

Challenge-Based Learning (CBL) Sample Lesson Plans



Created By:
Zane Carey
Jacquelyn Lopez
Brandon Voci
Amy Welch



WPI



ALBORADA

Introduction

This document contains sample Challenge-Based Learning (CBL) lesson plans for 4th, 5th, and 6th grade students. The majority of these lessons were implemented during our time at the Unidad Particular Educativa Alborada, in Cuenca, Ecuador. In addition to presenting a set of lesson plans, we provide an overview of the CBL learning framework and discuss its five essential stages. The primary source for all of this information is the Challenge-Based Learning user guide¹.

CBL Overview

What is CBL?

Challenge-Based Learning (CBL) is an effective learning framework, encouraging students to solve local and global challenges in a team-oriented environment. CBL offers a highly flexible and customizable framework, with multiple points of entry.

How is CBL different from other learning frameworks?

CBL is unique in its emphasis on addressing “real-world” problems and topics. Specifically, students are encouraged to reflect on complex issues and develop effective solutions, using academic material. Teachers can have students create their own solutions or have them follow a guided activity. In any CBL implementation, however, students must reflect on the “real-world” aspect in their solution.

What teaching practices does CBL use?

CBL integrates four High-Impact Teaching (HIT) practices. These practices were identified by the American Association of Colleges and Universities. The HIT practices involved include Learning Relevant to Student’s Lives, Community-Engaged Learning, Global Learning, and Collaborative Learning. Despite the identification of these practices by a collegiate organization, CBL can also be implemented at the K-12 level. Indeed, these HIT practices have been found beneficial in developing a wide range of skills, important for students of all ages, such as creativity, critical thinking, and civic responsibility.

How is a CBL lesson (usually) taught?

A CBL lesson is generally taught by dividing the lesson content into five sequential stages. In the preceding section, we shall detail each of these stages.

¹ Nichols, M., Cantor, K., and Torres, M. (2016) *Challenge Based Learner User Guide*. Digital Promise. https://www.challengebasedlearning.org/wp-content/uploads/2019/02/CBL_Guide2016.pdf

Stages of CBL

The five stages of a CBL lesson are given below. In general, each of these stages follows in sequential order:

1. **The Big Idea:** The Big Idea aims to fulfill learning objectives while acting as a medium to engage students on a deeper personal level. More concretely, the Big Idea captures a theme or idea, placed at the center of the CBL lesson. In this stage, the associated HIT practice is Learning Relevant to Student's Lives. Examples of Big Idea's are as follows:

- Environmental Justice
- Resilience
- Health

Grounding the Big Idea into student's lives has a larger impact on their learning experience, intrinsically motivating students to learn.

2. **Essential Questions:** Once a Big Idea is chosen, the Essential Questions contextualize this idea relative to issues and topics which affect the student in both their community and on a global scale. These questions move beyond the student's own experience and demonstrate community and global relevance. Examples of Essential Questions, corresponding to the previously mentioned Big Ideas, are given as follows²:

- How can we ensure that everyone has access to a healthy environment to live, learn, and work in?
- How can we help communities when they experience a disaster?
- How do we develop a healthy lifestyle?

During this stage, the corresponding HIT practices are Community Engagement Learning and Global Learning.

3. **Imperative Challenge:** In this step, Essential Questions are converted into guided questions and activities. The Imperative Challenge stage uses Collaborative Learning, in which students work in teams to address the question asked or activity presented.

² "Resources - Challenge Based Learning -." *Challenge Based Learning*, 7 Mar. 2021, <https://www.challengebasedlearning.org/toolkit/>.

4. **Solution Stage:** Using the guided questions and activities, students have a solid foundation to reach an effective solution. These solution concepts can involve multiple activities such as creating a plan for a campaign or improving school and community projects. Once students decide on a concept for their solution , they learn to develop prototypes, experiments, and tests.

