WHAT MAKES OBJECTS MOVE?

BIG IDEA 13: FORCES AND CHANGES IN MOTION

BENCHMARKS AND TASK ANALYSES

SC.1.P.13.1 Demonstrate that the way to change the motion of an object is by applying a push or a pull.
The student:

- changes the motion of an object by applying a push or a pull.

SC.1.P.12.1 Demonstrate and describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, and slow.
The student

- moves objects in various ways such as in a straight line, zigzag, back and forth, round and round, fast and slow.
- describes the motions they have observed.

SC.1.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration, and generate appropriate explanations based on those explorations.
The student:

- raises questions about the natural world.
- explores questions about the natural world with a team of students through free exploration and generates appropriate explanations for what was observed.

KEY QUESTION

What makes an object move?

SAFETY

Always follow OCPS science safety guidelines.

TEACHER BACKGROUND INFORMATION

Motion is what happens when an object changes its location relative to the original position. Objects are always in motion relative to some object. Although an apple sitting on a table is stationary with respect to the table, it is moving relative to the sun.

MATERIALS

Teacher/Class

The Enormous Carrot by Vladimir Vagin (optional)
chart paper to record student responses (optional)
circle map from OCPS lab In *What Ways Do Objects Move?*

Per group

ball or toy car

Per student

science notebooks or three column recording sheet

ENGAGE

1. Put a ball or toy car on a flat surface in the classroom. Ask students to brainstorm ways in which the ball can be put in motion.
2. List student answers on the board or chart paper.
3. Explain to students that all of their answers are correct and can be summed up by labeling each of the actions as push or pull.

EXPLORE

1. Begin the activity by asking students to describe examples of movement they see on the school playground. To guide their thinking, name different pieces of playground equipment and ask them to think about the type of motion each one makes. Take students to the playground and have them observe the playground equipment in motion.
2. Review the circle map from the OCPS Essential Lab*, In What Ways Do Objects Move?*
3. Distribute copies or have students create a three-column chart in their science notebook. The headings should be: push, pull, both push and pull.
4. Ask: *If something is falling, which way does it move?* (toward the Earth)
5. Ask*: Is it a push or pull when things fall to the Earth?* (pull- nothing is pushing it)
6. Place students with a partner or in a small group to identify objects on the playground that can be pushed, pulled or both. Students will record their findings on the chart. Students may choose to draw the equipment and label it.
7. Students will orally share their data to create a three-column class chart.

EXPLAIN

1. After all data has been recorded on the class chart, discuss the findings.
2. Ask: *Are there more objects on the playground that are pushed, pulled or both?*
3. A push or a pull is called a force. All objects chance their movement because of an unbalanced force.

EXTEND AND APPLY

1. Take students in the school's gymnasium to observe a class during physical education or to the cafeteria to observe students eating lunch. Have students observe and record at least 5 activities performed by various people. Students should identify the activity as a push or pull. For example: A student opening a milk carton would be labeled a pull because he/she has to pull the carton open.
2. Play the game Charades. Students take turns acting out an activity that involves some kind of force- either a push or a pull. The rest of the class guesses what action was portrayed and then tells whether the force used was a push or a pull.
3. After each dramatization, use the action portrayed as new words for the tune of the song, "We Go Round the Mulberry Bush." Each time the students come to the last phrase of the song, end with the words "with a push or a pull in the morning." For example, "This is the way we put up the flag, put up the flag, put up the flag. This is the way we put up the flag with a pull in the morning."
4. Review the lesson by reading *The Enormous Carrot* by Vladimir Vagin. Ask students, *How did the characters finally remove the enormous carrot from the ground?* (They pulled it.) Explain that a pull or a push is called a force. *What happens when an object is pushed or pulled?*

ASSESSMENT

- Discussion
- Use of vocabulary ("push" "pull") on the chart
- Data collected in on chart
- Students inferences and conclusions

Push	Pull	Push and Pull

HOW CAN ONE OBJECT MOVE ANOTHER?

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SC.1.P.12.1 Demonstrate and describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, and slow.
The student:

- moves objects in various ways such as in a straight line, zigzag, back and forth, round and round, fast and slow.
- describes the motions they have observed.

SC.1.E.5.2 Explore the Law of Gravity by demonstrating that Earth's gravity pulls any object on or near Earth toward it even though nothing is touching the object.
The student:

- explores how objects fall, or are pulled, to the Earth's surface, even when there is nothing touching the object.

