GIVE IT A PUSH

BIG IDEA 13: FORCE AND MOTION

BENCHMARKS AND TASK ANALYSES

SC.2.P.13.1 Investigate the effect of applying various pushes and pulls on different objects.
SC.2.P.13.4 Demonstrate that the greater the force (push or pull) applied to an object, the greater the change in motion of the object.
SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

- raises questions about the natural world.
- investigates them in teams through free exploration and systematic observations.
- generates appropriate explanations based on those explorations.

KEY QUESTION

How can we move the marble without touching it?

TEACHER BACKGROUND INFORMATION

An unbalanced force is a push or pull that makes something change its motion. A force is a push or pull that makes something start moving, stop moving, or change direction. If an object is not moving, a push or pull will set it in motion. If the object is moving, a push or pull will change its speed or direction. The same object will move different distances depending on the strength of the force on a given surface. (Realize that friction is a force acting on a object moving in everyday situations. If the frictional force is changed, the amount of force required for a given distance also changes.)

MATERIALS

Per group

2 large marbles
yardstick
ruler
tape
5" -10" piece of stiff cardboard to use as a ramp, half a paper towel tube works best
3 books or blocks

SAFETY

Marbles will move by rolling on the ramp; they should not be thrown.

TEACHING TIPS

- This activity requires groups to have wall and floor space. A hallway would allow room for all groups to set up.
- Begin collecting paper towel tubes early in the year and cut them half length-wise.
- For the initial lab all tubes should be the same but for further explorations you might want to offer ramps of different materials and different lengths.

ENGAGE

1. Tell students they will be doing an activity to see how they can change how something moves.
2. Lay a marble on a flat surface. Ask: *Is the marble moving? How could I make it move?*
3. Test any suggestions made by students.

4. Observe and describe which ways make the marble move the farthest.

EXPLORE

1. Put students into groups and find a flat surface, next to a wall to work. Give each pair of students a yardstick, ruler, two marbles and a piece of cardboard for the ramp.
2. Instruct students to tape the ruler to the wall so they can easily take vertical measurements.
3. Instruct students to create a ramp by placing one book on the ground and placing the cardboard tube on the edge.
4. Instruct students to tape the yardstick to the ground to measure how far Marble B travels.
5. Instruct students to place Marble B at the bottom of the ramp and hold Marble A at the top of the tube.
6. Instruct students to release, not push, Marble A. It will roll down to Marble B and bump it (or give it a push). Have students record the distance Marble B travels with one book ramp height in their science notebooks.
7. Have students repeat the procedure while increasing the ramp height by one book each time.

EXPLAIN

1. Ask: *What did you discover?*
   How made Marble B move?
   What happened to Marble B as you changed the height of the ramp?
   Why do you think this change occurred?

EXTEND AND APPLY

1. Have students work with a partner to build a ramp to race toy cars. Conduct a contest to see which ramp causes the cars to move farthest.
2. This lab can moved to an independent center for further investigations with different ramp materials and length of ramps.

ASSESSMENT

Teacher confers with student. Have student open and close a door. Have him/her move a chair. Have the student explain how he/she used a push or a pull to move the door and the chair.

THE MYSTERIOUS FLOATING PAPER CLIP

BIG IDEA 13: FORCE AND MOTION

BENCHMARKS AND TASK ANALYSES

SC.2.P.13.2 Demonstrate that magnets can be used to make some things move without touching them.
SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

- raises questions about the natural world.
- investigates them in teams through free exploration and systematic observations.
- generates appropriate explanations based on those explorations.

KEY QUESTION

How can we move the something without touching it?

TEACHER BACKGROUND INFORMATION

Magnets come in three different categories:
Natural magnets are found in some rocks that contain a lot of iron.
Permanent magnets are made out of steel (hard iron) or other magnetic alloys. They are strong and hold their magnetism for a long time.
Temporary magnets are weak and last only a short time.

Magnets usually have two poles – north-seeking and south-seeking. Like poles repel and unlike poles attract each other. Bar magnets have poles at each end. Horseshoe magnets are bar magnets that have been bent into that shape. The poles of ring magnets are on their flat sides. Magnets are strongest at their poles and weakest midway between them.

Every magnet has a magnetic field, which interacts with the magnetic fields of objects containing iron or other magnetic materials. Magnetic fields can pass through both magnetic and nonmagnetic materials. All metals are not magnetic.

MATERIALS

Per group

magnet
textbook
paper clips
string
tape
paper cup

SAFETY

- Magnets can pinch fingers if two strong magnets are used together.
- Ceramic magnets can break if dropped.

TEACHING TIPS

- Strong magnets are best for this activity and they need to be attached with a portion over hanging the edge of the cup.

- Students might find frustration when creating the floating paperclip if they pull back too fast. Have them practice moving the cup back very slowly until the paperclip just breaks away from the magnet.

ENGAGE

1. Distribute one paper clip to each student.
2. Allow time for each student to explore with the paper clip and the magnet.
3. Ask students to open their textbooks to any page and place the magnet under one page.
4. Instruct students to place the paper clip on top of the page and direct the students to move the magnet and observe the moving paper clip.
5. Challenge students to add more pages between the magnet and the paper clip, and then discuss with the class the results of the activity.
6. Ask students to repeat the test through the book cover or through a student's hand (depending on the strength of the magnet).
7. Distribute additional paper clips and direct students to determine how many paper clips the magnets are capable of moving.

