Anglophone School District - North

Grade 3 Science - Unit Lesson Guide

Invisible Forces

Table of Contents

The Aim of Science Education - Scientific Literacy
The aim of science education in the Atlantic Provinces is to develop scientific literacy.

Scientific Literacy is an evolving combination of the science-related attitudes, skills, and knowledge students need to develop inquiry, problem-solving, and decision-making abilities; to become lifelong learners; and to maintain a sense of wonder about the world around them. To develop scientific literacy, students require diverse learning experiences that provide opportunities to explore, analyze, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment.

The Three Processes of Scientific Literacy
An individual can be considered Scientifically Literate when he/she is familiar with, and able to engage in, three processes: Inquiry, problem solving, and decision making.

Inquiry
Scientific inquiry involves posing questions and developing explanation for phenomena. While there is a general agreement that there is no such sing as the scientific method, students require certain skills to participate in the activities of science. Skills such as questioning, observing, inferring, predicting, measuring, hypothesizing, classifying, designing experiments, collecting data, analysing data, and interpreting data are fundamental to engaging science. These activities provide students with opportunities to understand and practise the process of theory development in science and the nature of science.

Problem Solving
The process of problem solving involves seeking solutions to human problems. It consists of proposing, creating, and testing prototypes, products, and techniques to determine the best solution to a given problem.

Decision Making
The process of decision making involves determining what we, as citizens, should do in a particular context or in response to a given situation. Decision-making situations are important to their own right, and they also provide a relevant context for engaging in scientific inquiry and/or problem solving.

Science Assessment Overview

Science is a hybrid term that houses different disciplines such as: Physics, Chemistry, Biology, Environmental Studies, Engineering, Math, etc. Given this broad spectrum, it is not realistic that we can paint science assessment with a single brush in terms of probes that work for every science activity. However, regardless of school subject, let alone science, the frequency of assessment should be unbalanced with formative assessment occupying 80% of practise and summative with the remaining 20%.

80% Formative - 20% Summative

Formative Assessment
Formative assessment is a range of formal and informal assessment procedures employed by teachers during their learning process in order to modify teaching and learning activities to improve student attainment. It typically involves qualitative feedback (rather than scores) for both students and teacher that focuses on the detail of content and performance. Feedback is the central function of formative assessment. It typically involves a focus on the detailed content of what is being learnt.

Science Formative Assessment falls into 2 distinct categories, and they are divided about how feedback is given. Please be aware that an activity could be informal or formal, it is the purpose of the task that determines purpose.

Informal Formative
Informal Formative Science Assessment acts as a monitoring probe and is distinct because it is not graded.

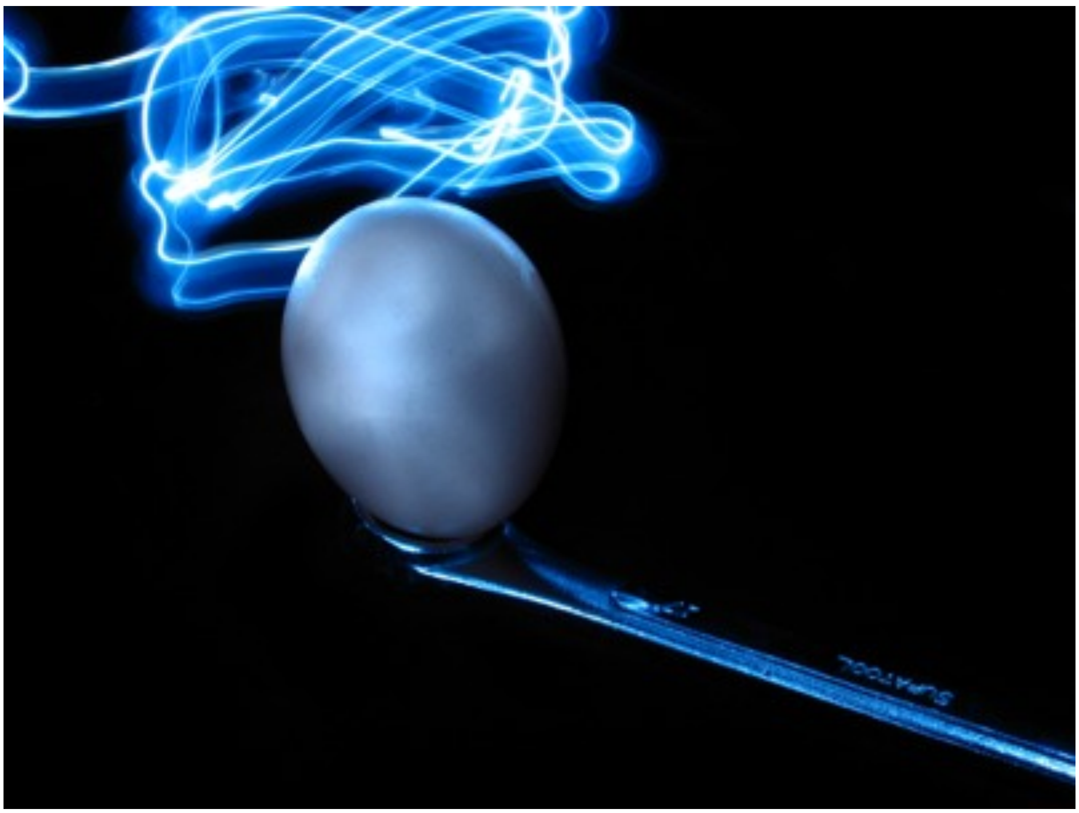
Formal Formative
Formal Formative Science Assessment provides specific feedback to students, the teachers corresponds via anecdotal feedback, rubrics, and written responses to offer progress to student attainment.

Summative Assessment
Summative assessment seeks to monitor educational outcomes, often for the purposes of external accountability. Usually occurring at the end of a learning unit and determines if the content being taught was retained.

Invisible Forces

Focus and Context

Inquiry, in the form of observation and recording, is the focus of this unit. Through explorations of magnetic and static forces, students observe and record the materials and conditions that alter the strength of these forces. Investigations of electrostatic forces are best done in the winter, when the air is very dry.



Unit Instructional Overview

Magnetic Forces	Electrostatic Forces
Access Prior Knowledge - Move the Pencil Activity	Activity - Charged Balloons
Access Prior Knowledge - Magnets	Activity - Picking Up The Pieces
1st Cycle - Activity - What Materials are Magnetic	Activity - Making a Charge Detector
2nd Cycle - Activity - Invisible Forces	Lesson/Activity - Everyday Static Electricity
3rd Cycle - Activity - Testing Magnet Strength	
4th Cycle - Activity - Make a Magnet	

* - EECD Grade 3 Inquiry package - available at
https://portal.nbed.nb.ca/tr/lr/k-8Science/Pages/default.aspx

