
Grade 3

Cluster 3: Forces that Attract or Repel

Overview

In Grade 3, students build on their initial awareness of forces as pushes or pulls (see *Grade 2, Cluster 3: Position and Motion*). In this cluster, the focus is on forces that act without direct contact: gravity, magnetism, and static electricity. Students describe evidence that shows that objects and living things on or near Earth are affected by a force called gravity, enhancing their understanding of the nature of science. Through their investigations, they determine that magnets have two poles and are surrounded by a magnetic field. They describe interactions of like and unlike poles, and compare Earth to a giant magnet. In addition, they identify ways of producing electrostatic charges using everyday materials. Students show how the strength of magnetic and electrostatic forces varies under different conditions. New understandings of gravity, magnetism, and static electricity are further refined as students identify and construct devices that use these forces.

PRESCRIBED LEARNING OUTCOMES

SUGGESTIONS FOR INSTRUCTION

Students will...

3-3-01 Use appropriate vocabulary related to their investigations of forces.
 Include: force, attract, repel, gravity, magnet, magnetize, magnetism, north pole, south pole, magnetic field, compass, electrostatic charge, static electricity, electrostatic force.
 GLO: C6, D4

➤ Introduce, explain, use, and reinforce vocabulary throughout this cluster.

3-3-02 Recognize that force is a push or pull and that attraction and repulsion are types of pushes and pulls.
 GLO: D4

➤ **Observing Forces**

Have students work in cooperative groups to explore how various objects move. Use objects such as toy cars, ball point pens, balls, wagons, toboggans, vacuum cleaners, etc. Have students classify objects that move according to the grid below.

Moves Using "Pushes"	Moves Using "Pulls"

3-0-4e. Respond respectfully to the ideas and actions of others, and recognize their ideas and contributions. (ELA 1.1.2, 5.2.2) GLO: C5, C7
3-0-4f. Assume roles and share responsibilities as group members. (ELA 5.2.1) GLO: C7

Ask the following question: "What are pushes and pulls?" If the term "force" does not come up in the discussion, introduce it at this time.

3-3-03 Describe evidence showing that objects and living things on or near Earth are pulled toward it by a force called gravity.
 GLO: A2, D4

➤ **Gravity in Space**

Have students view video clips showing astronauts in space and in spaceships. Use these images to initiate a discussion on gravity.

➤ **Finding Evidence of Gravity**

Have students observe their environment to find evidence of gravity. Example:

<u>Place</u>	<u>Evidence</u>
classroom	pencil falls off desk
playground	fly ball falls to ground
park	leaves fall off tree

3-0-2a. Access information using a variety of sources. *Examples: children's magazines, local farmers, CD-ROMs, Internet...* (ELA 1.1.2, 3.2.2; Math SP-I.1.2.3; TFS 2.1.1) GLO: C6
3-0-4f. Assume roles and share responsibilities as group members. (ELA 5.2.1) GLO: C7
3-0-5a. Make observations that are relevant to a specific question. GLO: A1, A2, C2

Ask students the following questions:

- Why do things fall to the ground?
- Why don't we fly off/fall off the Earth?

Ensure that a link is made to gravity as a pull and therefore a type of force, during discussions of gravity.

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Caution: Ensure that students are aware that a magnet should not be held near the following technological devices: television, VCR, microwave oven, computer, radio, loudspeakers, credit cards, wind-up watches, computer discs, audiocassettes, tape recorders, telephones, answering machines, and videotapes. Magnets disrupt the electronic components. This results in permanent damage.

The space around a large mass, such as the Earth, is called a **gravitational field**. It's the area where the force of gravity acts or can be felt.

Science Journal Entry: Gravity in Space

Have students answer the following question in their science journals: Gravity is invisible. What evidence do we have that gravity is acting on objects on the Earth? Give at least six examples.