EXPLORE

1. Distribute string, cups and tape to groups.
2. Have groups turn the cup upside down and tape the magnet to the bottom with some portion of the magnet hanging over the edge. The cup will act as a stand for the magnet and a handle to move the magnet around.
3. Have the groups tie a paperclip to the end of a string. Allow the paperclip to stick to the magnet and then tape the other end of the string to the desk to anchor.
4. Have students slowly pull back on the cup until the string is taut. Have the student continue to pull back slowly until the paperclip floats in the air.
5. Have the students explore moving the cup around and having the paperclip follow.

EXPLAIN

Ask:
Can magnets make some things move without being touched?
Can magnetic forces travel through paper? Air? The body?
How did you determine the magnet could move things through paper?

EXTEND AND APPLY

1. Have students explore the room for magnetic items and complete a Venn diagram.
   Ask: *What objects in your desk are magnetic?*
   How did you determine if objects were magnetic?
   Can objects have both magnetic parts and nonmagnetic parts? What are some examples?
   Are all metals magnetic?
2. Have students explore different thickness of paper and strength of magnets. Ask: *What is the thickest stack of paper you can move a paperclip through?*
3. Test other materials such as wood, plastic, cloth, etc.

ASSESSMENT

Ask: *You are in the driveway with your brother and drop a box of nails. You need to pick them up quickly before someone drives in the driveway. Which is the fastest way to pick up the nails – sweep them up, wave a magnet close to them, pick them up by hand.*

RACING FOR GRAVITY

BIG IDEA 13: FORCE AND MOTION

BENCHMARKS AND TASK ANALYSES

SC.2.P.13.3 Recognize that objects are pulled toward the ground unless something holds them up.
SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

- raises questions about the natural world.
- investigates them in teams through free exploration and systematic observations.
- generates appropriate explanations based on those explorations.

SC.2.N.1.2 Compare the observations made by different groups using the same tools.

- uses same materials in an investigation and reports and compares results with other groups.

KEY QUESTION

Do all things fall to earth at the same rate?

BACKGROUND INFORMATION

Gravity is the force that pulls all objects to Earth. The bigger the object the stronger the force is. However, gravity is only noticeable when it is very strong. The gravity of Earth has a strong pull because Earth is a large planet. Objects that weigh more will fall at the same speed as objects that weigh just a little

MATERIALS

Teacher
ruler
2 different size marbles/balls
3 ring binder
baby food jar
index card
water

Per group
dominoes
cup
index card/card stock
bear counter
strong magnet (e.g., cow magnet)
paper clips

Per student
science notebook

SAFETY

Always follow the OCPS science safety guidelines.

TEACHING TIPS

- When creating the ramp, build a ramp that is not very steep. The marbles need to roll slowly enough so the students can see them cross the finish line. A 3-ring binder works well for a ramp.
- Choose marbles/balls with a smooth surface so friction does not play a roll in speed.
- Set up centers with appropriate materials for student exploration.
- Purchase cow magnets from Home Depot, Lowes, or science suppliers.

ENGAGE

1. Place the binder on a flat surface.

2. Use a ruler to create a "starting gate" at the top of the ramp and place one large and one small marble behind the gate.
3. Lift the starting gate straight up quickly, release the marbles at the same time and watch closely to see which marble crosses the finish line first. Ask: *Why didn't the marbles roll when at the starting gate?* (the ruler was holding the marbles up)

EXPLORE

Center 1 – Dominoes
Center 2 – Magnets and Paper Clips
Center 3 – Paper Holding Object Over a Cup

Center 1 – Dominoes
Instruct students to design a domino trail leading up to the edge of the table. Have students predict in their science notebooks *what they think will happen when they push the first domino*. Have students test this. The group should discuss what happened and record the results in their science notebooks.

Center 2 – Magnets and Paper Clips
Instruct students to place paper clips on the table and predict in their science notebooks *what they think will happen when they put the magnet under the table, below the paper clips, and moved it out from under the table beyond the edge.* Have students test this. The group should discuss what happened and record the results in their science notebooks.

Center 3 – Paper Holding Object Over a Cup
Instruct students to place an index card over the mouth of a cup and set a teddy bear counter on top of the card. Have students predict in their science notebooks *what they think will happen when the index card is quickly pulled away.* Have students test this. The group should discuss what happened and record the results in their science notebooks.

EXPLAIN

1. Ask: *What similarities did you notice in all the centers?*
   What are some other forces you observed in the centers? (magnetism, push and pull)
   When the marbles were at the starting gate, were any forces acting on them? (yes the gravity pulled the marbles down the ramp.)

EXTEND AND APPLY

1. Have groups compare observations from the different centers and discuss.
2. Instruct students to fill a jar with water and place an index card over the mouth. Turn the jar upside down over a bucket/tray and observe that the water remains in the jar. Ask: *What will happen when I pull the index card away? Why?* Quickly pull the index card away. Ask: *What happened? Why?*

ASSESSMENT

The teacher observes that:

- science notebooks contain predictions, observations and explanations.
- students were engaged in the activities and discussions.