SC.1.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration, and generate appropriate explanations based on those explorations.
The student:

- raises questions about the natural world.
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SC.1.N.1.3 Keep records as appropriate - such as pictorial and written records - of investigations conducted.
The student:

- keeps records, such as student-drawn illustrations, science notebooks, or digital media, of investigations conducted.

KEY QUESTION

How can one object move another?

TEACHER BACKGROUND INFORMATION

An unbalanced force is a push or pull that makes something changes 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. It takes more force to move a given object a long distance rather than a short distance on a given surface. (Realize that friction is a force acting on an object moving in everyday situations. If the frictional force is changed, the amount of force required for a given distance also changes.)

MATERIALS

Teacher/Class
small ball

Per group
bag of dominoes
bag of hexagonal pattern blocks

SAFETY

Make sure that dominoes do not get thrown.
Always follow OCPS science safety guidelines.

TEACHING TIPS
Caution students not to interrupt, touch, or disturb other students' dominoes.

ENGAGE
1. Gather students in a circle near a table with dominoes. Place one domino standing up at one end of the table and another domino standing up at the other end of the table.
2. Ask: *If one domino is pushed, will it knock the other domino down? What could we do to make the other domino fall down without moving the dominoes closer together?* Try students' suggestions.

EXPLORE
1. Divide the class into small groups and distribute dominoes.
2. Ask: *How can you set up the dominoes so that they can move each other?*
3. Give students the opportunity to experiment with the dominoes until they can arrange them in such a way that they move each other.
4. Tell students that their task is to set the dominoes up in a pattern that is not a straight line and have them move into each other so they will fall when the first domino is pushed. For example, they can form a zigzag pattern, a circular pattern, or other shapes.

EXPLAIN
1. Ask: *How did the dominoes move each other? (*push*)*
2. Ask*: Were the movements pushes or pulls?*
3. Ask*: When the dominoes fell toward the table or floor were the movements pushes or pulls? (this is a pull, too- the pull of gravity)*
4. Ask: *How did you start the dominoes moving?*

EXTEND AND APPLY
Have students sit in a large circle. Ask one student to roll a small ball toward another student. Point out that he/she is "pushing" the ball. The student receiving the ball changes the direction and speed of the ball by pushing it to a different student. Relate this activity to a sport that uses a ball (e.g., baseball, soccer, tennis).

ASSESSMENT
Have students recreate the domino activity using hexagonal pattern blocks and have the students explain why the pattern blocks moved.

ARE HARD AND SOFT PUSHES DIFFERENT?

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The student:

- raises questions about the natural world.
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SC.1.N.1.3 Keep records as appropriate - such as pictorial and written records - of investigations conducted.

The student:

- keeps records, such as student-drawn illustrations, science notebooks, or digital media, of investigations conducted.

KEY QUESTION

How does the force of a push or pull affect the motion?

TEACHER BACKGROUND INFORMATION

An unbalanced force is a push or pull that makes something changes 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. It takes more force to move a given object a long distance rather than a short distance on a given surface. (Realize that friction is a force acting on an object moving in everyday situations. If the frictional force is changed, the amount of force required for a given distance also changes.)

MATERIALS

Teacher/Class

masking tape

Per group

paper clip, coin, large rubber eraser, masking tape

Per student

science notebooks

SAFETY

Always follow OCPS science safety guidelines.

TEACHING TIPS

In an open area with a smooth surface (table top or floor), use two pieces of tape to mark off a three-foot distance for each group of three students. You may also want students to measure this distance using non-standard measurement (30 Unifix cubes).

ENGAGE

1. Push a chair softly. Ask students what they observed. (the chair should move)

2. Push a chair harder. Ask students what they observed. (the chair should move more)
3. Ask: *What difference did you notice between the two pushes?*
4. Ask: *Does the amount of force you apply to object affect how far or how it moves?*
5. Have students discuss their answer with a partner and record their answers in their science notebook.

EXPLORE

1. Direct a student in each group to place the paper clip on one piece of tape. Tell him/her to gently use one finger to push the paper clip to the second tape.
2. Ask: *Was that enough force to make it to the tape?* If not, in their science notebooks, record the amount of gentle pushes it takes to push the paper clip to the second tape.
3. Have students create a table in their notebook:

Object	Hard pushes	Soft pushes

4. Instruct the same student to use hard pushes to move the paper clip. Again, count and record the amount of pushes it takes to push the paper clip to the second tape.
5. Repeat the same procedure with the coin and eraser.

