Lesson #8: Fishpond Engineering

Lesson Objective(s): *What standard(s) and understanding(s) will be developed?*

Strengthened Sense of Responsibility

We are lifelong learners who learn from our mistakes and continue to work toward attaining our goals.

- Learning is a process and that it's okay to make mistakes.
- Scientists and engineers carefully record their observations and use their notes to make informed decisions.
- Scientists ask questions and construct explanations.
- Engineers define problems and design solutions.

Lesson Launch Notes: *Exactly how will you use the first five minutes of the lesson?*

- Hold up a bottle of water and ask, "What is this?"
- What is it used for?
- Who uses it?

Lesson Closure Notes: *Exactly what summary activity, questions, and discussion will close the lesson and provide a foreshadowing of tomorrow? List the questions.*

(will add information)

Lesson Tasks, Problems, and Activities (attach resource sheets): *What specific activities, investigations, problems, questions, or tasks will students be working on during the lesson?*

Part One: Intro to the Engineering Design Process

TASK: Students will work in teams to design a device that can remove oil from ocean water. They will use the engineering design process to test the effectiveness of their tool.

1. Class Discussion

- Why is the ocean habitat in danger? There is an oil spill in the ocean.
- What will the oil spill cause to happen? The oil will cause harm to the ocean creatures and their natural habitat.
- Is there a way to solve this problem? We have designed a tool to remove the oil from the ocean.
- How will you know if it works? We are going to test it out in an experiment.

2. Share scenario: Oil Spill Rescue: Engineering Design Process Journal

SCENARIO: A ship hit the reef off the island of O'ahu near Pearl Harbor. As a result, many gallons of oil are spilling into the harbor and beginning to harm the living creatures in the ocean and on the land. Help! What can we do to help keep the animals safe from the oil before it's too late?

DESIGN CHALLENGE (Performance Task): Create a tool or a system that will remove the oil from the water.

Consider the following:

- What is the best material to remove the oil from the water?
- How will this oil removing tool work?
- Where will you put the oil once it's removed?

GOAL: Remove the oil from the water before it harms the living organisms in the ocean and on the land.

Part Two: Fishpond Engineering

Pacifici American Foundation Lesson: Engineering Ingenuity
How did Hawaiians engineer shoreline fishponds to grow fish, while maintaining water quality and preventing siltation?

Activity: Students build model fishponds in shallow pans and experiment with changing water levels outside the pond wall to simulate what happens with the rising and falling tides.

Lesson #8: Fishpond Engineering

Evidence of Success: *What exactly do I expect students to be able to do by the end of the lesson, and how will I measure student mastery? That is, deliberate consideration of what performances will convince you (and any outside observer) that your students have developed a deepened (and conceptual) understanding.*

(will add information)

Notes and Nuances: *Vocabulary, connections, common mistakes, typical misconceptions, etc.*

(will add information)

Resources: *What materials or resources are essential for students to successfully complete the lesson tasks or activities?*

Student Worksheets

- Oil Spill Experiment - Part 1
- Oil Spill Experiment - Part 2
- Oil Spill Rescue: Engineering Design Process Journal

Materials

- Ocean water
- Dark sesame oil (vs. toxic oil)
- Variety of materials for students to create oil-removing tool may include, but are not limited to the following items
  - cotton
  - sticks
  - fabric
  - coffee filters
  - pipe cleaners
  - plastic containers
  - sponge
  - styrofoam

SEE Pacifici American Foundation Lesson: Engineering Ingenuity for details

Homework: *Exactly what follow-up homework tasks, problems, and/or exercises will be assigned upon the completion of the lesson?*

- None at this time

Lesson Reflections: *How do you know that you were effective? What questions, connected to the lesson standards/objectives and evidence of success, will you use to reflect on the effectiveness of this lesson?*

Name of Scientist: _____ Date: _____

Oil Spill Experiment - Part 1

1. Predict: What do you think will happen when we add oil to the cup of water?

_____

_____

_____

2. Draw and label a picture of your cup with the water and oil added to it.

3. What happened when you dipped the pipe cleaner in the water with the oil?

_____

_____

_____

4. What happened when you dipped the feather in the water with the oil?

_____

_____

_____

Name of Scientist: _____ Date: _____

HCPSS Secondary Mathematics Office (v2); adapted from: Leinwand, S. (2009). *Accessible mathematics: 10 instructional shifts that raise student achievement.* Portsmouth, NH: Heinemann.

