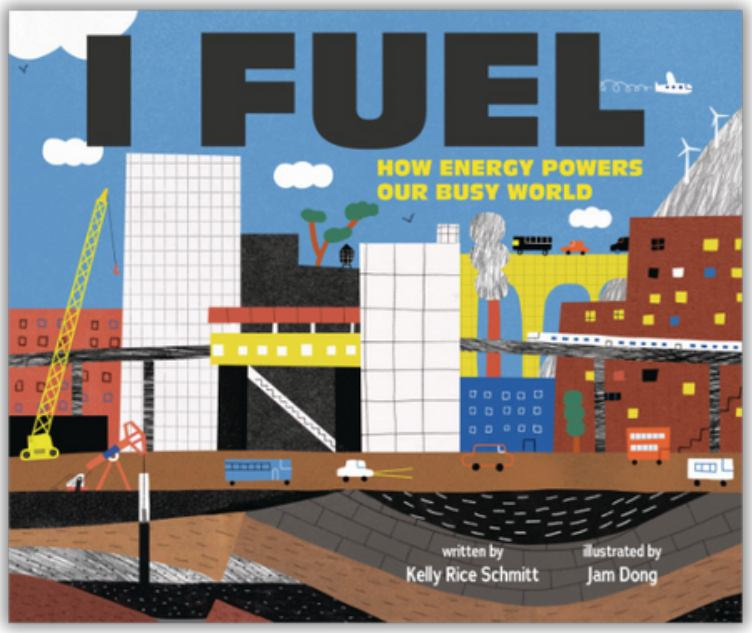

I FUEL

ACTIVITY & EDUCATOR GUIDE

Table of Contents

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.

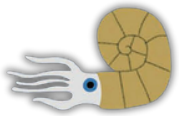
DISCUSSION QUESTIONS:

- 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?

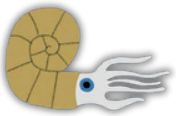
EDUCATORS - CONNECTION TO STANDARDS:

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.

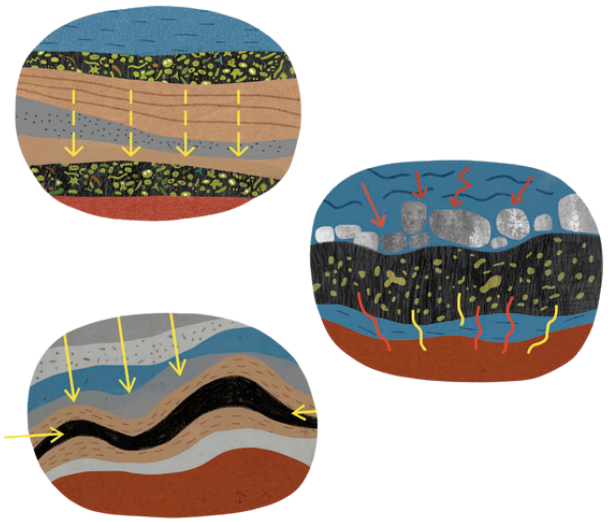
SEDIMENTARY ROCK FORMATION ACTIVITY



"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:

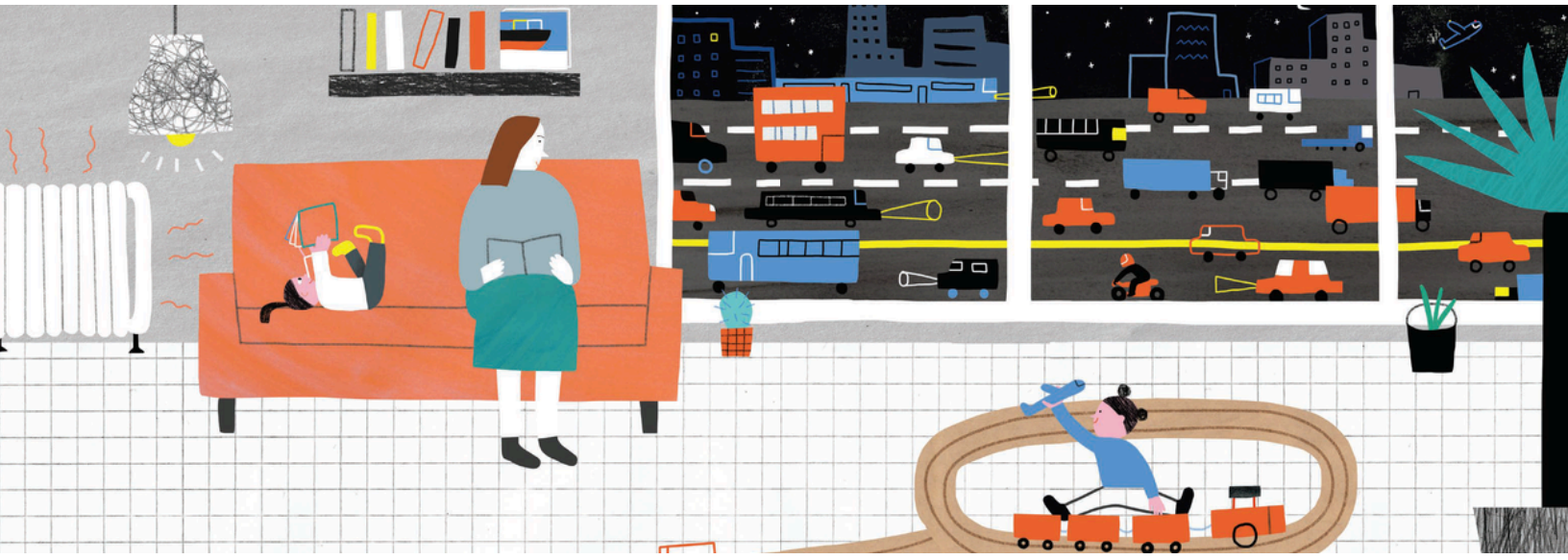
- 2-4 Fruits that are local, currently in season, washed, and prepared in serving sizes
- 2-4 Vegetables that are local, currently in season, washed, and prepared in serving sizes

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

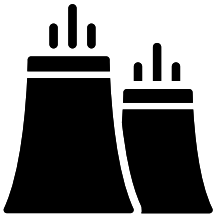
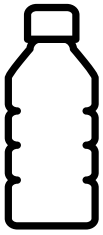
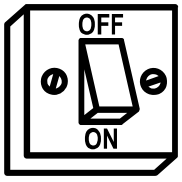
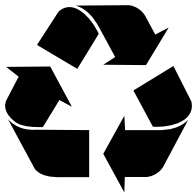
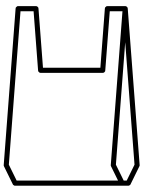
INSTRUCTIONS FOR EDUCATORS

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

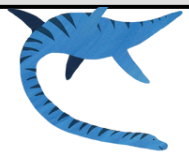
DINOSAUR WRITING EXERCISE

"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.

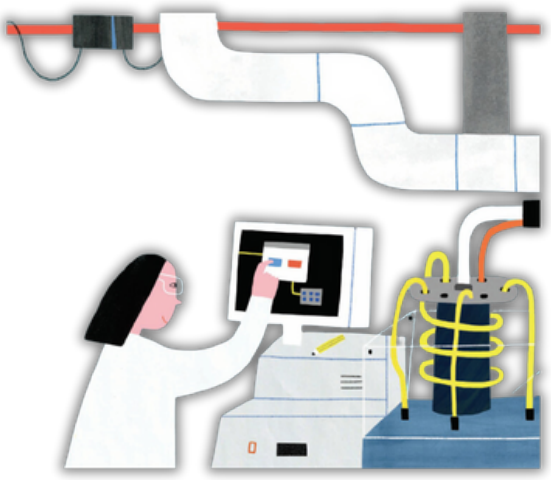
EDUCATORS - CONNECTION TO STANDARDS:

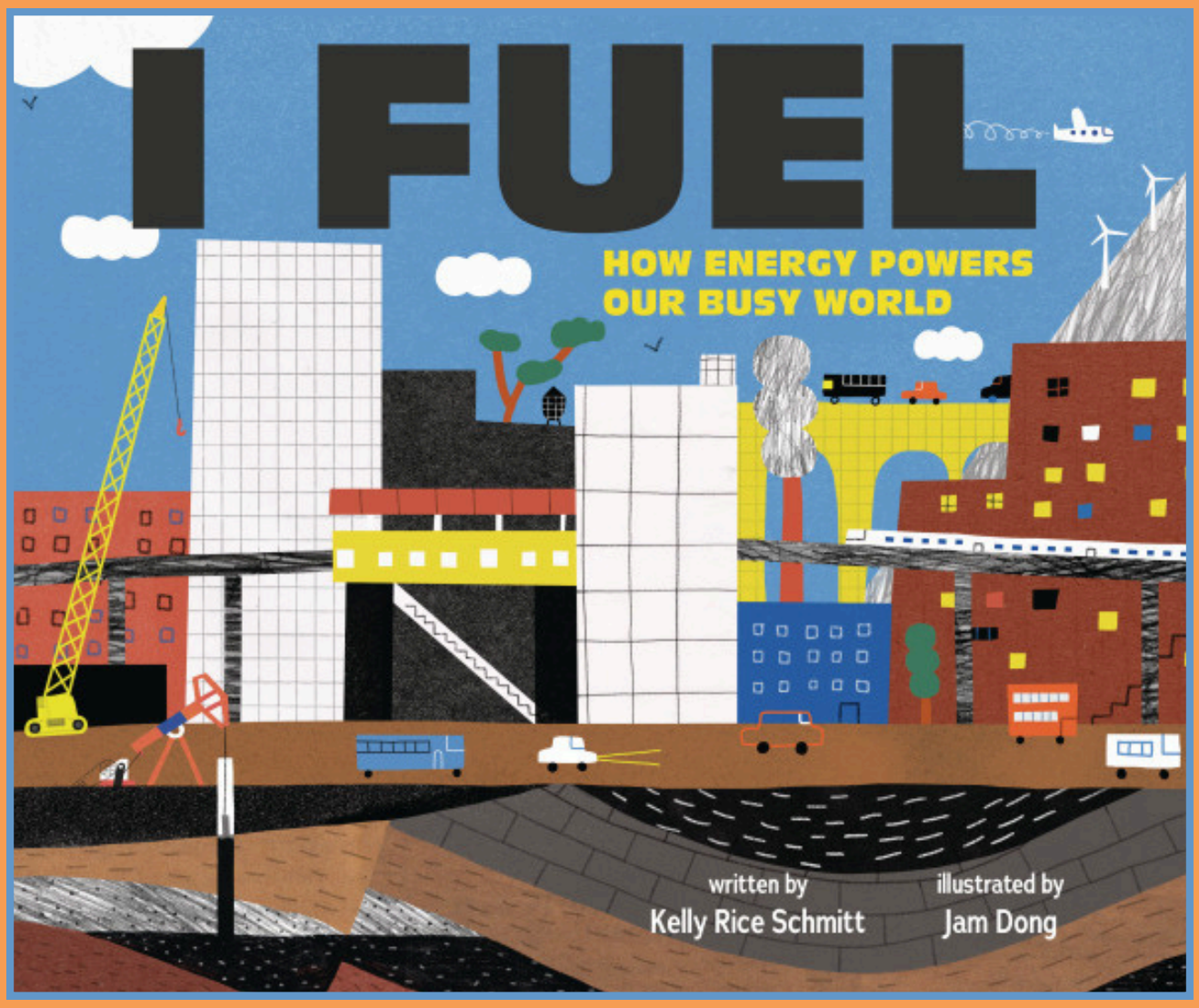
CCSS.ELA-LITERACY.W.K.3: Use a combination of drawing, dictating, and writing to narrate a single event or several loosely linked events, tell about the events in the order in which they occurred, and provide a reaction to what happened.
CCSS.ELA-LITERACY.W.1.3: Write narratives in which they recount 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?





