Investigation One – I'm Falling For You!

Standard IV Students will understand that objects near Earth are pulled toward Earth by Gravity.
Objective 1 Demonstrate that gravity is a force.
Intended Learning Outcomes 1. Use a science process and thinking skills 2. Manifest scientific attitudes and interests 3. Understand science concepts and principles 4. Communicate effectively using science language and reasoning

Standard IV

Objective 1

Background Information

Gravity is an invisible force that pulls together any two objects. It pulls us down toward our planet, Earth, and holds us connected to it. To prevent confusion in students who may think, based on this definition, that gravity is the same as magnetic forces, the force of gravity is presented as the force that pulls objects on or near Earth toward its surface.

In this activity, students will experience gravity just like Galileo did during his experiments. For background purposes, it should be noted that there is no concrete evidence that Galileo successfully performed this experiment. Because of air resistance, the likelihood of the musket ball and the cannon ball actually landing at the same time is doubtful. However, through many other additional experiments with controlled processes, Galileo is considered the scientist who first understood this physical force.

Gravity pulls on all objects, no matter what their mass, with equal acceleration towards Earth. That is why an apple falls from a tree, or why rain falls from the sky. Ignoring friction or air resistance, any two objects will reach the ground at the same time if they are dropped from the same height and at the same time. In this activity, experiments will demonstrate that the force of gravity on Earth is the same for all objects.

It is also important to demonstrate and explain that a baseball and a piece of paper will not hit the ground at the same time because of air resistance. As objects move through air, friction slows the objects. The more surface area an object has, the more air resistance it will have. This might be easier to visualize if you tell students that a baseball and a wadded up piece of paper will fall at the same time.

Pre-Assessment/Invitation to Learn

1. Teacher will ask the students these questions: "If I dropped a basketball and a marble, which one would hit the ground first? Make a prediction. Why did you choose that answer?"
2. Drop both items from a high vantage point. Allow students to observe but not to engage in a lengthy discussion.
3. Repeat the experiment three times to model good experimentation.
4. Make a comment such as, "That was odd, don't you think? The basketball is heavier than the marble, isn't it?"
5. Pretend to think about this question. Then tell all students, "I think this is something we need to experiment with and try to figure out in our groups."

Instructional Procedure

Materials
- Marbles
- Ping pong balls
- Eraser
- Pencil
- Feather
- Paperclip
- Sheet of paper
- Data collection sheet
- Baseball

1. Divide children into small groups.
2. Hand out the data collection sheets and materials to students.
3. Allow students approximately 10 minutes for the experiment.
4. Answer any questions that may arise as you help groups experiment.
5. Report predictions and findings from students' charts. Put on a large classroom chart. Students will discover that objects similar in shape, but with different weights hit the ground at the same time. However, they will also discover that the unfolded sheet of paper will hit the ground later than the ping pong ball. Or perhaps the feather will fall much slower than the marble. Help lead students to the knowledge that *mass should not affect the rate at which objects fall, but shape definitely makes a difference.*
6. Ask, "Does gravity change?" (No. Gravity remains constant. Shape changes; gravity does not.)
7. Ask, "Why is it important to know about gravity?" Help students discover that without gravity we would fly off the earth. Gravity helps us understand how things move around us in our physical world. It also helps plants to grow.
8. Have students complete a paragraph that states three important facts they have learned from their experimentation about gravity (For Science Journal). Example: Gravity is an invisible force. Earth's gravity pulls everything toward its center. Heavy and light objects that are about the same shape fall at an equal speed.

Curriculum Extension

Science –

- Students could test objects of varying shapes and sizes, or different weights. (Light object, empty soda can versus heavy object, a full soda can.) (*ILO 1*)
- Explore the influence that air resistance has on the force of gravity when Objects fall. (*ILO 2*)

Language Arts –

- Writing Workshop topic such as "How would it be different if there were no gravity?" (*Standard VIII, Objective 6*)

Math –

- Place the objects in sequence according to their weight from lightest to heaviest. (*Standard 1, Objective 3*)
- Order and compare the weights of the objects by plotting them on a number line. (*Standard 1, Objective 3*)
- Compare the relationship ("<", ">", and "=") between the weights of the objects. (*Standard 1, Objective 3*)
- Make a grid of the floor tiles (flight path) and indicate where the paper airplanes landed. (*Standard III, Objective 1*)

Assessment Suggestion

- Rubric for Activity Completion:
  - Group Work 25 pts.
  - Completion of Worksheet Activity 25 pts.
  - Class Discussion 25 pts.
  - Written Journaling 25 pts.

  - Response questions:
    1. Is gravity everywhere?
    2. Is gravity a force? What does that mean?
    3. Describe the observations made using the vocabulary words, gravity, speed, motion, distance, and force.

Resources

Web sites:

- www.lessonplanspage.com/ScienceSSMars7
- www.enc.org/weblinks/science/0.1578.1%2DGravity.00shtm

Books:

- *Gravity* by Dan Greenberg (Newbridge Education Publishing)
- *The Magic School Bus Plays Ball* by Joanne Cole (Scholastic Inc.)
- *Gravity: Simple Experiments for Young Scientists* by Larry While (Millbrook Press)
- *Bowled Over: The Case of the Gravity Goof-Up* by Chuck Harwood (McGraw Hill Trade)
- *Why Doesn't the Earth Fall Up? by Vicki Cobb (Lodestar Books)*
- *Which Way Is Up?* by Gail Kay Haines (Simon & Schuster)
- *The Science Book of Gravity* by Neil Ardley, Published by Gulliver Books, 1992

Videos:

- *Gravity is Attractive: What is Gravity?*

Laser Discs:

- *Windows on Science, Primary Vol. 3 Force and Motion* Lessons 12 + 13

Homework & Family Connections

Defying Gravity

1. Challenge the students to design and make a paper airplane that will defy gravity by flying the straightest and furthest path.
2. Have the students bring their airplanes to school the next day for test flights.
3. Have one student at a time fly their airplane. This is best done in a hall with tile on the floor.
4. Record the results. To determine each student's result: Count how many tiles out from the starting line. Then subtract the number of tiles off course (to the left or right).
5. Analyze which airplanes were the most successful in meeting the criteria and why.
6. Are there some variables in the experiment that could possibly influence the results? How could we control those variables?

I’m Falling For You

Data Collection Sheet

Objects Dropped		Which will hit the ground first?	Which object actually hit the ground first?
ping pong ball	marble		
flat paper	feather		
pencil	paper clip		
crumpled paper	eraser		
paper clip	ping pong ball		