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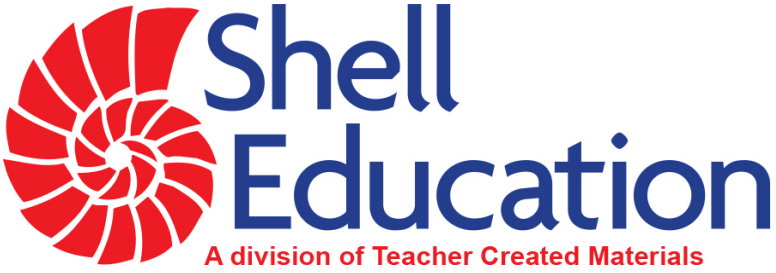

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Shell Education

180 Days of PRACTICE

GRADE 5

HANDS-ON STEAM

Science | Technology | Engineering | Arts | Mathematics

Table of Contents

Gravity Teaching Support

Overview of Unit Activities

Students will learn about and explore gravity on Earth through the following activities:

- reading about gravity
- studying a graphic about a hot-air balloon
- experimenting with the drop times of flat and crumpled paper
- making comics about doing daily tasks with little or no gravity
- using a table to explore how gravity affects weight in space
- creating devices that increase the amount of time objects take to reach the ground

Materials Per Group

Week 1

- basic school supplies

STEAM Challenge

- basic school supplies
- books or online resources about helicopter seeds, animals, and parachutes
- calculator
- coffee filters (2)
- fabric (various types)
- plastic wrap
- small box or another object weighing about 1 oz. (30 g)
- stopwatch
- string/yarn (3–4 feet, 1 m)

Setup and Instructional Tips

- Students might request a variety of materials not listed to create their gravity-defying devices. Provide them with their requests at your discretion.
- **Testing Days:** Choose objects for students to drop that weigh about one ounce. Make sure you have enough for each group to receive an identical object. It will be best if the object has a small surface area (to reduce air resistance).
- **STEAM Challenge:** The challenge can be done individually or in groups. Students working in groups should sketch their own designs first. Then, have them share designs in groups and choose one together.

Discussion Questions

- What is gravity?
- What would happen on Earth if there was no gravity? If there was more or less gravity?
- Can gravity be manipulated? How?
- How have humans engineered ways to reduce or slow the effects of gravity?

Additional Notes

- **Possible Misconception:** Heavier objects fall faster than lighter ones.
  Truth: Mass/weight does not affect the speed an object falls; however, greater air resistance can reduce the speed an object falls to the ground.

Scaffolding and Extension Suggestions

- Show students examples of "helicopter" seeds falling, squirrels jumping from heights, and birds flying; facilitate a discussion about the strategies these things use.
- Encourage students to research how companies want to use drones to deliver packages, and challenge students to use those ideas to create their devices.

Answer Key

Week 1 Day 1

1. B
2. A
3. D
4. C

Week 1 Day 2

1. The air has to be hot so it is less dense than the cold air and will rise.
2. Wicker is lightweight and strong.
3. 1783

Week 1 Day 5

1. They would have the lowest weight on the moon.
2. I would not be bigger because my mass would not change. My weight would be more because there is more gravity.
3. The larger the object, the more gravity it has.

Weeks 2 & 3

See STEAM Challenge Rubric on page 221.

Name: _____ Date: _____

Day 1

Directions: Read the text, and choose the best answer for each question.

Gravity

Imagine a person waking up in their bed. They walk into the kitchen. They get a cup out of the cabinet and pour orange juice into it. Nothing about that seems remarkable. But it is only possible because of gravity. Gravity is a force that pulls objects toward Earth. Without gravity, that person would be floating down the hallway and chasing down drops of orange juice in the air. People measure how much gravity is pulling on something by its weight. Earth's gravity does not just keep people and objects on the ground. It also pulls on the moon! The moon orbits Earth because of Earth's gravity.

1. Gravity is _____.

- (A) floating
- (B) a force
- (C) an object
- (D) a push

2. What does gravity do?

- (A) pulls objects to Earth
- (B) pushes objects to Earth
- (C) helps objects fall slowly
- (D) keeps objects in the air

3. _____ measures how much gravity is acting on an object.

- (A) Mass
- (B) Force
- (C) Pulling
- (D) Weight

4. Which of these statements is true?

- (A) The moon's gravity pulls on Earth.
- (B) The moon's gravity keeps objects on Earth from floating.
- (C) Earth's gravity pulls on the moon.
- (D) Earth's gravity does not affect the moon.

