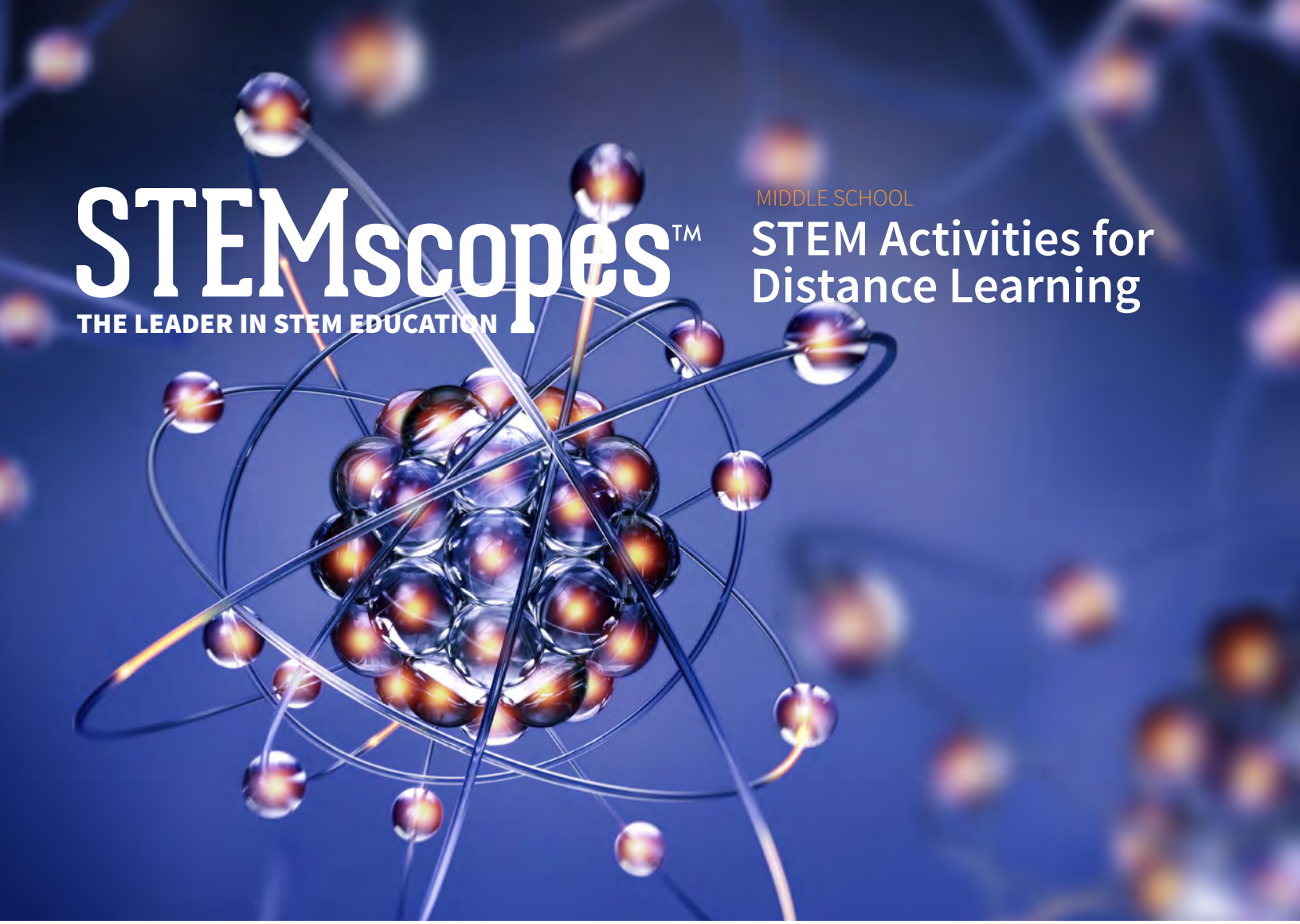


STEMscopes™

THE LEADER IN STEM EDUCATION

MIDDLE SCHOOL

STEM Activities for Distance Learning

Distance Learning

Even successful students can lose ground after a two- to three-month hiatus from the classroom. That's why it's important to keep our students actively engaged in learning and new experiences, especially in subjects like science that build upon previous knowledge and taps into the natural curiosity of the world that students have. Parents can be a wonderful and important factor in helping their children reinforce and retain content learned in the past school year so they're ready for the next grade. Immerse your child in a hands-on experience to help them see and touch science directly.

We've gathered several hands-on activities here that are easy to try at home. These activities focus on some of the most exciting middle school scientific concepts: scents and memory, reproduction in plants, gravity, geologic history of Earth, potential energy, and modeling conservation of mass. Coupled with each activity is a link to the STEMscopedia, a brief student-friendly text that dives deeper to help students understand the science behind the activity. Help your child get the most out of distance learning by sharing interesting activities, scientific literacy, and hands-on exploration!

