**It’s an Uphill Battle**

**Purpose**

This activity will allow students to observe and analyze the forces of gravity.

**Lesson Goal or Objectives**

By the end of the lesson, students will understand that gravity pulls objects toward the Earth.

**Lesson Inquiry Question**

Does the height at which an object is released down a pipe insulator affect the height at which it will travel up the other side of the pipe insulator?

**Target Group**

This activity is appropriate for students in third grade. To use with older students, the variables tested should be modified.

**Approximate Time**

Teacher prep: one hour to gather materials and create charts/graphs

Student: One class period or about 45 minutes

# Background Science Information

If you throw a ball into the air, the force you exert pushes the ball forward and/or up. The ball continues to move in that direction until the effect of gravity becomes stronger than the force of your throw. Gravity pulls the ball downward toward Earth.

Gravity is an invisible force of attraction between two objects. The greater the mass (amount of matter) of an object, the greater its gravitational force is on the other object. The earth’s force of gravity overrides all other gravitational force on it and pulls all things to its surface. Objects speed up as they fall. However, forces like friction in the form of air resistance and winds can slow the object down.

Weight is a measure of the force of gravity acting on an object. Mass is the amount of matter in something. Gravity has more pulling force on heavier objects on the ground than lighter objects on the ground.

Peters, Joseph A. & Stout, David L. (2011). *Science in Elementary Education: Methods,
 Concepts, and Inquiries*. Boston, MA: Pearson/Allyn & Bacon.

<http://www.uen.org/Lessonplan/preview.cgi?LPid=11032>

Drobrich, J. and Morrison, J. (1999). Pulley. *Motion of Objects* (p. 59). Grosse Pointe: Grosse
 Pointe Public School System.

Great Source Education Group. (2006). *Sciencesaurus, A Student Handbook*. Wilmington, MA.

**Discipline-based Content Expectations**

**P.FM.03.22** Identify the force that pulls objects towards the Earth.

**Inquiry Process:**

**S.IP.03.11** Make purposeful observation of the natural world using the appropriate senses.

**Inquiry Analysis and Communication:**

**S.IA.03.13** Communicate and present findings of observations and investigations.

**Reflection and Social Implications:**

**S.RS.03.11** Demonstrate scientific concepts through various illustrations, performances, models, exhibits, and activities.

**Materials Needed (per group)**

* Pipe insulator (cut in half lengthwise)
* Marble
* 2 chairs
* [It’s an Uphill Battle data recording sheet](http://www.uen.org/Lessonplan/downloadFile.cgi?file=11032-2-14807-uphill_battle.pdf&filename=uphill_battle.pdf)

**Safety Considerations**

Students should be careful when setting up the chairs and should not stand on the chairs. Also, pipe insulators should be pre-cut by the teacher. Students should not throw the marbles or put them in their mouths as it is a choking hazard.

**References**

Michigan Department of Education (MDE) (2000). *Michigan Curriculum Framework Science Benchmarks.* Lansing: Author.

Peters, Joseph A. & Stout, David L. (2011). *Science in Elementary Education: Methods,
 Concepts, and Inquiries*. Boston, MA: Pearson/Allyn & Bacon.

**PROCEDURE**

**Engage:** Tell the students they are going to pretend to go on a bike ride and they need to listen carefully as you describe the terrain and respond appropriately.

*“It is a nice spring day—great for a bike ride. You put on your helmet and pull your bike to the end of the driveway. You carefully climb onto your bike. After looking both ways, you start pedaling and turn right onto the road. The road is nice and flat for awhile. Now, you are approaching a small hill. To get to the top you have to push a little harder and faster on your pedals. The road levels off and then disappears. You suspect that the road goes downhill. You are correct. It is a long gentle slope. As you go down the hill, you can coast instead of pedal. You turn right at the bottom of the hill where the road flattens out. A nice steady even pedaling keeps you going at a constant speed. You spot a steep ravine up ahead. As you approach, you sigh before starting downhill. You have to apply the brakes to prevent yourself from going too fast. As soon as you reach the bottom, you start to climb uphill. It is so steep; you have to pedal really hard and fast. Once on top, you stop to catch your breath. The flat terrain is inviting. You pedal along at a steady speed. You turn left at the corner and continue your steady pedaling until you reach your friend’s house. You turn left into their driveway, stop, get off your bike, lean your bike against the wall, and take off your helmet.”*

What would you tell your friend about your bike ride and the effect of gravity as you went up and down the hills?

**Pre-Assessment:** Have students write in their journals describing what they think they know about gravity. Have them draw a picture of what they think will happen when the marble is released down the pipe insulator.

**Activity:**

1. **Explore:** Ask the question, "What will happen when you drop a marble down one end of the pipe insulator?
2. Give each group a pipe insulator, marble and two chairs. Have the students get familiar with the materials and generate questions.

 

1. Perform the demonstration.
	1. Place the chairs approximately 24” apart.
	2. Place the pipe insulator between the two chairs, forming a “U” and extending 36” off the floor at both ends. Tape the pipe onto the chairs.
	3. Explain to the students that you are going to release a marble from various starting points. Have the students predict how far up on the other side the marble will roll.
	4. Place the marble on the pipe insulator 30” from the floor and release it.
	5. Observe how far up the other side the marble traveled.
	6. Record your observations on the “It’s an Uphill Battle” data recording sheet.
2. **Explain:** Provide reference material on gravity for students to do research. Have students develop content and vocabulary. Students will research Newton’s Laws of Motion, specifically Newton’s Second Law. They will also research vocabulary terms such as gravity, force and free fall.
3. Discuss: What happened when you let go of the marble? Why did this happen? How does this relate to Newton’s Second Law of Motion?
4. **Expand or Elaborate:** Together, develop a simple investigation to find out if the height at which the marbleis released affects how far up the other side the marble will travel. Write the question on the board: “Does the height at which an object is released down a pipe insulator affect the height at which it will travel up the other side of the pipe insulator?
5. Create a procedure. (It would be advisable to do this together as a class.)
6. Have students test the variable. Repeat the experiment from a height of 24”, 18”, 12” and 6”.
7. Have students record their results.
8. Analyze the data they have collected. What surprised you? What can you say about force and motion? What is our conclusion? Students may be surprised that the marble travels so far up the other side of the pipe insulator, instead of stopping at the bottom because of the force of gravity.

**Post-Assessment:**

* Did the student accurately fill in the information on his/her data recording sheet?
* Have students draw a picture of what occurred in their activity. Label all parts of the diagram, carefully detailing what happened. Is their drawing accurate and labeled correctly?
* Can the student explain (written or orally) why the ball does not travel up as far on the opposite side compared to the spot from which it was released? This may be illustrated and explained in his/her science journal.

Post-Assessment Rubric:

|  |  |  |
| --- | --- | --- |
| Student did not fill out the data recording sheet or draw and label what occurred. | Data recording sheet is partially filled out. Drawing is incomplete/unlabeled or incorrectly labeled. | Data recording sheet is completely and correctly filled out. Drawing is complete and correctly labeled. |
| 0 Points | 5 Points | 10 Points |

**Real-World Connections**

Have the students select and research an amusement park ride of their choice. Write a report detailing when, where, why, how, and by whom the ride was invented. The student may also include technological advances in the ride since its original invention. Include what forces are involved.

Play Ball - Play a game with family that requires a ball. Instruct students to discuss the effect of forward momentum and gravity on the ball.

Family Bike- Ride Go on a family bike ride. Discuss how it requires more force to go up a hill than down a hill.

Amusement Park - Design (and construct) an amusement park ride at home with the help of family. Bring the ride to school and set up a class amusement park.

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