I Fuel: How Energy Powers Our Busy World
Ages 5 - 9 LB: 978-1-7284-7683-4 • $19.99 (list) • $14.99 (S&L)
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Kelly Rice Schmitt is an author of STEAM children's literature and is an advocate for girls in STEM, business, and other fields with gender gaps. She lives in North Carolina with her husband and young children.

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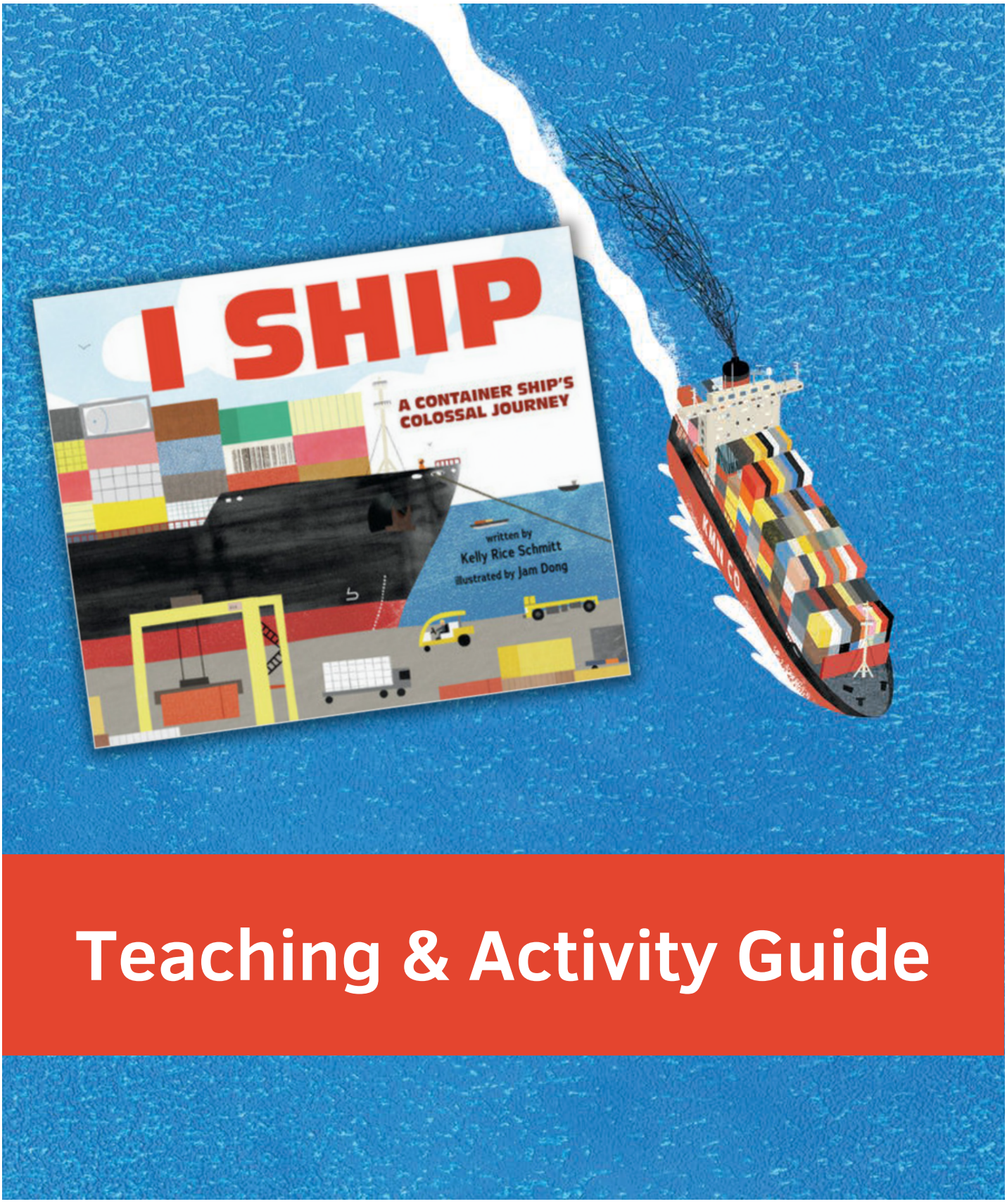
This guide was created by Grace Nowatzke and Kelly Rice Schmitt.



Teaching & Activity Guide

Lerner

This guide was created by Kelly Rice Schmitt

GRADES K - 5

Find Imported Items in Your Home or Classroom

Items imported into the United States and Canada must be clearly marked with where they are made.

With help from an adult, search for imported items. Check tags on clothes and jewelry, labels on food, and art supply containers, stickers on produce, and the writing on the underside of toys. How many countries can you find? Bonus: Look up how far away the countries are from where you live. What item traveled the farthest?

You might see:

- Product of _____
- Made in _____
- Manufactured in _____
- Imported from _____

Figurative Language Used in This Book

This book uses figurative language to enhance the experience for readers. **Figurative language** helps convey emotion and abstract ideas by using the senses and concrete ideas to convey the writer's message and ground readers in the world of the story.

Can you find examples of these in the book?

Alliteration – using words beginning with the same sound near each other in the text
Assonance – using words with the same vowel sounds near each other in text
Consonance – using words with the same end consonant sounds near each other in the text
Onomatopoeia – words that imitate natural sounds
Simile – a comparison of two unlike things using "like" or "as"
Metaphor – using a word or phrase for one thing to refer to another in order to show they are similar
Idiom - an expression that cannot be understood from the meanings of its separate words but that has a separate meaning of its own
Synecdoche - a figure of speech by which a part is used to represent the whole (such as hands for workers) or the whole is used to represent a part.

This guide was created by Kelly Rice Schmitt

Figurative Language Used in This Book – Answers

Alliteration – bobbing buoy; hum and hiss; preparing products for people; containers clang; time ticks; waves whip; sway, spray, swoosh; fuel flows; duty to deliver; heads held high

Assonance – mariners yanks; make my way toward the Cape, a fourteen-day delay; crew is feeling blue; thunder rumbles,

Consonance – checked, packed, and stacked; checks, inspects; vessels amassing, no one passing

Onomatopoeia – chug; honk; swoosh; crack; smack; crash; splash

Simile – the ocean sooths like a lullaby

Metaphor – a drop of color on a canvas of blue; a titan of the sea

Idiom – on our side; make up lost time

Synecdoche – all hands inside

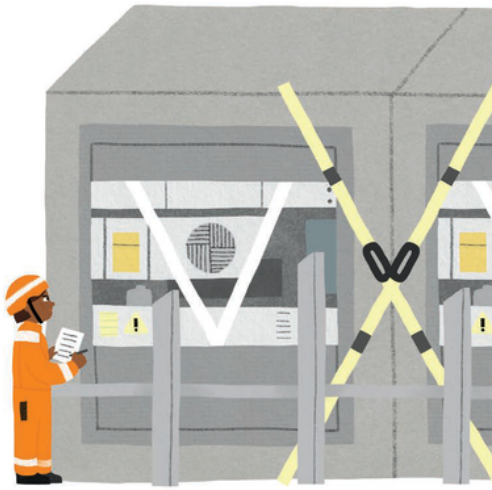
This guide was created by Kelly Rice Schmitt

BUOYANCY EXPERIMENTS FOR GRADES K - 5

Experiment 1: Exploring Density with Modeling Clay

Materials:

- A large clear cup (such as a measuring cup)
- Water
- A small ball of play dough or modeling clay



1. Fill your clear cup about ⅔ full with water.
2. Roll your clay or dough into a small ball.
3. Place it in the water.
4. Observe whether the ball sinks or floats.
5. Remove the ball of clay or dough.
6. Flatten the clay or dough into a bowl shape.
7. Place it in the water.
8. Observe whether the bowl shape sinks or floats.

Things to talk about:

Which object was more dense (full of stuff), the ball or the bowl? Which object sank? Which one floated?

More Information:

In step 4, the ball should have sank, and in step 8, the bowl shape should have floated. This is because the ball is dense and doesn't have a lot of surface area to displace water. Even though the bowl shape is made from the same amount of material, it has added air into it, which lowers its density. It also has more surface area to push aside water, increasing its displacement.

If container ships were made of solid steel, they would be too dense to float. Shipbuilders use a strong steel shell with a hollow core to keep a ship's density low.

This guide was created by Kelly Rice Schmitt

BUOYANCY EXPERIMENTS FOR GRADES K - 5

Experiment 2: Exploring Displacement with Rocks

Materials:

- A sink, large bowl, or bathtub full of water.
- A small plastic bowl
- Enough rocks or marbles to fill the bowl

1. Place the plastic bowl in the water, allowing it to float.
2. Gradually add rocks to the bowl.
3. Keep adding rocks until the bowl sinks.

Things to Talk about:

Why did the bowl float at first? What caused it to sink? Is the bowl denser with or without rocks?

More Information:

The bowl floats because the water the bowl displaces is more than the weight of the bowl. As rocks are added, the weight of the bowl increases, but so does the displaced water. That's because more of the bowl touches the water as the bowl is pushed deeper into the water. When the bowl finally sinks, it is because the weight of the water the bowl pushes aside, or displaces, is now less than the combined weight of the bowl and the rocks.

Notice how the bowl filled with rocks sits much deeper in the water than the empty bowl. On a container ship, this is called being laden. Look at how high the ship is out of the water when its empty at the beginning of the story compared to when it's full on the page that says "Engines ahead!" Can the bowl still float even with lots of heavy rocks in it?

Just like the bowl can still float with lots of heavy rocks in it, a container ship can float with lots of heavy containers in it!

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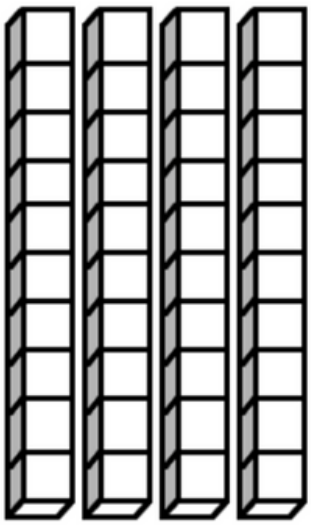
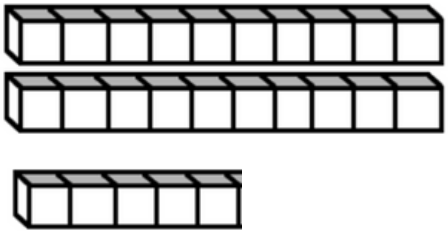
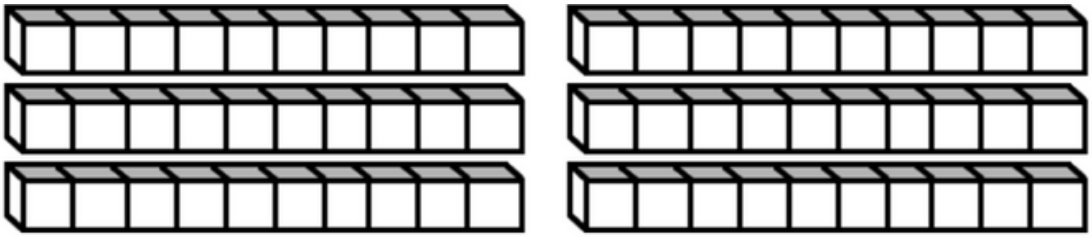
GRADES K - 2

Shipping and Trading STEM Exercises

Container yard base tens
How many containers are stacked?

1. 

2. 

3. 

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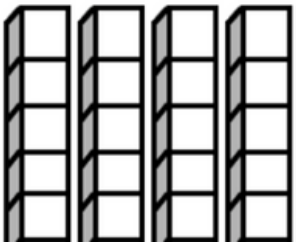
5. 

GRADES K - 2

Exercise 1: Stability

Which stack of containers do you think will be more stable? Why?

