I FUEL

ACTIVITY & EDUCATOR GUIDE

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This guide was created by Grace Nowatzke and Kelly Rice Schmitt

Lerner™

OCEAN OIL SPILL EXPERIMENT

"But we are not perfect. Spilling, dropping, and dumping us poisons and pollutes, making a nasty mess."

Oil spills are accidents where human activity leaks oil into the ocean or other bodies of water, creating a big mess that is harmful to sea creatures, birds, and plants. In this experiment, we will use our science skills to practice helping clean up and protect our oceans.

WHAT YOU NEED:

- Water
- Large container (e.g. 9"x13" or 13"x18" tin pan)
- Small bowl
- Water resistant plate
- Cooking oil
- Feather(s)
- Spoon
- Cotton balls
- Paper towel
- Dawn® dish soap
- Toothbrush
- Adult Supervision

OPTIONAL CLEAN-UP TOOLS:

- Medicine dropper
- Cheesecloth

INSTRUCTIONS:

1. Fill your large container with an inch or two of water to create your "ocean". On one side, have your feather and oil ready. Fill the small bowl with water and set aside with the other clean-up tools (spoon, paper towel, cotton balls, dish soap, toothbrush, etc.)

2. Observe the "ocean" water before a spill. Touch it. Does leave a residue on your fingers?

3. Observe the dry feather. The feather represents a seabird that lives in the ocean. What are some words you would use to describe the feather?

4. Now dip the feather in the "ocean" water. Remove. Observe the feather. Gently dry the feather with your paper towel. Now that the feather is dry, observe the feather. Has it changed from your observations in step 3?

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5. Set aside the feather.

6. Now it is time to make an oil spill. Pour 2 TBSP of oil in the middle of the water.

7. Observe what happens when the oil enters the water. Has anything changed?

8. With adult supervision, gently rock the large container to create the motion of waves we would find in an ocean. Observe the "ocean" How has it changed? Touch it. What has happened to your fingers?

9. Place your feather into the oil spill to represent the animal entering the spill. Take a minute to observe and discuss what happens to the feather.

10. Remove the feather and set on your plate. Observe if the feather has changed. How would you describe it now? Use your paper towel to dry it off like you did in step 4. After drying, is it different than when the feather got wet in step 4?

11. Now it's time to clean up the spill. Gather your clean-up tools, which may include a spoon, paper towel, cotton balls, eye dropper, cheese cloth, dish soap and toothbrush. Have students form a hypothesis. Which tool will remove the most oil from the water and feather? Why? Can they think of other ways to clean up the mess?

12. Set aside the dish soap and toothbrush to use last. Experiment with the other tools to try to remove the oil from the water. What happens? How much oil can you remove? What does the oil do when you interact with it? Discuss your findings.

13. Let's try this with our feather. Try to remove the oil from it using the same tools. How much oil can you remove? Can you get the feather to look like it did before the spill?

14. Now we are going to try our Dawn dish soap. Squirt dish soap into the "ocean" and use adult supervision to gently swirl the bowl and simulate ocean waves. Use your spoon to stir the water a bit more. Observe the oil. Has it changed?

15. Lastly, try cleaning the feather with the dish soap. Get your small bowl of water. Wet your toothbrush and add a little dish soap to it and clean the feather while on the plate. Use the small bowl of water to rinse the feather. Once thoroughly cleaned, allow time for the feather to dry or use a clean paper towel to dry. Discuss your findings. Were you able to get the feather back to how it was before the spill?

DISCUSSION QUESTIONS:

- What happened when we poured oil over the water? Did the oil mix well with the water?
- What happened to the oil when we rocked the container and "ocean waves" moved the "ocean water" around? If oil gets onto a beach, how might the oil affect the beach and humans or animals that use that beach?
- What happened when we tried to clean up the spill? Which removal process worked the best? Which one worked the worst?
- What did you learn about cleaning up an oil spill?
- What happened to the feather when placed in the oil? What changed about the feather? Was it easy to clean? The feather represented seabirds that might encounter spilled oil. How do you think oil-covered feathers might affect the birds?
- Can you think of other ways an oil spill might affect the environment?