Invisible Forces- Curriculum Outcomes

Magnetic Forces	Electrostatic Forces
100-31, 202-2 Investigate to identify and group materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are attracted to magnets	101-8, 203-3 Describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact (attract, repel)
100-32 Investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel	202-7 Identify materials to be used to investigate conditions which affect the force of static electricity, and suggest ways to use them in their investigations
201-1 Follow a simple procedure where instructions are given one step at a time to increase and test the strength of a temporary magnet by stroking it or string it next to a stronger magnet	100-33, 201-5, 202-7 Make and record relevant observations during investigations to identify conditions that affect electrostatic forces, draw simple conclusions about these conditions
200-2 Identify problems to be solved related to magnetizing materials	202-9 Identify new questions from what has been learned about static electricity
102-14 Identify familiar uses of magnets	
200-3 Make predictions about the number of objects a magnet can pick up under different conditions	102-15 Describe examples of the effects of static electricity in their daily lives, and identify ways in which static electricity can be used safely or should be avoided
100-33, 201-5 Make and record relevant observations during investigations about the number of objects a magnet can pick up under different conditions, and use the observations to identify conditions that affect the force of magnets	
202-7 Propose answers to questions related to magnetizing materials	
201-3, 202-8, 203-5 In cooperative groups, construct and evaluate a toy that is moving by attractive or repulsive magnetic forces	

Invisible Forces
Strand - Magnetic Forces

General Curriculum Outcomes	Specific Curriculum Outcomes
100-31 Investigate to identify materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are not affected by magnets	100-31, 202-2 Investigate to identify and group materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are not attracted to magnets
202-2 Identify problems to be solved	
100-32 Investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel	100-32 Investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel
201-1 Follow a simple procedure where instructions are given one step at a time	201-1 Follow a simple procedure where instructions are given one step at a time to increase and test the strength of a temporary magnet by stroking it or storing it next to a stronger magnet
202-2 Identify problems to be solved	200-2 Identify problems to be solved related to magnetizing materials
102-14 Identify familiar uses of magnets	102-14 Identify familiar uses of magnets
200-3 Make predictions, based on an observed pattern	200-3 Make predictions about the number of objects a magnet can pick up under different conditions
100-33 Identify conditions that affect the force of magnets and of static electric materials	100-33, 201-5 Make and record relevant observations during investigations about the number of objects a magnet can pick up under different conditions, and use the observations to identify conditions that affect the force of magnets
201-5 Make and record relevant observations and measurements, using written language, pictures, and charts	
202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research	202-7 Propose answers to questions related to magnetizing materials
201-3 Use appropriate tools to manipulate and observe materials and to build simple models	201-3, 202-8, 203-5 In cooperative groups, construct and evaluate a toy that is moved by attractive or repulsive magnetic forces
202-8 Compare and evaluate personally constructed objects with respect to their form and function	
203-5 Respond to the ideas and actions of others and acknowledge their ideas and contributions	

Science Resource Package: Grade 3

Invisible Forces: Magnetic Forces

New Brunswick Department of Education

December 2009

Background Information

Prior Knowledge:

These lessons would likely be the first lessons for the Invisible Forces Unit. Students are not expected to have previous knowledge before starting the unit.

Students may:

- know that magnets attract and/or repel but may not know that vocabulary
- have had their parents tell them to keep magnets away from computers
- have building kits that use magnets
- know that magnets have a variety of uses such as on the fridge, compasses and magnetic screwdrivers
- know that magnets can be different shapes and different strengths
- know that magnets have North and South poles

Common Misconceptions:

Bigger magnets are stronger magnets.

Magnets are attracted to all metals.

Equate North and South poles with positive and negative.

Did You Know?

A magnet is generally defined as a material that will attract pieces of iron. Magnetism is this ability to attract.

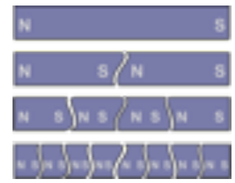
Electricity and magnetism are very closely linked since electricity can be used to create magnetism and magnetism can be used to create electricity. In fact, every time current flows through a wire, a magnetic field is created around the wire.

Magnets can be manmade but they also occur naturally. There are many legends about the discovery of magnets. One of the most popular is of a shepherd named Magnes who, while tending his flock in Magnesia (northern Greece) thousands of years ago, became stuck to the large black rock he was standing on by the iron nails in his boots and the iron tip of his shepherd's staff. The black rock was a type of mineral that became known as magnetite and was named either after Magnes or Magnesia; no one knows for sure. Lodestone is the mineral magnetite that has become magnetized. Not all magnetite is itself a magnet, though it is attracted to magnets.

Only a few metals (iron, nickel and cobalt) are attracted to magnets. Iron, usually as part of steel, is the most commonly experienced magnetic material. Materials that magnets attract are also the materials that make good magnets.

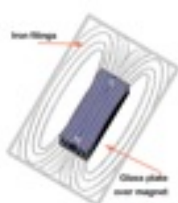
The shape of the magnet determines the area where the magnetic force is the strongest. For example, if you sprinkled iron filings around a bar magnet, you would find that most of the filings would be attracted to the ends. These ends are called the **poles**. Every magnet has a North pole and a South pole.

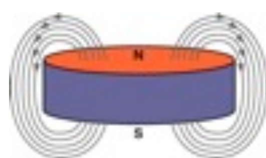
Both natural and manmade magnets will align themselves with the magnetic field of the Earth if suspended so they can rotate freely. The ends of magnets are labelled North and South, matching the Earth's pole they point towards. Read more at http://science.howstuffworks.com/magnet1.htm



If a bar magnet is broken in half, each half would have a North and South pole. If the halves are broken into halves, each of the quarters would have North and South poles, and so on. No matter how small a magnet is, it has a North pole and a South pole. If you could continue to divide the magnet down to the atomic level, the smallest magnets you could obtain are called domains.

The magnetic field is the three-dimensional area around a magnet where its magnetic force is felt. The field is composed of invisible lines of magnetic force called flux lines. It is possible to visualize the flux lines by placing a piece of glass or paper on top of a magnet and then sprinkling iron filings on it. The filings will arrange themselves in loops around the magnet.





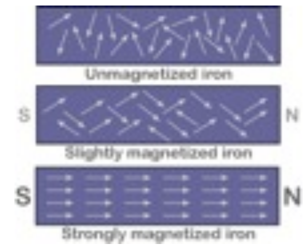
Students will often confuse North and South poles with positive and negative because attraction and repulsion can be observed with both. Like poles will repel, and like charges will repel. Unlike poles will attract, and unlike charges will attract. They are different mechanisms and not interchangeable.

Magnets are used in virtually all motors, and many kinds of speakers including classroom speakers connected to the PA system, headphones, and ear buds. There is a magnet in your computer hard drive. There are also many household uses including cupboard door latches, the refrigerator door latch, bottom of some shower curtains, some screwdrivers, and some toys. Credit and debit cards also have magnetic strips that hold the card's information. This is why it is important to keep cards away from magnets as they disrupt the orientation of the particles in the strip.

An interesting use of magnets is for cows. These magnets are fed to cows to attract bits of metal that could harm the cow. This (as well as other uses of magnets) is described at http://science.howstuffworks.com/magnet4.htm. Emphasize that people should never swallow magnets as they can tear tissue if attracted to metals outside of the body.

Students may hear of cases of magnets being used to improve health, as a water softener, or on vehicle fuel lines. There is no evidence to support the usefulness of magnets in these situations. For example, in the case of hard water, most of the minerals present are not magnetic and would not be attracted to a magnetic "filter".

Magnets can become weaker over time. This is minimized by storing with keepers (pieces of iron) across the ends of unlike poles. The keeper provides a path for the magnetism to flow, retaining magnetic strength.



Magnetism can be destroyed. One can imagine that a magnet is made of tiny magnets all aligned the same way. Any action that would disrupt the alignment of these tiny bits, would lower the overall magnetism. Magnets can be weakened by dropping or hammering and by heating.