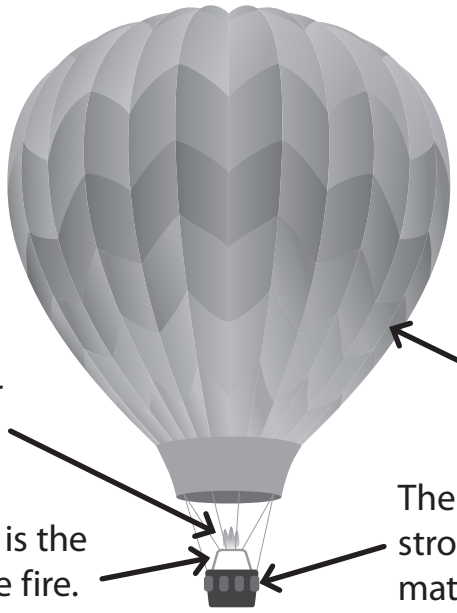
Name: _____ Date: _____

Directions: Read the text, and study the diagram. Then, answer the questions.

Hot-Air Balloons

Gravity might keep people on the ground, but that has never stopped them from dreaming of being up in the clouds! Long before airplanes defied gravity, there were hot-air balloons. In fact, people went up in a hot-air balloon for the first time in 1783.

Hot-air balloons stay afloat because they are filled with hot air. Cold air molecules are closer together, and hot air molecules are farther apart. So, the hot air is less dense and will rise above the cold air. Study the diagram to see the parts of a hot-air balloon.



1. Why is heating the air in the balloon important?

_____

_____

2. Why is the basket made of wicker?

_____

_____

3. When did people first travel in a hot-air balloon? _____

Name: _____ Date: _____

Directions: Follow the steps to experiment with how different shapes fall.

Question: How can the shape of paper affect how quickly gravity pulls it to the ground?

Materials

paper stopwatch

Steps

1. Stand from a height (on a ladder, staircase, balcony, etc.). Drop a flat sheet of paper. Use a stopwatch to time how long it takes to reach the ground. Record your results.
2. Fold the paper into fourths. Repeat the drop test. Record your results.
3. Crumple the paper into a tight ball. Repeat the drop test. Record your results.
4. Form a sheet of paper into a shape of your choice. Repeat the drop test. Record your results.

Shape of Paper	Time	Observations of Paper Movement During Drop
flat sheet of paper		
paper folded into fourths		
paper crumpled into ball		
shape of your choice _____		

Talk About It!

Which paper fell in the least amount of time? Why?

What affected the time it took the paper to reach the ground for each drop?

Do you think you could decrease the time it takes the paper to reach the ground? Could you increase it? How?

Name: _____ **Date:** _____

Directions: Imagine a day without gravity! What would eating breakfast be like? Or playing outside at recess? Or doing your homework? Make a comic of yourself trying to do something ordinary without gravity. Add captions, thought bubbles, and speech bubbles.

Name: _____ Date: _____

Directions: Read the text, and study the chart. Then, answer the questions.

People have both mass and weight. Their mass is the amount of matter they are made of, and their weight measures how much gravity is pulling on them. Gravity is the same all over Earth, but it can be different on places in space. Imagine a person traveling all over space. Their mass wouldn't change—they would stay the same size. But their weight would change depending on the amount of gravity.

Location	Weight
Earth	100 pounds (45 kg)
Jupiter	253 pounds (115 kg)
Mercury	38 pounds (17 kg)
Earth's moon	17 pounds (8 kg)
the sun	2,707 pounds (1,228 kg)

1. According to the chart, where would a person weigh the least?

_____

2. If you weighed 253 pounds (115 kg) on Jupiter, would you be bigger than you are on Earth? Explain your answer.

_____

_____

3. Think about the size of the moon and the sun. What inference can you make about gravity and size?

_____

_____

_____

Name: _____ Date: _____

Directions: Read the text. Then, summarize the challenge in your own words. Write any questions you have.

The Challenge

Plants, animals, and people have all found ways to cheat gravity. Gravity cannot be changed. But there are reasons people want to slow down falling objects. For example, some companies want to use drones to deliver packages. But fast-falling packages from the sky are not safe. Imagine you worked for one of these companies. Your challenge is to create a device that slows down a package as it falls. You will drop the object and device from a height and compare its drop time to a control.

Criteria

For the design to be successful, it must…

- slow the speed at which a package falls to the ground (compared to a control).
- clearly show a design for the company (you may create the name or symbol).

Constraints

- You may only use the materials provided to you.
- No electronics may be used.

Testing Note

The package size and weight and the drop height should be the same for all groups.

My Summary

_____

_____

_____

My Questions

_____

_____

_____

Name: _____ Date: _____

Directions: Research how different things fall or drop and answer the questions. Then, brainstorm and record ideas for your device. Discuss ideas with others, and add to your brainstorming.

1. What types of seeds fall slowly to the ground? How do they do it?

_____

_____

2. What animals are able to slow down a fall to the ground? How do they do it?

_____

_____

_____

3. How can people slow down a fall from the sky?

_____

_____

My Brainstorming

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name: _____ **Date:** _____

Directions: Sketch one or more designs for your package delivery design. Add the symbol or design for the delivery company. List the materials. Then, answer the question.

