, without assistance.	Occasionally able to use suggested internet links to find information, and navigates within these sites easily, without assistance.	Needs assistance or supervision to use suggested internet links and/or to navigate within these sites.

Element for Sale – Presentation Rubric

Category	4	3	2	1
Preparedness	Students are completely prepared and have obviously rehearsed.	Students seem pretty prepared but might have needed a couple more rehearsals.	Students are somewhat prepared, but it is clear that rehearsal was lacking.	Students do not seem at all prepared to present.
Stays on Topic	Presentation stays on topic all (100%) of the time	Presentation stays on topic most (90-99%) of the time.	Presentation stays on topic some (75-89%) of the time.	It was hard to tell what the topic was.
Content	Students show a full understanding of the topic.	Students show a good understanding of the topic.	Students show a good understanding of parts of the topic.	Students do not seem to understand the topic very well.
Comprehension	Students are able to accurately answer almost all questions posed by classmates about the topic.	Students are able to accurately answer most questions posed by classmates about the topic.	Students are able to accurately answer a few questions posed by classmates about the topic.	Students are unable to accurately answer questions posed by classmates about the topic.
Enthusiasm	Facial expressions and body language generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language sometimes generate a strong interest and enthusiasm about the topic in others.	Facial expressions and body language are used to try to generate enthusiasm, but seem somewhat faked.	Very little use of facial expressions or body language. Did not generate much interest in topic being presented.

Element for Sale – Sales Receipt

Group Members: _____

Element: _____ **Block:** _____

1) Would you buy this element? **YES** **NO**
2) Did the group present the relevant information? (Name, Symbol, Atomic Number, History, Uses, Facts, etc.) **YES** **NO**
3) Did the group present the information in a clean manner? **YES** **NO**
4) Was the presentation interesting? Did it keep your attention? **YES** **NO**
5) On a scale of **1 (poor) to 10 (best)**, how would you rate this presentation? _____
6) Any comments or suggestions for the group?

Element for Sale - Final Grade Sheet

Group Members: _____

Element: _____ **Block:** _____

Materials: (40 Points)

_____ Element Research Sheet (10)

_____ Storyboard/Roles (10)

_____ Script (10)

_____ Posters/Props (10)

Total Points _____

Rubrics: (40 Points)

_____ Research (20)

_____ Presentation (20)

Total Points _____

Sales Receipts: (20 Points)

_____ Peer Evaluations

_____ Overall Teacher Evaluations

Total Points _____

Total Points _____

MCAS Preparation

Eighth grade is an important landmark for MCAS testing. It is the last full test students will take before the test is administered in grade 10 to determine eligibility for graduation. In addition, eighth grade is significant because there is a Science and Technology section as well as Mathematics and English/Language Arts. Throughout the semester, materials were distributed with the goal of assisting students with MCAS preparation. Critical thinking problem solving questions were used, as well as short open-ended questions. Critical thinking questions tended to be similar to reading comprehension questions often encountered in the MCAS. These activities usually involved an application of the material learned. For example, one activity discussed a situation in which two people found a material they believed came from space. They analyzed the rock, and discovered that it could not be a new space material because it had the same properties as a known substance on Earth. Additionally, materials that helped the student learn how to solve problems were included. These questions will have long-range benefits, as they are applicable to a wide range of subjects.

9/26

Name _____ Class _____ Date _____

Skills Worksheet

Critical Thinking

Kryptonite!

In today's episode, we find Outback Jack and his clever partner, Diego, seeking knowledge and adventure in an exotic land. They are in the tropical nation of Colombia, searching for Kryptonite, the glowing, green rock from the distant planet, Krypton. Jack and Diego don't know much about Kryptonite, but they do know that it is unlike any rock found on Earth.

Suddenly, Diego stubs his toe on a mysterious green stone.

Diego: Jack, look! I think we've finally found it! Have you ever seen anything like this? The color, the luster—it must be from Krypton!

Jack: I think you're right, pal! This shiny green nugget must be from outer space!

Diego: But Jack, no one will believe us unless we prove it scientifically. . .

One Week Later

Jack: Diego, look at how it shines! It really looks like our mystery rock comes from a far away galaxy! Just to be sure, though, let's compare our rock's properties to the properties of different rocks on Earth.

One Month Later

Diego: Well, Jack, the density, hardness, and streaks of our rock match those of an emerald. It looks like our "Kryptonite" was nothing more than a common gemstone. We were wrong. It's a good thing we used the scientific methods!