EXPLORE THE SCIENCE:

Oil spill animal rescue crews really do use Dawn® dish soap to help clean oil-covered birds and other marine mammals! As we saw in the experiment, oil and water naturally repel each other because they are made of different kinds of molecules. This makes oil droplets stay together and separate from the water droplets. Dish soap molecules have both a water-compatible end and an oil-compatible end. This soap chemistry allows the oil to bind with water, breaking into small enough droplets to mix with the water and be washed away.

Seabirds rely on their unique feathers to keep them warm. These feathers are naturally water-resistant and arranged in a special way that keeps water off the birds' skin. When oil coats their feathers, the birds are no longer waterproof, which can put them at risk for becoming too cold or too hot. The oil can also make their feathers too heavy to fly. Sensing something is wrong, birds will try to clean themselves and can accidentally eat the oil, which is dangerous for their bodies.

EDUCATORS – CONNECTION TO STANDARDS:

Next Generation Science Standards
K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.
2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
5-PS1-3: Make observations and measurements to identify materials based on their properties.

WATER DISTILLATION EXPERIMENT

"Bubble, boil, drift apart, cool off, and float along."

In oil refineries, a special kind of distillation called fractional distillation is used to separate liquid crude oil into useful parts such as gasoline, diesel, and airplane fuel.

What is distillation? **Distillation** is a method of cleaning or separating out a liquid's different parts. A liquid mixture is heated until it becomes a gas either by boiling or evaporating. Then the gas is separated, cooled down, and recollected as a purified liquid. The purified liquid has been separated from any solids in the mixture, or from any other liquids with a different boiling point.

Distillation isn't used just for oil. Have you ever wondered how we can turn salty ocean water into clean drinking water? That's thanks to distillation, too! So, while we're learning how to make fresh water from salt water, we'll also be discovering the basic idea behind how we get so many important products from oil.

WHAT YOU NEED:

- Large Bowl
- Small Plastic bowl with a flat bottom to help it balance (the bowl cannot flip over when water enters it)
- Plastic cling wrap
- Water
- Salt
- Tape
- A few rocks
- A sunny day
- Adult supervision

INSTRUCTIONS:

1. Start by making some saltwater. You will need 2 TBSP of salt per 1 cup of water.
2. Fill your large bowl with enough saltwater so that your small bowl can float, approximately 1-2 inches deep of water.
3. Place your large bowl in a sunny spot, where it can stay undisturbed for several hours. Consider taking it outside.
4. Gently set your small plastic bowl on top of the water in the large bowl so it is floating. Do not let any water get in the small bowl or on the plastic wrap.
5. Using the plastic cling wrap, cover the large bowl completely. It must be completely sealed. If your cling wrap isn't very clingy, use tape to secure down the edges and make a nice seal on the bowl.

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6 Finally, gently add the on top of the plastic so that the plastic slopes down towards the small bowl. Ensure the rocks are on top of the area where the small bowl is floating.

7. Leave your bowl undisturbed for several hours, preferably up to a day.
8. After letting it sit, gently remove the plastic wrap, being careful not to disturb the small plastic bowl. You do not want to let the small plastic bowl tip over or it will ruin the experiment. Observe the small bowl. What has happened? Is there water in the small bowl? Carefully remove the small bowl. How does the water taste?

EXPLORE THE SCIENCE:

In this experiment, the sun heats the water, causing it to evaporate and form water vapor, a gas. The water vapor leaves the salt behind, rises and sticks to the plastic wrap. As the vapor cools, it becomes liquid again and drips into the small bowl as freshwater. This process leaves saltwater in the large bowl and freshwater in the small bowl. Please note that while distillation is a possible solution for those without clean drinking water, in reality, implementing this method is expensive and much more complex than this simple experiment may make it seem.

Oil refineries use a more complex process called fractional distillation, but it works on a similar principle. Oil refineries start with the raw crude oil found inside the tiny pores of rock. This liquid oil mixture contains many components that can be used for different things. When the crude oil mixture is boiled, different liquids turn into gas at unique temperatures. As each different liquid in the mixture becomes gas, the gas is collected, separated, and then cooled back into a liquid, just like how we collected and separated the water vapor from the salt water! By using fractional distillation, refineries separate the oil into different parts, making it useful for producing gasoline, heating oil, and many other products! See back matter in *I Fuel* for more information on this process.