Though not part of the grade 3 curriculum, a student may raise the topic of electromagnets. Some background information can be found at http://science.howstuffworks.com/electromagnet.htm . Research on electromagnets or activities involving electromagnets could be used as enrichment.

Instructional Plan

Access Prior Knowledge

Part I: Move the Pencil Activity

The purpose of this activity is to provide students with a way to visualize forces and understand what a force is.

Materials:

Pencil (preferably not round)

- Ask students to place a pencil on their desks, then find 5 ways to make the pencil move. Things students may try include blowing, pushing, pulling, tipping the desk, etc. Have students make a list of the ways they tried.
- Next ask students to come up with a sorting rule that can be used to sort the types of movements they tried into 2 groups.

Discuss: *What method(s) did you use successfully to make your pencil move?* Record their methods on the board or chart paper.

What was your sorting rule? Are there other ways to sort the pencil movements?

Students should arrive at the understanding that everything they did was some form of a push or a pull, i.e. a force. The term “force” may need to be introduced. That force could act directly on the pencil (e.g., by using a finger to push) or indirectly (e.g., by blowing) on the pencil. We often cannot see a force; sometimes we only see the result of the force.

Part II: Magnets

Think, Pair, Share

Give each student a magnet and ask them (first individually, then with a partner) to brainstorm a list of facts about magnets.

Have pairs of students share with the whole class, giving each pair a turn. Go around the class as many times as it takes to get all the statements. Write the “facts” on a chart that can be revisited during each cycle.

As the purpose of this activity is to find out what students think they already know, accept all answers without redirecting or correcting responses. If students begin to disagree with one another, remind students to keep the discussion about ideas and to respond to others respectfully. The discussion tips on pages 23-24 of EECD Invisible Forces document may be helpful.

✓ **Assessment:**

Note the concepts and misconceptions students are expressing. You will need to know these to plan effective questions for subsequent activities and discussions so that studer will examine and adjust their alternate conceptions.

Post student versions of curricular outcomes on chart paper (see page 26 of EECD Invisible Forces document). Inform students that these outcomes will be addressed over the next portion of the unit. Point out to students which outcomes are being addressed in each activity.

🚲 1st Cycle

✪ Curriculum Outcomes

100-31 Investigate to identify materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are not affected by magnets
102-14 Identify familiar uses of magnets
201-1 Follow a simple procedure when instructions are given step by step
201-5 Make and record relevant observations and measurements, using written language, pictures and charts
202-2 Place materials and objects in a sequence or in groups according to one or more attributes
202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research
202-9 Identify new questions that arise from what was learned
203-3 Communicate procedures and results using drawings, demonstrations, and written and oral descriptions
203-5 Respond to the ideas and actions of others and acknowledge their ideas and contributions

Activity - What materials are magnetic?

Materials:
Clear plastic containers with lids
Magnet
Nickels from before and after 1981
Pennies from before and after 2001
Other materials could include:
magnets, wood, paper, pencil, paper clips, nails, spoon, keys, comb, marbles, building blocks, aluminum foil, cork, cardboard, coins, plastic bag, tissue, balloon, bolt, buttons, ruler, scissors, washers, staples, bolts

Safety note:
Magnets should be kept away from things like computers, televisions, flash drives, debit cards, cassette and VHS tapes. They will distort images and damage saved information.

- Place 7 or 8 items, some magnetic, some non-magnetic, in a clear container. This could be a jar or a clear plastic container such as a reusable Ziploc container.
- Ask students to predict what items will be attracted to the magnet and which will not.
- Students will use a magnet to determine which items are attracted by the magnet.
- Students can use the table on page 30 or make their own to record their findings.

Cross-curricular links:
ELA
2c. Students will be expected to:
Give and follow instructions and respond to questions and directions
3a. Students will be expected to:
Use basic courtesies and conventions of conversation in group work
8a. Students will be expected to:
Use writing and other forms of representation to
- record experiences

- When they are finished, they should try to determine what is similar about the items that were attracted by the magnet and those that were not.

ⓘ Teacher note: Prior to 1981 nickels were made mainly from nickel and will be attracted by a magnet. Between 1981 and 2000, they were mainly copper with a bit a nickel, but not enough to make them magnetic. After 2000, nickels were mainly steel so they will be attracted by a magnet.

Up to 2001, pennies were mainly copper and are not magnetic. Since 2002, they are mainly steel.

The easiest way to separate magnetic and non-magnetic nickels and pennies is to separate them using a magnet.

Having some nickels and pennies that yield different answers when tested by students should generate more questions about the types of metals attracted by magnets and enrich the post-activity discussion.

✓ **Assessment:**
During the student activity, make notes on outcomes (or parts of outcomes) you observe being addressed. Process skill outcomes are part of the curriculum and should be assessed. Using the observation chart or the checklist (see pages 31 to 33) on a clipboard may be helpful to you. Develop your own code for quick notes.

A suggested code:
√ observed and appropriate,
WD with difficulty,
A absent.

This chart may be used on multiple days, using a different coloured pen or pencil each day and putting the date in the corner. You may not have a symbol or note for every child every day. Some teachers like to focus on a group or two each time. However you choose to make note of your observations, you will always have a sense of who you need to take more notice of and who might need extra support. The information will also help you when it is reporting time.

Reflection: Class Discussion

- Have the students discuss with partners: *What results were surprising? Why do you think that happened?* Then have partners share with the whole class. The discussion tips on pages 23-24 of EECD Invisible Forces document may be helpful.

- Having some nickels and pennies that yield different results when students test their materials should generate more questions about the types of metals attracted by magnets and enrich the discussion. Say to students: W*hat questions could we investigate that might help us explain this?*

  Make a list of questions generated by students and try to answer/investigate them together.

- The idea of magnetic force acting across a space might arise but there is no need to raise it at this point if it does not.

- Revisit vocabulary including: attract, force, magnet, magnetic

- Revisit the "Think-Pair-Share" information created in the Accessing Prior Knowledge Activity (page 6). Ask: *Which of these statements have to do with what items are magnetic? Are there any items that should be revised?* Re-write the identified statements onto a new chart, revising them as students think necessary. Remind students that scientific knowledge gets changed as scientists discover new things.

  Ask: *Is there other information we could add?* Remind your class about respectful discussion. The discussion tips on pages 23-24 of EECD Invisible Forces document may be helpful.

Cross-curricular links:
ELA
1. Students will be expected to:
 a. Describe, share, and discuss thoughts, feelings, and experiences and consider others' ideas
 b. Ask and respond to questions to clarify information and to explore possibilities or solutions to problems
 c. Express and explain opinions and respond to the questions and reactions of others
 d. Listen critically to others' ideas and opinions
2. Students will be expected to:
 a. Participate in conversation, small-group and whole group discussion, understanding when to speak and when to listen
 b. Adapt volume, projection, facial expression, gestures, and tone of voice to the speaking occasion

Health
Demonstrate the ability to interact effectively with others, showing an insight into their emotions and the ability to express their feelings clearly (Explain the importance of communication skills, as well as demonstrate the effective use of these)

Show respect for and attempt to understand the ideas, opinions and feelings of others

Reflection: Journal

Have students:

Think about the results from the experiment and ideas raised in the discussion, then use pictures and words to tell about the characteristics that make an object attracted to a magnet.

Cross-curricular links:
ELA
8a. Students will be expected to:
 Use writing and other forms of representation to
- generate and organize language and ideas
- record experiences
- explore how and what they learn

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can identify what characteristics make an object magnetic.