MIDDLE SCHOOL **LIFE SCIENCE**

Sensory Receptors: Scents and Memory

Summary

Sensory receptors gather and synthesize information by sending messages to the brain for immediate behavior or storage as memories. For example, think about a time you smelled something and immediately had a memory triggered. That one chemical stimulus was sensed, sent to the brain, analyzed, and had a memory recalled almost instantaneously.

In this activity, you will experience various scents as stimuli to trigger memory responses and use these cause-and-effect relationships to make predictions.

Everyday Phenomena

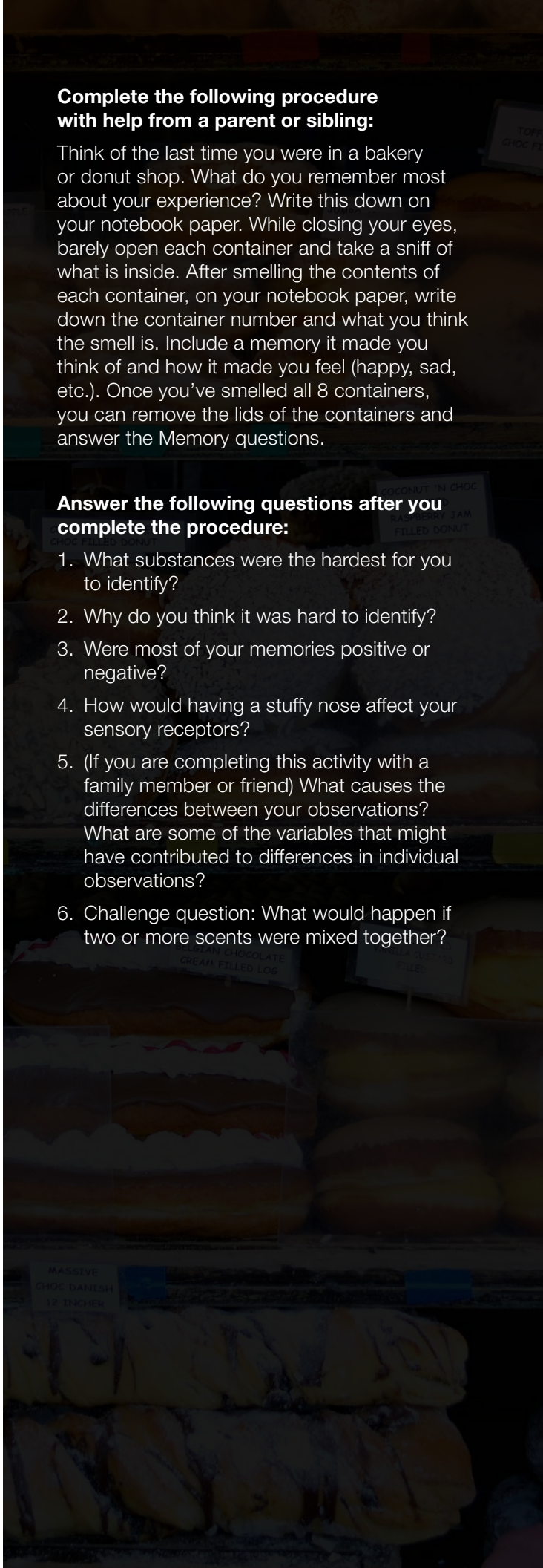
How can different scents trigger memories?

For this activity, you will need:

- Paper and pencil to record your observations
- 8 Containers with tight lids
- vanilla extract, 1 oz
- orange extract, 1 oz
- cough syrup, 2 oz
- 1 pine needle bundle (or any foliage or flower)
- 1 crayon and pencil sharpener
- 1 mothball
- ground cinnamon, 1 tsp
- 1 match
- 3 cotton balls
- 3 droppers (to pour liquid; optional)

Set up your activity:

Number the tops of the containers 1-8. Place a cotton ball in three containers. Carefully, so you don't get any of the liquid on the outside, use a dropper to place 10 drops of the vanilla extract on a cotton ball in the container. Repeat with the orange extract and cough syrup. Be sure to use different pipettes for each liquid so the scents do not blend. Break up the pine needles, and put them in a container. Shave the crayon with a pencil sharpener before putting it in a container. Place a mothball in a container, 1 tsp of ground cinnamon in a container, and a matchstick in a container. Put lids on and snap shut all containers. Now rearrange (or have a family member or friend do this) the containers so that you don't know what is in each container before beginning the experiment.



Complete the following procedure with help from a parent or sibling:

Think of the last time you were in a bakery or donut shop. What do you remember most about your experience? Write this down on your notebook paper. While closing your eyes, barely open each container and take a sniff of what is inside. After smelling the contents of each container, on your notebook paper, write down the container number and what you think the smell is. Include a memory it made you think of and how it made you feel (happy, sad, etc.). Once you've smelled all 8 containers, you can remove the lids of the containers and answer the Memory questions.