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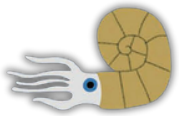
DISCUSSION QUESTIONS:

- How did we end up with freshwater in the small bowl?
- Can you explain in your own words how distillation separates the water from the salt?
- Where might people use distillation in the real world?
- What do oil refineries use distillation for?
- Can you think of other examples where we need to separate things?
- How does using the sun to heat the water help the environment?
- What are some other ways we can use solar energy in our daily lives?

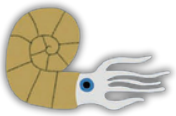
EDUCATORS - CONNECTION TO STANDARDS:

Next Generation Science Standards
K-PS3-1: Make observations to determine the effect of sunlight on Earth's surface.
4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

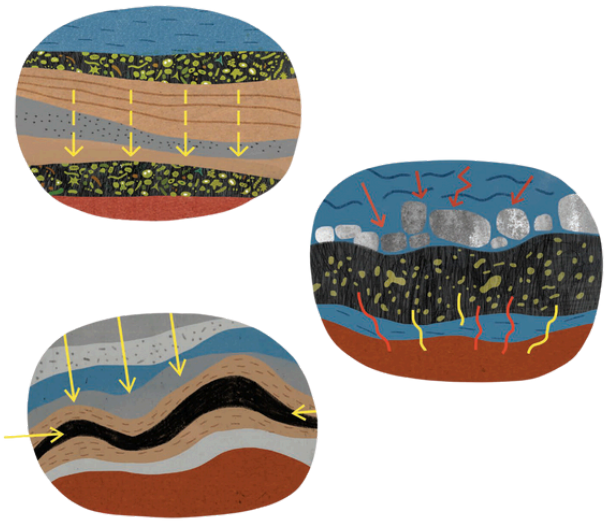
SEDIMENTARY ROCK FORMATION ACTIVITY



"The earth squeezes us slowly. Rocks crush, ocean pressure pushes, and temperatures rise, transforming us into something new."



In *I Fuel* you see sedimentary rock form over time. This rock helps to crush, squeeze and transform plankton into oil. In this tasty experiment, model the formation of rock using a yummy treat!



WHAT YOU NEED:

- Colored fruit chew candies (such as Tootsie Rolls®) in 3 different colors, ideally use green for one color.
- 2 small plates
- Kid-safe knife
- Adult supervision

INSTRUCTIONS:

1. Designate two fruit chew colors as rock and one fruit chew color as plankton (use green if you have it). Unwrap the rolls. Put the "rock" colors on one plate and set aside your "plankton" candy on the other.

2. Weathering is the process of breaking up, decomposing or changing the color of rocks. Now we are going to "weather" your candy "rocks" to represent how nature and the real weather does outside! Cut the 2 tootsie candies that have been chosen as "rock" into pieces using the knife.

3. Erosion is the movement of rocks and sediment that have been broken apart from weathering. Now we are going to simulate erosion. Then gently shake your plate to act like the "wind" or "water" moving around your weathered candy "rocks" so they are all mixed up.

4. Now, using your second plate, cut your "plankton" candy into pieces that are smaller than your rocks.

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5. Imagine the energy-filled "plankton" specks sinking to the bottom of the ocean. Now imagine all the "rock" bits falling into rivers that carry them all the way to into the ocean. Once they reach the ocean, imagine them sinking to the bottom. Over time, the ocean moves and changes, bringing new pieces of rocks and plants to the ocean floor, covering the plankton. The earth's hot core and pressure push on the bits to form new sedimentary rock, with the plankton trapped inside it. Over millions of years, the plankton transforms into crude oil, just like we see in *I Fuel.* We are going to simulate this process now! Take your "rocks" bits and sprinkle them on top of the "plankton" specks, spreading them throughout to represent the plankton being trapped. Using your hands, smush your "rock" and "plankton" pieces together.