USEFUL TERMS

galaxy a system of stars, dust, and gas held together by gravity
properties the qualities that something has
emerald a valuable stone that is bright green

ASKING QUESTIONS

1. What question do Jack and Diego want to answer?

_____

_____

_____

_____

_____

Name _____ Class _____ Date _____

Critical Thinking *continued*

FORMING A HYPOTHESIS

2. What hypothesis do Jack and Diego form about the mysterious rock?

TESTING THE HYPOTHESIS

3. How do Jack and Diego test their hypothesis?

ANALYZING RESULTS

4. How do Jack and Diego analyze their results?

DRAWING CONCLUSIONS

5. After Jack and Diego analyze their results, they conclude that the rock is not from another planet after all. Does the scientific method help them successfully answer their original question? Explain.

PREDICTING CONSEQUENCES

6. What might have happened if Jack and Diego had not tested their hypothesis before announcing their findings to the public?

Name _____ Class _____ Date _____

Skills Worksheet

Critical Thinking

Jet Smart

You receive this letter from a top-secret airplane manufacturer:

Agent X:

We were impressed by your work on our flying saucer project. Your help is now needed in the design of our newest stealth airplane, the FX-2000. *We need your help with one simple but important matter—selecting the best metal for the plane's engines. Our team has narrowed the choices to two metals: titanium and platinum. Your mission is to gather facts about titanium and platinum, compare their properties, and recommend the better material. Report your answer within 24 hours.*

You immediately turn to your reference books and study the properties of the two metals.

Platinium

- a precious metal
- density: 21.4 g/cm^3
- resists corrosion
- melting point: 1,772°C
- weaker than steel

Titanium

- a metal
- density: 4.51 g/cm^3
- resists corrosion
- melting point: 1,675°C
- as strong as steel

USEFUL TERM

corrosion wearing away gradually by rusting or the action of chemicals

MAKING COMPARISONS

1. How are platinum and titanium similar? How are they different?

Name _____ Class _____ Date _____

Critical Thinking *continued*

DEMONSTRATING REASONED JUDGMENT

2. Think about the extreme conditions within the engine of a jet. What properties would a metal in this engine need to have?

3. Which material would you recommend? Explain your answer.

PREDICTING CONSEQUENCES

4. Assume that the raw materials will be mined and sent directly to the manufacturing plant without being purified. Predict the possible consequences to the *FX-2000*'s performance. Explain your answer.

Name _____ Date_____ Class_____

WORKSHEET

5 THINKING SKILLS

Using Logic

Have you ever wondered how detectives solve a crime? Detectives piece together bits of information to get an overall picture. To do this, they have to draw on partial information, going from the **known** to the **unknown.** Imagine that you are a detective, and try to solve the following puzzle:

> Somebody has taken the official game ball from the sports equipment locker. The basketball team must have that ball for the big home game tonight. Three students—Keith, Donald, and Allison—are suspects. Each is carrying a round object in his or her sports bag. The three round objects are two soccer balls and a basketball. Donald and Allison are not carrying the same thing. Allison and Keith are not carrying the same thing. Who has the basketball? How do you know?

_____

_____

_____

_____

_____

_____

IF This, THEN That

Detectives use **logic** to solve puzzles like the one above. Logic is a particular way of thinking that allows you to solve problems. Certain words or phrases are common in this kind of thinking, such as *if this, then that, cause and effect,* and *therefore.* In solving the above puzzle, you may have thought, "*If* Allison and Donald aren't carrying the same thing, and *if* Allison and Keith aren't carrying the same thing, *then* Donald and Keith are carrying the same thing. *Therefore,* Donald and Keith have the soccer balls, and Allison has the basketball" (because there is only one basketball and there are two soccer balls). Case closed!

Like detectives, scientists use logic to test their hypotheses and theories. Suppose you hypothesize that putting a spin on a Frisbee™ will make it fly farther. How would you test this? You might use the following *if-then* statements in your logical thinking:

- *If* a spinning Frisbee consistently goes farther than a non-spinning one, *then* my hypothesis may be correct.
- *If* a spinning Frisbee consistently drops quickly, *then* my hypothesis may be incorrect.

Name _____ Date_____ Class_____

From the Known to the Unknown

The most important tip for using logic is to move from what you ***know*** to what you ***want to know***. One way to do this is to make notes, listing what you know and all the clues you learn as you go along. Just as detectives carry notepads so that they can keep track of clues, you can make lists of your own to solve logic puzzles. Another way to do this is to use graphics to help you visualize what is happening. How does this work? Keep reading to find out!

The Mystery of the Three Stiletto Sisters, Part 1

Betty, Hette, and Letti Stiletto are sisters, and they are going to a concert! When they arrive, they go to their row. There are eight seats in the row, numbered from 1 to 8. Seats 7 and 8 are already taken, and the sisters want to sit together. Betty sits down in seat 5. Hette won't sit in seat 3, and Letti will sit only between two people. In which chair does each sister sit?

Solution

Solve the problem with an information table. Draw 8 boxes to represent the 8 seats, and number them 1–8.

