



Teacher Created Resources®

STEM

Hands-On Challenges

Grade

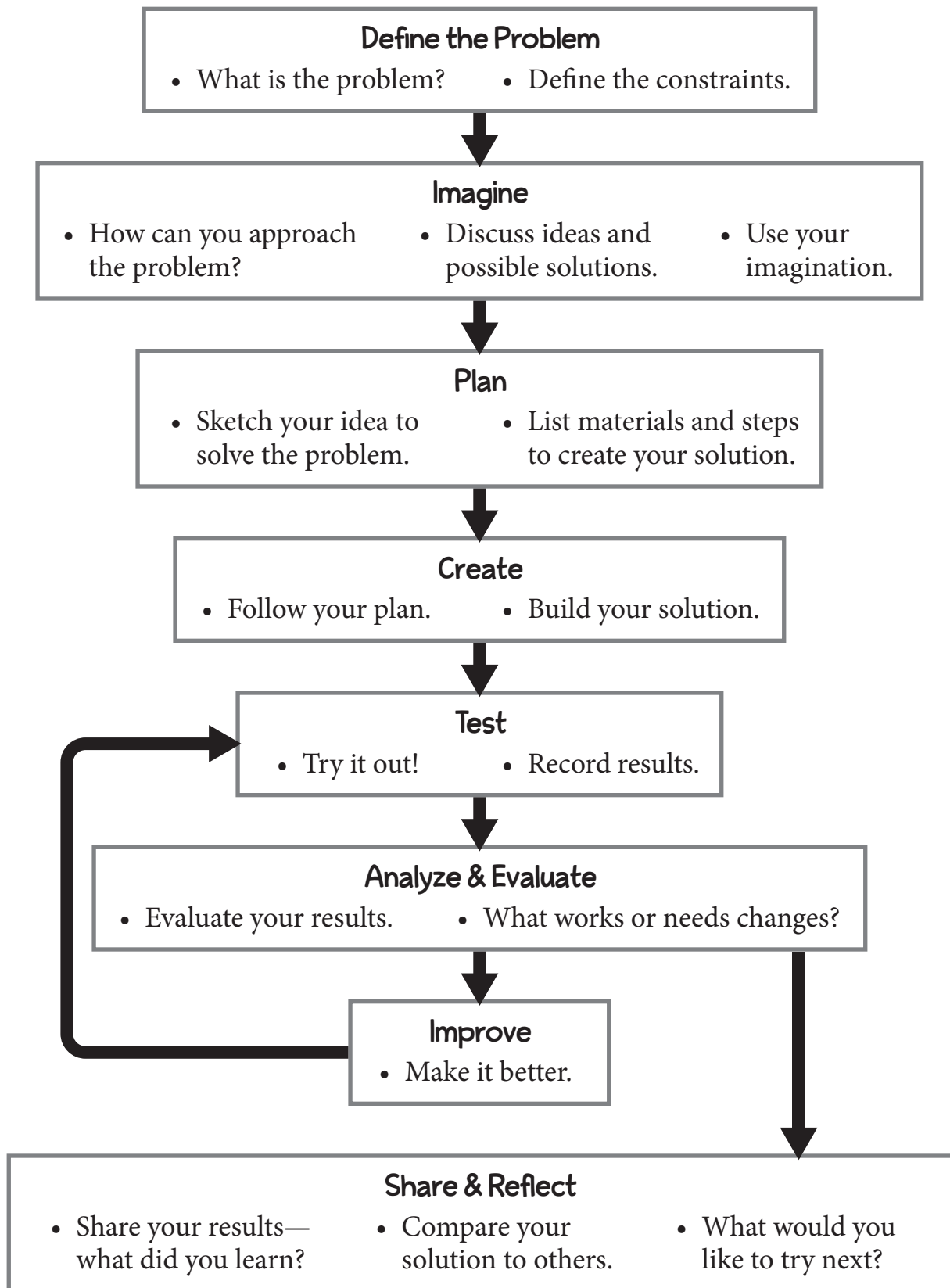
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Engineering Design Process

—a series of steps used by engineers in order to solve a problem—



Oil-Spill Cleanup

Objectives

Students will think about the changes that can affect an environment and its inhabitants. They will design and create a model of a solution to an environmental oil spill.

STEM Focus

Life Science: Populations live in a variety of habitats, and change in those habitats affects the organisms living there. For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Engineering Design: Make a claim about the merit of a solution to a problem caused when the environment changes and how the types of plants and animals that live there may change.

Science and Engineering Practices: Design solutions and construct explanations; engage in argument from evidence.