6. Mold them so that they stick together. You now have a tasty treat to represent plankton being trapped in sedimentary rock waiting to become oil!

DISCUSSION QUESTIONS:

- Why is weathering an important process in the formation of sedimentary rocks?
- How does this represent real plankton getting trapped in sedimentary rocks?
- How do real rocks come together to form sedimentary rock layers?
- What conditions are necessary for plankton trapped in rocks to eventually turn into oil?

EDUCATORS - CONNECTION TO STANDARDS:

Next Generation Science Standards
2-ESS1-1: Use information from several sources to provide evidence that Earth events can occur quickly or slowly.
4-ESS1-1: Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time.

**Please note that *I Fuel* and this experiment can also be adapted to fit into middle school rock cycle curriculum.

SOLAR PANEL OVEN EXPERIMENT

"Beams of sunlight sink into solar cells."

Solar energy is an incredible, renewable source of power that can help us cook food, power gadgets and even heat our homes. With simple materials and the energy from the sun you can cook a delicious treat in your very own solar panel oven!

WHAT YOU NEED:

- Empty Pizza Box
- Sharpie
- Exacto Knife or Cardboard Cutter
- Foil
- Black Construction Paper
- Glue
- Tape
- Plastic Wrap
- Paper Plate
- Stick or Ruler to hold up the Panel
- A warm Sunny Day
- Adult Supervision
- Something to Cook, e.g. Chips and shredded cheese for nachos, graham cracker, chocolate, and marshmallow for smores, etc.

INSTRUCTIONS:

1. Draw a square on the pizza box lid. The square should be a few inches smaller than the size of the lid.
2. Ask an adult to help you cut along those lines. Carefully remove the cut-out piece of cardboard and set it aside for later.
3. Cover the bottom inside of the pizza box with aluminum foil. Smooth it out and tape it down securely.
4. Glue down the black construction paper on top of the foil. This will help absorb heat.
5. Cover the extra piece of cardboard (cut from the lid) in foil. This piece will serve as the reflector.
6. Generously cover the pizza box lid in plastic wrap and tape to keep in place. This will create a window-like feature and help keep the oven insulated.
7. Close the pizza box lid and use a stick or ruler to prop up the foil-covered square of cardboard. Angle it so it reflects sunlight into the oven through the plastic window.
8. Place the oven outside in the sun without food to "preheat" for 30 minutes.
9. Cut the paper plate to fit in the oven. Then place your food that you are planning to cook on top of the plate and into the oven.
10. Cook outside in the sun for 20 to 30 minutes.

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EXPLORE THE SCIENCE:

The shiny tin foil reflects the sun's light into the box, where the black paper absorbs the light rays, turning the light energy into radiant heat energy. Darker colors absorb more light than lighter colored ones, which is why we use black paper instead of white. The box helps to keep the heat trapped, insulating the area used for cooking so that it can heat your food!

DISCUSSION QUESTIONS:

- Did the solar oven cook the food as you expected? Why or why not?
- What factors affect how well the solar oven works (e.g., time of day, weather conditions, placement)?
- How does the sun's energy get converted into heat inside the solar oven?
- Can you think of other ways we use the sun's energy in our daily lives?
- How can using solar ovens help reduce our carbon footprint and benefit the environment?
- Can you think of other inventions that use solar energy to function?

EDUCATORS – CONNECTION TO STANDARDS:

Next Generation Science Standards
K-PS3-1: Make observations to determine the effect of sunlight on Earth's surface.
2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-4: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

SAVE THE POLAR BEARS ACTIVITY

"Using us carelessly overheats the earth."

I Fuel mentions how greenhouse gasses emitted from burning fossil fuels is one of the many factors contributing to climate change. One result of climate change is the overwarming of Earth. Animals and people can both be affected by this rise in temperature. In this activity, you'll have the chance to help polar bears stay afloat as the ice around them melts.