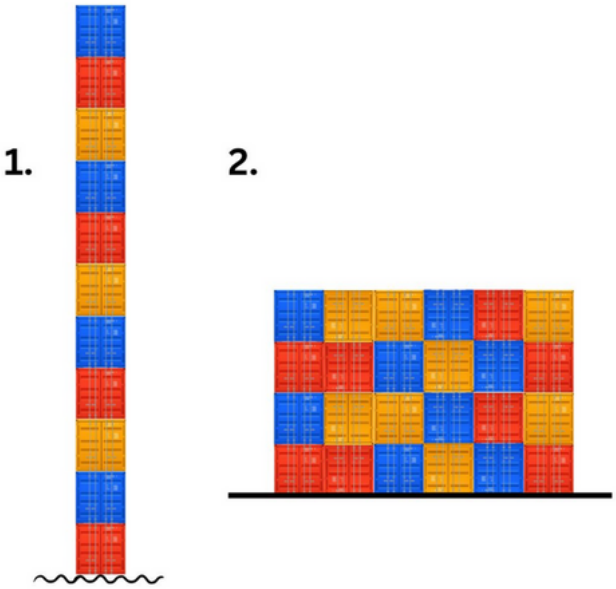
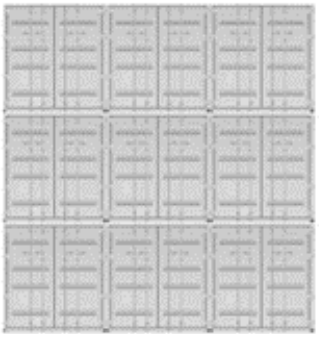


Image credit: macrovector on Freepik.com

Exercise 2: Weight Distribution

The blue containers are very heavy.
The red containers are a little bit heavy.
The orange containers don't weigh very much.



Which containers would you put on the bottom of your stack? Which next? Which would go on top?

Color the blank stack in the order you would stack them. Why did you choose that order?

Discussion Questions

- What are some good things about container shipping?
- What are some problems with container shipping?
- How would the world be different if we didn't trade with other countries?
- Do you think working on a container ship and living at sea would be difficult? Why or why not?

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GRADES 3 - 5

Shipping and Trading STEM Exercises

Import or make locally?

Math comparing costs of production + shipping.

1. Country A can grow apples for $2.00 per pound.
   Country B can grow apples for $1.00 per pound.
   The cost to ship apples from Country B to Country A is $0.50 per pound.

Should Country A import apples from Country B? Why?

_____

_____

2. Country A can grow apples for $2.00 per pound.
   Country B can grow apples for $1.00 per pound.
   Costs of fuel have gone up. Now the cost to ship from Country B to Country A is $1.50 per pound.

Should Country A import apples from Country B now? Why?

_____

_____

3. Country A had a harsh winter, and many apples were ruined. There are less apples to harvest this year, so the cost of Country A's apples has risen.

Country A can grow apples for $4.00 per pound.
Country B can still grow apples for $1.00 per pound.

Costs of fuel have gone up even more. Now the cost to ship from Country B to Country A is $2.00 per pound.

Should Country A import apples from Country B now? Why?

_____

_____

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GRADES 3 - 5

How Does Container Shipping Reduce Costs for Customers?

Containers help customers fit as many goods as possible into one ship. Inside each container, shippers neatly pack their items tightly together, filling the container with as many items as possible. Then, because containers are a standard size, like building blocks, each full container can be neatly stacked with the others to make a tower that fills all the available space on the ship.

Before container ships, all types of different sized goods were packed together into the cargo hold of the ships, but they were not able to stack neatly on top of each other. This wasted a lot of space. Using containers allows more goods to fit into the same cargo holding area. Because more items will make the journey across the water, the cost to move each item is lower than it would be if the ship wasn't as full.

It's kind of like carpooling. The cost to drive a car from one place to another is the same, whether your car has 1 person in it or is full. But if you look at the cost for each person to take that ride, the cost is lower per person when the car is fuller. The same people go to the same place, but the cost is shared between more people.

Maximizing Space Activity

Materials:

- A medium or large rectangular-shaped container with a lid
- Plastic building blocks that fit together, such as Lego Duplo bricks. Gather more than you need to fill the container. (This works better with blocks that are medium sized rather than the smallest sized Lego blocks.)

1. Separate all blocks so none are attached.
2. Randomly dump as many blocks as will fit into the container. You must be able to fit and close the lid onto the container.
3. Once you have filled the container, remove the lid and the blocks. Count how many blocks you fit into the container. Write down this number and call it "Old Way of Shipping".
4. Now, fill the container again, but this time, join blocks together into rows that fit neatly into the container. Make sure the lid can close.
5. Once you have filled the container, remove the lid and the blocks. Count how many blocks you fit into the container. Write down this number and call it "Container Shipping".

Observe which method of filling your container, or "shipping" fit more blocks into the container.

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GRADES 3 - 5

Maximizing Space Math Example

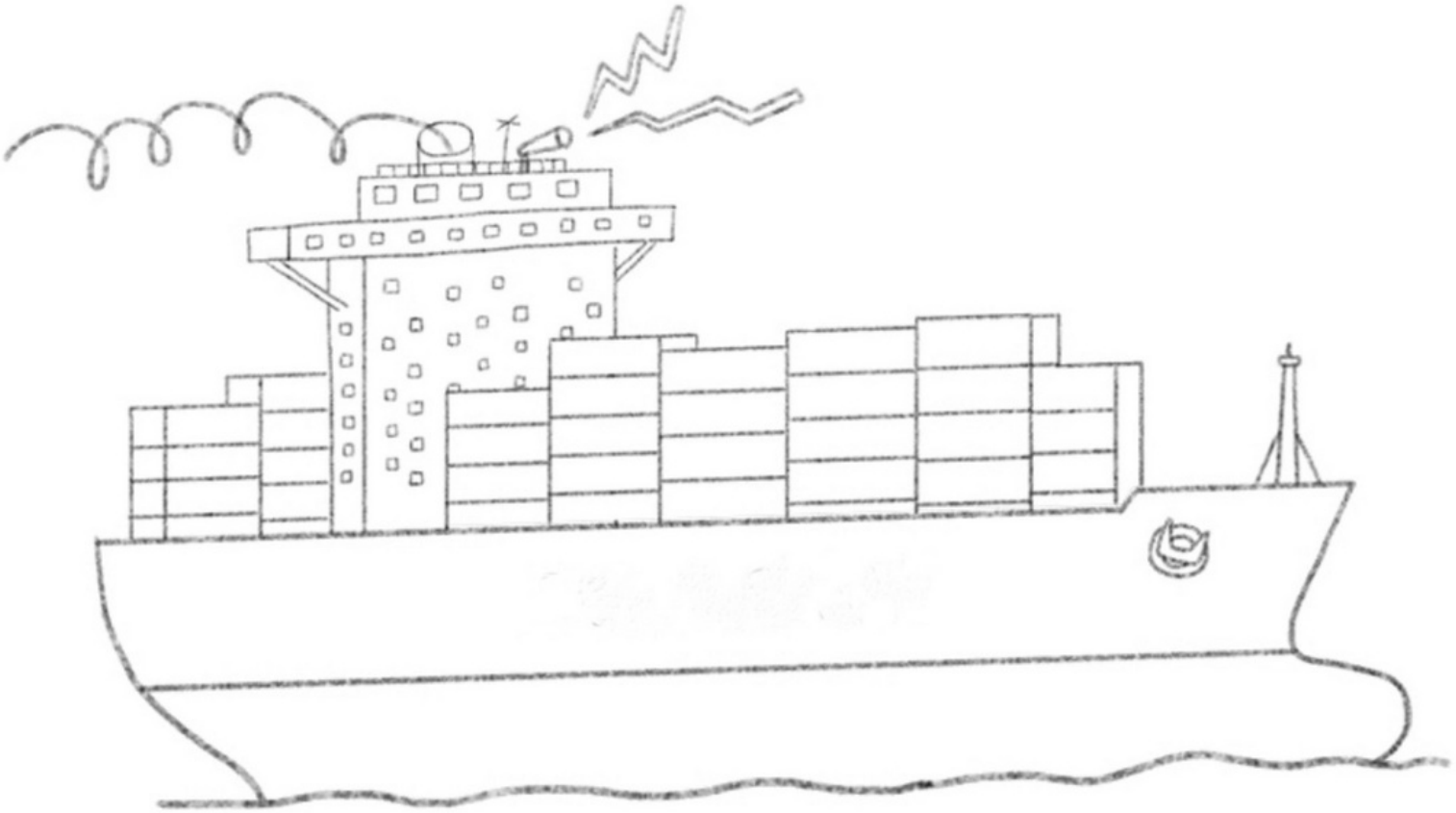
Ship A is fully loaded with 20 containers.
Ship B is partially loaded with 15 containers.
A voyage from the USA to Spain costs $300 for both Ship A and Ship B.

What is the cost per container for Ship A and Ship B? _____
Which ship has a lower cost per container? _____
Does how full a ship is affect the cost per container? _____

Discussion Questions

- Discuss the benefits and challenges of container shipping.
- How did international trade change how countries work together?
- How would the world be different if we didn't trade with other countries?
- Can you think of a reason why a country wouldn't want to trade with another?
- What do you think it would be like to work on a container ship and live at sea for long periods of time?

Name: _____



What is your ship's name? _____

Where is it going? _____

What country is it coming from? _____

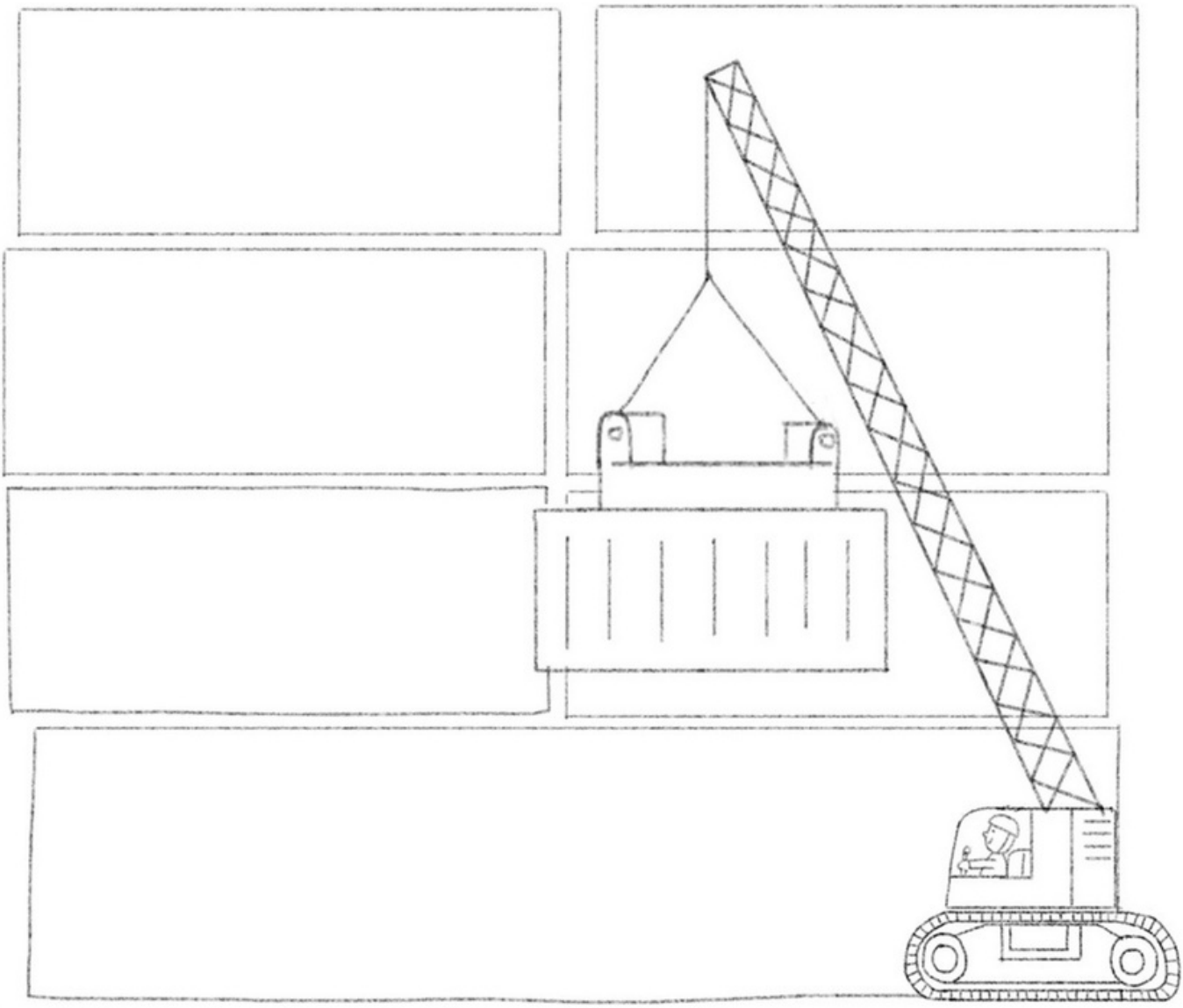
What is it carrying? _____

Name: _____

Fill the containers! What items will you choose?