Crosscutting Concepts: Systems and system models; cause and effect

Setup

For Mini Challenge

- ▶ Make double-sided copies of the *Environmental Changes Flipbook* pages, as needed.
- ▶ Make a model of the flipbook to show students.

For Main Challenge

- ▶ Prepare photos and/or video of oil spills and their effects to share with students. (optional)
- ▶ Set up a workstation for each group of three to five students:
 - Create a mock ocean in a container for each station. Fill large, leak-proof containers half full with water.
 - Prepare “oil” by mixing vegetable oil with cocoa powder. Use 1 teaspoon of cocoa powder for 2 cups of oil. Each station will need $\frac{1}{4}$ cup of this oil mixture.
 - Place a large, clear plastic cup at each station for the cleaned up “oil.”
 - Place paper towels at each station for spills.
- ▶ Gather building materials. Provide some **absorbent** materials that can soak up liquids easily, some that can be used to skim oil off the water’s surface, and some items to provide structure to the students’ builds.

Materials

Introduction and Mini Challenge

- *Environmental Changes Flipbook* (pages 41–42)
- document camera or other display

Main Challenge

- *Clean It Up!* (page 43)
- *Reflections—Oil-Spill Cleanup* (page 44)
- cocoa powder
- deep containers for water and “oil” such as storage containers, or aluminum roasting pans. (They should be wider than they are deep for a large water surface area.)
- large, clear plastic cups, one per group
- paper towels
- photos or video of oil spills and their effects (optional)
- vegetable oil
- materials and tools for building:
 - Absorbent:** cotton balls, cut-up sponges, egg cartons, paper towels, toilet paper, feathers, fake fur, coffee filters, or muffin liners
 - Skimming:** plastic spoons and knives, small plastic or paper cups
 - Structural:** straws, craft sticks, toothpicks, string, rubber bands

Time Frame

The Introduction and Mini Challenge will take about 40 minutes.

The Main Challenge will take approximately 45–60 minutes.

Follow up with the Writing Reflection as time allows.

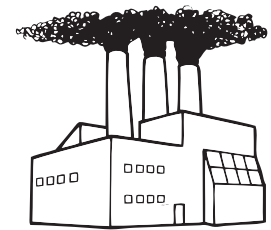
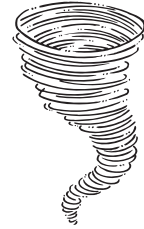
Vocabulary

absorbent	manmade
environment	pollution
natural	

Oil-Spill Cleanup

Introduction

1. Ask students, “How can an environment change?” Explain that an **environment** is the surroundings or conditions in which a person, animal, or plant lives. Have students share their ideas with a partner (turn and talk or think-pair-share) and then share with the class.
- ➡ Write the word *environment* and its definition on the board.
2. Write *Environmental Changes* on the board or chart paper. Tell students that, in this Mini Challenge, they will learn how environments can change and how those changes affect the animals and plants living there.
3. Under the heading *Environmental Changes*, start three columns headed *Natural Changes*, *Man-made Changes*, and *Either*. Ask students to define the terms.
 - ➔ **Natural** means not caused by people.
 - ➔ **Man-made** means caused by people.
- ➡ Write the words “natural” and “man-made” and their definitions on the board.
4. Ask students to name some changes that could happen in an environment that are natural and to write them in the *Natural* column.
5. Ask students to name some changes that could happen in an environment that are caused by people and write them in the *Man-made* column.
6. Tell students that some types of changes might be man-made or natural, depending on how they are caused. Ask students if they can think of any changes such as **pollution**, that could be either man-made or natural. Here are some examples:



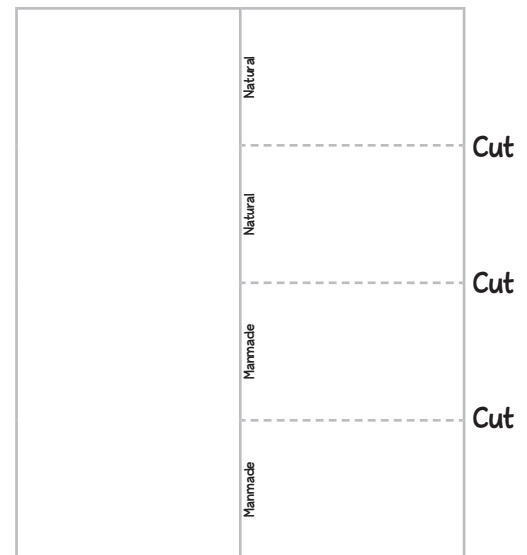
Environmental Changes		
Natural Changes	Man-made Changes	Either
Day to night	Cutting down forests	Fire
Seasons	Clearing land for farming	Invasive species
Flood	Building cities	Hunting
Tsunami	Pollution	
Tornado	Digging for oil	
Hurricane	Mining	
Volcano		
Drought		