WHAT YOU NEED:

- Water (to freeze and to use later)
- Medium-sized freezer-safe container
- Low sided container
- Small plastic figure to represent a polar bear
- Blow dryer or heating other tool to melt ice
- A partner
- Adult Supervision

INSTRUCTIONS:

1. Fill the medium container with 1 inch of water and place it in the freezer.
2. Once the water is completely frozen, crack it out of the container and into 3-4 ice blocks.
3. Place the ice blocks into your low sided container.
4. Place 2 polar bears into the container on the ice blocks.
5. What do you think will happen to the ice if we heat it? Make a hypothesis. Using adult supervision, have one partner simulate the ice melting. Have them try pouring in extra water, removing an ice block, and heating the ice with a blow dryer or other heat tool. While one person melts the ice, the other must continue to move the polar bears to keep them afloat.

DISCUSSION QUESTIONS:

- What did you observe happening in step 5?
- How did the melting ice affect the pretend polar bears in our experiment?
- Polar bears use sea ice to help them hunt for seals and other food. If a lot of sea ice melts, what does that mean for polar bears?
- Can you think of other ways melting polar ice might affect the earth and its creatures?

EDUCATORS - CONNECTION TO STANDARDS:

Next Generation Science Standards

K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

CARBON FOOTPRINT PLEDGE

"People are caring, conserving, sharing. One day they may not need me at all, but until then. . . I Fuel"

NAME: _____

Fill the footprints with ideas on how to reduce your carbon footprint. Draw or write your ideas.

CARBON FOOTPRINT PLEDGE

Today, we're going to make a pledge to reduce our carbon footprint. By making a pledge, you are helping to protect our planet!

INSTRUCTIONS FOR EDUCATORS:

1. Discuss what a carbon footprint is. For example, explain to students, "When we do things like drive a car, use electricity, or play on a computer, we emit carbon dioxide gas into the air. This gas can make the Earth warmer, so it's helpful to try to make less of it. Just like when we leave footprints in the sand, different activities leave 'footprints' on the Earth in the form of carbon dioxide."
2. After reading *I Fuel* and having a class discussion on ways to reduce your carbon footprint, print one worksheet for each student. Remember to review the *I Fuel* back matter section about how trees absorb carbon.
3. Have students create their own carbon footprint pledge. They may write or illustrate the ways they personally will reduce their carbon footprint.
4. Hang their finished product and allow students a few minutes to look at each other's pledges.

EDUCATORS - CONNECTION TO STANDARDS:

The following standards apply to the Carbon Footprint Pledge, Reducing Carbon Footprint, and Happy Earth, Sad Earth Activities.

Next Generation Science Standards

K-ESS3-3: Communicate solutions that will reduce the impact of humans on the land, water, air, and/or other living things in the local environment.

4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

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REDUCING CARBON FOOTPRINTS

One way to reduce carbon footprint is by eating locally grown fruits and vegetables that are in season. In this experiment, taste test different fruits and vegetables that are currently in season, to find out which ones you like.

WHAT YOU NEED:

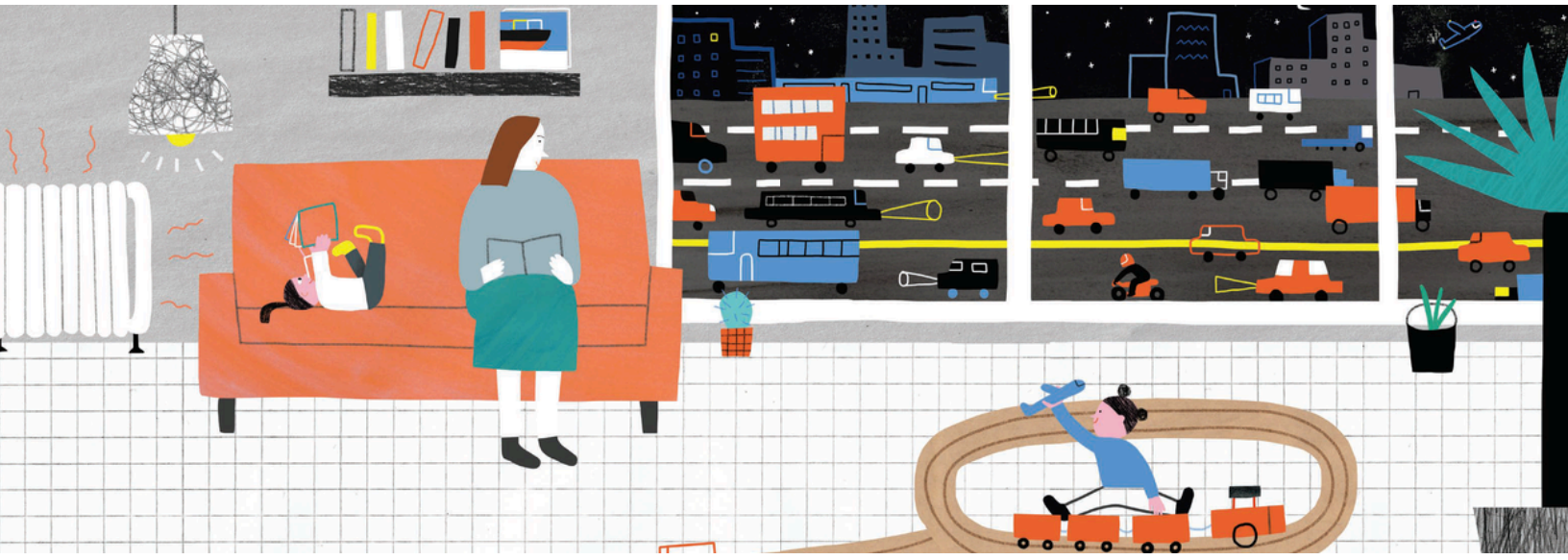
- 2-4 Fruits that are local, currently in season, washed, and prepared in serving sizes
- 2-4 Vegetables that are local, currently in season, washed, and prepared in serving sizes

INSTRUCTIONS:

1. After making your very own carbon footprint pledge taste test locally grown fruits and vegetables to find out which ones you like to eat that are currently in season.
2. Allow kids and students to try each of the different prepared fruits and vegetables.
3. Talk about the benefits of buying locally grown fruits and vegetables and why eating in season is beneficial.

DISCUSSION QUESTIONS:

- Does buying strawberries from your own state or from a far-off state have a smaller carbon footprint? Why?
- If you live in North America, is eating tomatoes from South America leaving a smaller or larger carbon footprint?
- What are some ways you can add the local fruits and vegetables you like into your meals?



HAPPY EARTH, SAD EARTH

INSTRUCTIONS

Cut out the twelve activity cards on page 17. Then sort the activity cards by placing them beneath the earths: the happy earth for things that are good for the planet and the sad for activities that are not.

HAPPY EARTH, SAD EARTH

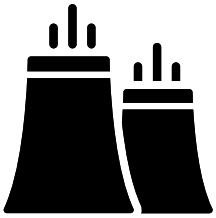
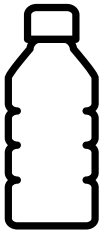
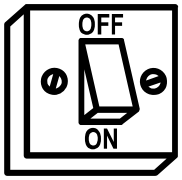
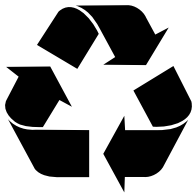
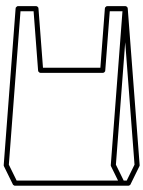
INSTRUCTIONS FOR EDUCATORS

1. Print the Happy Earth and Sad Earth plus the activity cards.
2. Cut out the 12 activity cards or have your students cut them out.
3. Kids can work in groups, alone or as a class to complete this activity.
4. Students will be sorting the activity cards by placing them on the earths. The Happy Earth is for things that are beneficial and the Sad Earth for activities that are not.
5. Have a discussion about these activities—why are they good or bad? How we can partake in more of the beneficial activities?

ANSWER KEY

- Pick up litter
- Recycle
- Plant trees
- Turn off lights
- Ride bicycles
- Reuse bags

- Car exhaust
- Oil spill
- Factory smoke
- Single use plastics
- Littering
- Water pollution

PICK UP LITTER 	FACTORY SMOKE 
PLANT TREES 	OIL SPILL 
LITTERING 	SINGLE USE PLASTICS 
 CAR EXHAUST	 TURN OFF LIGHTS
 RECYCLE	 REUSE BAGS
 RIDE BICYCLES	 WATER POLLUTION

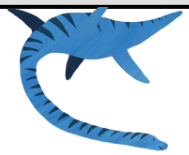
DINOSAUR WRITING EXERCISE

"As dinosaurs thump about, my life begins."