 5. **Assessment Stage:** Once students reach an effective solution, they are expected to reassess their solution to find potential flaws. The assessment stage allows students to reflect on their process and connect their solution to a “real-world” application.
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Lesson Plans

Below we include sample CBL lesson plans, which include a Big Idea, Essential Question(s), and a Challenge. First, we first present the academic background material. Next, we present the teacher and student instructions for the Challenge. Finally, we conclude with an assessment period. Each of these lessons were planned for one hour, though can be modified to accommodate longer time frames. Lessons which were implemented during our time at the Alborada School are indicated by a “ * ”, next to the lesson title.

Lesson: Water Filter Activity* (4th Grade)

Big Idea: Water Flow & Purification

Essential Question(s):

1. How do water purification systems work?
2. Why do we need water purification systems?

Challenge: Students must use plastic cups, napkins, and rocks to create a single-stage water filter.

1. Background Material:

- a. We begin by asking students what “water purification” is, why it is important. and what the stages of the water purification are.
 - i. “Water purification” refers to the process of removing contaminants from surface water.
 - ii. Water purification is important for providing clean drinking water, keeping the environment safe and clean, and further making the human digestion system strong.
 - iii. The stages of the water purification are filtration, coagulation, flocculation, decanting, filtration (again), and disinfection. A brief explanation of these stages should be prepared.
- b. To help the students further understand the water purification system, consider using the following diagram, while explaining each major stage:



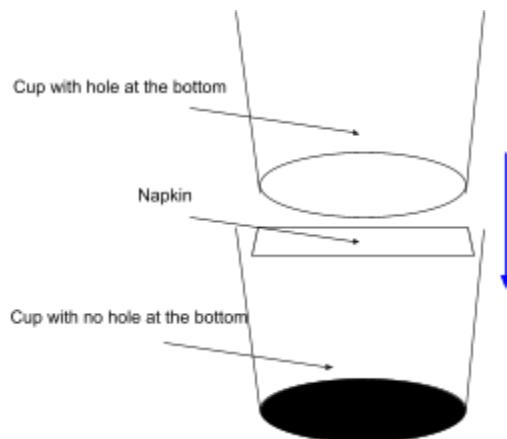
2. The Challenge:

a. Instructions for Students:

- Today, we are going to make our own water filters. We are going to give you a cup with a hole on the bottom, a cup without a hole, a paper napkin, and some small rocks. To create your water filter, place a napkin over the cup without a hole and then place the cup with the hole into this other cup. Above the napkin, place the small rocks. Your filter should allow for water to be poured onto the rocks, drip through the napkin, and collect at the bottom of the cup without a hole.

b. Instructions for Teachers:

- First, demonstrate to the students what their water filters should look like. Consider using the following diagram:



The blue arrow indicates the direction of the water flow and small rocks should be placed on top of the napkin.

- Have students work in groups of 2-3.

- Once a group is formed, pass out the described materials to each team:

- One cup with a hole on the bottom.
- One cup with no hole.
- One paper napkin.
- A couple of rocks/pebbles

- iv. Walk around to make sure the students are building their filters properly. Help and give guidance as needed.

3. Assessment:

- a. Pour dirty water into the student's water filters.
 - i. Did your water filter work? Explain why or why not.
- b. Reflection Questions:
 - i. Why is clean water important?
 - ii. What part of the water purification process did you mimic today?

Lesson: Pollution Catcher Activity (4th Grade)

Big Idea: Air Purification

Essential Question(s):

1. How can we reduce air pollution?
2. How is air pollution detrimental to our health?

Challenge: Students must create a “pollution catcher”.

1. Background Material:

- a. We begin by asking students the following questions:
 - i. What is air pollution?
 - 1. It is a mixture of harmful solid particles and gasses in the air.
 - ii. What causes air pollution?
 - 1. Car emissions, chemicals from factories, dust, pollen, ozone, gas, etc.
 - iii. Why is air pollution bad/how does it harm?
 - 1. It can increase the risk of heart and respiratory diseases such as lung cancer. It can also make asthma worse.
 - iv. What is fossil fuels? Why are they harmful?
 - 1. They are made from decomposing plants and animals and are burned for energy. Coal, oil, and natural gas are examples of fossil fuels.
 - 2. Producing and burning fossil fuels creates air pollution that harms our health and generates toxic emissions that drive climate change.
- b. We then explain:
 - i. Ways to reduce air pollution
 - 1. Using public transport, turning off the lights when not being used, recycling and reusing, no plastic bag usage, reduction of forest fires and smoking.
 - ii. How can you reduce air pollution at home?
 - 1. Using buses, walking, or cycling instead of cars.
 - 2. Recycling used materials to use less energy.
 - 3. Turning off the lights when they are not being used.