Answer the following questions after you complete the procedure:

1. What substances were the hardest for you to identify?
2. Why do you think it was hard to identify?
3. Were most of your memories positive or negative?
4. How would having a stuffy nose affect your sensory receptors?
5. (If you are completing this activity with a family member or friend) What causes the differences between your observations? What are some of the variables that might have contributed to differences in individual observations?
6. Challenge question: What would happen if two or more scents were mixed together?

MIDDLE SCHOOL **LIFE SCIENCE**

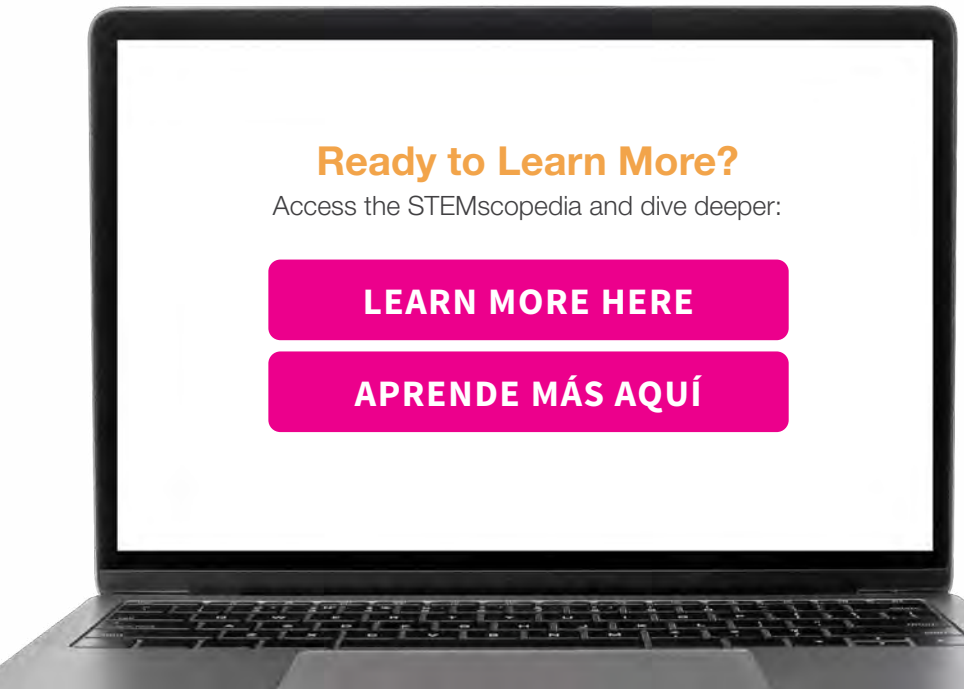
Sensory Receptors: Scents and Memory

Why Is This Important?

As humans, we use our senses to experience the world around us. We are more likely to enjoy foods that we perceive to have a pleasant aroma and smells allow us to recall a memory, even more so than a visual cue.

Did You Know?

In order to survive, animals can detect certain sensations from a stimulus, a change in one or more conditions (e.g., light, sound, temperature). The stimulus can come from a change in the external or internal (inside the body) environment. Different sense receptors are specialized for particular kinds of information, which is then processed by an animal's brain. Animals are able to use their perceptions and memories to guide their actions, allowing them to see, feel, hear, taste, smell, sense heat and cold, sense which way is down, and even sense acceleration (change in speed), and then transfer the meanings of those sensations to the brain. Not all senses are equal for all animals and senses vary between animals depending on their particular needs for survival.



Ready to Learn More?

Access the STEMscopedia and dive deeper:

LEARN MORE HERE

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MIDDLE SCHOOL **LIFE SCIENCE**

Reproduction in Plants: Engineering Solution/Design a Flower

Summary

In our world today, with the population increasing dramatically and the number of pollinators decreasing, pollination of plants is a very important part of a human's diet and nutrition. Most pollination of our foods occurs by animal pollinators. They provide us with the nuts, fruits, and a variety of vegetables that we enjoy. Without these animal pollinators, our diets would be severely limited, and we would have a hard time acquiring the vitamins and minerals we need to be healthy.

In this activity, you will design a flower that will attract a chosen type of pollinator.

Everyday Phenomena

What flower parts attract pollinators the best?

For this activity, you will need:

- Paper and pencil to record your observations
- 1 computer with Internet access
- 1 set of markers or colored pencils
- Variety of materials to construct a flower such as: tissue paper, pipe cleaners, construction paper, toothpicks, glue, tape, or other materials you have available around the house

Set up your activity:

Using the internet, research and explore flower parts and pollination. It will also help you to review the following vocabulary terms before you design your flower model.