Materials

_____ _____ _____

_____ _____ _____

1. What concerns do you have about your design?

_____

_____

Name: _____ Date: _____

Directions: Gather your materials, plan your steps, and build your delivery device design. Record notes as you build. Then, answer the question.

Delivery Device Building Plan

	Job or Task	Group Member(s)
1		
2		
3		
4		
5		
6		

Building Notes
(additional steps, problems, changes, etc.)

1. What do you think will happen when you test your design?

_____

_____

Name: _____ **Date:** _____

Directions: Decide as a group what height to test your package delivery devices from. Drop the package without your design for the control. Then, drop the package with your design. For each drop, have two people time how long it takes to reach the ground. Record the times and find their average. Then, answer the questions.

Drop Height: _____

	Timer 1	Timer 2	Average Time
control			
package with your device			

Note: To find the average, add the two times together and then divide by two.

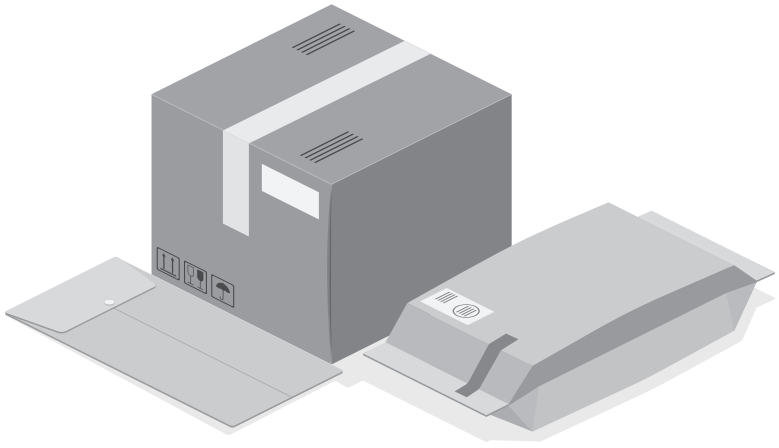
1. Which drop took longer? _____
2. What was the difference in time? _____
3. Would you consider your design a success? What is your evidence and reasoning?

_____

_____

_____

_____



Name: _____ Date: _____

Directions: Reflect on your design, and answer the questions. Then, plan how you will improve it. Conduct additional research if needed.

1. What went well with your delivery device?

_____

_____

_____

2. What flaws did you discover from testing?

_____

_____

_____

3. How could you make your delivery device work better?

_____

_____

_____

Draw a star next to one or more ways you will improve your design.

- My first design did not meet all the criteria. To improve it, I will

  _____

  _____

- Increase the drop time of your package.
- Drop a delicate item, such as an egg, and keep it from breaking.
- My own idea: _____

  _____

Name: _____ Date: _____

Directions: Plan and sketch your new delivery device design. Label the parts and the materials you will use for each part. Then, complete the sentence.

In my redesign, I will…

add _____

remove _____

change _____

1. The change or improvement I am most excited about is _____

_____

_____

Name: _____ Date: _____

Directions: Gather your materials, plan your steps, and rebuild your delivery device design. Record notes as you build. Then, answer the question.

Delivery Device Rebuilding Plan

	Job or Task	Group Member(s)
1		
2		
3		
4		
5		
6		

Building Notes
(surprises, problems, changes, etc.)

Name: _____ Date: _____

Directions: Decide as a group what height to test your package delivery devices from. Drop the package without the device for the control. Then, drop the package with the device. For each drop, have two people time how long it takes to reach the ground. Record the times, and find their average. Then, answer the questions.

Drop Height: _____

	Timer 1	Timer 2	Average Time
control			
package with device			

Note: To find the average, add the two times together and then divide by two.

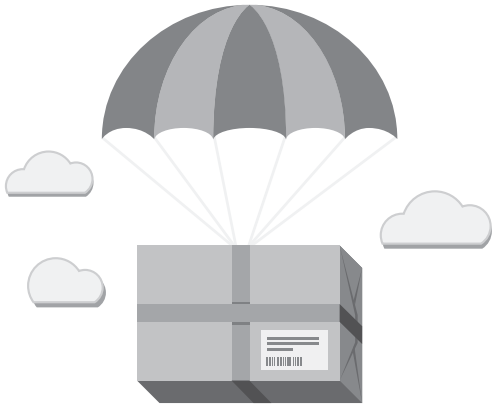
1. Which drop took longer? _____
2. What was the difference in time? _____
3. Did your new design work better? What is your evidence and reasoning?

_____

_____

_____

_____



Name: _____ Date: _____

Directions: Reflect on the work you did for this challenge, and answer the questions.

1. What science concepts did you apply in this challenge?

_____

_____

2. How would this challenge have been different if you had dropped a heavier object?

_____

_____

3. Do you think drones delivering packages is safe? Explain your answer.

_____

_____

4. Draw your delivering device being used in the real world. Write a caption telling what is happening.

_____