Look for the following examples:

- objects falling
- water running downhill
- a ball thrown into the air comes back down again

PRESCRIBED LEARNING OUTCOMES
<i>Students will...</i>
<p>3-3-04 Predict and test to identify materials that are attracted by magnets and those that can be magnetized. GLO: C2,, C5 D3</p> <p>3-3-05 Investigate to determine how to magnetize a given object. Include: contact with another magnet, proximity to a magnet. GLO: C2, D4</p>
<p>3-0-1b. Make predictions based on observed patterns, collected data, or data provided from other sources. (ELA 1.1.1; Math SP-IV.2.3) GLO: A1, C2</p> <p>3-0-3d. Brainstorm, in small groups, possible solutions to a practical problem, and reach consensus on which solution to implement. GLO: C3, C7</p> <p>3-0-4a. Carry out a plan, and describe the steps followed. (Math SP-V.2.3) GLO: C2</p> <p>3-0-4g. Verbalize questions, ideas, and intentions during classroom-learning experiences. GLO: C6</p> <p>3-0-7e. Communicate results and conclusions in a variety of ways. <i>Examples: point-form lists, sentences, simple diagrams, charts, demonstrations...</i> (ELA 2.3.5, 3.3.2, 4.1.3; Math SP-III.2.3; TFS 2.1.4) GLO: C6</p>

SUGGESTIONS FOR INSTRUCTION

➤ **Magnetic or Not?**

Provide students with a variety of objects. Have students predict which objects will be attracted to the magnet. Include metals such as copper, brass, and aluminum which are not magnetic. Have students test to determine the accuracy of their predictions.

<u>Item</u>	<u>Prediction</u>	<u>Attracted</u>
paper clip	attract	yes
straw	will not attract	no

Provide students with an opportunity to review and reflect on the results. Help guide students' reflections by asking the following question:

How are the materials attracted by magnets alike?

➤ **Investigation — Creating Temporary Magnets**

Provide students with bar magnets, paper clips, and iron nails. Tell students that temporary magnets can be made by stroking the metallic object with a magnet. Have students test to determine whether they can magnetize a paper clip and an iron nail. Following the investigation, ask students the following questions to reflect on the process:

- Were you able to magnetize the paper clip and the nail?
- What procedure did you try?
- What procedure worked best?
- What did you notice about the strength of the magnetic attraction with the paper clip and the nail?

Have students try to magnetize other materials and report their findings to the class.

➤ **Magnetic Neighbours**

Have students use a permanent magnet and a non-magnetic metallic object, such as a paper clip to determine whether an object can become magnetized from being near a magnet.

TEACHER NOTES

There are three different kinds of magnets: natural, temporary, and permanent.

Natural magnets are rocks with a lot of iron in them and are magnetic when found in the ground (lodestone).

Temporary magnets can be made from steel; however, they are weak and last only a short time.

Permanent magnets are made from hard iron (iron and other materials).

Magnets need to be stored properly in order to ensure that they stay strongly magnetized. They should be stored with opposite poles together.

If magnets do become de-magnetized, they can be re-magnetized. High school science labs often have the device with which to effect this. If not, it can be purchased from a science supply store.

attract - to pull toward or hold in place

repel - to push away or force apart

magnet - a material that can attract a piece of iron

ceramic magnet - magnets made from a powdered iron oxide called ferrite, are strong and versatile

When a magnetic metal is attracted to a permanent magnet, it becomes a magnet, too. It can attract other objects but only while it is touching a permanent magnet. This is called **induced magnetism**.

SUGGESTIONS FOR ASSESSMENT

Observation Checklist: Magnetic or Not?

The student

- uses safe and appropriate procedures with the magnets
- records observations accurately
- predicts which objects would be attracted to a magnet
- tests to confirm predictions
- participates in the development of a plan for magnetizing an object
- follows the plan
- asks relevant questions
- explains ideas to others
- represents findings using a variety of methods
- demonstrates proper care of magnets