Anther: the part of a flower that contains the pollen; located at the end of the stamen

Stamen: the male structure of the flower; contains the anther

Ovary: a female reproductive organ that produces eggs

Petals: the colorful, leaf-like structures that encircle the center part of the flower

Pistil: the female structure of the flower

Criteria and Constraints

- The flower model must have some way to attract an animal pollinator.
- You must describe your flower and include a stem and a flower with petals.
- You must describe the parts of the flower necessary for pollination to occur.
- You must include how your animal pollinator will access the pollen from your flower and why your flower is the best design for animal pollination. (Include things like color, location, growing season, odor, etc.)
- Describe how your pollinator will move the pollen from one location to another.

Complete the following procedure with help from a parent or sibling:

1. Brainstorm and research your ideas about how you can design your flower.
2. Design a plan to build your flower. Draw your plan and label the parts. Be sure to list which each part is made of.
3. Build your flower design and test it. Does it meet all the criteria and constraints? If not, list what problems you need to fix your design and draw a new design that would solve the problems.
4. Present your design to a family member or someone in your household.

MIDDLE SCHOOL **LIFE SCIENCE**

Reproduction in Plants: Engineering Solution/Design a Flower

Why Is This Important?

Pollination is important because it leads to the production of fruits we can eat and seeds that will create more plants. Pollination is not just important to the foods we eat, but is an essential ecological survival function. Without pollinators, the human race and all of earth's terrestrial ecosystems would not survive.

Did You Know?

Usually, plants rely on animals or the wind to pollinate them. When animals such as bees, butterflies, moths, bats, and hummingbirds pollinate flowers, it is accidental. They are trying to get the nectar at the base of the petals, not pollinate the plant. When feeding, animals rubs up against the stamens (the part of the flower that holds the pollen), and the pollen grains get stuck on their feathers, fur, or bristles. When they move to the next flower, some of the pollen rubs off on to the new flower's stigma.

MIDDLE SCHOOL **EARTH AND SPACE SCIENCE**

The Solar System: Gravity

Summary

The saying “what goes up must come down” explains the invisible force called gravity. There is gravitational attraction between all objects. You can’t see or feel the gravitational attraction, but it’s what keeps your feet planted firmly on the ground. For example, imagine spinning on a merry-go-round. As long as you hold on, you will stay on. Don’t let go or you will fly off and land on the ground! This analogy helps to visualize the gravitational attraction between you and Earth. Even though Earth is spinning on its axis, gravity keeps you on the surface rather than flying out into space.

In this activity, you will create a model that shows how larger objects attract smaller objects, how distance makes a difference in the amount of attraction, and how this information relates to the law of universal gravitation.

Everyday Phenomena

What is the law of universal gravitation?

For this activity, you will need:

- 1 Pencil and piece of paper (or use student journal)
- 1 Sheet
- 4 Chairs of similar height
- 1 Basketball (or object of similar size)
- 1 Tennis ball (or object of similar size)
- 1 Golf ball (or object of similar size)
- 1 Circular bowl or plastic container
- 1 Marble (or object of similar size)

Set up your activity:

Take a bed sheet of any size and tie each of the four corners to a chair of similar height. Move the chairs apart until the sheet is pulled tight. Gather the three ball types (basketball, tennis ball, and golf ball) at the front of the room and make sure to grab your pencil and paper to record your observations.

Before you begin, rank the objects according to mass, from greatest to least, and identify which ball represents the sun (greatest mass), the earth, and the moon (least mass). Record your answers.

Complete the following procedure with help from a parent or sibling:

Part 1: Gravitation, Gravitation, Gravitation

Have a family member keep the chairs stable and gently place the basketball in the center of the sheet. Observe and record the effect that the basketball has on the shape of the sheet. Next, place the tennis and golf balls on one edge of the sheet. Observe, record, and explain what happens. The tennis and golf balls should roll toward the basketball at the sheet’s center. This models the powerful gravitational pull of an object with a large mass (the basketball) over objects of smaller mass (the tennis ball and golf ball). Notice that gravity causes the smaller objects to be pulled toward the objects of greater mass. Remove all of the objects from the sheet.

Next, place the basketball in one corner of the sheet and the tennis ball in the opposite corner. Then place the golf ball a few inches from the tennis ball and observe what happens. The golf ball should move toward the tennis ball because the distance is shorter compared to the distance from the basketball to the golf ball. Because there’s less distance between the golf ball and tennis ball, the strength of the basketball’s gravitational pull isn't enough to attract the golf ball. This models the law of universal gravitation of all objects with mass.

Vocabulary terms:

- *Gravitational pull* is the attraction between two objects due to the invisible force of gravity.
- Sir Isaac Newton’s *law of universal gravitation* explains how the strength of the gravitational force between any two objects in the universe depends on both the size and distance of each object.