2. Instructions for Challenge:

- a. Instructions for Students:
 - i. With a few simple materials, we can make a pollution catcher to help us see the dirt in the air with our own eyes. We are going to give you the following materials [state]. With the paper plate, you are going to make a small hole and you are going to tie a string to the hole. Then you are going to grab some vaseline and rub it all over the paper plate, this will collect all the harmful particles in the air. Once you are done. You are going to hang your paper plate at a location where you can catch pollution, for example, a tree branch or inside your classroom. Once you are done, you are going to get your notebooks and write your observations.
- b. Instructions for Teachers:
 - i. First, have students pair up in teams of 2..
 - ii. When the groups are formed, passed out the following materials to each team:
 1. One paper plate
 2. One pair of scissors
 3. One small portion of vaseline
 4. One piece of string
 - iii. Let the students know to get started as soon as they receive the materials.
 - iv. Walk around and make sure students are placing their pollution catchers in a good location. The class should be split in half by placing half of the plates outside, and the other half in a classroom.
 - v. Walk around labeling each plate “indoor” or “outdoor.”

3. Assessment:

- a. What did you guys observe between the classroom vs outside paper plate?
 - i. Is there a difference in the average number of particulates found on the two different plates?
- b. Do you think the result of the paper plate would be different if we placed it on a busy road vs a quiet road?
 - i. Which plate will be dirtier and why?
- c. What can you do at home to improve the air quality?

Lesson: Compass Activity* (5th Grade)

Big Idea: Navigation

Essential Question: How did people geographically orient themselves before GPS technology?

Challenge: Students must build their own compass.

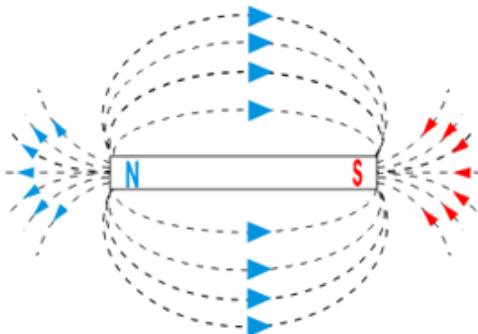
1. Background Material:

- a. We begin asking the students the following questions:

- i. How does a magnet work?

1. A magnet is a rock or a piece of metal that can pull certain types of metal toward itself. The magnetic force in a magnet flows from the North pole to the South pole. This creates a magnetic field around a magnet.

Consider using the following diagram to illustrate the magnetic field:



- ii. Which materials are magnetic?

1. Metals like iron, steel, nickel, and cobalt are good magnets.

- iii. How is Earth a magnet?

1. At the center of the Earth spins the Earth's core. The core is made up of mostly iron. The outer portion of the core is liquid iron that spins and makes the earth into a giant magnet. This is where we get the names for the north and south poles. These poles are actually the positive and negative poles of the Earth's giant magnet. This is very useful to us here on Earth as it lets us use magnets in compasses to find our way and make sure we are heading in the right direction. It's also useful to animals such as birds and whales who use the Earth's magnetic field to find the right direction when migrating.

- iv. How does a compass work?

1. A compass has an iron needle that is magnetized. The compass' needle can detect the magnetic field of the Earth and faces the Magnetic North when you hold it in your hand. It uses the Earth's north and south magnetic poles to make it work.