_____

_____

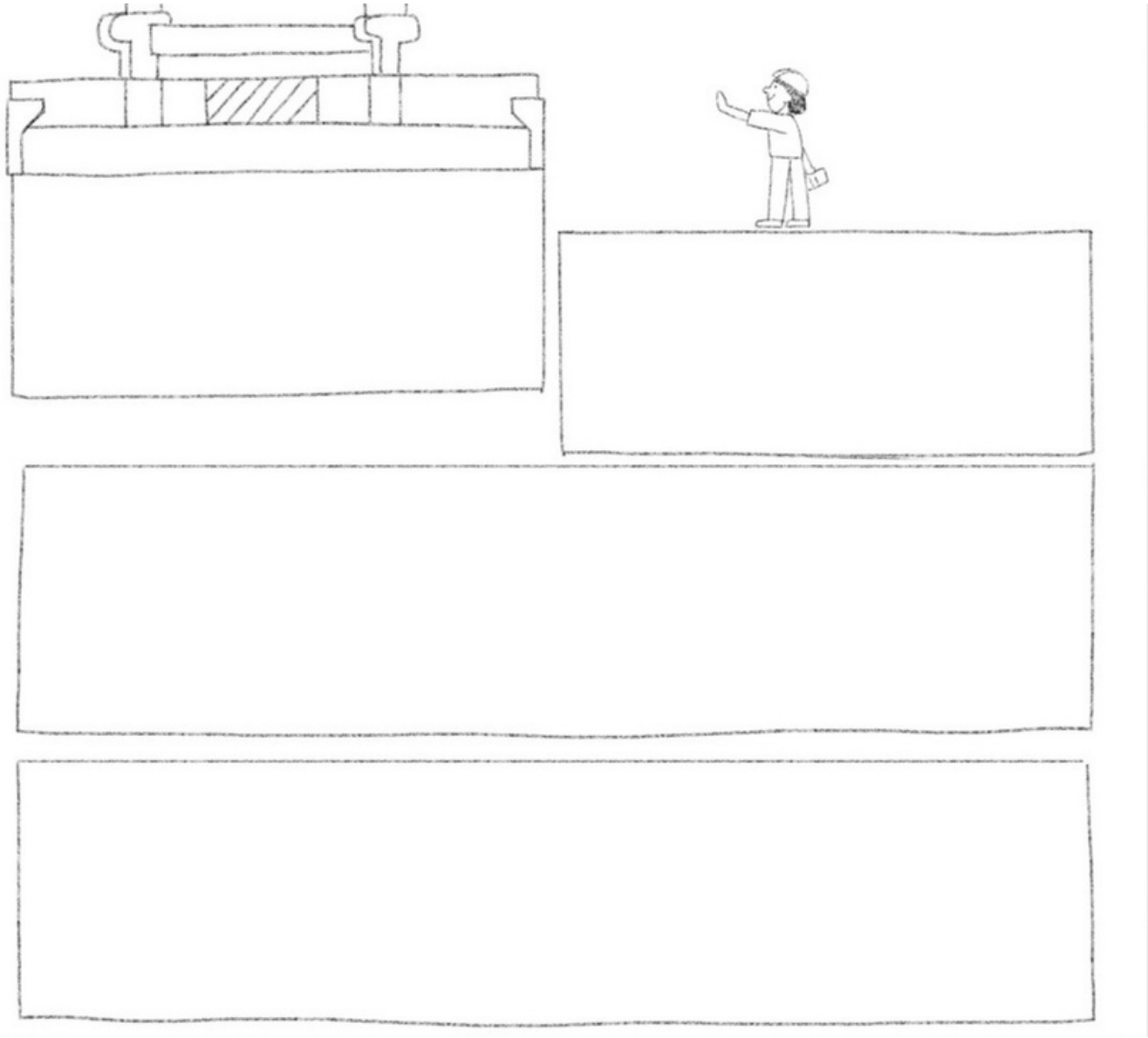


Name: _____

Fill the containers! What items will you choose?

_____

_____



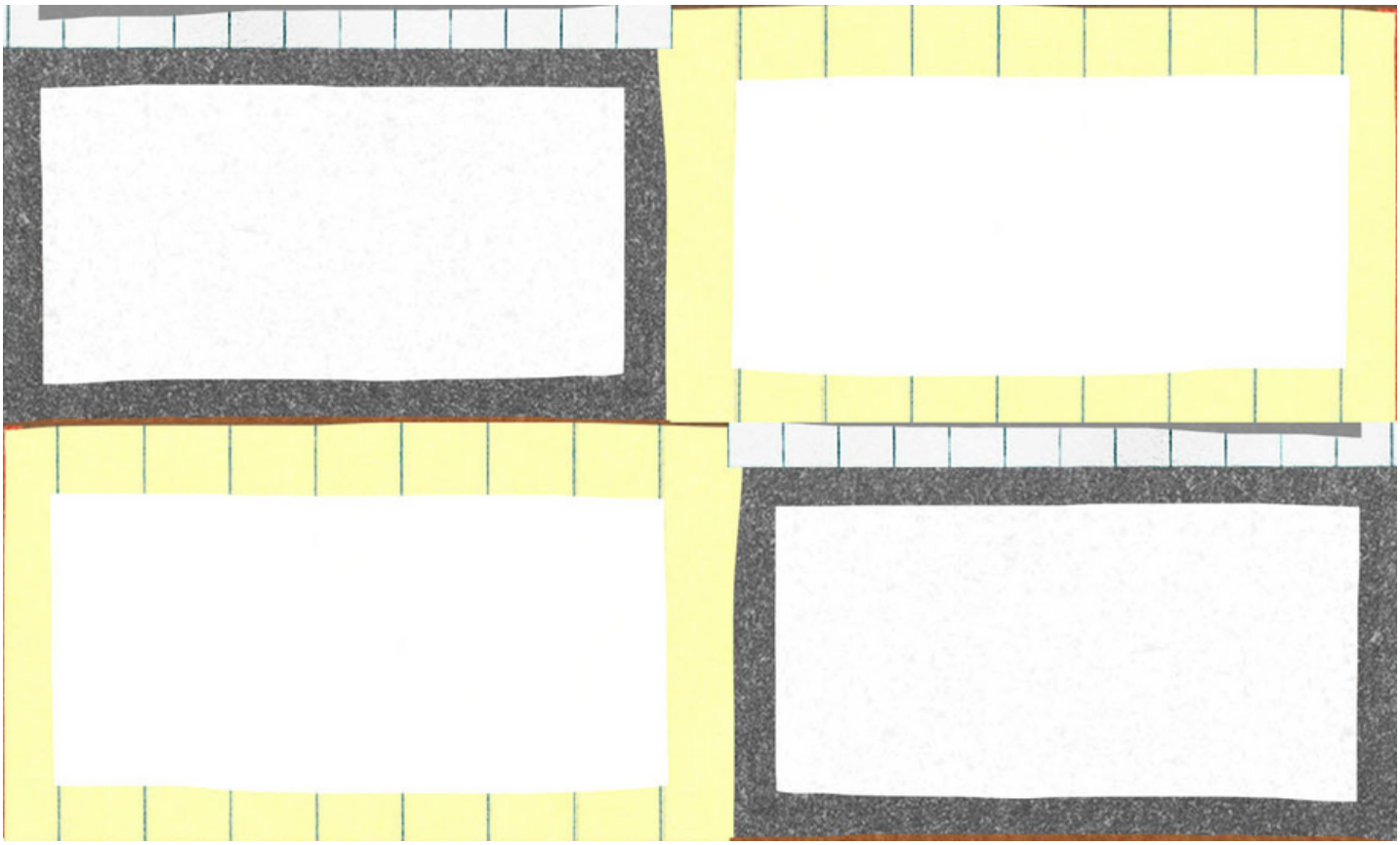
Name: _____

What would you fill a ship with?

_____

What countries would your items come from?

_____



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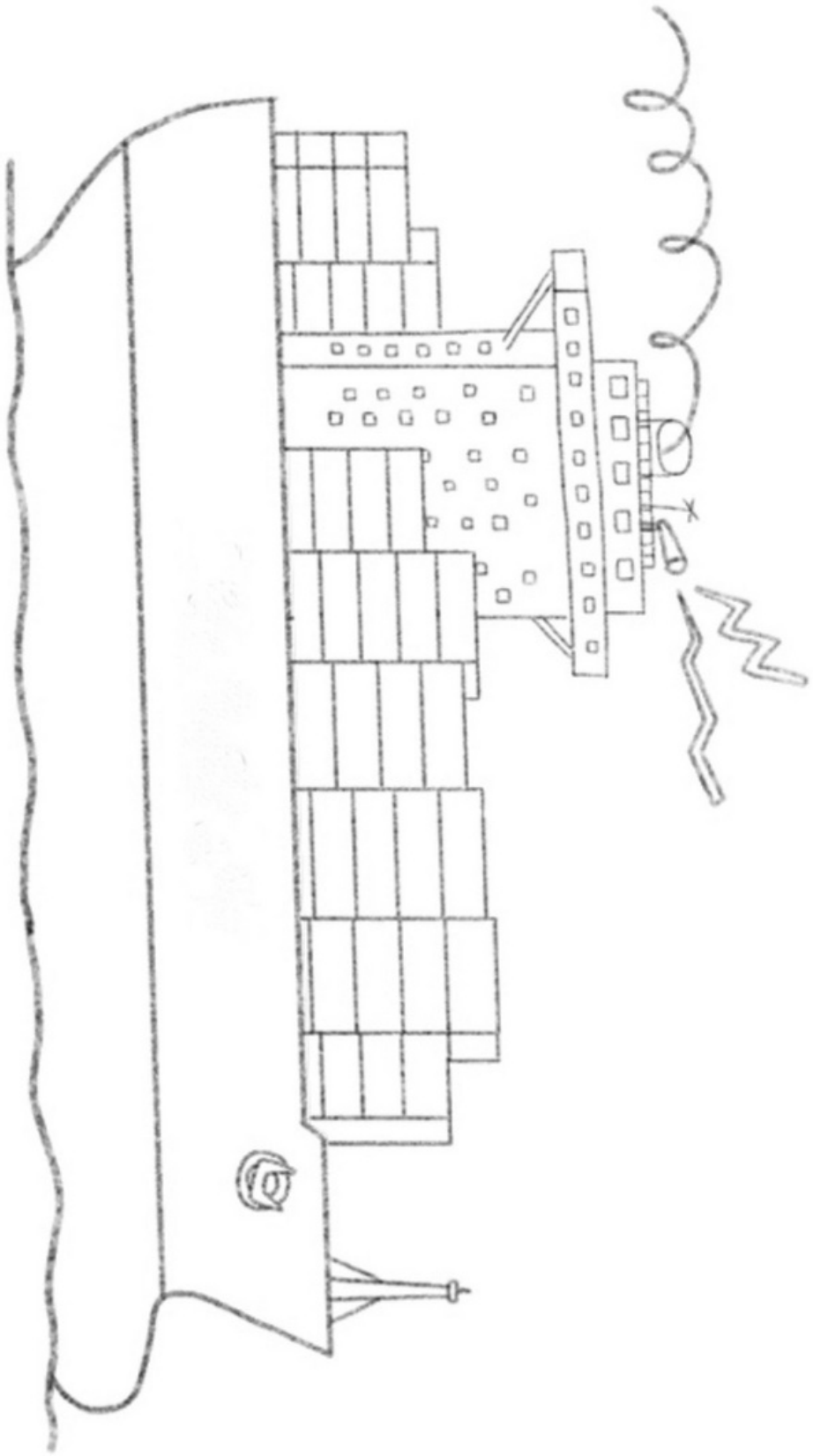