Part 2: The Role of Gravity in Planetary and Solar System Motion

Grab a bowl or round container and turn it over so that the opening is at the bottom. The container will represent gravity. Place a marble under the container and move the container in a circular motion to make the marble spin like a planet orbiting around the sun. When the marble is spinning, lift the container to see what happens. Record the motion of the marble over several trials and draw your observations.

Answer the following questions after you complete the procedure:

1. How would you define gravity?
2. Which one of the following has the most gravitation: the sun, Jupiter, or Mars? Why?
3. Is gravity predominantly an inward-pulling or outward-pushing force? How do you know?
4. What would result if gravity on Earth disappeared?
5. How is the law of universal gravitation related to why we stay on Earth?
6. Challenge question: Based on what you’ve learned about gravity, would you agree that the moon’s gravitational pull is less than Earth’s? Why?

MIDDLE SCHOOL **EARTH AND SPACE SCIENCE**

The Solar System: Gravity

Why Is This Important?

Gravity has existed since the beginning of the universe and holds everything in place. It is the invisible force that attracts all objects, no matter their size or mass. Gravitational force is what keeps all components of our solar system in orbit around the sun, as well as moons in orbit around planets. The force of gravity even affects our ocean tides and holds us on the surface of our planet.

Did You Know?

The sun has the strongest gravitational force of any object in our solar system. It attracts all astronomical objects into orbit around itself. Without this force, everything would fly off into the universe.

MIDDLE SCHOOL **EARTH AND SPACE SCIENCE**

Geologic History of Earth: Law of Superposition

Summary

The study of rock layers (strata) is called stratigraphy. Over the long history of Earth, layers of sediment and rock have been deposited, one on top of the other, preserving the clues to the past. Because of Earth's gravity, younger sediments are deposited over older sediments. Sometimes the remains of plants and animals get buried in the different layers and become fossilized. These rock formations and the fossils they contain are used to establish the relative age of major events in Earth's history, such as the last ice age, volcanic eruptions, the earliest evidence of life, when dinosaurs roamed the earth, and even the formation of the earth itself.

In this activity, you will use observations to determine the sequence of events and relative age of rock strata to better understand how the geologic time scale is used to organize Earth's 4.6 billion-year-old history by using the law of superposition.

Everyday Phenomena

How can we determine the relative age of rock strata?

For this activity, you will need:

- 1 Clear plastic cup, 24 oz
- 1 Measuring cup, ½ cup
- ½ Cup of brown sugar
- ½ Cup of sugar
- ½ Cup of chocolate pebble cereal (or cereal of similar size/texture)
- ½ Cup of mini marshmallows
- 1 Pencil and piece of paper to record your observations
- 4 Crayons of different colors

Set up your activity:

Premeasure the four pourable materials (brown sugar, sugar, cereal, and marshmallows) so you have ½ cup of each "rock strata" for the activity, or you can wait and measure as you go.

Complete the following procedure with help from a parent or sibling:

When analyzing rock layers, geologists follow the law of superposition to determine the age and order of strata. Sometimes each layer represents thousands or millions of years of deposition of sediments.

Today, you will create your own "rock strata" and observe the different layers like a geologist! To begin, pour one-half cup of brown sugar into the clear plastic cup. Now, pour one-half cup of sugar into the cup on top of the brown sugar. Next, pour one-half cup of chocolate pebble cereal into the cup on top of the sugar. And finally, pour one-half cup of mini marshmallows into the cup on top of the cereal. Notice how the layers pile up on top of each other like sediments that form sedimentary rock.

Place the cup on a surface so you can see it from the side. Grab your paper and pencil, and then draw the cup with the four layers. Color and label each layer to help identify the different levels of "rock strata". Once you're finished, feel free to snack on your "strata layers" while you answer the reflection questions below.

Vocabulary terms:

- *Law of superposition* is the way in which geologists determine the age of rock strata; this simply means that the oldest layer is generally found at the bottom, with younger layers on top. By looking at any two layers, you would know which came before the other one, based on their relative positions.

Answer the following questions after you complete the procedure:

1. Which "rock layer" in your cup is the oldest? How can you tell?
2. Which "rock layer" is the youngest? How can you tell?
3. Which are considered sedimentary layers and which are rocks? Why?
4. What can geologists learn by using the law of superposition?
6. Challenge question: What can you determine about the differences of the "rock layers" on bottom from the ones on top? Why do you think the bottom layers are more compacted while the top layer takes up more space and has larger "rock pieces"?

MIDDLE SCHOOL **EARTH AND SPACE SCIENCE**

Geologic History of Earth: Law of Superposition

Why Is This Important?