At the beginning of *I Fuel*, we see lots of different species of dinosaurs. For this fun writing activity, roll the dice to determine what dinosaur your story will be about!

INSTRUCTIONS:

Roll the die once for each column to determine your story's character, setting, and plot. Use the character, setting, and event you rolled to write a creative story. If you roll a marine reptile, use your imagination to fit the setting to the characters needs - for example if you roll Mosasaur and Volcano, create an underwater volcano in your writing. Be sure to include details to make your story interesting and exciting!

ROLL	CHARACTER	SETTING	EVENT
⚀	 PLESIOSAUR	CAVE	FLASH FLOOD
⚁	 EDMONTOSAURUS	JUNGLE/ CORAL REEF	PATHWAY IS BLOCKED
⚂	 ALAMOSAURUS	FOREST	DINOSAURS BECOME TRAPPED
⚃	 TRICERATOPS	BEACH	A NEST NEEDS TO BE BUILT
⚄	 T-REX	VOLCANO	DINOSAURS CAN'T FIND FOOD
⚅	 MOSASAUR	OCEAN	A BABY DINOSAUR IS BORN

DINOSAUR WRITING EXERCISE

INSTRUCTIONS FOR EDUCATORS:

1. Give each student one die, a "Dinosaur Roll a Story" board, a pencil, and a lined piece of paper to write on.
2. Have students roll their die once for each column to determine their story's character, setting, and event. Allow students to then write and illustrate a creative story, making sure to include the elements that they rolled.
3. After writing, give them a chance to share their story with a partner, class, etc.

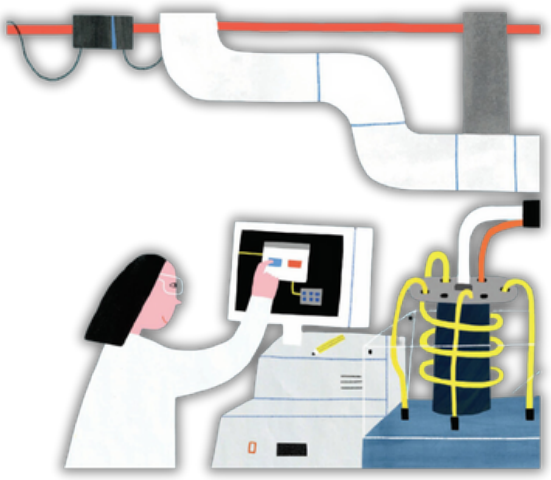
EDUCATORS - CONNECTION TO STANDARDS:

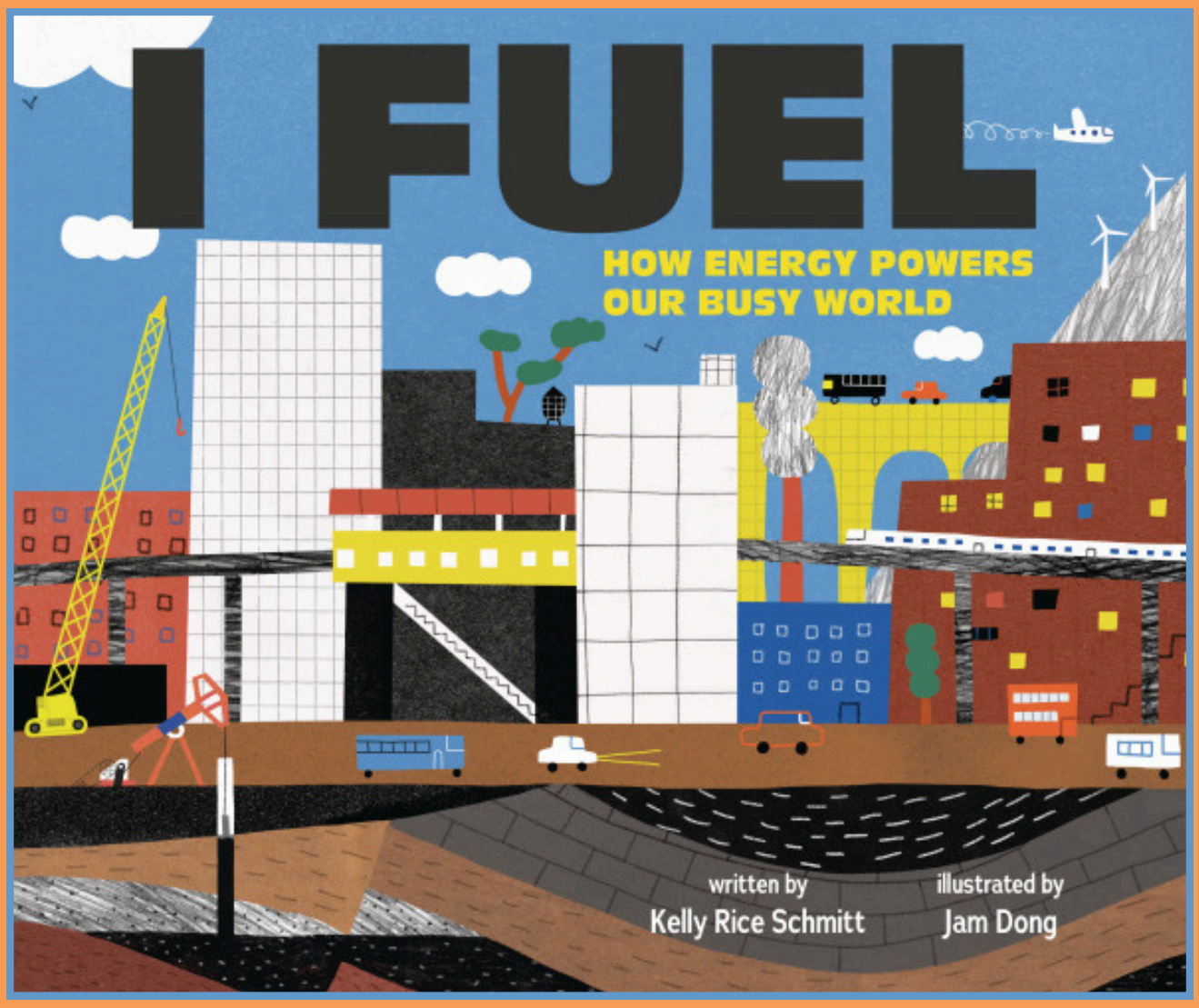
CCSS.ELA-LITERACY.W.K.3: Use a combination of drawing, dictating, and writing to narrate a single event or several loosely linked events, tell about the events in the order in which they occurred, and provide a reaction to what happened.
CCSS.ELA-LITERACY.W.1.3: Write narratives in which they recount two or more appropriately sequenced events, include some details regarding what happened, use temporal words to signal event order, and provide some sense of closure.
CCSS.ELA-LITERACY.W.2.3: Write narratives in which they recount a well-elaborated event or short sequence of events, include details to describe actions, thoughts, and feelings, use temporal words to signal event order, and provide a sense of closure.
CCSS.ELA-LITERACY.W.3.3: Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
CCSS.ELA-LITERACY.W.4.3: Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.
CCSS.ELA-LITERACY.W.5.3: Write narratives to develop real or imagined experiences or events using effective technique, descriptive details, and clear event sequences.

GENERAL DISCUSSION QUESTIONS

1. In today's society we are very dependent on fuel and oil. What are some of the benefits of using these resources? What are some of the downfalls?
2. What has to happen in order to make oil? How do we get the energy from oil?
3. Alternative fuels can be another energy option. What are some examples of alternative fuels? What benefits do they have? What limitations do they have?
4. Do you know what a Carbon Footprint is? How can we minimize our Carbon Footprints?
5. What life-changing tools have been created due to energy and fuel? Have you utilized any of these creations?
6. What's one way you have used oil, fuel, or energy today?

WHAT OTHER QUESTIONS DO YOU HAVE?





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