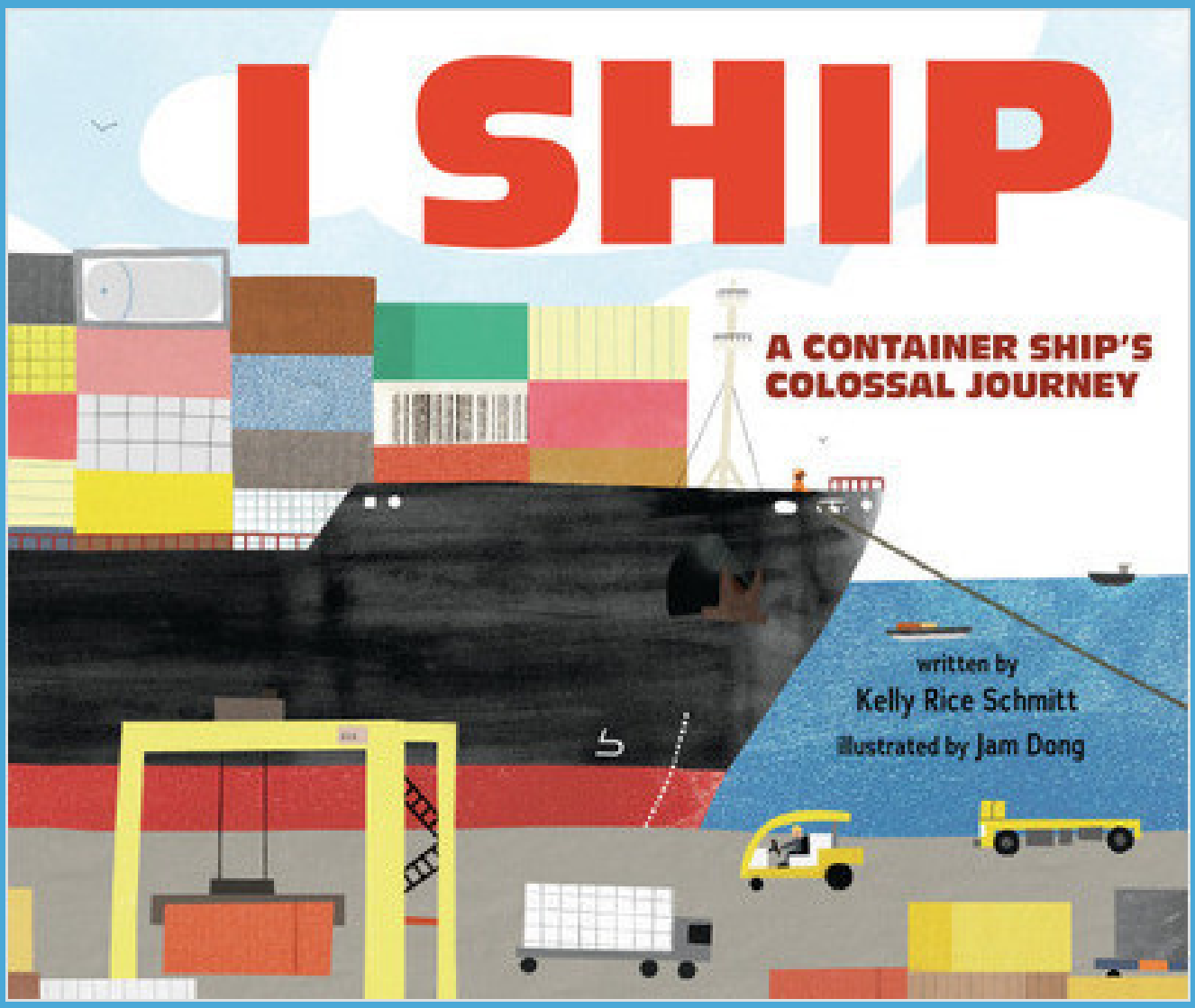

I Ship: A Container Ship's Colossal Journey

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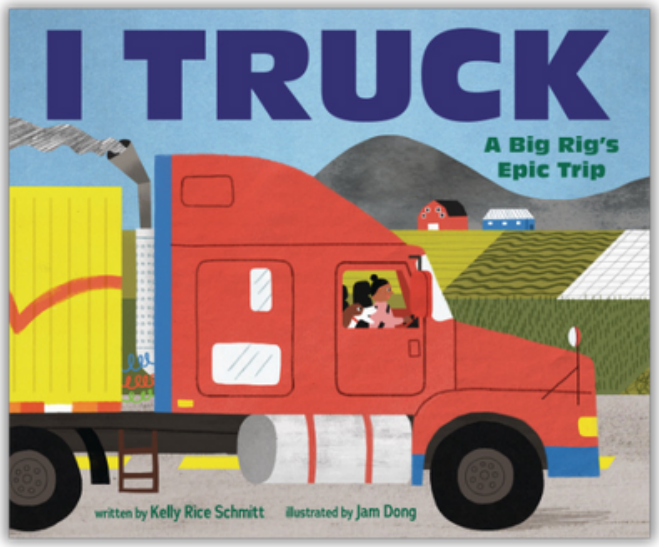
Jam Dong was born in Shanghai, China. She has an MA degree of Moving Image at University of Arts London and graduated from MFA Illustration Practice of Maryland Institute College of Art in 2021. She likes to use bright colors and simple shapes to build the imaginary world inside her mind. The nature provides her with ultimate inspirations all the time. She is a freelance illustrator based in Boston, US.



I TRUCK

ACTIVITY & EDUCATOR GUIDE

Table of Contents

This guide was created by Grace Nowatzke and Kelly Rice Schmitt

Lerner

TOY LOADING & WEIGHT SORTING

"Our trailer is waiting, and everyone's eager to load up. We'll be carrying . . . TOYS!"

Proper loading is essential for safety and efficiency in trucking. In this hands-on activity, students step into the role of a truck loader to explore how estimation, weight, and size affect how a truck is packed.

WHAT YOU NEED:

- Boxes
- Toys of various sizes and weights
- Optional: scale

SET UP:

1. Find an area in your classroom that you can use as a pretend "loading dock." Each group will have a box to represent a semitrailer.
2. Instruct students that the goal is to load their trailer efficiently, as if preparing it for a long haul delivery.
3. Have students start by observing their trailer and the "cargo" available.
4. Instruct students to estimate how many toys will fit into the box. The toys must not be sticking out or falling over the edges.
5. Have them write down the number of toys in their science journal or on another sheet of paper.
6. Optional: If using a scale, have them also estimate the total weight of their loaded trailer.
7. Have students pack their toys into the trailer in a way that keeps the trailer balanced, stable, and refrain from over-filling.
8. Once the trailer is fully loaded: Students count the total number of items that fit.
9. Optional: Use the scale to determine the actual weight.
10. Have students write down the actual numbers and weight.
11. Then have students compare this data to their original estimates.

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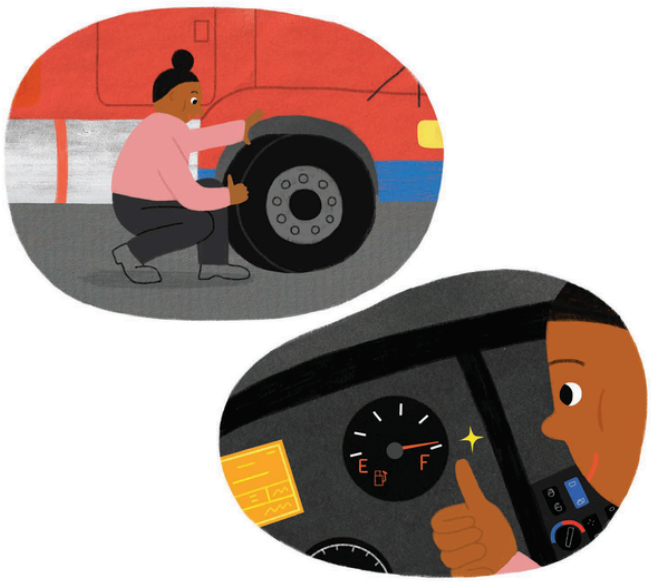
DISCUSSION QUESTIONS:

- Why do you think a real truck driver has to think about weight when loading?
- What happens if the truck is too full or unbalanced?
- Which toys were heavy but small? Light but large?
- Was your estimate too high? Too low? Or just right?
- Is it easier to load the heavy objects or lighter objects first? How about size? Does it matter if you load the bigger objects vs the smaller first?

EXPLORE THE SCIENCE:

Before a truck begins its big journey, it gets loaded with all kinds of toys or goods. But loading a truck isn't as simple as just tossing things in. It takes careful planning! In this activity, you're learning how to make smart choices about how much will fit and where things should go. This is called **optimization**. Optimization is finding the best way to do something. Real truck drivers and warehouse workers have to think about weight, balance, timing, and space. Their goal is to keep the truck and drivers safe and on time, while also efficiently distributing the weight, so that everything arrives undamaged.



EDUCATORS – CONNECTION TO STANDARDS:

K.MD.A.1 – Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.
K.MD.A.2 – Directly compare two objects with a measurable attribute in common, to see which object has "more of" or "less of" the attribute, and describe the difference.
4.MD.A.1 – Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz; l, ml; hr, min, sec. Express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.
5.MD.A.1 – Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems.
K-PS2-1 – Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
2-PS1-1 – Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
3-PS2-1 – Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
ELA (W.K.2, SL.1.1): Describing observations and sharing reasoning.

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TRUCK LOAD GRAPHING

"Beep-beep-beep. Twist, click, connect!
Now I'm a big deal—a giant on eighteen wheels."

Practice classification, counting, graphing, and organizing visual data in this hands-on simulation of loading a semitruck. Give your students a chance to place cargo correctly and keep their truck running safely and smoothly.

WHAT YOU NEED:

- Printed outline of a semitrailer side view
- Printed and cut out pictures of various toys/items (You can use pre-cut or laminated sets, printable sheets, or magazines)
- Glue
- Editable bar graph (with room for at least 4-6 groups)
- Paper or notebook
- Writing utensil

SET UP:

1. Provide students with a variety of cut-out images of toys or cargo items (e.g., blocks, balls, bikes, books, dolls, etc.), a printed side-view outline of a semitrailer truck, and a bar graph.
2. Instruct students to "load" their semi by carefully gluing their cargo pictures inside the trailer outline. Emphasize that items must not overlap and everything should be visible, just like in a real cargo manifest or inventory.
3. Once their truck is loaded, instruct students to count how many of each item they have and tally or write their totals on a paper.
4. Using their collected data, have students fill in their bar graph to reflect their semitrailer stats. (Have students label the cargo category on the x-axis and the quantity on the y-axis.)
5. Follow up with discussion questions to compare quantities.

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DISCUSSION QUESTIONS:

- Which item did you load the most?
- Who had the most of one item?
- Whose truck had the most variety?
- What would happen if your real truck only had one kind of cargo?
- Do you think it's important to have variety?