Homework:

Ask your students to take a walk around their houses and find places where magnets are used. Students should write a list.

Examples of things they may find include: cupboard doors, electric can opener, shower curtain, shower door, fridge door, screwdriver, binders, and toys.

One toy is a Magna Doodle which is described in the video clip at the following http://videos.howstuffworks.com/howstuffworks/4658-how-magna-doodles-work-video.htm

Possible Extension:

Research cow magnets: What are they used for? How do they work? What do they look like?

Safety Tip:
People should never eat magnets as they can cause tearing inside a person if attracted to something on the outside of the person or if more than one is ingested, they may be attracted to each other inside the person which may cause internal damage.

🚲 2nd Cycle

✪ Curriculum Outcomes

100-32 Investigate the polarity of a magnet, determine the orientation of its poles, and demonstrate that opposite poles attract and like poles repel
200-3 Make predictions based on an observed pattern
201-1 Follow a simple procedure when instructions are given step by step
201-5 Make and record relevant observations and measurements using written languages, pictures and charts
203-3 Communicate procedures and results using drawings, demonstrations, and written and oral descriptions
203-5 Respond to the ideas and actions of others and acknowledge their ideas and contributions

✋ Invisible Forces Activity

Students explore the properties of magnets using a variety of differently shaped magnets. This activity can be set up as stations with one type of magnet at each station. Remind students of outcome 201-1 on following a simple procedure and that other uses of magnets are to be avoided for safety reasons.

Materials:

Pairs of magnets of various shapes and sizes (donut-shaped, horseshoe-shaped, bar, disc)

- Ask students to bring two magnets together in different orientations (including side by side, end to end, perpendicular).
- They should draw the orientations of the magnets and indicate the push or pull observed. (This is a case of observing by feel rather than by seeing.)
- Students can be rotated through different stations (shapes of magnets) to notice similarities and differences among the differently shaped magnets. They should discuss the similarities and differences in their partner or small groups.

For the donut-shaped magnets station, students can be given a pencil or dowel to stack the magnets on.

Cross-curricular links:
ELA
2c. Students will be expected to:
Give and follow instructions and respond to questions and directions
3a. Students will be expected to:
Use basic courtesies and conventions of conversation in group work
8a. Students will be expected to:
Use writing and other forms of representation to
- record experiences

✓ Assessment:
On observation chart (or other record), note how students are performing on the skill outcomes.

Reflection: Class Discussion

Ask the students: *What did you notice?* Have students share their diagrams as appropriate.

Additional questions, if the students have not talked about these points:

- *Did all the shapes behave the same way? How were the different shapes the same? Or different?*
- *Did you notice differences when the magnets were close together or farther apart?*
- *What about the "N"s and "S"s or blue/red colours on the magnets?*

As the discussion moves along, provide students with the appropriate vocabulary such as *attraction, repulsion, North pole, South pole* and *invisible forces*.

Demonstration: Show students how iron filings can make the invisible magnetic force around a magnet visible. Put iron filings into a clear tray and place a bar magnet under the tray. If placed on an overhead, all students will have a good view.

One situation at a time (showing the result after each prediction), have students (in pairs or small groups) predict (by drawing) what the magnetic field might look like:

- around a horseshoe magnet
- around a donut magnet
- around a disc magnet
- if two bar magnets are placed North pole towards South pole but not touching
- if two bar magnets are placed North pole to North pole
- other combinations students wish to try

Cross-curricular links:

ELA

1. Students will be expected to:
   a. Describe, share, and discuss thoughts, feelings, and experiences and consider others' ideas
   b. Ask and respond to questions to clarify information and to explore possibilities or solutions to problems
   c. Express and explain opinions and respond to the questions and reactions of others
   d. Listen critically to others' ideas and opinions
2. Students will be expected to:
   a. Participate in conversation, small-group and whole group discussion, understanding when to speak and when to listen
   b. Adapt volume, projection, facial expression, gestures, and tone of voice to the speaking occasion

Health

Demonstrate the ability to interact effectively with others, showing an insight into their emotions and the ability to express their feelings clearly (Explain the importance of communication skills, as well as demonstrate the effective use of these)

Show respect for and attempt to understand the ideas, opinions and feelings of others

You may wish to use the online *Gizmo* called "Magnetism" at http://www.explorelearning.com/ to revisit how two magnets interact. It will also show magnetic fields around one or two bar magnets. Find the Gizmo by typing magnetism into the search box. This site allows unregistered users to run each Gizmo for 5 minutes a day. It is also possible to sign up for a free trial. Membership is not free.

- Revisit the "Think-Pair-Share" information created in the Accessing Prior Knowledge Activity. Ask: *Which of these statements are about the interactions between magnets? Are there any items that should be revised?* Re-write the identified statements onto a new chart, revising them as students think necessary. Remind students that scientific knowledge gets changed as scientists discover new things.

Ask: *Is there other information we could add?* Remind your class about respectful discussion. The discussion tips on pages 23-24 of EECD Invisible Forces document may be helpful.

Reflection: Journaling

Look at the diagrams drawn during the activity. Label the diagrams and use the science vocabulary words to describe what is happening in each diagram.

or

Draw and label diagrams that show:

a) Attraction

b) Repulsion

Explain how attraction and repulsion are different.

Cross-curricular links:
ELA
8a. Students will be expected to:
Use writing and other forms of representation to
- generate and organize language and ideas
- record experiences
- explore how and what they learn

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can use the magnet vocabulary appropriately.

The Bill Nye video "Magnetism" can be found at http://learning.aliant.net/. The sections *Magnets and Magnetism, Magnetic Earth, Magnets*, and *Magnets: A Review* are particularly useful at this time. A table of contents opens beside the video so that you may select only these sections for viewing.

To access the video, type the title into the search box. Videos are available free of charge at this site. You will need to register, however registration is free. If you try to watch the video without logging in, you will be prompted to do so. There is also an option to watch the video full screen.

3rd Cycle

✪ Curriculum Outcomes

100-33 Identify conditions that affect the force of magnets and of static materials
200-3 Make predictions based on an observed pattern
201-5 Make and record relevant observations and measurements, using written language, pictures, and charts
202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research
203-3 Communicate procedures and results, using drawings, demonstrations, and written and oral descriptions
203-5 Respond to the ideas and actions of others and acknowledge their ideas and contributions

Testing Magnet Strength Activity

Students will be testing whether all magnets are of equal strength. This activity can be set up as stations (described below).

Materials:

Differently-shaped magnets (same as Cycle 2)
Paperclips
Shoe boxes
Thread
Non-magnetic items of various thicknesses such as: pieces of paper, boxboard, erasers, CD cases, books, metallic looking granola or fruit bar wrappers

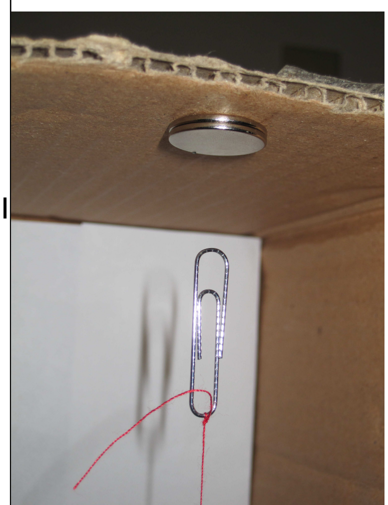
Cross-curricular links:
ELA
2c. Students will be expected to:
Give and follow instructions and respond to questions and directions
3a. Students will be expected to:
Use basic courtesies and conventions of conversation in group work
8a. Students will be expected to:
Use writing and other forms of representation to
- record experiences

Math
SS3 Demonstrate an understanding of measuring length (cm, m) by:
- Estimating length using referents
- Measuring and recording length, width and height

Station 1

Materials	Set up	Test
3 Different shapes/ types of magnets A box of paperclips all the same size	No special set up	Ask students to use one of the magnets to pick up as many paperclips as they can. Count and record the number of paperclips. Repeat with 2 other magnets. (Student directions on page 28.)