Oil Spill Experiment - Part 2

Clean-up Item	PREDICTIONS What do you think will happen?	RESULTS How much oil did it remove from the water?
1. Cotton Ball		None A little A lot All
2. Feather		None A little A lot All
3. Napkin		None A little A lot All
4. Nylon		None A little A lot All
5. Paper Bag		None A little A lot All
6. Pipe Cleaner		None A little A lot All
7. Rubber band		None A little A lot All
8. String		None A little A lot All
9. Tissue Paper		None A little A lot All
10. Towel		None A little A lot All

Based on your observations, work with your team to figure out how to clean up the oil spill. What will you need?

Material(s) we will use:

Our Plan: What will you do to clean up the oil spill?

Investigate: Try out your idea.

Results. What happened? Did it work? What would you do differently?

Name of Engineer: _____ Date: _____

HCPSS Secondary Mathematics Office (v2); adapted from: Leinwand, S. (2009). *Accessible mathematics: 10 instructional shifts that raise student achievement.* Portsmouth, NH: Heinemann.

Lesson #8: Fishpond Engineering

Oil Spill Rescue: Engineering Design Process Journal

SCENARIO: A ship hit the reef off the island of O'ahu near Pearl Harbor. As a result, many gallons of oil are spilling into the harbor and beginning to harm the living creatures in the ocean and on the land. Help! What can we do to help keep the animals safe from the oil before it's too late?

DESIGN CHALLENGE (Performance Task): Create a tool or a system that will remove the oil from the water.

Consider the following:

- What is the best material to remove the oil from the water?
- How will this oil removing tool work?
- Where will you put the oil once it's removed?

GOAL: Remove the oil from the water before it harms the living organisms in the ocean and on the land.

What is the problem?	What are you being asked to design?

THE ENGINEERING DESIGN PROCESS

STEP 1: ASK: Ask questions about the problem. What else do you need to know to solve the problem?

1. _____

_____

2. _____

STEP 2: IMAGINE: Use your background knowledge about oil and water to determine what materials you might need.

Draw your oil-removing tool and label the parts. Be ready to share and explain your design. Your team will be choosing one idea to develop.

STEP 3: PLAN: Draw the diagram of your team's prototype. A prototype is the original or model on which something is based or formed.

- Label each part
- List the materials used
- Include measurements

Materials we will use:

Our prototype:

STEP 4: CREATE: Build the prototype of your oil-removing tool. Follow your team's design. Keep to the plan.

- What changes did you need to add in order to be sure that your design would hold together and work?
- Use the materials listed on your plan as well as the measurements that your group decided on.

STEP 5: EXPERIMENT

DATA: Did the tool remove the oil?					
Trial #	**How much oil was removed from the water?**				**Observations**
1	None	A little	A lot	All	
2	None	A little	A lot	All	
3	None	A little	A lot	All	

STEP 6: IMPROVE:

ASK: Looking at your data, answer the following questions:

- What worked? Why?
- What didn't work? Why?

IMAGINE: What can you change to improve your oil-removing tool to make it better?

PLAN: Draw the diagram of your team's prototype. A prototype is the original or model on which something is based or formed.

- Label each part
- List the materials used
- Include measurements

Materials we will use:
Our prototype:

CREATE: Build your second prototype. Follow your team's plan. Use the materials listed as well as the measurements that your group decided on.

EXPERIMENT:

DATA: Did the tool remove the oil?

Trial #	How much oil was removed from the water?				Observations
1	None	A little	A lot	All	
2	None	A little	A lot	All	
3	None	A little	A lot	All	

Data Analysis: Compare the data from your first and second prototypes.

1. Which prototype was more effective? **Prototype 1** **Prototype 2**

Use your background knowledge of oil, water and your data to explain your answer.