EDUCATORS - CONNECTION TO STANDARDS:

K.MD.B.3 Students classify objects into given categories, count the number of objects in each category, and compare the quantities between groups.
1.MD.C.4 Students organize, represent, and interpret data with up to three categories; they ask and answer questions about the total number of data points, how many are in each category, and how many more or less are in one category than another.
2.MD.D.10 Students draw a picture graph and a bar graph to represent a data set with up to four categories; they solve simple put-together, take-apart, and compare problems using information presented in the graphs.
3.MD.B.3 Students draw a scaled picture graph and a scaled bar graph to represent a data set with several categories, and solve one- and two-step problems using information presented in these graphs.
4.MD.B.4 Students make a line plot to display a data set of measurements in fractions of a unit and use addition or subtraction to solve problems involving the data.
5.MD.B.2 Students make a line plot to display data sets of measurements in fractions of a unit and use operations on fractions to solve problems involving the data.

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WHAT'S THE LIMIT?

"Skyline in the rearview, we're making excellent time. Then Driver groans. Weigh station ahead."

Students will have the opportunity to become freight loaders and ensure their own semitrailer can make it through the weigh station, just like the book. Their goal is to get as close as possible to the weight limit without going over, through careful planning and execution.

WHAT YOU NEED:

- Small cardboard boxes
- Toys or various classroom objects of various weights
- Scale that will work with boxes
- Notebook or paper to record data
- Writing utensil

SET UP:

1. Use the scale to create a designated weigh station.
2. Provide each student or group a cardboard box to act as their semitrailer.
3. Assign the class a weight limit (example: 20 pounds).
4. Have your students use the selection of toys or other classroom items to begin filling their trailer.
5. Allow students to periodically make their way to the weigh station to measure the total weight.
6. Have students work until they have gotten as close as possible to the weight limit without going over.

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7. Encourage students to use estimation, trial and error, and collaboration as a group to exchange, rearrange or replace items to meet the goal.

8. Once each group has finished, compare data points and see which student or group was able to get closest to the desired weight.

9. After they have graphed and compared, have each group select one item from their load and bring it to the teacher.

10. As a class, weigh each individual item and write down the weight.

11. Have students complete mathematical problems using addition and subtraction.

EXAMPLE PROBLEMS:

FOR SECOND TO THIRD GRADERS

a. "How much would the load weigh if we had toy A + toy B in the container?"

b. "How much would the load weigh if we loaded all the toys together?"

c. "How much would the load weigh if we loaded all the toys together except toy B?"

FOR FOURTH GRADERS

a. "How much would the load weigh if you had two of toy A + three of toy B in the container?"

b. "How much would the load weigh if you loaded all the toys of together? What would it weigh if you only wanted one fourth of that?"

DISCUSSION QUESTIONS:

- Which student or group got the closest to the desired weight?
- Which items felt too heavy or took up too much space?
- How many times did you have to go to the weigh station before you loaded the trailer correctly?
- What strategies did you use while loading the trailer?
- Would loading freight on a trailer be an easy or complicated job?
- If you were driving a semitrailer, would you get worried about going through weigh stations?

EXPLORE THE SCIENCE*:

When semitrucks drive on the roads, they put pressure on the surface beneath them. The heavier the truck is, the more force it pushes down with. If a truck is carrying too much weight, it could cause stress on bridges, damage roads, or become a safety issue. That's why trucks go through weigh stations. Scientists and engineers have figured out safe weight limits so that trucks don't wear out the roads too quickly or break bridges with too much weight. Weigh stations help determine if a truck is within limits and are an important stop on a truck's journey.

**Teacher's Note: This Explore the Science principle applies to both the "What's the Limit?" activity and the "Build a Bridge" activity.*

EDUCATORS - CONNECTION TO STANDARDS:

2.OA.A.1 / 3.OA.D.8: Solve word problems with addition/subtraction.
3.MD.A.2: Measure and solve problems involving weight/mass.
4.MD.A.2: Use the four operations to solve measurement problems.
K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
K-3-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple design problem.

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BUILD A SUPPORT BRIDGE

"Too much weight and bridges could break. Fail the test, and we'll fall behind."

Do you wonder how much weight a bridge could hold? Using simple materials students will test the limit of their very own bridge in this engaging activity!

WHAT YOU NEED:

- Popsicle sticks
- Tape
- Small bin or cup
- Cubes, toys, or various weighted items that fit in the bin

SET UP:

1. Decide if students will be working in groups or as a class to complete this activity.
2. Use the popsicle sticks, tape, and two chairs to set up a bridge. Place two strips of tape from chair to chair with sticky sides facing to the ground. Note to adults: A real bridge would not be designed with the sticks on the bottom, but it allows the bridge to easily fail without requiring too much weight and a possibly dangerous collapse. The type of tape used will affect how strong the bridge is. Masking or scotch tape will break faster than duct tape. For older students, the experiment can be altered to challenge students to make the strongest bridge and allow them to create it themselves. See end of experiment for more ways to enhance this activity for older students.
3. Place the popsicle sticks on the sticky side of the tape to form the bridge.
4. Choose a student or group to place the small bin on the bridge. Ensure students are a safe distance from the bridge so no one gets hurt when the bridge collapses.
5. Observe how the bridge is holding up with just the bin.
6. Slowly take turns adding items to the bin.
7. Observe the bridge and how it changes over time.
8. Add items to the bridge until it can no longer bear the weight of the box. Remember to keep a safe distance from the bridge as the weight increases.
9. Observe what happens to the bridge, box and items once it collapses. Follow up with discussion questions about why weight matters and how important weight stations are.

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EXTRA CHALLENGES:

For Older Students

1. Open up a discussion about what measurement units you would use with weight.
2. Weigh the bin.
3. Discuss what measurement units you need to use to label the weight of the final bin.
4. Why wouldn't you want to measure it just in ounces? Why are pounds important?
5. How many ounces are in a pound? If we only used ounces to label the weight, how many ounces would it be? (Help them convert pounds to ounces.)
6. Are there any other measurement units that would be relevant to weight? (example: kilograms, grams)
7. If your scale allows, weigh the bin in grams.
8. Have your students convert grams to kilograms.

DISCUSSION QUESTIONS:

- How much weight do you think the average bridge can hold?
- Why is it important to weigh semitrucks?
- What would happen if we didn't have weigh stations?
- Do you think other drivers should have to be conscious of how much their vehicle weighs? Why or why not?
- How much weight do you think your popsicle stick bridge held?
- Did you expect the popsicle stick bridge to hold more or less than it did?

EDUCATORS – CONNECTION TO STANDARDS:

K-PS2-1 Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.
2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
4.MD.A.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.
5.MD.A.1 Convert among different-sized standard measurement units and use these conversions in solving multi-step problems.

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WHAT ROAD IS BEST?

(DRY VS. ICE VS. SNOWY ROADS)

"I press on in the chilly rain with traffic, stop-and-go, and cruise along in sunshine, free on open country roads."

Students will explore different road conditions and how they affects a truck's ability to drive. Just like real truck drivers have to be careful on icy roads, students will test how far a truck slides on different surfaces and compare the results.

WHAT YOU NEED:

- 3 trays or sheets of cardboard
- Instant snow or 1-2 lbs baking soda, 1 can foam shaving cream, a bowl, and spoon to make pretend snow. The ratio is about 4 oz shaving cream per 1 lb baking soda.
- Paper
- Sheet of ice (ex. frozen water on a baking sheet)
- A toy truck (you could also sub a remote control car/truck)
- Ruler or measuring tape
- Marker to mark distances on cardboard or trays

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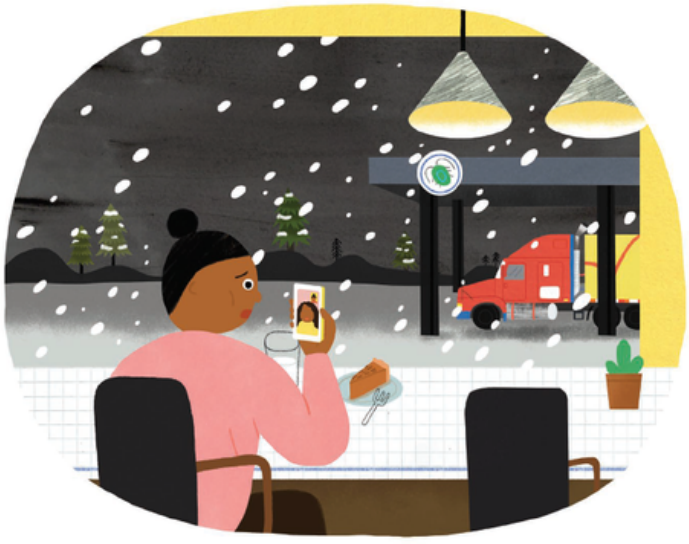
SET UP:

1. If making your own snow, pour 1 lb baking soda into the bowl. Add half the shaving cream can (~4 oz) and mix. Adjust quantities as needed to create your preferred texture.
2. Place your 3 different trays or cardboard pieces on the floor in a flat area to act as your roads. Leave space in between each one.
3. Prepare each surface. Start by spreading the snow on one surface.
4. Place your ice on the second surface.
5. Place some paper on the third surface as the "dry road" or leave the third surface blank.
6. Have students make predictions about what surface will be easiest to drive on. Which one will be the hardest? And which surface will help the truck go the farthest?
7. Place the toy truck on the first surface (with snow). Push and release the toy truck in the snow.
8. Observe how it drove. Was it easy or hard? How far did it go? Measure the distance and mark it.
9. Next take the truck to the icy surface. Push and release the truck on the ice.
10. Observe how it drove. Was it easy or hard? Were the conditions on the ice better or worse than the snow? Why? How far did it go? Measure the distance and mark it.
11. Next take the truck to the dry surface. Push and release the truck on the dry surface.
12. Observe how it drove. Was it easy or hard? Were the conditions of the ice, snow, or dry surface best? Why? How far did the truck go? Measure the distance and mark it.
13. Compare your observations to your predictions.
14. Have a discussion about the different surfaces, keeping trucks safe in different conditions, etc.



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DISCUSSION QUESTIONS:

- Did the truck go farther on one surface than another? Which one did it go farthest on?
- Which surface was the hardest to drive on?
- Which surface is the safest to drive on? Should truck drivers pull over if weather conditions become unsafe
- Was it easier or harder to control the truck on different surfaces? Why? Is having control important?
- Why do you think the truck slid more or less on each surface?
- Which surface had the least amount of friction? The most?
- What could truck drivers or others helping the roads do in the winter to keep roads safe?

EXPLORE THE SCIENCE:

Truck drivers need the right amount of friction to stay safe while driving. You might be wondering what friction is. **Friction** is a force that happens when two things rub together, such as a truck's tires on the road. When a surface is rough, like a dry road, it creates more friction, helping trucks to drive and stop safely. However, when a surface is smooth or slippery, like snow or ice, there is less friction, making it harder for trucks to stop. That's why winter roads are so dangerous!

EDUCATORS – CONNECTION TO STANDARDS:

2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
K.MD.A.2 Directly compare two objects with a measurable attribute in common, to see which object has "more of"/"less of" the attribute.
2.MD.A.1 Measure the length of an object by selecting and using appropriate tools.
SL.1.1 – SL.3.1 Participate in collaborative conversations with diverse partners about grade-level topics and texts with peers and adults.

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ICE VS. SALT EXPERIMENT

"With salty streets and clear skies, westward we drive!"

In the story the truck drives through snow and ice just like real trucks would in the winter! But what happens to the icy roads when workers put salt on them? In this experiment we will observe how salt changes the melting of ice.

WHAT YOU NEED:

- 2 trays per group
- Ice cubes
- Salt
- 1 scoop per group (ex. 1/4 cup measuring cups or tablespoons)
- Timer that can record 2 different times simultaneously.
- Notebook or paper to record observations
- Writing utensil

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SET UP:

1. Grab both of your trays and place them where your students can observe OR give each student two trays.
2. Place a few ice cubes on each of your trays. Begin the timer for each tray.
3. Designate one tray as the salt tray and one tray that will stay as ice only.
4. Have students observe the properties of their ice. Over the experiment, they will observe as the ice on each tray melts.
5. If students are participating on their own, have them each dump 1 scoop of salt onto the tray they designated as the "salt tray."
6. If doing this as a class, the teacher will pour 1 scoop of salt onto the tray while students observe from their desks.
7. Pause and observe what happens. Encourage students to touch, smell, listen, and visually compare the two different trays. Remind children this experiment is not for tasting. Take a few minutes to write down your observations.
8. Pour a second scoop of salt onto the salted ice. Wait for a few minutes and then observe again. Continue leaving the other tray alone.
9. Watch as the ice continues to melt.
10. Continue pouring salt onto the ice in intervals and observing in between.
11. Pay attention as the ice on each tray is nearly all melted and be sure to stop each timer at the point when it has fully melted. Have students compare the melt times. Which tray melted faster?