EXPLORE

1. Ask: *How did you get the object to move?* (pushed it)
2. Ask: *Did the number of pushes differ for each object?*
3. Ask: *Did it take more hard pushes or soft pushes to move your object?* (The number of hard pushes required to move each object from one location to another should have been less than the number of soft pushes.)

EXTEND AND APPLY

- Ask students, why do you think it took more pushes to move the eraser? (Because it was heavier than the penny and paper clip)
- Would it have been harder to blow the objects from one piece of tape to the other?

ASSESSMENT

- Discussion (add new information to chart made earlier)
- Vocabulary
- Data collected in the science notebooks
- Students inferences and conclusions

HOW DO MAGNETS MOVE?

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KEY QUESTION

What happens when magnets come near each other?

TEACHER BACKGROUND INFORMATION

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. Permanent magnets are made of steel (hard iron) or magnetic alloys. Iron, nickel, and cobalt are attracted to magnets. Alloys such as steel and alnico are also attracted to magnets.

MATERIALS

Teacher

2 magnets
string

Per pair of students

2 strong bar magnets with the north and south poles marked as directed in the Teaching Tips section
1 styrofoam tray, file folder, or tag board

SAFETY

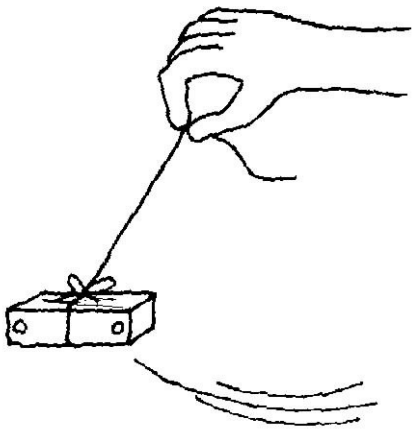
Goggles are recommended when swinging the magnets.
Always follow OCPS science safety guidelines.

TEACHING TIPS

Label each bar magnet with a red dot on the north pole and a blue dot on the south pole.

ENGAGE

Suspend a magnet so that it is allowed to swing freely as shown in the illustration. (The magnet should be labeled with the red and blue dot as directed in **Teaching Tips**.) Bring a second magnet near the swinging magnet and ask students to observe what happens. Discuss what will happen to the swinging magnet when the red end of the second magnet is placed near the red end of the swinging magnet. Repeat by bringing the red end of the



magnet to the blue end of the swinging magnet. Have students observe and describe the action of the magnets.

EXPLORE

1. Have students work in pairs. Give each pair two bar magnets and one tray, folder or tag board. Direct the students to hold the flat surface of the tray in one hand with a magnet resting on top.
2. Demonstrate how to hold a second magnet under the flat tray (with the other hand) to make the magnet on the tray move without actually touching it. Challenge students to move the magnet in as many ways as possible without touching it.

EXPLAIN

1. Give each pair an opportunity to share ways they moved the magnet by demonstrating to the rest of the class. Ask:
   - *Why do you think the magnet on the surface moved without the other magnet actually touching it?*
   - *What happened when the blue ends of both magnets came near each other?*
   - *What happened when the red ends of both magnets came near each other?*
   - *What happened when the red end of one magnet came near the blue end of the other magnet?*
2. At this time, introduce the terms ***repel*** **and** ***attract***.
3. Using two magnets, have several students demonstrate repelling and attracting. Ask:
   - *When two magnets attract each other, what kind of force do we call that?* (pull)
   - *When two magnets repel each other, what kind of force do we call that?* (push)

EXTEND AND APPLY

Direct students to draw a maze on the styrofoam tray, file folder, or tag board. Then try to move a magnet placed on the tray around the maze by using a second magnet under the tray.

ASSESSMENT

Ask and discuss:

You are in the driveway with your brother and drop a box of small nails. You need to pick them up quickly before someone drives in the driveway. What is the fastest way to pick up the nails?

1. *sweep them up*
2. *wave a magnet close to the magnets*
3. *pick them up by hand*

WHAT DETERMINES HOW WELL A BALL WILL BOUNCE?

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SC.1.N.1.2 Using the five senses as tools, make careful observations, describe objects in terms of number, shape, texture, size, weight, color, and motion, and compare their observations with others.
The student:

- uses the five senses as tools to:
    - make careful observations.
    - describe objects in terms of number, shape, texture, size, weight, color, and motion.
    - compare own observations with observations of others.

