Weighing in

Summary

Gravity is a force that has pulling power and keeps everything pulled toward the Earth. To overcome the force of gravity, another force is needed. A Slinky and rubberbands are used in investigating weight and its relationship to gravity.

Time Frame

2 class periods of 30 minutes each

Group Size

Small Groups

Materials

For the teacher:

- Slinky
- A piece of yarn or string about 12 inches long.
- A paper cup
- Strong tape that will hold the Slinky suspended.
- A strip of paper 5cm x 2meters
- A variety of coins, but especially 10 pennies

For each student group:

- Two rulers
- Paper clips
- Books (such as dictionaries) to stack
- Rubber bands (stretchy enough to hold several washers)
- A variety of washers or items that will hang from a hook
- Pencil and paper

Background for Teachers

A spring scale is used to measure things. A Slinky works well for the teacher as a large spring scale while the class begins investigating force needed to overcome gravity. This experiment will measure how much stretch from a spring scale, or Slinky, it takes to overcome the force of gravity that tries to pull objects to the Earth. As students understand that the stretch in these objects is a way to measure resistance to gravity, they will be able to understand that a force is in place. Students will measure that heavier objects require more stretch, or force than lighter ones. As they create a simplified spring scale with the rubber band and paper clips, questions will be asked and investigated about the invisible but fascinating force of gravity.

Student Prior Knowledge

Students will have better success and understanding with concepts of gravity if they understand the principles of forces and motion. A basic understanding of gravity as a force is also helpful.

Intended Learning Outcomes

- Observe simple objects and patterns and report their observations.
- Make simple predictions and inferences based upon observations.
- Conduct a simple investigation when given simple directions.
- Pose questions about processes.

Explain science concepts and principles using their own words and explanations.

Instructional Procedures

Step 1. Prior to students arrival into the classroom, tape one end of a large Slinky from the top of a door frame and near the vertical side. Beside the suspended Slinky, tape the long vertical strip of paper 5cmx2meters. Poke or punch two holes into the cup and thread the string or yarn through the holes to create a swinging basket. Then hook the string handle to the bottom of the hanging Slinky so the paper cup basket is suspended.
Step 2. Have students group around the doorway and review the definition of gravity. ("Gravity pulls objects toward the earth; gravity is a force.") Drop a few pennies to show the power of gravity as they end up on the floor. Then ask the class:
If I put five pennies in this paper cup, what will happen? Will the force of gravity pull the pennies toward the earth until they are together?
Accept all predictions from students. As you put each penny into the cup, comment on the amount of "stretch" that occurs. Mark the point where the cup stops.
Step 3. Ask the students: Why don't the coins get pulled all the way to the ground? Is the "stretch" of the Slinky helping to overcome or slow the force of gravity? Which of our predictions was correct? What observations could we record about what has happened?
Step 4. Ask students what might happen if you increase the amount of pennies (or the weight in the cup). Record predictions and repeat the experiment with ten pennies. Mark where the Slinky stretches to when the cup stops. Why did the Slinky stretch more with the additional weight? What forces were involved? Continue to add coins as time permits and mark the amount of stretch the Slinky uses to counteract the force of gravity.
Step 5. During the next time period together, student groups will be creating their own device, a spring scale, for measuring the stretch of a rubber band and its effect on the force of gravity. Have students stack books into two identical piles approximately 8 inches high and 9-10 inches apart on a desk. They will place their rubber band around a ruler and then place the ruler on the two piles of books so the rubber band is suspended in the middle from the ruler (like something hanging from a bridge).
Step 6. Bend the paper clip into a hook and attach to the rubber band. Using the washers for weight, students will be measuring the amount of "stretch" or force used by the rubber band to overcome the pull of gravity.
Step 7. Fold a paper in half. Across the top, label the two columns: "Our predictions" "Actual amount of stretch." Groups will predict the length of their rubber band as they place different amounts of washers on the paper clip hook. They will then measure the actual distance from the hanging ruler to the washers and record the two on their paper. There will be two colums of data, one that is predictions and the other the actual measurements.
Step 8. As students work together, encourage them to discuss their observations about gravity and the force used to overcome it.
Does weight change the length of the rubber band? What does that mean? Do heavier objects require more force than lighter ones to overcome gravity? What represents the force in our experiment?
Step 9. Discuss experiments and results as a group. Have the class create two conclusions in sentence form that will explain the results of their findings. ("A force is required to overcome gravity." "Heavier objects require more force than lighter ones to overcome gravity." "The rubber band stretched more (worked harder) to keep gravity from pulling the washer to earth with heavy stuff.") Help students use key words in their explanations to show understanding.

Extensions

Place these experiments in a corner with the materials needed and allow students to continue exploring the concept of weight and gravitational attraction.
Use a variety of coins to compare weights.
Would the coins move the same distance with a metal Slinky as a plastic one? Set up the experiment and let students find out.
Do different lengths of rubberbands change the results? Provide some and let students conduct the experiment again.
Some students might be interested in investigating the idea of gravity and its place on the moon or on other planets.

Assessment Plan

Display charts from different groups in a learning center. Check for understanding of concepts and accuracy of data in the sentences that the class created.

Bibliography

Van Cleave, Janice, Gravity: Spectacular Science Projects, John Wiley and Sons, New York, 1993.

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