DISCUSSION QUESTIONS:

- What did you see, smell, or feel that was the same between the two trays? What was different between the two trays?
- Which ice tray melted faster?
- Why do you think one melted the ice faster?
- How can this knowledge help cars and trucks drive more safely in the winter?
- What would happen if roads stayed icy in the winter?
- Can you think of anything else that would help ice melt?

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EXPLORE THE SCIENCE:

When we sprinkle salt on ice, the ice melts faster! Why? Because salt lowers the freezing point of water, which means it remains a liquid at the temperature at which it would usually freeze. Normally, water freezes at 32°F (0°C), but saltwater typically freezes at 28.4°F (-2°C). How? When salt is added, it dissolves into the water, creating saltwater. The added salt molecules change the water's ability to form ice crystals, making it easier for saltwater to melt at temperatures where pure water would remain frozen.

EDUCATORS - CONNECTION TO STANDARDS:

2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
K-2-ETS1-1: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through development of a new or improved object or tool.
3.W.7: Conduct short research projects that build knowledge about a topic. (Re: How does ice melt?)

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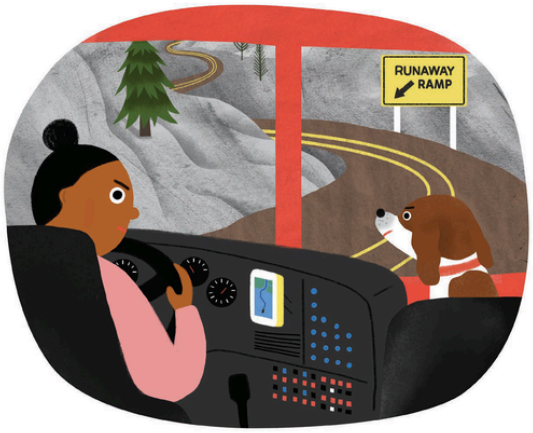
RAMP RACES

"We brace for the decline. Gears on low, we try to go slow,
but gravity pulls us down, down, round the curves I turn."

In the story, the big truck faced a steep hill and felt the strong pull of gravity. Today we're going to explore the force of gravity by testing ramps and seeing what different heights and angles do to the way trucks move. Let's see what ramp gives your truck the most momentum!

WHAT YOU NEED:



- Cardboard pieces to use as ramps
- Toy trucks or cars
- Surfaces to lean cardboard against for various ramp heights (tables, chairs, blocks, etc.)
- Journal or writing surface to write down observations
- Writing utensil

SET UP:

1. Give each group of students a cardboard ramp and a toy truck or car.
2. Instruct students to make predictions about which ramp shapes will help the truck go the farthest. Higher (steeper angle) or Lower height (gentler angle)?
3. Have your students work as a group to experiment with different ramp heights. They may want to lean the cardboard up against tables, chairs, blocks, stacks of books, etc.
4. With each different ramp, have students measure the ramp's height and length. Then place the truck at the top of the cardboard, release the truck, and measure how far it goes.
5. Have students continue to measure and collect data as they go.
6. After testing various ramp heights, have each group place their ramp at the angle that helped their truck go the farthest.
7. Have groups take turns showing the class their ramp that was the most successful.

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DISCUSSION QUESTIONS:

- What happened when your ramp was steeper? Did your truck go nearer or farther?
- What do you think helped your truck move faster on some ramps than on others?
- How did you decide what ramp angle to test next? Did you go higher or lower?
- Was your group's prediction correct?
- What do you think would happen if you changed the weight of the truck?
- If a truck is too heavy going down a hill, what do you think would happen? Could it cause any problems?

EXPLORE THE SCIENCE

Gravity is an invisible force that pulls everything toward the center of the earth. It's why we stand on the ground instead of floating around the earth. It's why an object falls if you drop it is also why the earth orbits around the sun. But gravity isn't the only force that acts on an object. When a truck is on a flat road gravity pulls it down but the ground pushes it back. The forces are balanced and so the truck doesn't move on its own. However, when the truck is on a hill, gravity pulls it down and forward along the slope. The ground still pushes back up, but it doesn't cancel out the forward pull, and the truck can roll down the hill.

The steeper the hill, the more gravity pulls the truck forward along the slope. That's why a truck will move faster and travel farther on a steeper hill.

MORE FOR OLDER READERS

The experiment **What Road is Best?** on page 10 explores the force of **friction**, the force that happens when two things rub together. Friction also plays a part in how a truck rolls down a hill. For a truck to move, the force of gravity pulling the truck down the hill must be stronger than the force of friction acting on the tires. When the driver pushes the brake pedals, the brakes increase friction on the tires to slow down the truck. Friction is also why a truck can park on a steep hill. The parking brakes create enough friction to hold the truck in place despite the strong pull of gravity. Drivers also use another friction tool for safety when parking on hills—they turn their wheels into the curb which increases friction on their tires.

EDUCATORS - CONNECTION TO STANDARDS:

K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or directions of pushes and pulls on the motion of an object.
3-PS2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
W.2.8 / W.3.8: Recall information from experiences or gather information from provided sources to answer a question.
SL.2.1 / SL.3.1: Participate in collaborative conversations about grade-level topics and texts.

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GRAVITY PAINTING

"Fighting against gravity, leaves me completely . . . breathless."

Art meets science in this activity as students see firsthand how gravity affects motion and come away with a truck themed painting!

WHAT YOU NEED:

- Semitruck outline print outs (1 per child), found on page 20
- White cardstock
- Water colors or thinned washable paint
- Tape
- Cookie sheet or tray
- Books or something to rest the tray on to create a sloped surface

SET UP:

1. Begin by having students cut out the truck shape from their worksheet. The goal is to have a paper with a truck-shaped hole in the middle. It's okay if the students must cut a line from the side of the paper to enter the truck area. It can be fixed when the outline is taped down.
2. Place the truck outline down on the middle of a white piece of cardstock and secure it along the outer and inner edges using tape. Fix any slits made in the shape when cutting out the truck. The goal is to only allow the paint to touch the cutout truck area negative space so the end will reveal a colorful painted truck shape
3. Set up your cookie sheet against some books so that the surface is sloped.
4. Tape the cardstock onto the cookie sheet so that the paper is sloped.
5. Using the watercolors, put a big drip of paint at the top end of the painting and watch as gravity helps pull it down the paper.
6. Encourage students to experiment with different paint amounts or angles. Gravity will help the paint come down in streaks!
7. Once dry, remove the paper truck outline to reveal your colorful truck!

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DISCUSSION QUESTIONS:

- What made the paint move down the paper? Why didn't the paint go sideways or up?
- What would happen if we tilted the paper more or less?
- Did the paint always follow the same path?
- What else in the real world does gravity affect?

EDUCATORS – CONNECTION TO STANDARDS:

K-PS2-1: Plan and conduct an investigation to compare the effects of different strengths or directions of pushes and pulls on the motion of an object.
2-PS1-1: Plan and conduct an investigation to describe and classify different materials by their observable properties.
3-PS2-2: Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
VA:Cr2.1.K-5: Through experimentation, build skills in various media and approaches to art-making.

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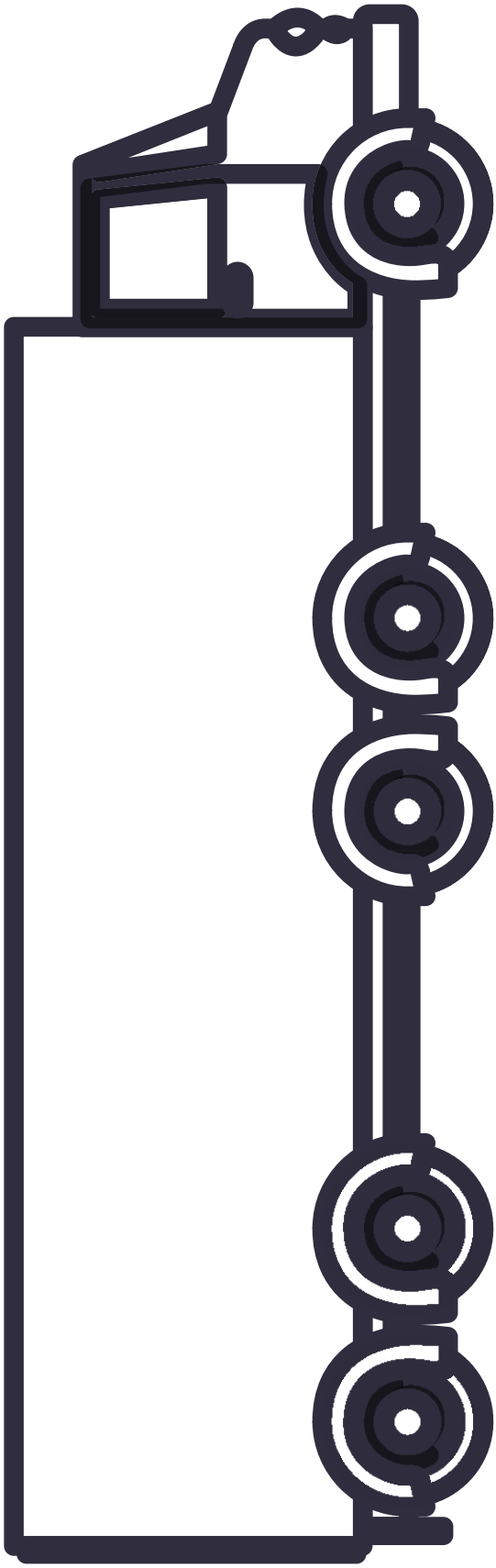
GRAVITY PAINTING



TRUCK DRIVER DIRECTIONS

"Still, neighborhoods need their goods, so I'll be rollin' again soon, because . . . I TRUCK!"

Truck drivers have to follow directions to help them get from coast to coast and even from stop to stop. In this activity, you'll get a chance to practice giving and following directions so that you can get to the correct ending spot!

WHAT YOU NEED:

- North, South, East, and West signs
- Compass to know the correct cardinal directions for sign placement
- Designated starting and ending locations
- Optional: timer

SET UP:

1. Using your compass, place the North, South, East, and West signs in the correct locations in your room.

2. Designate a starting spot and ending spot.

3. Have one student go to the starting spot. This student is the "driver."

4. Classmates will take turns giving them navigational directions to get to the final spot. Only give one instruction at a time and don't let the "driver" go over 3 steps.

5. Anexample direction may be: "Take 3 steps North." (The student who is the truck driver would then move themselves 3 steps North.)

6. Next student tells the driver, "Take 2 steps West," and so on.

7. If using a timer, time each driver's "ride." Challenge the class to work as a team to get a driver to the ending spot as quickly as possible.

8. Students will need to work together to send the driver in the correct direction!

9. After the students have had time to participate, pause and give each student a graph paper.

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10. Together as a class, work together to map out the classroom so that everyone has their own classroom map.

11. Once everyone has a map, go to the starting point.

12. Students will help give you (the teacher) directions. (Eg. Take 2 steps West.)

13. Pause after each instruction (eg. Take 2 steps West.) and have the students map the route you took.

14. Go back to the starting point.

15. Ask the students to raise their hand if they are confident in their mapping.

16. Pick a student and take their map.

17. Using the students map, try to get from the starting point to the ending point. The idea is that you will take the same route you just finished.

18. Discuss how important maps are. Show them a real map. Why do you need accurate routes? What do you do if you make a wrong turn? What happens if the route looks different?