SC.1.N.1.3 Keep records as appropriate - such as pictorial and written records - of investigations conducted.
The student:

- keeps records, such as student-drawn illustrations, science notebooks, or digital media, of investigations conducted.

KEY QUESTION

What determines how well a ball will bounce?
In what ways does a ball move when bounced?

TEACHER BACKGROUND INFORMATION

When an object collides with another object or obstacle several things happen. In Newton's Second Law of Motion there is a description of the force, motion, slowing of the motion, and stopping. Children love to experience motion and with the bouncing of a ball they can see how Newton's Law is in action. In this activity, students will experiment with a ball and see what happens when they bounce the ball on a surface.

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MATERIALS

Teacher
variety of balls
overhead copy of (BLM) Better Bouncer Test
overhead projector, chart paper

Per group
ball
copies of BLM Better Bouncer Test

SAFETY

- Always follow OCPS science safety guidelines.
- Talk with the students of the importance of bouncing the balls carefully and being aware of things around them which might be knocked down or broken.

TEACHING TIPS

Make sure there is plenty of room for this activity to take place and that all materials that might be knocked down or broken have been moved.

ENGAGE

1. Bring students together for a group discussion.
2. Show students two different types of balls (e.g., a tennis ball and a ping-pong ball).
3. Ask: *When I drop the ball, is it being pushed or pulled?* (pulled toward the Earth)
4. Ask: *When I let go of the ball, which way does it fall?* (down toward the Earth)
5. Ask: *When the ball hits the ground, it bounces back up. Is this a push or a pull?* (help students understand that once the ball hits the Earth, the Earth is basically pushing it back up)
6. Ask: *Which ball is a better bouncer?*
7. Ask students to explain what they think it means to be a better bouncer. List their ideas on chart paper.
8. Let students know that they will be describing different balls and then comparing bounciness by counting the number of times a ball bounces.

EXPLORE

1. Tell students you will now test how the balls bounce and have them be the judge of the better bouncer.
2. With dramatic flair, slam one ball to the ground, and then lightly drop the other.
3. Assist students in recognizing that there is a problem with the contest, and ask the class to assist you by telling you how to test the balls.
4. Test how the balls bounce again, and improvise with another “problem” (e.g., drop the balls from different heights, have one ball hit your foot on the way down, etc.).
5. Ask students to assist you again by identifying the problem with the test and how to correct it.
6. Introduce the idea of a “fair” test, and ask the class to list the rules for a fair bounce test on chart paper (e.g., dropping balls from the same height, dropping balls on the same surface, etc.).
7. Ask: *How could a ruler be used to determine the height of the drop?*

8. Assist the class in deciding exactly how to test a ball, count the number of return bounces and record the data. Post these rules on a chart for reference during the investigation.
9. Use the overhead transparency of the BLM *Better Bouncer Test* to demonstrate how to identify and describe the tennis ball and record the number of bounces from six trials.
10. Divide the class into pairs and give student pairs one ball and one ruler.
11. Pass out the BLM *Better Bouncer Test.* Point out that there are spaces for six trials.
12. Ask: *Why is this important to do?* [mistakes in the test, etc.]
13. Have students complete the name, date, and ball description sections before doing the ball bouncing trials.
14. While students are running bounce tests, check for correct use of the ruler, accurate counting of bounces, and adherence to the fairness rules for this investigation.
15. When students have finished collecting data, have each pair of students present the data to the class and discuss the results.

EXPLAIN

Ask: *In what way did the ball drop?* (straight toward the Earth)
Ask: *What was the push in this activity?* (the Earth pushing back up on the ball)
Ask: *What was the pull?* (when gravity pulled the ball toward the Earth)
Ask: *Which ball bounced the most times?*
Ask: *Why do you think this happened?*

EXTEND AND APPLY

Demonstrate what happens to a ball of clay when it is dropped using the same rules for a fair test. Discuss the results.

ASSESSMENT

At the end of the investigation, bring students together for a group discussion and recording of findings. To guide student discussion, ask questions such as:

Did you have the same number of bounces in each trial?
Why do you think they were different?
Did your ball bounce the way you expected? Why or why not?
Which balls had the greatest number of bounces? The least?
Which balls have a similar number of bounces?
Are these balls similar in their size? Materials? Mass?

Better Bouncer Test

I have a_____ball.

Describe the ball:

<u>Write the number of bounces for each trial in the box</u>

Trial 1	**Trial 2**	**Trial 3**
Trial 4	**Trial 5**	**Trial 6**