Oil-Spill Cleanup

Mini Challenge

1. Distribute copies of *Environmental Changes Flipbook* to each student. Students will also need pencils and scissors.
2. Show students a model of an assembled flipbook. Have students fold the page down the center and then cut along the dotted lines and fold the flaps over.
3. Have the class do the first section together. Choose a natural environmental change (you could have the class vote). On the first flap, have students write the name of the change and have them draw a sketch representing the change.
4. Discuss whether the change happens quickly or slowly. Have students open the flap and circle either *Quickly* or *Slowly* on the inside.
5. Discuss the kinds of effects the change might have on living things in the environment.
 - How would animals be affected?
 - Could they leave or adapt to the change, or would they disappear?
 - How would plants be affected?
 - Have students write some of these effects in the first section on the right side of the flipbook.
6. Point out to students that the next change in their flipbook should be a natural change, and the last two should be man-made changes.

Fold



Flipbook (outside)

Circle one: Quickly or Slowly	How does it help or hurt living things? _____ _____ _____
Circle one: Quickly or Slowly	How does it help or hurt living things? _____ _____ _____
Circle one: Quickly or Slowly	How does it help or hurt living things? _____ _____ _____
Circle one: Quickly or Slowly	How does it help or hurt living things? _____ _____ _____

Flipbook (inside)



Depending on student support needs, you could let students work independently to complete the flipbook, work in pairs or groups, or continue working together as a class.

Oil-Spill Cleanup

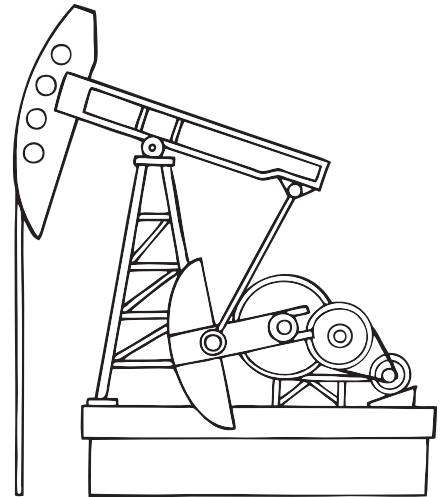
Main Challenge

Define the Problem

1. Ask students to share experiences in which they had to clean up a spill or a mess.
 - How did they clean it up?
 - What did they use?
2. Tell students that one man-made environmental change that happens very quickly is an oil spill. Ask students to share what they know about oil.
 - Have they ever seen or experienced vegetable oil and water together—maybe in salad dressing?
 - What happens when water and oil get together? Do they mix well?
3. Share the facts below about crude oil with students. If appropriate, make half-page copies of these facts for students to reference, or enlarge the facts sheet and post it in the classroom.
4. Ask students why oil in the water might be a harmful change for living things. If possible, share photos or a video of an ocean oil spill.

Facts About Crude Oil

- Crude oil is a thick, dark liquid that can be found deep underground.
- We pump crude oil out and use it to make things like gasoline and plastic products.
- Sometimes, we pump oil up from under the ocean. If a well or a pipe in the ocean leaks, oil will get into the water.
- The oil that is pumped has to be moved from where we pump it to places that use it. It can be moved through pipelines, on railways, in trucks, or in tankers.
- Oil is often moved using ships. If a tanker ship carrying oil has an accident or a leak, oil can get into the water.
- Crude oil is very thick and sticky. It sticks to sand, rocks, plants, and animals.
- Crude oil is very hard to clean up.



Oil-Spill Cleanup

Main Challenge (cont.)

Imagine & Plan

1. Tell students that their challenge is to build something that will clean oil out of water. Show students the prepared “oil” and let them know that it is not real crude oil—it is vegetable oil with cocoa powder, and it is safe for them to handle.

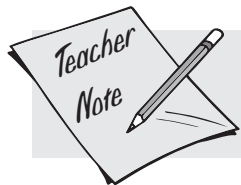


Let students know that the cocoa could stain their clothes, so they should be careful.

2. Show students the workstations and materials that they will be using for the challenge. Remind them to choose some materials that are **absorbent** (able to soak up liquid easily).
 3. Allow a few minutes for students to explore the building materials and to note their properties.
 4. Go over the constraints for this challenge with students. Remind students that, in engineering, the rules are called “constraints.” The constraints tell the engineers what they can and can’t do.
- ➡ Write the constraints for the challenge on the board or chart paper, or make copies for students to refer to throughout the challenge.