DISCUSSION QUESTIONS:

- What was your strategy to help the driver get to the ending spot the quickest?
- Why is it important for truck and delivery drivers to know directions?
- Did you have to change plans while giving directions? What did you learn from that?
- How could this activity work if we added roadblocks or detours?

EDUCATORS - CONNECTION TO STANDARDS:

K-3 Geography (C3 Framework) - Use maps, globes, and spatial thinking to understand the world and directions.
D2.Geo.2.K-2 - Use maps, graphs, photographs, and other representations to describe places and environments.
D2.Geo.1.3-5 - Construct maps and models of places that include physical and human characteristics.
3-5-ETS1-2 - Generate and compare possible solutions to a problem (e.g., which direction path is best).
K-ESS3-3 - Communicate solutions that will reduce the impact of humans on land and the environment (extend by discussing route efficiency).
SL.K.1 - **SL.3.1** - Participate in collaborative conversations, follow rules for discussions, and build on others' ideas.

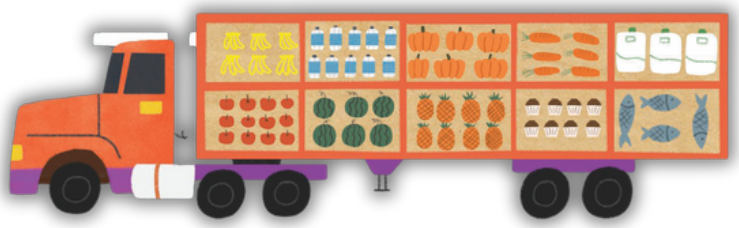
DELIVERY RACE

"My trailer is empty, and hearts are full."

Students will step into the role of truck driver navigating the entire logistical process from loading all the way to delivery in this active simulation! Students will have to work safely, efficiently, and solve problems along the way to get their truck and cargo through the route.

WHAT YOU NEED:

- Backpack(s) (number determined by how many students at a time you will have completing the course simultaneously)
- Objects to load into the backpack
- Spoon
- Item to balance on the spoon (ex. plastic eggs)
- 2 Scales that will hold the weight of objects chosen
- Predetermined weight limit requirement for weigh station
- "Weigh Station" area
- Delivery location (designated ending spot)
- Math facts for students to solve
- Optional: timer



SET UP:

1. Set up a physical course with different stations for students to go through the process of getting their load from one spot to another.

2. Include the following stations:
    a. Loading station: Include the backpack, items to load, and a scale.
    b. Inspection and Departure Station: Set this up a few steps away from Loading. Have room for students to inspect their backpacks and cargo for safety. Include the spoons and eggs here.
    c. Weigh Station: Set up this station at least 10 to 15 feet away from the Inspection and Departure station. Include a scale and math facts for them to solve at this station.
    d. Delivery Location: Position this spot 10 to 15 feet from the Weigh Station.

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3. To start the activity, quickly show or explain what your students will need to do at each station.

4. Students will start at the station with the backpack. Students will need to load their backpack with a certain amount of items or weight. Have them weigh their bags and adjust to not go over the limit.

5. Students will then need to check the backpack for any tears, check the corners (tires), etc.

6. Have students put on the backpack and walk to the next station to "drive."

7. Students will need to balance an object on a spoon to make sure they drive carefully. If they drop the object, have them go back to the start of the drive and try again.

8. Students will have to stop at a weigh station. Have them weigh their backpacks and ensure they meet the weight limit requirements. Then have them complete a math fact to move on.

9. Students will then put their backpack back on and rebalance their eggs on spoons before racing to the delivery spot.

10. Optional: Time them for added fun or have them compete in teams.

DISCUSSION QUESTIONS:

- Discuss the logistical process of getting items across the country or from place to place and why each step is important.
- Why do truck drivers need to check their vehicles before they leave?
- What might happen if your truck is too heavy or damaged before you left?
- Why is it important to drive carefully?
- How is this relay similar to what truck drivers do? How is it different?
- What was the most challenging part of the delivery process for you?

EDUCATORS – CONNECTION TO STANDARDS:

1.MD.A.1 / 2.MD.A.1: Measure lengths and use tools appropriately (estimating backpack weight or item size).
3.MD.A.1: Tell and write time; measure time intervals (timing delivery).
3.OA.C.7 / 4.OA.A.3: Fluently multiply/divide and solve problems using the four operations (weigh station math facts).
K-PS2-1: Pushes and pulls affect motion (balancing the object on a spoon, walking carefully).
3-PS2-2: Observe how forces affect motion in predictable ways.
K–2-ETS1-1: Define problems based on a need (like safely getting to the delivery spot).
3–5-ETS1-2: Generate and compare solutions to a problem using models or testing.
SL.K.1–SL.4.1: Participate in collaborative conversations and build on others' ideas.
PE Standard 1: Demonstrates competency in a variety of motor skills.
PE Standard 4: Exhibits responsible behavior that respects self and others in physical activity settings

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WRITING PROMPTS

JOURNAL ENTRY:

"Gravity pulls me down just like it pulled the truck. I saw gravity when..."
Students write a journal entry of a time they jumped, slid, fell, or rolled and draw a picture.

OPINION ESSAY:

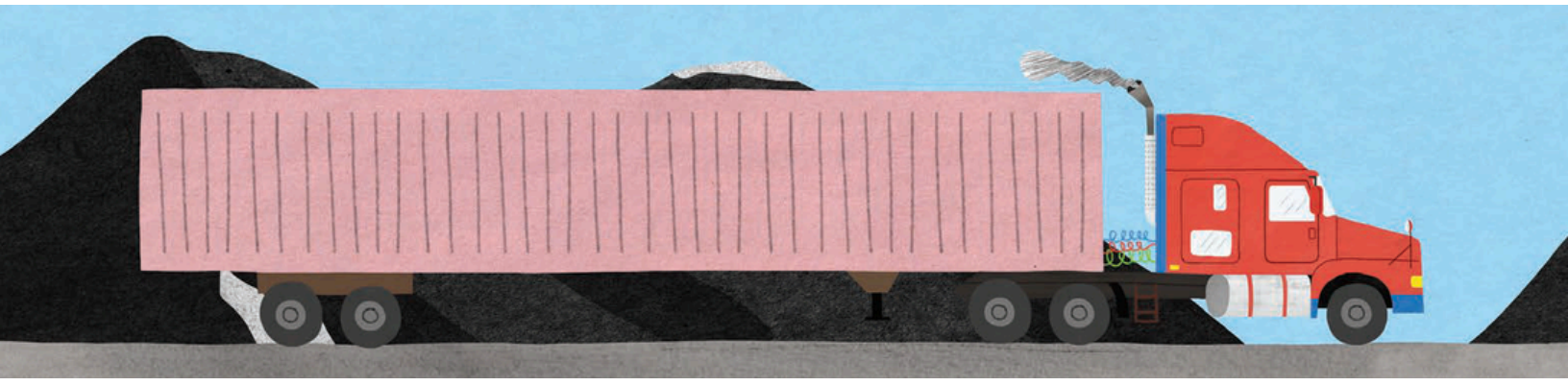
"Would I like being a truck driver?" After reading *I Truck* and the book's included back matter, write your opinion about whether or not you would enjoy being a truck driver as your job and explain why. Require a minimum amount of sentences or paragraphs that fits the age of your students.

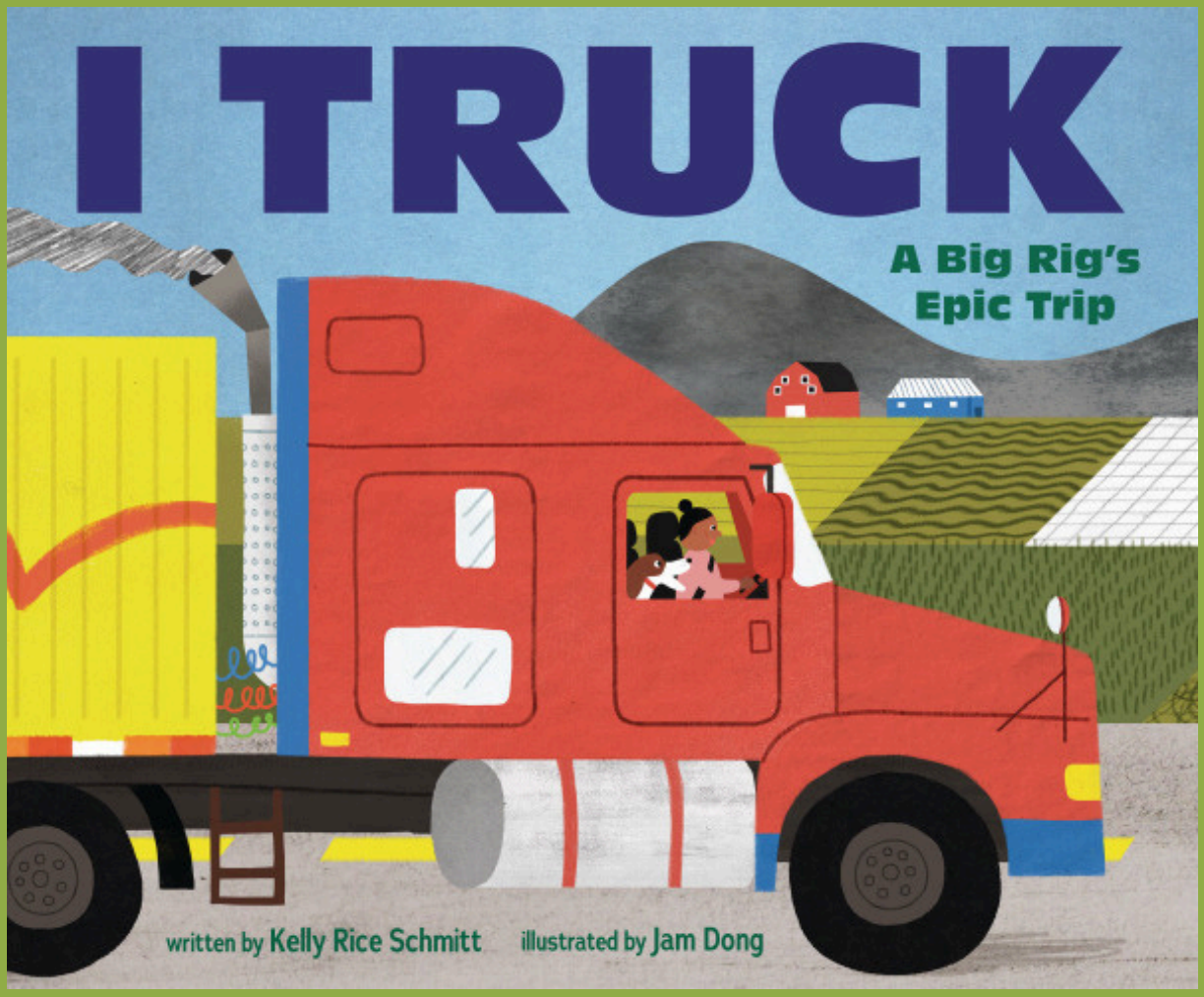
REPORT ESSAY:

Report and detail the steps a truck driver takes from load to delivery. Make sure to include why each step is important and how it helps us get our goods from one place to another.

DESCRIPTIVE ESSAY:

Write a short story about the adventures of a truck driver. What do they see along the way? What stops do they have to make? Are there any scary or funny moments? What is their favorite part?





I Truck: A Big Rig's Epic Trip
Ages 5 - 9 LB: 979-8-7656-1982-7 • $19.99 (list)
EB: 979-8-7656-8245-6 • $33.32 (list) • $24.99 (S&L)

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Jam Dong was born in Shanghai, China. She has an MA degree of moving image from University of Arts London and graduated from Maryland Institute College of Art in 2021 with an MFA in illustration practice. She likes to use bright colors and simple shapes to build the imaginary world inside her mind. The beauty of nature provides her with inspiration all the time. She is a freelance illustrator based in Boston, Massachusetts.

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