1	2	3	4	5	6	7	8

Add the information you know:

1. Seats 7 and 8 are occupied, so put an X in those seats.
2. Betty is sitting in seat 5, so put a B in that space.
3. Hette won't sit in seat 3, so write "Not H" in that space.
4. Letti will sit only between two people. Remember that for later.

Your table should look like this:

1	2	3	4	5	6	7	8
		Not H		B		X	X

Now decide where Hette and Letti will sit. There are three possible arrangements.

1. Letti in 3, Hette in 4, and Betty in 5
2. Letti in 4, Betty in 5, and Hette in 6
3. Hette in 4, Betty in 5, and Letti in 6

So what's the solution?

Arrangements 1 and 2 won't work because Letti will only sit between two people. So, the only solution is Hette in seat 4, Betty in 5, and Letti in 6.

Name _____ Date_____ Class_____

The Mystery of the Three Stiletto Sisters, Part 2

On page 9 you saw a verbal solution to a logic problem, and on page 10 you saw a visual solution to a logic problem. Both methods are useful—choose the one that works best for you. Let's use both methods to solve the next problem.

> There is a five year difference between the youngest sister and the middle sister and a five year difference between the middle sister and the oldest sister. All of the sisters are younger than 35. Betty is 25 years old. Letti is not the youngest, and Hette and Betty are not 10 years apart. Who is the youngest?

Verbal

Where should we start? When solving a mystery, you want to go from the known to the unknown. Get out your detective note pad, and start by making a list of what you know. (Just the facts!)

> **Fact 1:** Each sister is either five years older or five years younger than the sister nearest her own age.
>
> **Fact 2:** Betty is 25 years old.
>
> **Fact 3:** Letti is not the youngest.
>
> **Fact 4:** Hette and Betty are not 10 years apart.
>
> **Fact 5:** All the sisters are younger than 35.

Now that we have a list of the facts, let's gather some clues. First, let's use Fact 1 and Fact 2. If Betty is 25 years old and if each sister is five years older or younger than the sister nearest her age, then there are three possible clues. Do the math!

> **Clue 1:** *If* Betty is the youngest, *then* her sisters are 30 and 35 years old.
> 25-year-old + 5 = 30 30 + 5 = 35
>
> **Clue 2:** *If* Betty is the middle sister, *then* her sisters are 20 and 30 years old.
> 25-year-old – 5 = 20 25 + 5 = 30
>
> **Clue 3:** *If* Betty is the oldest, *then* her sisters are 20 and 15.
> 25-year-old – 5 = 20 20 – 5 = 15

Okay, let's move on to Fact 3: Letti is not the youngest. This means that Letti must be either the middle or the oldest sister. *Another clue!*

Now let's move on to Fact 4: Hette and Betty are not 10 years apart. That means Letti and either Betty or Hette must be 10 years apart. But Betty cannot be the youngest either (Clue 1 and Fact 5).

Hmmm . . . let's go back through clues 1–3. Which clue told us that Betty's sisters are 10 years apart? Right! Clue 2—if Betty is the middle sister, then her sisters are 20 and 30 years old.

Name _____ Date_____ Class_____

We're almost there! Now, piece it together. Try another list:

1. If Betty's sisters are 20 and 30 years old, and
2. Letti is not the youngest, then we solved the mystery:
3. Hette must be the youngest. **Congratulations!**

Visual

Fact 1: Draw 7 boxes, with each box representing the possible age of one of the sisters. Label the boxes from 5 years to 35 years.

5	10	15	20	25	30	35

Fact 2: Place a B in box 5 to represent Betty.

5	10	15	20	25	30	35
				B		

Fact 3: This clue does not help much at this point, so let's move on to the next one.

Fact 4: Write NOT H in boxes 3 and 7.

5	10	15	20	25	30	35
		Not H		B		Not H

Fact 5: Place an X in box 7 to show that no sister is 35.

5	10	15	20	25	30	35
		Not H		B		X

Let's write down the possibilities left from Fact 1:

1.

5	10	15	20	25	30	35
			L	H	B	X

2.

5	10	15	20	25	30	35
		L	B	H		X

3.

5	10	15	20	25	30	35
			H	B	L	X

But fact 3 eliminates choices 1 and 2—Letti cannot be the youngest. Choice 3 is correct. **Hette is the youngest!**

Name _____ Date _____ Class _____

Sleuthing on Your Own

Here is another mystery to solve on your own.

You are conducting a scientific experiment, and you need a solution with a 13% salt concentration. Four test tubes containing salt solutions are lined up in a test-tube rack, and they are labeled *A*, *B*, *C*, and *D*.

Here's what you do know: *D* has the highest concentration, and *A* does *not* have the lowest concentration. You also know that the concentration of *B* is greater than the concentration of *A*. The salt concentrations are 5%, 9%, 13%, and 17%, but you don't know which test tube contains which concentration!

a. Start by making a list. What are the facts?