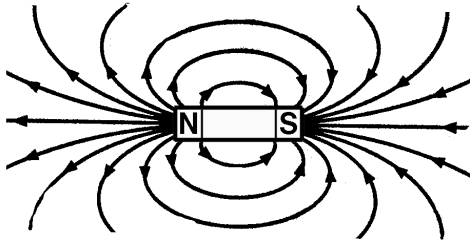
PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
<p><i>Students will...</i></p>	
<p>3-3-06 Investigate to determine the location of poles on a magnet, and the shape of the magnetic field around a magnet. GLO: A1, C2, D4</p> <p>3-3-07 Demonstrate that opposite poles attract and like poles repel. GLO: C2, D4</p>	<p>➤ Exploring Magnetic Poles</p> <p>Part 1) Provide small groups of students with two bar magnets that have their poles labelled. (This can be done with masking tape.)</p> <p>Have students explore to determine what happens when like poles are placed together and when unlike poles are placed together. Have each group present its findings. If the terms “repel” and “attract” do not come up in the discussion, they should be introduced at this time. Students should recognize that because magnetism either pushes or pulls, it is a force.</p> <p>Part 2) Provide each group with a labelled bar magnet and magnets that do not have labelled poles. Have students determine the location of the north and south poles on the unlabelled magnets and explain the procedure used.</p>
<p>3-0-4h. Follow given safety procedures and rules, and explain why they are needed. GLO: C1</p> <p>3-0-7e. Communicate results and conclusions in a variety of ways. <i>Examples: point-form lists, sentences, simple diagrams, charts, demonstrations...</i> (ELA 2.3.5, 3.3.2, 4.1.3; Math SP-III.2.3; TFS 2.1.4) GLO: C6</p> <p>3-0-9a. Listen to and consider differing opinions. (ELA 5.2.3) GLO: C5, C7</p>	<p>➤ Investigating Magnetic Fields</p> <p>Provide small groups of students with cardboard, iron filings in a shaker, and different types and shapes of magnets (bar, horseshoe, fridge). Have students place the magnet under the cardboard and then gently sprinkle the iron filings on top. Have students draw what they observe. Ask students the following questions:</p> <ul style="list-style-type: none"> • What did the magnets have in common? • What do you call the pattern made by the iron filings? (magnetic field) <p>Have students explore to answer the following questions:</p> <ul style="list-style-type: none"> • How does the magnetic field change when you put north and south poles together? • North and north poles together? • South and south poles together?

TEACHER NOTES

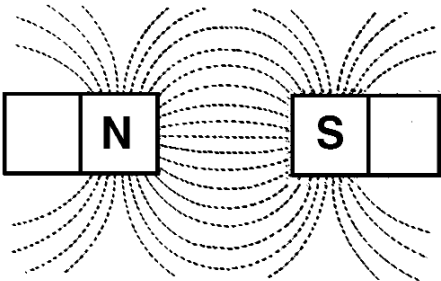
SUGGESTIONS FOR ASSESSMENT

The space around a magnet is called the **magnetic field**. It's the area where the force of a magnet acts or can be felt.

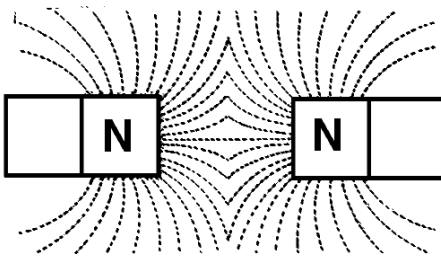
Magnetic Fields



Where the lines are closest, the magnetic field is strongest.



Opposite poles have a powerful attraction.



Two like poles (north and north, or south and south) push against or repel each other strongly.

Interview: Magnets

Before the interview, gather a labelled bar magnet and an unlabelled bar magnet. Ask students the following questions:

1. Explain what will happen when the poles of two bar magnets are put together in the following ways:
 North pole to south pole? (They will be attracted to each other.)
 North pole to north pole? (They will repel each other.)
 South pole to south pole? (They will repel each other.)
2. Draw the magnetic field for this bar magnet. (See Teacher Notes.)



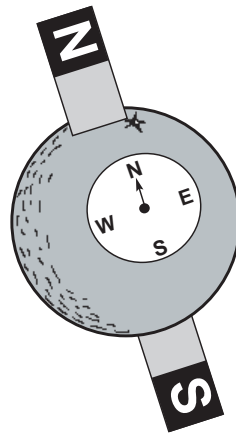
3. Explain how you would find the poles on a magnet that is not labelled. (Use the labelled bar magnet to find the poles on the unlabelled magnet.)
4. How should you care for magnets?
 - don't drop them
 - store them with unlike poles together
 - keep them away from electronic equipment
 - other

PRESCRIBED LEARNING OUTCOMES
<i>Students will...</i>
<p>3-3-08 Explain why Earth can be compared to a giant magnet. Include: Earth has a magnetic field with poles adjacent to the geographic poles. GLO: D4, E1, E2</p> <p>3-3-09 Demonstrate and explain how a compass operates by magnetism. Include: Earth’s magnetic pole attracts the magnetic needle of a compass. GLO: B1, D4</p>
<p>3-0-4a. Carry out a plan, and describe the steps followed. (Math SP-V.2.3) GLO: C2</p> <p>3-0-5a. Make observations that are relevant to a specific question. GLO: A1, A2, C2</p> <p>3-0-5b. Use tools to observe, measure, and construct. Include: ruler, metre stick, pan balance, magnifying glass, bathroom scale, thermometer, magnet. (Math SS-I.1.3, SS-III.1.3, SS-IV.1.3, SS-VII.4.3) GLO: C2, C3, C5</p> <p>3-0-9c. Take the time to repeat a measurement or observation for greater precision or detail. GLO: C5</p>

SUGGESTIONS FOR INSTRUCTION

➤ **Earth Magnetic Simulation**

Stick a bar magnet through the centre of an orange but make sure the ends are visible to the students. Demonstrate with a compass that the needle will point to the magnet’s north when placed near the orange. If you go outside with your compass, the needle will point to the Earth’s magnetic north.