2. Instructions for Challenge:**a. Instructions for Students:**

- i. Today, we are creating simple magnets, which use the Earth's magnetic core. To build these magnets, you will each be given a styrofoam plate, a paper clip, and a styrofoam triangle. You will also need water and a small magnet. To begin, unbend your paper clip and magnetize the end, by rubbing it against the small magnet. Then, place the paperclip on the styrofoam triangle. Next, fill the plate with water and carefully place the triangle close to the center of the plate. Observe the motion of the paperclip as it points North.

b. Instructions for Teachers:

- i. To begin, divide the students into groups of 2-3.
- ii. To each group, administer the following materials:
 1. 1 Styrofoam Plate
 2. 1 (Small) Styrofoam Triangle
 3. 1 Paper Clip
 4. 1 Magnet
- iii. Students should assemble their compass as follows: unbend the end of the paper clip and magnetize the unbent part by rubbing it against the given magnet. Place the paper clip on the styrofoam triangle and further on the center of the plate.
- iv. Once their triangle with the magnetized paper clip is on the center of the plate, distribute a small amount of water to each group.
- v. The styrofoam triangle should float on the surface of the water; ensure the students are working on a leveled surface.

3. Assessment:

- a. Have students reflect on the observed behavior of the magnet. Perform this independently and then discuss the results as a class.
- b. Ask the students the following reflection questions:
 - i. Why did the paperclip point North?
 - ii. How does the paperclip know where to point?
 - iii. Why did we rub the paperclip with the magnets? What did this do?

Lesson: Healthy Lifestyle Activity (5th Grade)

Big Idea: Health and Fitness

Essential Questions: How can you change your habits to create a healthier lifestyle?

Challenge: Students must analyze and change habits at home and school to attain healthier lifestyles.

1. Background Material:

- a. We begin by asking students the following questions.
 - i. What does it mean to have a healthy lifestyle?
 - 1. A healthy lifestyle includes a balanced diet, regular exercise, sufficient amount of sleep, and a good work-play balance.
 - ii. How do you sustain healthy habits?
 - 1. Healthy habits include sustaining a balanced diet, regular exercise, and a balanced sleep schedule. You can sustain these habits by creating small goals and aiming to achieve them everyday.
 - iii. What role does fitness play in a healthy lifestyle?
 - 1. Fitness is important because it makes you less prone to illness or injury. Fitness also helps mental health and relieves potential stress.

2. Instructions for Challenge:

- a. Instructions for Students:
 - i. Students, using the provided worksheet that has a divider for good and bad health habits, begin filling in some of your lifestyle habits. Don't be afraid to be honest with yourselves. This activity is to help you reflect on both your positive and negative habits, in order to reach a healthier lifestyle.
- b. Instructions for Teachers:
 - i. Prepare a worksheet with Healthy Habits and Unhealthy Habits divider. Review the meaning of a healthy lifestyle, and why all students should aim to live healthier lifestyles.
 - ii. Once students have finished filling out the worksheet, walk them through how they can change their unhealthy habits into positive ones by setting small goals and achieving them on a daily basis.

3. Assessment:

- a. Check in with students on a weekly basis once they have declared a plan to make their negative habits into positive ones. Have students reflect on how their habits have (or haven't) changed for the better, by writing a paragraph about changes in their lifestyles.
 - i. Have students share with the class how they have become healthier and changed their unhealthy habits into healthy ones.

Lesson: Volcano Activity* (6th Grade)

Big Idea: Volcanoes & Natural Disasters

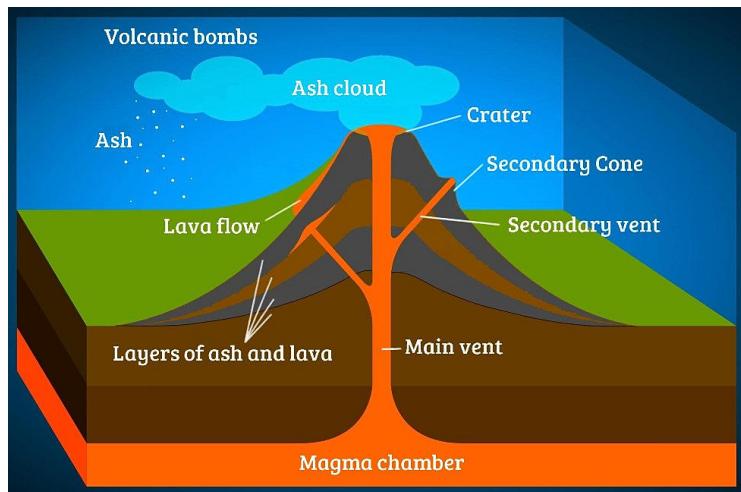
Essential Question:

1. How do volcanoes erupt?
2. Why do volcanoes cause natural disasters?

Challenge: Create a volcano, label its parts, and describe how it erupts.