Station 2

Materials	Set up	Test
3 Different shapes/ types of magnets 2 Paperclips Shoe box Thread (about 2/3 length of box) Metal washer, magnetic coin or another magnet Ruler or tape measure	• Stand the box on end so it is tall. • On the top of the box, place a metal washer, magnetic coin, or another magnet. The piece of metal or magnet will be used to hold a variety of magnets on the inside of the box. • At the bottom of the box, make a hole. • Put the thread through the hole. The thread should have a paperclip attached to each end. The paperclip inside the box will be used to find the greatest distance it will still be attracted to a magnet. The other paperclip will be used outside the box to hold the thread in place at different lengths. 	Ask students to change the length of the thread to discover the greatest distance the paperclip can be from the magnet and still be attracted. Repeat with 2 other types of magnets. (Student directions on page 28) 

Station 3

Materials	Set up	Test
2 Paperclips Shoe box Thread (about 2/3 length of box) Metal washer, magnetic coin or another magnet Non-magnetic items (such as pieces of paper, boxboard, erasers, CD cases, books, metallic looking granola or fruit bar wrappers)	Set up box similar to Station 2. The difference between Station 2 and this activity is that the top inside magnet will stay the same and the distance between the paperclip and magnet will stay the same. Items will be placed between the paperclip and magnet to determine if magnets can attract items across or through a variety of materials of varying thicknesses.	Ask students to make a wide gap between the levitating paperclip and the top magnet. Test if the magnetic force will remain strong by inserting different items between the two. (Student directions on page 29.)

Station 4

3 Pairs of magnets of different types Ruler	No special set up	Ask students to make a pair of magnets repel each other. Now place one on the table and slowly bring the other magnet closer. Measure the shortest distance between the magnets before the other magnet is pushed away. Repeat the test with the other pairs of magnets. (Student directions on page 29.)

✓ **Assessment:**
On observation chart (or other record), note how students are performing on the skill outcomes.

Reflection: Class Discussion

Ask students to share one interesting thing they noticed. Discuss:

- *Does size matter?*
- *Does shape matter?*
- *Is a magnet stronger at pulling or pushing?* (Students can get a rough idea if there is a difference by looking at their results from the levitating paperclip/ magnet and the distance between two repelling magnets).

Revisit the "Think-Pair-Share" information created in the Accessing Prior Knowledge Activity. Ask: *Which of these statements are about the strength of magnets? Are there any items that should be revised?* Re-write the identified statements onto a new chart, revising them as students think necessary. Remind students that scientific knowledge gets changed as scientists discover new things.

Ask: *Is there other information we could add?* Remind your class about respectful discussion.

Reflection: Journaling

Of all the magnets you tested, which magnet was the strongest? Explain how you know that. Which was the weakest?

or

What magnets in your home should be strong magnets? Why?

or

Why is it important for different magnets to have different strengths?

> ✓ **Assessment:**
> Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.
>
> Note whether students can explain how to test if a magnet is stronger or weaker than another magnet.

Think like a scientist

Asking good questions is an important skill in science. Initially students will need support. Model the skill with the whole class and students will begin to have the confidence to contribute. After some practice, students will be able to generate questions successfully individually.

Present students with a situation and ask them to generate questions that could be investigated scientifically. (These situations and questions do not have to be limited to those that can be done in a classroom.)

Situation:

> A few countries are designing high-speed trains called maglev trains which use powerful magnets. These trains float over their "track" using the repulsion of magnets.
>
> What is one question concerning the floating of a maglev train that could be investigated scientifically?

For example:

> Which shape of magnets gives the most repulsion and might be better at holding up the train?
> Is it better to have fewer large magnets or many smaller magnets?
> Will maglev trains stay over the track or go off sideways?

Cross-curricular links:
ELA
1. Students will be expected to:
   a. Describe, share, and discuss thoughts, feelings, and experiences and consider others' ideas
   b. Ask and respond to questions to clarify information and to explore possibilities or solutions to problems
   c. Express and explain opinions and respond to the questions and reactions of others
   d. Listen critically to others' ideas and opinions
2. Students will be expected to:
   a. Participate in conversation, small-group and whole group discussion, understanding when to speak and when to listen
   b. Adapt volume, projection, facial expression, gestures, and tone of voice to the speaking occasion

Health
Demonstrate the ability to interact effectively with others, showing an insight into their emotions and the ability to express their feelings clearly (Explain the importance of communication skills, as well as demonstrate the effective use of these)

Show respect for and attempt to understand the ideas, opinions and feelings of others

Possible Extensions:

- Do research to find the "biggest" magnet. What is it used for?
- Use magnets to make a board game you can play upside down (or that could be played in space).

Cross-curricular links:
ELA
8a. Students will be expected to:
Use writing and other forms of representation to
- generate and organize language and ideas
- record experiences
- explore how and what they learn

What materials are attracted to magnets?

1. **Write the name of the item in the box on the table below.**
2. **Decide if you think the item will be attracted or not attracted to the magnet. Place a check mark on the table showing what you think will happen.**
3. **Test the item and place a check mark in the box that shows what you saw.**

Testing Magnet Strength

Station 1

- See how many paperclips the magnet picks up.
- Draw the magnet and record the number of paperclips.
- Repeat this test with two other types of magnets and record your results.

Do different magnets have different strengths? How do you know?

ITEM	Prediction		What you saw	
	ATTRACTED	NOT ATTRACTED	ATTRACTED	NOT ATTRACTED

Station 2

- Stand the box on end so it is tall.
- On the top of the box, place a metal washer, magnetic coin, or another magnet. The piece of metal or magnet will be used to hold a variety of magnets on the inside of the box.
- At the bottom of the box, make a hole.
- Put a thread through the hole. The thread should have a paperclip attached to one end. The paperclip inside the box will be used to find the greatest distance it will still be attracted to a magnet. The other paperclip will be used outside the box to hold the thread in place at different lengths.
- Adjust the thread to find the greatest distance the paperclip will still be held up by the magnet. Estimate the distance. Draw what you see.
- Measure the distance between the magnet and paperclip and record it on your drawing.
- Change the type of magnet used and find the distance to the paperclip.
- Repeat again with the third type of magnet.

Do different magnets have different strengths? How do you know?

Station 3

- Stand the box on end so it is tall.
- On the top of the box, place a metal washer, magnetic coin, or another magnet. The piece of metal or magnet will be used to hold a variety of magnets on the inside of the box.
- At the bottom of the box, make a hole.
- Put a thread through the hole. The thread should have a paperclip attached to one end. The paperclip inside the box should be held up by the magnet with a space between it and the magnet. The other paperclip will be used outside the box to hold the thread in place.

- Can you put items between the magnet and paperclip without the paperclip falling?
- Record the items tested. Which caused the paperclip to fall? Which did not?

What is happening to the magnet’s force?