➤ **Making Floating Compasses**

Have the students work in small groups to make floating compasses. Have students gather needed materials including: objects that float such as a leaf, piece of styrofoam, cork or piece of plastic; a magnet; a non-metallic dish of water; and a large sewing needle. Have students magnetize the needle with the magnet and test it to ensure it is magnetized. Students then place the floating device in the water and set the needle on it. The floating device should turn until the needle points north/south. Use a compass to test if the needle is pointing north. Turn the floating needle away from the north and observe what happens. Use the following questions to guide the discussion:

- What causes the needle to point to the north magnetic pole?
- Why couldn’t you use a steel bowl to hold the water?

(continued)

TEACHER NOTES

The centre, or inner core of the Earth is made up of iron and nickel. This inner core flows and rotates faster than the outer core and it is believed that this movement creates the **Earth's magnetic field**.

As a magnet, the Earth has north and south magnetic poles. Scientists have found that the location of the poles is shifting over time. Every few hundred thousand years, the magnetic poles actually reverse themselves, but scientists don't know why.

The Earth also has another set of poles, the geographic North and South Poles. These poles are at the axis upon which the Earth turns. The **magnetic north pole** and the **geographic North Pole** are approximately 1600 kilometres apart. People navigating using a compass and geographic maps must make adjustments for the differences in location between the two north poles of the Earth.

Ensure that the discussion of the Earth as a magnet does not become confused with discussions about gravity.

SUGGESTIONS FOR ASSESSMENT

Performance Task: Finding Poles With a Compass

Student directions: You have been asked to determine the poles on an unmarked magnet using only a magnetic compass. Develop a written plan. Demonstrate how your plan works, using the unmarked magnet and a compass.

Scoring Rubric

Scale	Plan	Follows Plan	Identifies Poles
4	complete and well organized	yes	yes
3	clear and complete	yes	yes
2	complete but unclear	yes, with assistance	perhaps
1	unclear, may contain misconceptions	no	perhaps

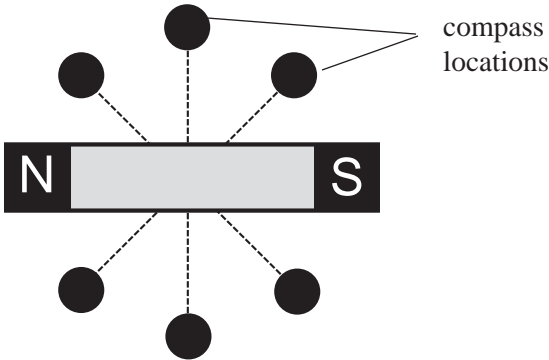
PRESCRIBED LEARNING OUTCOMES

SUGGESTIONS FOR INSTRUCTION

Students will...

➤ **Finding Poles With a Compass**

Have students use a magnetic compass and a bar magnet to observe the effects of moving the compass to different locations around the bar magnet. Students should record their observations in their science journals.



Ask students: “How can you use this information to locate the poles on an unmarked magnet?” Have students test to determine if their plan will work.

3-3-10 Describe potentially harmful effects of magnets on magnetized materials.
Examples: computers, videotapes, credit cards...
GLO: B1, C1, D4

➤ **Magnets Affect Electronic Equipment**

Part 1) Make a tape and play it for the students. Place a magnet close to the tape and play the tape again. Discuss the results using the following questions:

- What happened to the tape?
- Why did this happen?

Part 2) Show students a sensor pad warning label.



3-0-2a. Access information using a variety of sources. *Examples: children’s magazines, local farmers, CD-ROMs, Internet...* (ELA 1.1.2, 3.2.2; Math SP-1.1.2.3; TFS 2.1.1) GLO: C6
3-0-2b. Review information to determine its usefulness to research needs. (ELA 3.2.3, 3.3.3) GLO: C6, C8
3-0-4h. Follow given safety procedures and rules, and explain why they are needed. GLO: C1

Ask the students what other objects might be affected by magnets and record the information on a class chart. Have students add to the chart as study of the cluster ensues. For this learning outcome, any research that takes place should be undertaken by using books, CD-ROMs, the Internet, etc., and not by exploring with magnets.