Through the law of superposition, geologists have determined the relative ages of rocks around the world and built a kind of geologic time scale as a way to organize Earth's history. By interpreting rock strata, they realized that fossils contained in the rock could also be used to determine relative age. With this information, in combination with the other principles of stratigraphy, geologists have recognized how life has changed or evolved throughout our planet's history.

Did You Know?

Geologic processes that occur today are the same as those that occurred in the past. Geologists compared marks in old rock layers and noticed that the same structures are seen in present rock layers. Geologists concluded that the processes now operating on Earth must be the same processes that operated in the past. So when a section of an ancient exposed rock layer shows repeated layers of basalt, geologists might conclude that volcanic activity occurred many times during its geologic history.

MIDDLE SCHOOL **PHYSICAL SCIENCE**

Potential Energy: Electrostatic Potential Energy

Summary

We know that an object gains gravitational potential energy as it moves away from the Earth, but there are other types of potential energy. Objects can also store potential energy as a buildup of electrons on the surface of an object, known as static electricity. The electrons are stationary, so they are "static." Stationary electrons generate an electric field, which has the potential to act on other charged objects nearby.

For example, a balloon can become electrically charged by rubbing it with a woolen cloth. The amount of its potential energy will depend on the amount of static electric charge built up on the balloon's surface, which determines the strength of the electric field. The balloon will continue to generate an electric field as long as it is charged, and it will remain charged until the static electric charge is discharged as an electric shock.

In this activity, you will investigate the correlation between the level of electrostatic potential energy in a charged balloon and the distance at which it acts on a piece of tissue paper.

Everyday Phenomena

What is the relationship between the level of electrostatic potential energy in a charged balloon and the distance at which it acts on tissue paper?

For this activity, you will need:

- 1 metric ruler
- A timing device (stopwatch or phone)
- A wool sweater or piece of cloth (30cm x 30cm)
- 1 balloon
- 1 piece of tissue paper cut into thin strips

Complete the following procedure with help from a parent or sibling:

1. Rub the wool on the balloon for 30 seconds.
2. Place the zero-value end of the ruler gently against the balloon.
3. Hold the strip on one tip so that it's hanging down.
4. Starting at the far end of the ruler, move the strip closer until the balloon makes the strip bend toward it.
5. Record the distance on the data table.
6. Rub the wool on the balloon for 60 seconds and repeat steps 3-6.
7. Rub the wool on the balloon for 90 seconds and repeat steps 3-6.

Answer the following questions after you complete the procedure:

1. What relationship did you observe between the amount of stored potential energy (time that the balloon was rubbed on the cloth) to the distance at which the static electricity will act upon the tissue paper?
2. Write a scientific explanation as to how the amount of electrostatic potential energy on a balloon affects the distance it can act on pieces of tissue paper. Provide your claim, evidence, and reasoning.

MIDDLE SCHOOL **PHYSICAL SCIENCE**

Potential Energy: Electrostatic Potential Energy

Why Is This Important?

You may only think of electrostatic energy when you rub a balloon on your head to make your hair stand up straight, but you'd be surprised by the prevalence of this type of energy throughout our daily lives. One example of electrical potential energy is the electricity stored in a battery. You can use the energy in the battery to power a flashlight. If you use more batteries in a series, you store more electrical potential energy to be released when you turn on the circuit.

Did You Know?

When you see a lightning bolt shoot across the sky during a thunderstorm, you're watching electric potential energy transform into light, heat and sound energy. And just how much energy does lighting carry? Up to one billion volts, the same amount of power as 666,000,000 AA batteries—wow!

MIDDLE SCHOOL **PHYSICAL SCIENCE**

Modeling Conservation of Mass: Construction Models

Summary

The law of conservation of mass states that matter, and inherently the atoms that make up that matter, cannot be created or destroyed. Rather, they are rearranged and conserved (protected from loss). In this activity, you will construct a physical model of how a chemical reaction supports the law of conservation of mass.

In this activity, you will construct a model of a chemical equation to demonstrate the law of conservation of matter.

Everyday Phenomena

How do chemical reactions support the law of conservation of matter?

For this activity, you will need:

- Sphere-shaped materials (cotton balls, pom poms, etc.)
- Rod-shaped materials (short strips of paper, cut-up popsicle sticks, etc.)
- Construction paper
- Scissors
- Tape and/or glue

Complete the following procedure with help from a parent or sibling:

1. On a piece of paper, draw an illustrated model of the chemical reaction, $2H_2 + O_2 = 2H_2O$. Use different shapes, colors and sizes to represent different parts of the model, and create a key.
2. Identify the number of atoms represented on both the reactants and products side to ensure that your model obeys the law of conservation of mass.
3. Now, use your supplies to construct a 3D model of the reaction. Use different shapes, colors and sizes to represent different parts of the model, and create a key.
4. Repeat steps 1-3 for the following equations:
   a. $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$
   b. $2H_2 + V_2O_5 \rightarrow V_2O_3 + 2H_2O$
   c. $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$

Answer the following questions after you complete the procedure:

1. What are the benefits of using models?
2. What does the law of conservation of mass state?
3. How can we use a model to check if a chemical equation obeys the law of conservation of mass?

