May the Force Be With You

Summary

The hands-on activities described in this lesson will help students better understand the effects of force on an object.

Main Core Tie

Mathematics Grade 3

Strand: GEOMETRY (3.G) Standard 3.G.1

Additional Core Ties

Mathematics Grade 3

Strand: MEASUREMENT AND DATA (3.MD) Standard 3.MD.3

Group Size

Small Groups

Materials

Invitation to Learn Activity

- wind-up moving toy OR pull string moving toy
- large paper clip
- 20 washers

Over the Edge

- sock
- one cup of rice
- 12" piece of string
- 36" piece of string
- large paper clip
- 20 washers

Collision Zone

- 1" balls of different weights (glass, steel, cork, wood, rubber, etc.) (per pair of students)
- two 1/2" wooden dowels (per pair of students)
- masking tape
- Collision Zone recording sheet (pdf) (one per student)

Straw Rocket

- Straw Rocket Directions (pdf)
- soft plastic bottle, with pop-up lid
- two straws (one smaller than the other one in diameter)
- modeling clay
- scissors
- ruler

Background for Teachers

What a Load

The force of the car remains the same. Additional weight is added to each run. At first, the amount of washers (weight) added does not affect the toy's performance. Later on, each additional washer

(increased weight) makes it more and more difficult to move the load. Finally, the load (weight/washers) cannot be moved by the amount of force applied.

Over the Edge

The sock filled with rice remains the same weight. As force (washers) is added to the paper clip, it reaches the point where the force is enough to move the weight. The greater the amount of force (# of washers), the greater the effect on the weight (sock) thus making the sock move across the tabletop and over the edge quicker.

Collision Zone

The balls are all the same size, but they are not all the same weight. The weight of each ball helps to determine how it will react when it collides with another ball. The material used to make each ball will also affect the experiment. Some materials absorb energy.

Straw Rocket

When the bottle is squeezed, the air is pushed up the smaller straw. The force of the air escaping from the smaller diameter straw pushes the larger diameter straw into the air. The greater the force, the greater the speed and distance traveled by the large diameter straw rocket.

Intended Learning Outcomes

1. Use a Science Process and Thinking Skills
2. Manifest Science Interests and Attitudes
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Instructional Procedures

Invitation to Learn

Materials:

- wind-up moving toy OR pull string moving toy
- large paper clip
- 20 washers

Launch your straw rocket. Ask the students "What did you observe?"

Instructional Procedures

Part 1: What a Load

Preparation:

Bend apart the two loops of the paper clip (so it looks like an "S".
Pull out the loose end of the larger loop.
Attach the smaller loop to the back end of the moving toy.

Activity:

Wind-up (or pull the string) on the toy and let it go. Observe the amount of time lapsed and distance traveled before the toy stops moving.
Predict what will happed as washers (weight) are added to the paper clip.
Place four washers on the paper clip, repeat step four. Compare the results to the first run.
Place six washers on the paper clip, repeat step four. Compare the results to the first two runs.
Place eight washers on the paper clip, repeat step four. Compare the results to the previous runs.
Repeat step four, with two additional washers on each new run, until the toy cannot move the weight. Compare the results of each run with previous runs.
Discuss what is happening in this experiment.

What's Happening?

The force of the car remains the same. Additional weight is added to each run. At first, the amount of washers (weight) added does not affect the toy's performance. Later one, each additional washer (increased weight) makes it more and more difficult to move the load. Finally, the load (weight/washers) cannot be moved by the amount of force applied.

Part 2: Over the Edge

Materials:

sock
one cup of rice
12" piece of string
36" piece of string
large paper clip
20 washers

Preparation:

Fill the sock with one cup of rice and tie it shut with the 12" piece of string.
Attach the 36" piece of string to the cuff of the sock.
Bend apart the two loops of the paper clip (so it looks like an "S").
Pull out the loose end of the larger loop.
Attach the smaller loop to the loose end of the 36" piece of string.

Activity:

Place the bag of rice on a smooth surface (approx. 30" from the edge), with the end of the string with the paper clip hanging off the edge.
Predict how many washers will need to be placed on the paper clip before the bag of rice begins to move.
Predict how many washers will need to be placed on the paper clip before the bag of rice is pulled over the edge of the table.
Start adding washers to the loose end of the paper clip until the bag of rice begins to move and eventually is pulled over the edge of the table. Compare the results of your prediction with the actual results.

What's Happening?

The sock filled with the rice remains the same weight. As force (washers) is added to the paper clip, it reaches the point where the force is enough to move the weight. The greater the amount of force (number of washers), the greater the effect on the weight (sock) thus making the sock move across the tabletop and over the edge more quickly.

Part 3: Collision Zone

Materials:

1" balls of different weights (glass, steel, cork, wood, rubber, etc.) (per pair of students)
two 1/2" wooden dowels (per pair of students)
masking tape
- Collision Zone recording sheet (pdf)
(one per student)

Preparation:

Tape the dowels together at each end.

Activity:

Place the dowels (ramp) on a flat surface.
Select the first two balls on the chart and place them on opposite ends of the ramp.
Predict what will happen when the two balls collide. Write your prediction on the Collision Zone Worksheet.

Using the same amount of force, roll the balls toward each other. Write what you observe happening on the worksheet.
Repeat steps 3 and 4 until the students have investigated what happens when each ball has collided with another.

What's Happening?
The balls are all the same size but they are not all the same weight. The weight of each ball helps to determine how it will react when it collides with another ball. The material used to make each ball will also affect the experiment. Some materials absorb more energy.
Curriculum Integration
Math/Science
Objective 4:2 Use appropriate techniques and tools to determine measurement.
1. Measure and record the distance the wind-up or pull string toy goes each time.

Extensions

Make a pinwheel and blow on it with different amounts of force.
Adaptation: All three main activities can be investigated by the students individually or in small groups at a learning station, or demonstrated to the entire class by the teacher.
Homework & Family Connections
Have the student make a straw rocket at home.
Materials

- Straw Rocket Directions (pdf)
  soft plastic bottle, with pop-up lid
  two straws (one smaller than the other one in diameter)
  modeling clay
  scissors
  ruler

Possible Resources
Books
Tell Me How Fast It Goes (Whiz Kids) by Shirley Willis (Franklin Watts)
Feel the Wind by Arthur Dorros (Children's Books)
The Berenstain Bears' Science Fair by Stan and Jan Berenstain (Random House, Inc.)
Gizmos and Gadgets: Creating Science Contraptions that Work and Knowing Why by Jill Frankel Hauser (Williamson Publishing)
Forces by Graham Peacock (Steck-Vaughn)
Laser Discs
Windows on Science, Primary Vol. 3, Force and Motion Lessons 6-10, 14-17

Authors

Utah LessonPlans