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Caution: Ensure magnets remain in the classroom and that students are aware of the potential danger they pose to magnetized devices such as computers.

PRESCRIBED LEARNING OUTCOMES

Students will...

3-3-11 Describe and demonstrate ways to use everyday materials to produce electrostatic charges.
Examples: rubbing feet on carpet, brushing hair, rubbing a balloon on clothes...
 GLO: D4

3-0-3b. Identify, with the class, variables that have an impact on an investigation. GLO: A1, A2, C2, C7
3-0-7a. Draw a simple conclusion based on their observations. GLO: A1, A2, C2
3-0-7b. Explain why conclusions related to classroom experiments should be based on multiple trials or classroom data rather than on an individual result. GLO: A1, A2, C2
3-0-8a. Recognize that valid experiments normally have reproducible results, which may vary slightly. GLO: A1, A2, C2
3-0-8b. Recognize that scientists develop explanations from observations and what they already know about the world, and that good explanations are based on evidence. GLO: A1, A2, C2

SUGGESTIONS FOR INSTRUCTION

➤ **Exploring Electrostatic Charges**

Provide each student with an inflated balloon. Have them rub the balloon against their hair and observe what happens. Ask the students why they think this is happening. If the concept of static electricity or electrostatic charges does not occur in the discussion, it should be introduced at this time. Have students work with a partner or in small groups to find other ways of producing electrostatic charges. Provide materials such as: wool, cotton, polyester, paper, plastic, silk, a carpet sample, and charged inflated balloons.

➤ **Stick to It**

Have students select the three materials that they feel work best to create electrostatic charges. Have students investigate to see if increasing the number of times the balloon is rubbed increases the time that it will stick to the wall. Have students use a chart to record results.

Electrostatic Charges

<u># of Rubs</u>	<u>Material Used</u>	<u>Time It Clung</u>
5 rubs	cotton	
10 rubs	cotton	

Math link: graph the results.

Have students share the results with other pairs of students. Provide time for students to think about their results. Discuss findings using the following questions:

- Does the balloon stick longer when rubbed with certain materials?
- Do more rubs with the same material increase the sticking time?
- Are the results from your group the same as results from other groups? Why or why not?

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

The **atoms** of all matter are made up of **electrons** (negative charges), **protons** (positive charges), and **neutrons** (no charge). Protons and neutrons are found in the nucleus. Electrons whirl around the nucleus. Some have the ability to move from one atom to another. There are an equal number of protons and electrons in each atom. As a result, atoms are ordinarily electrically **neutral**.

When a balloon is rubbed on a cloth, electrons are transferred from the cloth to the balloon. The balloon becomes negatively charged. If a balloon comes in contact with a neutral wall/hair, etc., it pushes away electrons from that section of the wall/hair. This results in a positive charge on that part of the wall. Because opposites attract, the balloon will stick to the wall or will make the hair stick to the balloon temporarily. After a while the negative electrons pass from the balloon to the wall and also into the air. Then the balloon/hair falls.

Caution: Do not allow students to put balloons on the computers. Remind them that computers should always be grounded.

Science Journal Entry: Electrostatic Charges

Student directions: Describe, using words and diagrams, how to produce a static charge.

Look for

- rubbing two materials together
- rubbing long enough to create a charge (more than just touching two materials together)

PRESCRIBED LEARNING OUTCOMES
<i>Students will...</i>
<p>3-3-12 Investigate to determine how electrostatically charged materials interact with each other and with uncharged materials.</p> <p>Include: charged materials attract or repel each other, charged materials attract uncharged materials.</p> <p>GLO: A2, C2, D4</p>
<p>3-0-1b. Make predictions based on observed patterns, collected data, or data provided from other sources. (ELA 1.1.1; Math SP-IV.2.3) GLO: A1, C2</p> <p>3-0-3c. Create, with the class, a plan to answer a given question. (ELA 3.1.4) GLO: C2, C7</p> <p>3-0-5e. Record observations in a variety of ways. <i>Examples: point-form notes, sentences, simple diagrams, charts...</i> (ELA 3.2.1, 3.3.2, 4.1.3; Math SP-II.2.1, SP-V.2.3) GLO: C2, C6</p> <p>3-0-7a. Draw a simple conclusion based on their observations. GLO: A1, A2, C2</p>

