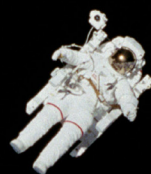


THE FORCE OF GRAVITY

A LESSON IN UNDERSTANDING THE EFFECT OF GRAVITY ON DIFFERENT OBJECTS

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The Force of Gravity

A lesson in understanding the effect of gravity on different objects

Skill Level

Beginner (4th and 5th grade)

Learner Outcomes

The learner will be able to:

- Develop a basic understanding that gravity is a force
- Understand gravity accelerates all objects at the same rate regardless of mass
- Demonstrate how gravity influences all objects

Educational Standard(s) Supported

5.PS2.1, 5.PS2.4

Tags

4-H Science

Time Needed

30 minutes

Materials List

LCD projector, computer

YouTube video

Student handout (one per student)

Experience 1

- Dowel rod
- Large paperclips (3)
- 12-inch pieces of string (3)

Experience 2

- A small rock
- An 8.5x11 inch sheet of paper
- An 8.5x11 inch sheet of paper crumpled into a small ball about the same size as the rock

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Introduction to Content

Gravity is a force in nature. Gravity is what causes objects to fall and why objects fall down rather than up! Without the force of gravity, it would be impossible to keep your feet on the ground. You would just simply float up into the sky. Gravity is also what holds the planets in orbit around the sun and what keeps the moon in orbit around Earth.

Introduction to Methodology

This activity guides students through understanding that gravity is a force that tries to pull two objects together. Students will conduct experiments to develop a basic understanding of how the force of gravity affects objects.

Terms and Concepts

Acceleration - increase in the rate or speed of an object

Force - is a push or pull upon an object that causes the object to move, change speed, or change shape

Gravity - is a force which tries to pull two objects toward each other

Matter - is any substance that has mass and takes up space by having volume

Mass - is the amount of matter or substance that makes up an object

Setting the Stage

Ask “What force on Earth keeps you from floating up into the sky?” **Students will probably say the Earth’s gravity. Every object in the universe exerts a gravitational force on other objects. We feel the gravitational pull of the Earth because it is so strong. The moon stays in place as it revolves around the Earth and the planets keep their place because of the gravitational pull between the sun and planets.**

NOTE: *In science and engineering, the **weight** of an object is a measure of the force of gravity pulling down on that object. It depends on the object’s **mass** and the **acceleration** due to gravity.*

Show the students the following YouTube video: <https://www.youtube.com/watch?v=ljRIB6TuMOU>. (It is 3:11.)

Ask the students to explain what gravity is and what it does. **Gravity is a force that keeps you on the ground, what causes objects to fall, and is why objects fall down rather than up!**

Say, “Let’s conduct some experiments to learn more about how gravity on Earth affects objects. You will generate hypotheses about how gravity pulls objects toward the Earth and whether the mass of an object influences how fast an object falls toward the Earth.”

Experience 1

Ask students to answer question 1 on the student worksheet and then perform the experiment.

1. Have the students tie large paperclips to the end of three pieces of string.
2. Next have them tie the other end of the strings onto the dowel rod.
3. Have the students lift up the dowel rod perpendicular to the ground so the paperclips hang from the string.
4. Ask the students which direction are the paperclips pointing?
5. Have the students tilt the dowel rod.
6. Ask the students which direction the paperclips point when they tilted the dowel rod.

Strategies to Increase Student Engagement

- If you have enough materials, let every student complete the hands-on activities.
- Ask students what would happen if the moon disappeared. How or would gravity be affected at all?

Share

Ask the students “What force keeps us from floating up into the sky?”

The Earth’s gravity is the force that keeps us and other objects stuck to the ground.

Process

Ask the students “Why do the paperclips always point straight down when you tilt the dowel rod?” **The paperclips are being pulled down toward the Earth by gravity. The paperclips don’t fall because the string is holding them up. No matter which way the dowel rod is tilted, gravity always pull the paperclips straight down toward the Earth.**

Notes

Experience 2

Ask students to answer questions 5 and 6 on the student worksheet and then perform the experiment.

1. Have students crumble a 8 ½ x 11 sheet of paper into a ball the size of the small rock.
2. Have students hold the rock and paper ball at the same height.
3. Next, have the students drop the two objects at the same time. It is important the objects drop from the same height and at the same time.
4. Observe which object reaches the ground first.
5. Repeat the experiment several times.

Share

Ask the students “Which object has the greatest mass, the rock or paper ball?” **The rock has the greatest mass.**

Process

Ask the students “Why did both objects hit the ground at the same time?” **Back in the 16th and 17th Century, a famous scientist named Galileo first demonstrated that two objects that are similar in size but with different masses will hit the ground at the same time when dropped from the same height. This happens because the acceleration due to gravity is the same for both objects. The acceleration due to gravity has nothing to do with the mass of an object.**

Generalize

Ask the students to explain the difference between weight and mass. **The weight of an object is a measure of the force of gravity pulling down on that object. It depends on the object's mass and the acceleration due to gravity.**

Apply

Ask students to fill out the remaining questions on their worksheet. When everyone is finished, ask the students "Why can astronauts jump higher on the moon than the earth?" **Although gravity exists on the moon, it is only 1/6 as strong as that on earth. This why astronauts can jump higher on the moon than on Earth.**

Supplemental Information
Educational Standards Met

5.PS2: Motion and Stability: Forces and Interactions

- 1) Test the effects of balanced and unbalanced forces on the speed and direction of motion of objects.
- 4) Explain the cause-and-effect relationship of two factors (mass and distance) that affect gravity.

Student Worksheet

Name: _____ Date: _____

Answer the following questions.

1. What is your hypothesis for Experience 1?
-

2. Now perform the experiment.
- a. Tie big paperclips to the end of 3 pieces of string.
 - b. Tie the other end of the strings onto the dowel rod.
 - c. Lift up the dowel rod perpendicular to the ground so the paperclips hang from the string.
 - d. Observe the direction the paperclips are pointing?
 - e. Tilt the dowel rod.
 - f. Observe the direction the paperclips are pointing with the dowel rod.

3. Did the direction of the paperclips change when the dowel rod was tilted? Circle your answer.
- Yes No

4. Were you correct in your hypothesis? Yes No

5. What is your hypothesis for Experience 2?
-

6. Which object will hit the ground first? Circle your answer.
- Paper Rock Both will hit the ground at the same time

7. Now perform the experiment.
- a. Crumple a 8.5 x 11 sheet of paper into a ball the size of the small rock.
 - b. Hold the rock and paper ball at the same height.
 - c. Drop the rock and paper ball at the same time.
 - It is important both objects drop from the same height and at the same time.
 - d. Observe which object reaches the ground first.
 - e. Repeat the experience several times.

8. Were you correct in your hypothesis? Yes No

9. Which object has the greatest mass? Circle your answer. Paper Rock

10. Which object has the greatest acceleration due to gravity? Circle your answer.
- Paper Rock The acceleration due to gravity
is the same for both objects





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