MIDDLE SCHOOL **PHYSICAL SCIENCE**

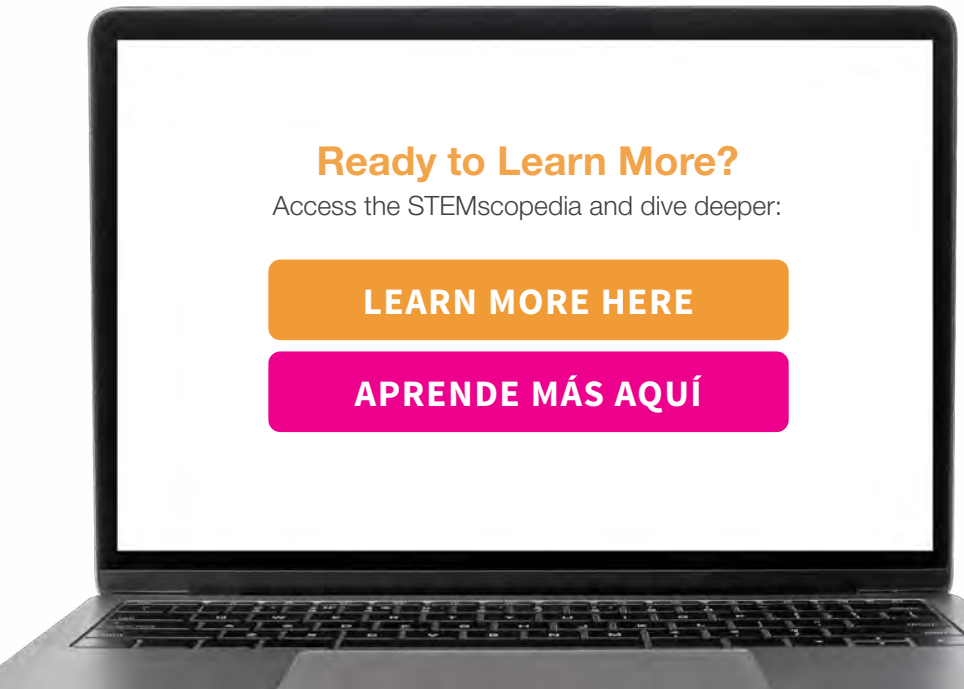
Modeling Conservation of Mass: Construction Models

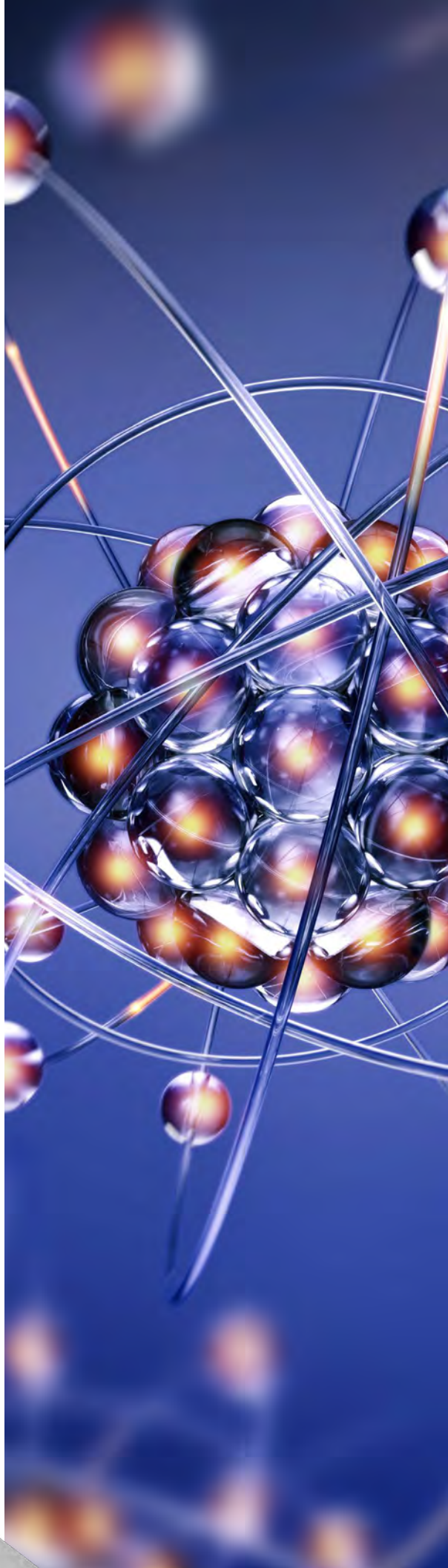
Why Is This Important?