SUGGESTIONS FOR INSTRUCTION

- **Electrostatic Interactions**

Provide small groups of students with two inflated balloons and a length of thread or string for each. Have students tie a piece of thread on the end of each balloon and hold the balloons by their threads so that they are about 5 cm apart. Students observe what happens. Have students charge one balloon and then hold the balloons together. Have students charge both balloons and then hold them together. Use the following questions to guide the discussion:

 - What happens when uncharged materials are placed together? (Nothing.)
 - What happens to uncharged material when a statically charged material is placed near it? (It is attracted to the charged material.)
 - What happens when two statically charged materials come together? (They repel or attract one another.)

- **Statically Charged Materials**

Provide a piece of plastic wrap and paper towel for each student. Have students charge the plastic wrap by placing it on a flat surface and rubbing it with the paper towel. The students lift the plastic wrap by one corner and observe what happens and record their observations. Then have students straighten out the plastic wrap and rub it again to recharge. Have them pick it up in the midpoint of the opposite side and observe and record what happens.

- **Demonstration: Moving Water**

Charge a comb by rubbing it on a piece of wool. Hold the comb near slowly running tap water. Have students observe how the water reacts to the statically charged comb. (The water will surprisingly appear to be drawn to the comb.) Discuss the results.

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Paper and Pencil Task: Electrostatic Interactions

Using words and diagrams, have students answer the following questions:

- What happens when uncharged materials are placed together?
- What happens when uncharged materials come in contact with a statically charged material?
- What happens when two statically charged materials come together?

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
<p><i>Students will...</i></p>	
<p>3-3-13 Identify ways in which problems associated with static electricity can be avoided or eliminated.</p> <p><i>Examples: staying indoors when there is a lightning storm, grounding yourself before using computers, avoiding shuffling your feet on carpets...</i></p> <p>GLO: B1, C1, D4</p>	<p>➤ Staying Safe</p> <p>Have students work in small groups to brainstorm and list what they might do to be safe during a lightning storm. Discuss with students the recommended safety precautions one should take if caught outside during a storm such as: crouch down, spread out, avoid trees, telephone poles, and fences, and do not touch metal objects, e.g., bicycle, fishing rod, etc.</p> <p>➤ Safety Posters</p> <p>Discuss with students home safety procedures to follow during a storm. Suggestions could include: avoid using the telephone unless there is an emergency, no standing near open doors or windows, and stay away from electrical appliances. Have students use these ideas to create safety posters.</p>
<p>3-0-4e. Respond respectfully to the ideas and actions of others, and recognize their ideas and contributions. (ELA 1.1.2, 5.2.2) GLO: C5, C7</p> <p>3-0-4h. Follow given safety procedures and rules, and explain why they are needed. GLO: C1</p>	<p>➤ Avoid the Static!</p> <p>Organize a discussion regarding the safety procedures to be used in order to avoid static electricity at school. Focus on the care of electronic equipment and the concern for personal safety. Students may suggest such things as grounding yourself before using the computer, avoiding shuffling feet on carpets, etc.</p>

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Lightning is caused by static electricity. Sparks jump between two areas of opposite and built-up electrical charges. This can occur from one part of a cloud to another or from a cloud to the ground. In the latter, there is a bolt from the cloud to the ground and a return bolt, upward from the ground. These two strokes appear as one lightning bolt and they take place in less than a second. Manitoba experiences intense summer thunderstorms and each year Manitobans are killed or seriously injured by lightning strikes.

PRESCRIBED LEARNING OUTCOMES
<i>Students will...</i>
<p>3-3-14 Investigate to determine the change in magnetic and electrostatic forces at different distances. GLO: C2, D4</p> <p>3-0-3a. Brainstorm, with the class, one or more methods of finding the answer to a given question and reach consensus on which method to implement. GLO: C2, C7</p> <p>3-0-3b. Identify, with the class, variables that have an impact on an investigation. GLO: A1, A2, C2, C7</p> <p>3-0-3c. Create, with the class, a plan to answer a given question. (ELA 3.1.4) GLO: C2, C7</p> <p>3-0-4a. Carry out a plan, and describe the steps followed. (Math SP-V.2.3) GLO: C2</p> <p>3-0-5e. Record observations in a variety of ways. <i>Examples: point-form notes, sentences, simple diagrams, charts...</i> (ELA 3.2.1, 3.3.2, 4.1.3; Math SP-II.2.1, SP-V.2.3) GLO: C2, C6</p> <p>3-0-6a. Display data using more than one way to represent the same data. (Math SP-III.2.3) GLO: C2, C6</p> <p>3-0-6b. Discuss data and generate new questions from displayed data. (Math SP-IV.1.2) GLO: A1, A2, C2, C5</p>