_____

_____

_____

_____

_____

b. Now gather some clues. What is the concentration of *D*?

_____

c. What are the possible salt concentrations of *A*? Explain.

_____

_____

d. Have you solved the mystery? Which solution do you need? Explain.

_____

_____

_____

Conclusion

This project was very important on several levels. First, it provided an opportunity to teach in a classroom with guidance from the practicum mentor. This was invaluable, as any issue that arose had been faced at some point in the mentor's career. The mentor's guidance can be likened to a template, a blank guide to assist in the creation of lessons and course materials. Second, the practicum demonstrated many of the obstacles that teachers face daily, such as unruly students, limited resources, and rigid frameworks. Many student teachers have an idealized view of the teaching environment. This practicum serves to give a taste of the true difficulties teachers must overcome to provide an adequate learning environment. Finally, and most importantly, it established an experience with which one can completely, honestly, and consciously answer the question, "Why teach?"

"Why teach?" is a question that many teachers and teaching hopefuls must address often. Teaching is, quite possibly, the most important profession in any community. All other positions – doctors, engineers, administrators – are worthwhile and significant, necessary to keep the world running. What, though, or rather *who*, passed to these men and women the skills they need to succeed, the life-skills, the *passion* for the field, the desire to continue to learn, so their roles might be better filled?

Why is teaching so important? As an institution, teaching is an integral part of society. Any community can be likened to a living organism – growing, adapting, sustaining, replicating. All communities must grow and adapt; if they did not, they would stagnate and die. These adaptations, these pearls of wisdom, must be passed from one generation to the next, from one

field to another, and across cultural boundaries. All of this, a teacher can accomplish in her classroom.

And yet, teaching is among the most underappreciated professions in society. From age five to eighteen, at least six hours a day for five days a week are spent in the classroom, under the guidance of a teacher. So much information can be exchanged, so much knowledge acquired, in this time, and this knowledge is not restricted to academics. An understanding of and appreciation for literature, for science and math – these are important, but also are the skills required to participate in the world to which these things apply. Communication, people-skills, sharing and cooperation, responsibility, independence, reliability – *these* are the things we most need to know, to be full and valuable members of our society. Survival is instinctual, but *living* must be *taught*.

Whatever their reasons for their profession, all teachers have a passion for teaching. They *like* what they do; they enjoy the challenge inherent in getting their students (who, in many cases, would rather be anywhere else) interested and participating in engaging lessons, and enjoying the course material. Teachers can always know their job will *never* be boring – how can it be, with twenty-odd students in each class? Every day is something new. Additionally, teachers can know that their job is important, that they have done something worthwhile.

So, why teach? Despite the hardships, the frustration, and the obstacles, teaching is a highly rewarding career: the change to make a difference, to affect the future in a positive way, to inspire, to connect to people every day in new and positive ways. Teaching is a chance to *give* in a way that no other career can match, to give everything: enthusiasm, energy, passion and

experience. It is also a chance to receive so much more: the respect and trust of peers and students; the chance to influence the way a new generation will think, the way they will think about and react to the world around them and themselves, and each other.

Teaching is not easy. Then again, nothing worth doing is.

References

[1] Massachusetts Department of Education, SIMS Report, 1 Apr 2009.

[2] "DHCD Community Profiles," 2009. *Massachusetts Department of Housing and Community Development*. [Online]. Available: http://www.mass.gov/?pageID=ehedterminal&L=4&L0=Home&L1=Economic+Analysis&L2=Executive+Office+of+Housing+and+Economic+Development&L3=Department+of+Housing+and+Community+Development&sid=Ehed&b=terminalcontent&f=dhcd_profiles_profiles&csid=Ehed [Accessed: 25 March 2009].

[3] "State & County QuickFacts," 20 Feb 2009. *U.S. Census Bureau*. [Online]. Available: http://quickfacts.census.gov/qfd/states/25000.html. [Accessed: 25 Mar 2009].

[4] "School and District Profiles: Gardner," 2008. *Massachusetts Department of Elementary and Secondary Education*. [Online]. Available: http://www.profiles.doe.mass.edu/profiles/general.aspx?topNavId=1&orgcode=01030405. [Accessed: 27 Mar 2009].

[5] "Massachusetts Comprehensive Assessment System: Overview," 19 Mar 2009. *Massachusetts Department of Elementary and Secondary Education*. [Online]. Available: http://www.doe.mass.edu/mcas/overview.html. [Accessed: 25 Mar 2009].

[6] "Massachusetts Science and Technology/Engineering Curriculum Frameworks," 2006. *Massachusetts Department of Education.* [Online]. Available: http://www.doe.mass.edu/frameworks/scitech/1006.pdf. [Accessed: 8 Sep 2008]

Appendices