Station 4

- Place a pair of magnets on the table with like poles facing each other.
- Slowly bring the second magnet towards the first magnet.
- How close can the magnets get before the other magnet gets pushed away? Estimate the distance.
- Draw a diagram. Measure and record the distance.
- Repeat the test with the other pairs of magnets.

Do different magnets have different strengths? How do you know?

🚲 4th Cycle

✪ Curriculum Outcomes

201-1 Follow a simple procedure where instructions are given one step at a time
202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research
202-8 Compare and evaluate personally constructed objects with respect to their form and function
203-3 Communicate procedures and results, using drawings, demonstrations, and written and oral descriptions
203-5 Respond to the ideas and actions of others and acknowledge their ideas and contributions

Make a Magnet Activity

Materials:

Paperclip (or nail, pin, or other iron or steel object)
Magnet

- Give students a paperclip and a magnet and say: *Materials that magnets attract are the materials that make good magnets. Is it possible to make this paperclip into a magnet?*

  Give students time to explore.

- Have students share what does and doesn't work. Make a list of each on chart paper. Reinforce the idea that knowing what doesn't work is also important knowledge.

- If there are students having some success, develop a written procedure with them for creating a magnet. It is an excellent chance to model this. If not, give students a directed procedure to follow. One is outlined below, the student version is on page 33.

A paperclip can be made into a magnet by stroking it with a magnet. The magnet must be moved along the paperclip in one direction only (not back and forth). Stroke the paperclip 5 times. Test it to see if it has become a magnet. Will it pick up other paperclips? Record how many. Stroke the paperclip 5 more times. Retest it. Continue this procedure. How strong a magnet can the paperclip become? Do the results depend on the type of magnet used?

✓ Assessment:
On observation chart (or other record), note how students are performing on the skill outcomes.

Reflection: Class Discussion

Have students share their results. Discussion questions: *What did you find? Could you make a magnet? How strong a magnet could you make? Did different magnets give different results?*

Ask students: *Is possible to do the opposite? How can you make your paperclip magnet weaker?* Have students try and then test the strength of their paperclip. Have the class discuss the results.

Revisit the “Think-Pair-Share” information created in the Accessing Prior Knowledge Activity. Ask: *Which of these statements are about making magnets? Are there any items that should be revised?* Re-write the identified statements onto a new chart, revising them as students think necessary. Remind students that scientific knowledge gets changed as scientists discover new things.

Ask: *Is there other information we could add?* Remind your class about respectful discussion.

Cross-curricular links:
ELA
1. Students will be expected to:
   a. Describe, share, and discuss thoughts, feelings, and experiences and consider others' ideas
   b. Ask and respond to questions to clarify information and to explore possibilities or solutions to problems
   c. Express and explain opinions and respond to the questions and reactions of others
   d. Listen critically to others' ideas and opinions
2. Students will be expected to:
   a. Participate in conversation, small-group and whole group discussion, understanding when to speak and when to listen
   b. Adapt volume, projection, facial expression, gestures, and tone of voice to the speaking occasion

Health
Demonstrate the ability to interact effectively with others, showing an insight into their emotions and the ability to express their feelings clearly (Explain the importance of communication skills, as well as demonstrate the effective use of these)

Show respect for and attempt to understand the ideas, opinions and feelings of others

Reflection: Journaling

Ben was trying to make a magnet but it didn't work. Why might it not be working? What should Ben do differently?

✓ **Assessment:**
Journal entries should not receive a score or mark. A positive comment followed by a question to refocus attention or suggest the next step in learning is very effective.

Note whether students can identify the correct procedure for creating a magnet.

A video called "The Magic of Magnetism" could be a way to review magnets and magnetism.

It is available at http://learning.aliant.net/. Type the title into the search box.

Videos are available free of charge at this site. You need to register, however registration is free. If you try to watch the video without logging in, you are prompted to do so. Note that a table of contents opens beside the video so that you may select only certain sections for viewing if you wish. There is also an option to watch the video full screen.

Cross-curricular links:
ELA
8a. Students will be expected to:
Use writing and other forms of representation to
- generate and organize language and ideas
- record experiences
- explore how and what they learn

Make a Magnet

- Hold a paperclip (or nail).
- Touch a magnet to one end and slide or rub the magnet the length of the paperclip. This is one stroke.
- Rubbing in the same direction each time, stroke the paperclip 5 times.
- Test the paperclip to see if it has become a magnet. Will it pick up other paperclips? How many? Record your observation.
- Stroke the paperclip 5 more times. Test its strength again. Record the information.
- Continue this procedure.

How strong a magnet can the paperclip become? Does a different kind of magnet give different results?

Investigating The Properties of Magnets

Outcomes
100-31 Investigate materials that can be magnetized and materials that are attracted by magnets, and distinguish these from materials that are not affected by magnets

- Actively explore magnets and their interactions
- Determine, via quantitative and qualitative inquiry, whether magnetism is cumulative

Materials:

- Assortment of Small Magnets
- Assortment of Miscellaneous objects
- String
- Paper Clips
- Meter stick

Inquiry Lesson:

1. Begin the lesson with an open exploration of the magnets. Present student groups with some concrete materials (several magnets of varying shapes and sized and a few miscellaneous objects such as paper clips, index cards, plastic pen caps), little to no introduction or direction by the teacher, and ample time to “play” with the materials. Simply give the groups time to do some trial-and-error exploration with the materials, under the condition that when the agreed upon time is up (15 minutes should be sufficient), each group will briefly report to the class regarding something that they learned about the materials and how they interact. (One student should be chosen to keep brief notes and drawings of the findings.) During the exploration time, circulate among the groups, gently facilitating an inquiry of the materials’ interactions but not pressing students in any particular direction; encouraging divergent and innovative thinking.

2. When the exploration time is up, allow each group to choose a spokesperson who reports one aspect of what the group members learned to the class (usually the person who took the notes and made the drawings of the findings.) As students talk about their findings, reinforce or introduce appropriate terms and concepts through nurturing and inquisitive dialogue. Depending on the grade level, such terms might include , but would not be limited to, *push, pull, attraction, repulsion, poles, attact, and repel.* Concepts and terms may be reinforced or introduced through comments and questions. For example, “I notice that you said the magnets ‘stuck together’ - in science we might say that they were *attracted* to each other.” Or, “You mentioned that the magnets could push away from each other, even through the index card. That’s a very good observation. We could say that the magnets push or *repel* each other. Can the magnets do this no matter how they are arranged?” The point is for students to have an opportunity to use authentic dialogue when connecting science ideas to their own exploratory experiences.

3. Students group can elaborate on their understanding by measuring how far one magnet can push another magnet of similar size and shape (instruct students to hold the magnets together and let one “spring” away in repulsion from the first.) After predicting the number, students conduct five trials and record the data on the Activity Sheet 1. Next, students measure and record how far two magnets can push a single magnet (Table 2). Then students try it with three magnets pushing a single magnet (Table 3). Graph the class results (number of magnets pushing vs. distance pushed). Compare results and reach conclusions together as a class. Ask students, “Is magnet power cumulative?

4. Next, have each group tie or tape a magnet to a string and tape the other end of the string to the edge of a desk so that the magnet hangs freely in the air. Students then predict how many paper clips the magnet can attract and hold (Table 4). To determine exactly how many paper clips the magnet can hold, students run three trials, record and average the data, and reach conclusion. After students are done with their trials, ask them to place the paper clips end-to-end so that the clips are just touching, but not hooked together. Ask students, “How many paper clips can the magnet hold now? How do yo explain the fact that the paper clips can attract other paper clips? Can paper clips do this when they are not touching a magnet?” Then say, “You saw how many paper clips could be held up by a single magnet. Next, predict how many clips can be held by two magnets tied together.” Another option is to have each student group discuss, invent, illustrate, and report to the class on (through not necessarily build) an invention that uses magnets and/or magnetism.