SUGGESTIONS FOR INSTRUCTION

➤ **Forces Over Distances**

Part 1: Magnets

Have students work in pairs to determine if increasing the distance between a permanent magnet and an object has any effect on the strength of the magnetic force. Have students use a permanent magnet and a collection of paper clips. Students will gradually increase the distance between the magnet and the paper clips. They may record observations on a chart such as the following

<u>Distance</u>	<u>Number of Paper Clips Attracted</u>
1 cm	_____
2 cm	_____
3 cm	_____

Math Connection: Have students record their observations on a graph.

Part 2: Electrostatics

Have students develop and test a plan for examining the effects of increased distance on electrostatic forces. Have students report the results to the class. Example: Use a charged balloon to pick up small pieces of paper (small, circular scraps from a hole puncher).

<p>3-3-15 Predict and test to determine the effect of placing materials between a magnet and an attracted object and between charged objects. <i>Examples: different thicknesses of paper, glass, water, metal...</i> GLO: C2, C5, D4</p> <p>3-0-1a. Ask questions that lead to investigations of living things, objects, and events in the local environment. (ELA 1.2.4) GLO: A1, C2, C5</p> <p>3-0-1b. Make predictions based on observed patterns, collected data, or data provided from other sources. (ELA 1.1.1; Math SP-IV.2.3) GLO: A1, C2</p> <p>3-0-4g. Verbalize questions, ideas, and intentions during classroom-learning experiences. GLO: C6</p> <p>3-0-9b. Express enjoyment when sharing and discussing science-related experiences from daily life. (ELA 4.4.3) GLO: C5</p>

➤ **Forces Through and Through**

Part 1: Magnets

Provide partners with a strong magnet, paper clips, and a variety of materials such as cardboard, paper of various thicknesses, fabric, glass, tinfoil, plastic, wooden rulers, etc. Have students predict the effect of placing different materials between the magnet and the paper clips. Students then test to determine if their prediction was accurate, and then record their findings on a chart such as the one below.

<u>Object</u>	<u>Prediction</u>	<u>Observation</u>
thin paper	-will still pick up paper clip	-picked up the paper clip
cardboard	_____	_____

Give each pair of students a clear glass of water with a paper clip in the water. Have students try to remove the paper clip using the magnet on the outside of the glass. Partners share their results with the class.

(continued)

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Have students use Blackline Master 2: Scientific Inquiry Recording Sheet: Grades 3 and 4.

Observation Checklist: Forces Over Distances

The student

- makes an organized list to record findings
- makes logical predictions based on previous observations
- uses safe and appropriate procedures
- works cooperatively and shared materials
- records predictions and observations accurately
- communicates results with others
- notices patterns forming in test results
- provides insight into the reaction of objects at different distances
- returns materials and tools to appropriate location

Self-Reflection: Forces Through and Through

1. I liked _____.
2. I had a problem with _____.
3. If I did this investigation again I would _____.
4. I learned _____.
5. I would like to learn more about _____.

PRESCRIBED LEARNING OUTCOMES	SUGGESTIONS FOR INSTRUCTION
<p><i>Students will...</i></p>	
	<p>Part 2: Electrostatic Forces</p> <p>Have students determine the effect of placing materials between charged objects using a procedure similar to the one above for magnets. Ask students the following questions:</p> <ul style="list-style-type: none"> • What effect does the addition of a material between the force and the attracted object have on the force itself? • Why did some students get different results with the same materials? • How did your results compare with your predictions?
<p>3-3-16 Recognize that gravitational, magnetic, and electrostatic forces can move certain objects without touching them directly. GLO: D4</p> <p>3-3-17 Distinguish between motion that is caused without contact and that which is caused by contact. GLO: D4</p>	<p>➤ Reflection — Forces that Can Move without Touching</p> <p>Have students use their science journals to list or draw explorations they have undertaken showing how forces can push or pull objects causing them to move without directly touching them (all magnetic and electrostatic explorations). For contrast, remind students of some of the learning experiences from Grade 3, Cluster 2: Position and Motion, in which they caused objects to move using direct pushes and pulls.</p>
<p>3-0-7d. Examine how new experiences, ideas, and information connect to prior knowledge and experiences, and record these connections. (ELA 1.2.1, 2.1.2, 3.3.3) GLO: A2, C6</p>	
<p>3-3-18 Identify devices that use gravitational, magnetic, or electrostatic forces. <i>Examples: balances, magnetic cupboard latches, dust mops...</i> GLO: B1, D4</p>	<p>➤ Observing the Environment: Find the Force</p> <p>Have students explore the school environment to find uses of gravitational, magnetic, or electrostatic forces (e.g., fridge door, cupboard doors, balance scales, dust mops, etc.). Have students record their findings. Challenge students to add to their lists with examples from home.</p>
<p>3-0-7e. Communicate results and conclusions in a variety of ways. <i>Examples: point-form lists, sentences, simple diagrams, charts, demonstrations...</i> (ELA 2.3.5, 3.3.2, 4.1.3; Math SP-III.2.3; TFS 2.1.4) GLO: C6</p>	