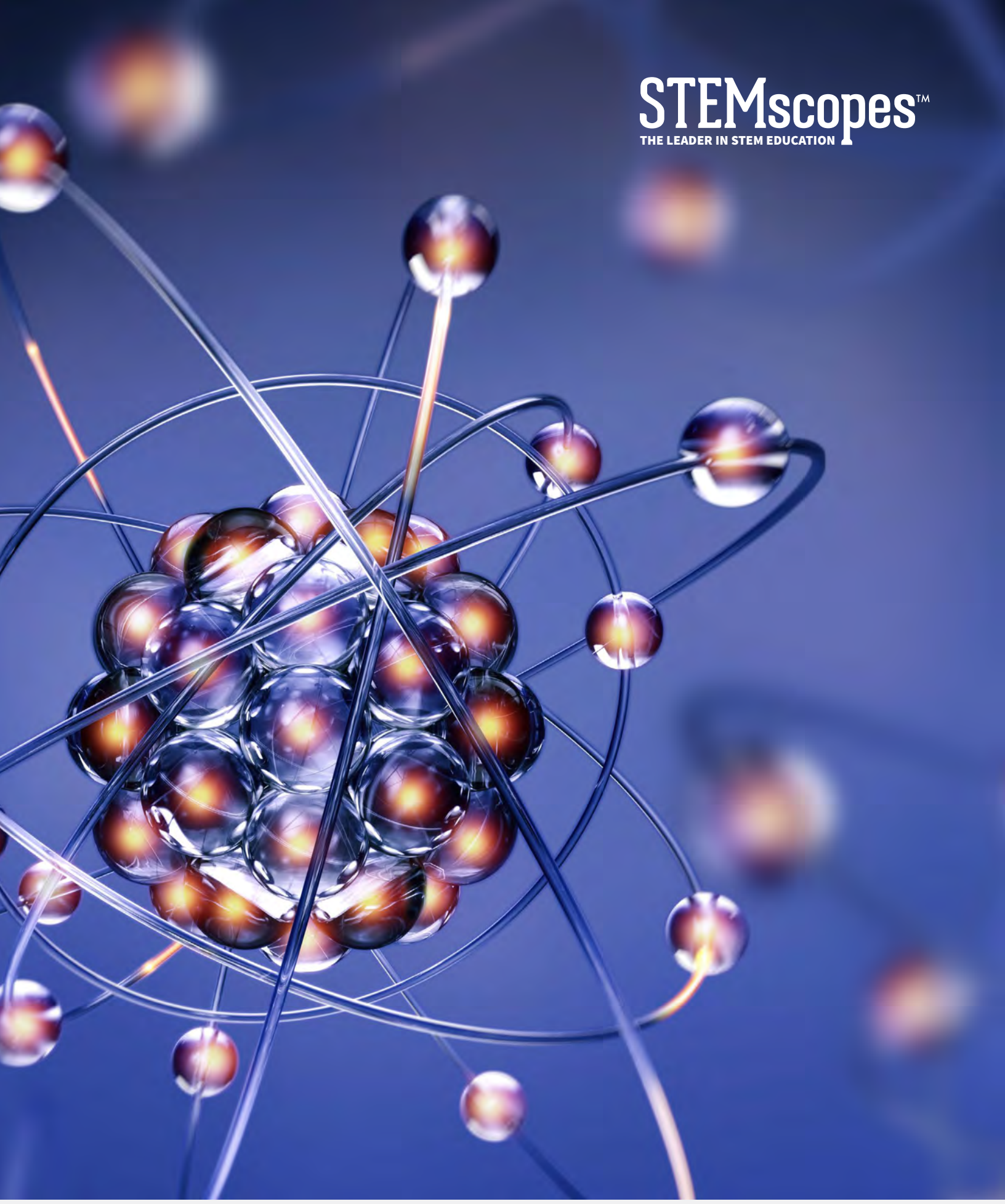
The law of conservation of mass allows scientists to predict the amount of reactants needed to produce a certain amount of products, as well as how much product they will produce with a certain amount of reactants. Sometimes, a slight shift in the amount of reactants can have adverse consequences, so it is important to balance equations before putting them into practice.

Did You Know?

To launch space shuttles, NASA uses liquid hydrogen, a very dangerous chemical compound. It takes extreme measures to liquefy hydrogen gas, and the liquid must be stored at a temperature below 250 degrees Celsius. Any exposure to heat will cause liquid hydrogen to expand very quickly, and its low molecular mass means that it can easily leak through even the smallest opening. In order to launch a shuttle, liquid hydrogen must be combined with the oxidizing agent, liquid oxygen. How do you think NASA knows how much liquid hydrogen to combine with liquid oxygen to launch their space shuttle?







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