Challenge Constraints

- ⚙ Build something that will clean as much oil as possible from the water.
- ⚙ Choose from the materials available. You do not have to use all of the materials.
- ⚙ Put all of your cleaned “oil” into the large, plastic cup.
- ⚙ If the oil is soaked into some of the materials, put the materials in the cup, too.



If you will challenge students by pricing materials and giving students a budget, add the budget to the constraints. (See pages 8–10.)

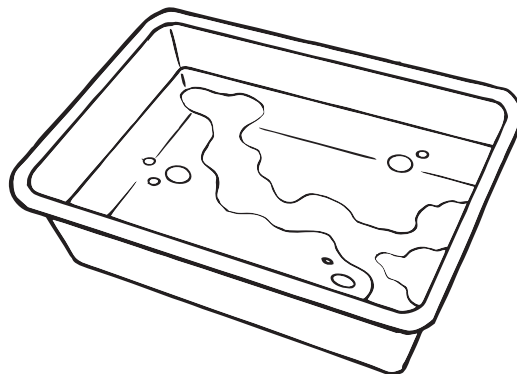
5. Distribute a copy of *Clean It Up!* to each student group. Go over the recording sheet together.
- ➡ Give students time to fill out the recording sheet and to plan their cleaning device.

Oil-Spill Cleanup

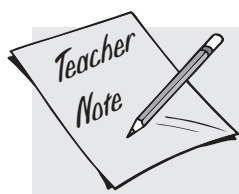
Main Challenge

Create

1. Have students pour the “oil” into their “ocean.” Have them observe the oil and water for a minute or so.
2. Have students gather their materials and give them ample time to build their oil cleaners according to their plans.
3. Circulate as students work on their cleaners. Observe and ask questions for formative evaluation, such as:
 - How did you choose the materials for this challenge?
 - How will your cleaner remove the oil?



 Remind students to write their results on their *Clean It Up!* recording sheets.



Dispose of the oil and water mixture by pouring it in a planted area. Cocoa powder, in small amounts, is said to be useful as fertilizer. Do not pour it down a drain. The oil might cause a clog. Put paper towels into the oil cups to absorb the oil and throw cups in the trash.

Analyze & Evaluate

1. Have each group tell the class about how they built their oil cleaner and how it worked.
2. Have a class discussion about the oil cleaners students created and any patterns they noticed. For example, they may notice that one particular material was the most absorbent or that trapping the oil in one area allowed them to remove more of it from the water.

Writing Reflection

 Have each student complete the *Reflections—Oil-Spill Cleanup* writing reflection individually.

Extensions

- Research human impact on your local environment and the effect it has on plants and animals.
 - Why do these impacts exist?
 - What is the advantage or disadvantage to humans?
- Have students research ways they can help reduce human impact on the environment, such as picking up litter, recycling, and saving water. Make posters to share these positive behaviors with your school.

Environmental Changes Flipbook (outside)

	Natural
	Natural
	Man-made
	Man-made

Environmental Changes Flipbook (inside)

Circle one: Quickly or Slowly	How does it help or hurt living things?
Circle one: Quickly or Slowly	How does it help or hurt living things?
Circle one: Quickly or Slowly	How does it help or hurt living things?
Circle one: Quickly or Slowly	How does it help or hurt living things?

Name _____

Date _____

Clean It Up!

Directions: Answer the questions below to help you plan and to build your oil cleaner.

1. What material do you think will best help remove oil from water? _____

Why do you think that this material will work better than the others? _____

2. How will you hold and move the cleaning device in order to remove the oil? _____

3. Sketch what you will build:



4. List the materials that you will use.

Directions: Answer the questions below about how your oil cleaner worked.

5. How did your oil cleaner work? _____

Circle the amount of oil that you think you were able to get out of the water.

all of it

some of it

a little of it

none of it

6. Describe what happened when you used your cleaner to try to clean the oil out of the water.

Name _____

Date _____

Reflections—Oil-Spill Cleanup

1. Did you have to change your original idea as you were building? YES NO

How? _____

2. Did any method completely remove the oil? YES NO

If yes, which one? _____

3. Do you think that a larger version of your cleaner would be able to clean up a real oil spill in the ocean?

YES NO

Why or why not? _____

4. What part of creating your oil cleaner was the hardest? _____

Why? _____

5. What part of creating your oil cleaner was the most fun? _____

Why? _____

6. What is something that you can do to protect your environment?