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Self-Assessment: Creating Electrostatic Forces

(Answer Yes or No)

1. I followed written and oral directions during the investigation.
2. I worked in an organized way.
3. I kept trying even when I was not successful.
4. I talked about my discoveries with others.

During this investigation I learned _____
_____.

PRESCRIBED LEARNING OUTCOMES
<i>Students will...</i>
<p>3-3-19 Use the design process to construct a game, toy, or useful device that uses gravitational, magnetic, or electrostatic forces. GLO: C3, C5</p>
<p>3-0-1c. Identify practical problems to solve in the local environment. GLO: C3</p> <p>3-0-3d. Brainstorm, in small groups, possible solutions to a practical problem, and reach consensus on which solution to implement. GLO: C3, C7</p> <p>3-0-3e. Create, in small groups, a written plan to solve a problem or meet a need. Include: identify steps to follow, prepare a simple diagram. (ELA 1.2.3) GLO: C3, C7</p> <p>3-0-3f. Develop, in small groups, limited criteria to evaluate an object or device based on its function and aesthetics. GLO: C3, C7</p> <p>3-0-4b. Construct an object or device to solve a problem or meet a need. GLO: C3</p> <p>3-0-4c. Test an object or device with respect to pre-determined criteria. GLO: C3, C5</p> <p>3-0-4d. Identify and make improvements to an object or device, and explain the rationale for the changes. GLO: C3</p> <p>3-0-5b. Use tools to observe, measure, and construct. Include: ruler, metre stick, pan balance, magnifying glass, bathroom scale, thermometer, magnet. (Math SS-I.1.3, SS-III.1.3, SS-IV.1.3, SS-VII.4.3) GLO: C2, C3, C5</p> <p>3-0-7c. Identify new problems that arise. GLO: C3</p> <p>3-0-8c. Recognize that designing a solution to a simple problem may have considerations, such as cost, materials, time, and space. GLO: B2, C3</p>

SUGGESTIONS FOR INSTRUCTION

➤ **Design Project: Construct a Toy**

Sample design scenario: A local toy manufacturer is holding a design competition. In order to enter the contest you must design and construct a game or toy that uses gravitational, magnetic, or electrostatic forces. You must also prepare a presentation to show your product to the judges. Examples of toys or games could include the following:

- magnetic fishing game
- magnetic maze
- ring toss (uses gravity)
- gameboard for “Tic-Tac-Toe” that sticks to the fridge, a window, etc.
- paper jumping beans

To make paper jumping beans, use coloured construction or bond paper, and cut out small bean shapes. Place these in a card box with a clear plastic lid. Rub the lid with a cloth to make the beans jump and stick to the lid. Tap the lid to make the beans drop.

TEACHER NOTES

SUGGESTIONS FOR ASSESSMENT

Have students use Blackline Master 4:
Design Process Recording Sheet:
Grades 3 and 4.

Design Process Checklist: Construct a Toy

The student

- understands the problem
- actively participates in small-group brainstorming
- includes written list of steps to follow
- includes simple diagram
- contributes to the development of design criteria
- constructs the game or toy
- tests the game or toy based on given criteria
- identifies improvements to be made
- makes improvements
- works cooperatively
- shares group responsibilities

Peer Assessment of Design Presentation

Yes or No?

1. The speaker spoke so all could hear.
2. The speaker used visual aids or props.
3. The speaker clearly explained how the game or toy worked.
4. The speaker made me want to buy the toy or game.

Recommendations: _____

_____.

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