5. Finally, find out what else the students want to know about magnets. Especially for older students, allow them to measure something else about magnets - something that they devise and want to know about, such as how much mass a particular magnet can lift or whether differently shaped magnets can lift different amounts of materials. The group should carry out and eventually report on their investigations.

Extension:

1. Challenge students to figure out how an electromagnet works and ask them to make one from a battery and a length of insulated wire.

2. Ask students,

- What does magnetism have to do with generating electricity?
- Can you find out how a generator works?

Discussion Questions:

1. What have you learned about magnets and magnetism? What did you do to find this out?

2. What do you still want to know about magnets and magnetism? How could you find our what you want to know?

3. How can magnets and magnetism be useful to us in everyday life?

4. When we measure how far one magnet would “spring away” from the other, why did we conduct five trails and then calculate an average rather then just doing a single trial?

Assessment:

1. Did students actively explore magnets and their interactions? (Use your observations of student activity during procedure 1 as an embedded assessment)

2. Were students successful in connecting meaningful science terms concepts to their exploratory experiences, and in applying those concepts and terms to their expanded investigations? (Listen to student responses to Discussion Question 1-3 during procedure 1-5 as embedded evidence , or use the Discussion Questions as prompts for science journal entries.)

3. Were students able, via quantitative and qualitative inquiry, to determine whether magnetism is cumulative? (Use student responses to the exercises in Activity Sheet as a form of performance assessment.)

Rubric:

	Developing 1	Proficient 2	Exemplary 3
Did students actively explore magnets and their interactions?	Marginally engaged in the exploration process	Satisfactorily engaged in the exploration process	Significantly engaged in the exploration process
Were students successful in connecting meaningful science terms and concepts to their exploratory experiences, and in applying those concepts and terms to their expended investigations?	Some success with discussing terms and concepts but unable to connect but unable to connect or apply them to any significant extent	Satisfactory success with connecting the terms to their experiences and some success in applying them to their expanded investigations	Significant success connecting the terms to their experiences and in applying them to their expanded investigations
Were students able, via quantitative and qualitative inquiry, to determine whether magnetism is cumulative	Attempted the investigation, but unable to clearly determine	Able to clearly determine	Able to clearly determine and applied that understanding

Activity Sheets - Tables

Table 1

How far can one magnet “push” another magnet (from procedure 3)?
Prediction: ________________ cm

Trial	Distance (cm)
1	
2	
3	
4	
5	
Average	

Table 2

How far can two magnets “push” another magnet (from procedure 3)?
Prediction: _________________ cm

Trial	Distance (cm)
1	
2	
3	
4	
5	
Average	

Table 3

How far can three magnets “push” another magnet (from procedure 3)
Prediction: __________________ cm

Trial	Distance (cm)
1	
2	
3	
4	
5	
Average	

Conclusion:

Table 4

How many paper clips can the hanging magnet attract at one time (from procedure 4).
Prediction: _______________ clips

Trial	Number of paper clips
1	
2	
3	
Average	

Conclusion:

Invisible Forces
Strand - Electrostatic Forces

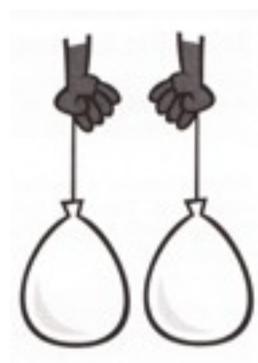
General Curriculum Outcomes	Specific Curriculum Outcomes
101-8 Describe and demonstrate ways to use everyday materials to produce static electric changes, and describe how charged materials interact	101-8, 203-3 Describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact (attract, repel)
203-3 Communicate procedures and results, using drawings, demonstrations, and written and oral descriptions	
202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research	202-7 Identify materials to be used to investigate conditions which affect the force of static electricity, and suggest ways to use them in their investigation
100-33 Identify conditions that affect the force of magnets and of static electric materials	100-33, 201-5, 202-7 Make and record relevant observations during investigations to identify conditions that affect electrostatic forces, draw simple conclusions about these conditions
201-5 Make and record relevant observations and measurements, using written language, pictures, and charts	
202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research	
202-9 Identify new questions that arise from what was learned	202-9 Identify new questions from what has been learned about static electricity
102-15 Describe examples of the effects of static electricity in their daily lives, and identify ways in which static electricity can be used safely or should be avoided	102-15 Describe examples of the effects of static electricity in their daily lives, and identify ways in which static electricity can be used safely or should be avoided

Charged Balloons

Outcomes:
• 101-8 Describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact (attract, repel)
• 203-3 Communicate procedures and results, using drawings, demonstrations, and written and oral descriptions
• 202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research

Background information for Teacher
When two materials are rubbed, electrons will move from one material to another, and the materials will have opposite charges due to an excess of electrons on one of the materials (negative) and a reduction of electrons on the other (positive). If two balloons are rubbed with the same material, both balloons will have the same charge, and will repel each other. They will both be attracted to the original materials with which they were rubbed, since opposite charges attract. Any other pair of materials that are rubbed together can then be held close to the balloons, and one of the pair will attract the balloon, while the other will repel it. If a highly charged object is attracted to the balloon so much that it touches it, electrons will be transferred as they touch. Both the balloon and the objects now hold the same charge, and will repel each other.

Please check out this simulation
http://phet.colorado.edu/en/simulation/balloons



Materials:
• 3 Balloons
• Thread
• Wool cloth
• Plastic wrap

Predict, Observe & Explain Lesson:
Have you ever tried to stick a balloon to a wall by rubbing the balloon on your sweater? Do you have any idea about why it sticks to the wall?
1. Inflate two similar balloon to relatively the same size. Tie a piece of thread to the end of the balloons so they can be hung, use this diagram as our guide.
2. Charge up each of the balloons by rubbing them on our shirt or sweater. Be cautious to use the same material for both balloons. (Don't rub on against your jeans and the other against your shirt)
3. Bring the charged balloons close to one another.
4. What do you think will happen?

Predict

Check one ✓

Do you expect the balloons to

A. attract each other _____ B. repel each other _____ C.do nothing_____

Please give your reasons.

Observe

Let’s do it! What do you observe?

Explain

Try to explain what you saw happen

Extension

Rub one balloon agains your sweater and rub another with plastic wrap.

Watch what happens when you bring them close.

How can you explain this?

Assessment: Informal Formative

1. Could students predict and give a rationale for their response (Prediction phase)

2. Were students able to record their observations accurately and effectively to understand the repelling of like forces

3. Were students able to formulate an explanation of what is happening to the change in charge that results in the repelling of the objects.

Rubric:

	Developing 1	Proficient 2	Exemplary 3
Could students predict and give a rationale for their response	Attempted to predict but unable to do so	Predicted what they expected to see happen	Predicted what they expected to see and gave a plausible rationale based on prior knowledge
Were students able to record their observations accurately and effectively to understand the repelling of like forces	Observed the repulsion but did not explain what they saw	Observed the repulsion and gave a plausible explanation of what they saw	Observed the repulsion and gave an insightful and appropriate report of what they saw
Were students able to formulate an explanation of what is happening to the change in charge that results in the repelling of the objects.	Attempted to explain repulsion but were unable	Explained the repulsion related to similar charges	Explained the repulsion related to similar charges and give insight as to how the charges have changed

Assessment: Formal Formative

Journal **-** How can you get two balloons that are suspended on threads to move away from each other without moving them apart?