1. Background Material:

- a. We begin with a brief review on Volcano terms.
 - i. **Crater:** a bowl-shaped pit that lies at the top of the volcano.
 - ii. **Main Vent:** channel where the magma from the volcano flows out.
 - iii. **Secondary Vent:** smaller channels where magma flows out from the volcano.
 - iv. **Secondary Cone:** if the main vent becomes clogged or blocked with magma, the magma is forced through another route.
 - v. **Magma Chamber:** where the magma is stored, underneath the volcano.
 - vi. **Lava (Flow):** molten rock once it reaches the surface and leaves the vent of the volcano.
 - vii. **Ash:** cloud that is produced from a mixture of rocks and minerals from the volcano.
- b. Consider using the following diagram, to aid the student's understanding:



- c. Next, discuss how a volcano erupts:
 - i. Volcanoes erupt when molten rock called magma rises to the surface. Magma is formed when the earth's mantle melts. Melting may happen where tectonic plates are pulling apart or where one plate is pushed down under another. Magma is lighter than rock so rises towards the Earth's surface. As the magma rises, bubbles of gas form inside it.

2. Instructions for Challenge:

- a. Instructions for Students:
 - i. Use your provided plastic water bottles, construction paper, and tape to construct 3D models of volcanoes. The volcanoes should be properly labeled with their different parts. Lastly, each team must write a short paragraph describing how a volcano erupts.
- b. Instructions for Teachers:
 - i. Divide the class into teams of 4-5.
 - ii. Provide the students with the following materials:
 1. A medium-sized piece of cardboard (to serve as the volcano base)
 2. A large plastic water bottle (to serve as the template for the actual volcano)
 3. Construction Paper
 - iii. Read the “Instructions for Students” . Encourage the students to use additional materials on hand, to add detail to their designs.

3. Assessment:

- a. Presentation: Each team presents their Volcano to the class, along with an explanation of how volcanoes erupt Additionally, have students reflect on the following questions:
 - i. Why do volcanoes cause natural disasters?
 - ii. Given what you know about volcanic eruptions, how can we minimize the effect of such disasters?

Lesson: Plants Activity (6th Grade)*

Big Idea: Plants and Ecosystems

Essential question:

1. Why do plants need to survive?
2. What role do plants play in their ecosystems?
3. How can we promote plant growth?

Challenge: Reflect on how plants survive

1. Background Material:

- a. Talk about what plants need to survive:
 - i. Water, Light, Soil, Carbon Dioxide
- b. Discuss Talk about the role that plants play in their ecosystems:
 - i. Plants play an important role in their ecosystem, providing nutrients and oxygen for other animals and organisms.
- c. National Geographic, “Our World” , Pages 94-97 might be helpful (English).
 - i. Ask the students to write a paragraph describing the features of plants which aid their survival.

2. Challenge:

- a. Instructions for Students: The different features of plants play an important role in their survival. In a paragraph, describe how these features help them to survive. You may find your workbooks helpful!
- b. Instructions for Teachers:
 - i. Draw on the whiteboard an example of a plant with all its labeled parts in English and Spanish..
 - ii. Next, have the students draw a plant in their notebook, label all its important parts and write 1-2 sentences about what plants need to survive.
 - iii. Walk around to observe student drawings and sentences. If students need help with new vocabulary, write it on the board for other students to use.

3. Assessment Period:

1. Assessment Period (15 minutes)
 - a. Get volunteers to share their paragraphs with the class and ask the following question(s)
 - i. How is the survival of plants important to our own survival?
 - ii. What steps can we take to promote plant growth?