Picking Up the Pieces

Outcomes:
• 101-8 Describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact (attract, repel)
• 100-33 Identify conditions that affect the force of magnets and of static electric materials
• 201-5 Make and record relevant observations and measurements, using written language, pictures, and charts
• 202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research

Background information for Teacher
When two materials are rubbed, electrons will move from one material to another, and the materials will have opposite charges due to an excess of electrons on one of the materials (negative) and a reduction of electrons on the other (positive). If two balloons are rubbed with the same material, both balloons will have the same charge, and will repel each other. They will both be attracted to the original materials with which they were rubbed, since opposite charges attract. Any other pair of materials that are rubbed together can then be held close to the balloons, and one of the pair will attract the balloon, while the other will repel it. If a highly charged object is attracted to the balloon so much that it touches it, electrons will be transferred as they touch. Both the balloon and the objects now hold the same charge, and will repel each other.

Please check out this simulation
http://phet.colorado.edu/en/simulation/balloons

Lesson Activity Overview:

Students can observe attraction and repulsion caused by static electricity using materials different materials. This investigation will have students rubbing a balloon with different materials (cotton, fur, other materials that you have access to) to try to see how much puffed rice will be attracted.
Before students begin, have them make predictions about which materials will created the greatest attraction.

Which Material Will Cause the Greatest Static Charge in Rubber?

Balloon Rubbed with	# of Puffed Rice Attracted
Cotton	
Fur	
Other...	

Complete the chart as you investigate which materials will produce the most charge on a balloon. When students are finished have them write what they have discovered.

Assessment: Informal Formative
Completion of the Chart - There should be at least 2 “others” added to the chart so that students get a good cross section to understand charged particles.

Assessment: Formal Formative
What have the students discovered about which materials produce the greatest attraction?

Making a Charge Detector

Outcomes:
• 101-8 Describe and demonstrate ways to use everyday materials to produce static electric charges, and describe how charged materials interact (attract, repel)
•100-33 Identify conditions that affect the force of magnets and of static electric materials
• 203-3 Communicate procedures and results, using drawings, demonstrations, and written and oral descriptions
• 202-7 Propose an answer to an initial question or problem and draw simple conclusions based on observations or research

Materials:
• Styrofoam or Wooden block
• Coat hanger wire
• Nylon thread
• Wheat puff
• Plastic strip or ruler

Predict, Observe & Explain Lesson:
After combing your hair, have you ever tried picking up pieced of paper with your comb? What happens? Do you have any idea why this happens?
Do you ever have flyaway hair? Any ideas why?

1. Using your block of wood or styrofoam as your base, insert a straightened wire coat hanger so that it will stand up vertical. At the top quarter of the wire coat hanger, bend it so that the end of the hanger is parallel to the the side secured in the base. Tie the thread to the end of the coat hanger, make sure that your thread will not touch the ground. Attach the wheat puff to the free end of the thread. Again, make sure that the wheat puff will not contact the ground. Use this diagram as our guide.

2. Charge a plastic strip such as a ruler by rubbing it on your sweater.

3. Bring the charged plastic ruler close to the wheat puff. (Students should observe the attraction between the wheat puff and plastic ruler, because the objects have opposite charges)

4. What do you think will happen if you allow the wheat puff to touch the strip? Will the wheat puff and ruler still attract each other?

Predict

Check one ✓

Will the plastic ruler

A. still attract the puff _____ B. not attract it anymore _____ C.Repel it _____

Please give your reasons.

____

____

Observe

Let's Try it! Allow the puff to move along the strip. What happens?

____

____

Explain

Try to use the idea of charge to explain what happens.

____

____

____

____

Extension

Now touch the puff with your and and try again. Can you explain what happens?

____

____

____

____

Assessment: Informal Formative

1. Could students predict and give a rationale for their response (Prediction phase)

2. Were students able to record their observations accurately and effectively to understand the repelling of like forces

Assessment: Formal Formative

Were students able to formulate an explanation of what is happening to the change in charge that results in the repelling of the objects.

Rubric:

	Developing 1	Proficient 2	Exemplary 3
Could students predict and give a rationale for their response	Attempted to predict but unable to do so	Predicted what they expected to see happen	Predicted what they expected to see and gave a plausible rationale based on prior knowledge
Were students able to record their observations accurately and effectively to understand the repelling of like forces	Observed the repulsion but did not explain what they saw	Observed the repulsion and gave a plausible explanation of what they saw	Observed the repulsion and gave an insightful and appropriate report of what they saw
Were students able to formulate an explanation of what is happening to the change in charge that results in the repelling of the objects.	Attempted to explain repulsion but were unable	Explained the repulsion related to similar charges	Explained the repulsion related to similar charges and give insight as to how the charges have changed

Everyday Static Electricity

Outcomes:
• 102-15 Describe examples of the effects of static electricity in their daily lives, and identify ways in which static electricity can be used safely or should be avoided
• 202-9 Identify new questions from what has been learned about static electricity

Lesson Activity Overview:

This lesson is intended to connect what students have learned in previous static electricity activities to their life via asking new questions in light of what has been learned.

Begin by tying in previous lessons (Charged Balloons, Picking Up The Pieces, and Making a Charge Detector) and ask students to discuss (volleyball discussion) what new questions based on these investigations could be explored related to their life? Remember the focus is on application to their life, so the questions should be geared to day to day static electricity (i.e., static cling from dryer, plastic wrap, swiffers, etc...).

Based on the question submitted by student groups, products that inhibit static electricity (e.g., spray products used for clothes) or use static electricity (e.g., swiffer dusters) can be displayed around the classroom.

Students might explore techniques to reduce static attraction or “static cling”, such as making things moist, or touching them with grounded metal. Students may relate this to why hair can stand on end when combed.

Assessment: Formal Formative
Describe what can happen when taking your clothes out of the dryer. How do you think this is related to static cling?

Extension:
Create a poster that shows products developed to reduce static (e.g., hair conditioners, stray for clothes, static cling sheets for the dryer).

Suggestion: Create an interactive SMARTBoard display that is personalized by groups. All group displays can be merged to one document and it can be exported as a scrolling video for display on the school web site.

Investigating Surface Tension and Soap

Outcomes:
*Surface tension is a noted “invisible force” and this lesson is appropriate as an investigation lesson in this unit.

- Carry out their own investigations of surface tension and draw conclusions from their data
- Understand how soap affects surface tension

Materials:
- Water
- Clear, small plastic cups
- Pennies
- Liquid soap or detergent
- Graph Paper
- Colored, dustlike substance, such as graphite powder (available from hardware stores), Ground pepper, or colored chalk
- Paper towels

Inquiry Lesson:
1. Begin the class with a demonstration: Show students a full cup of water (best to use a clear cup or glass, filled right up to the rim). Ask, “How many pennies do you predict that I can place in the water before it overflows?” Record student predictions. Gently drop pennies into the water into the water (edgewise works the best) until the water actually overflows the rim of the cup. You will probably use more pennies than either you or the students expect, so be sure to have plenty on hand. The water will actually rise above the rim of the cup, forming a dome like bulge. When the water finally spills over and the demonstration is complete, give student groups a few minutes to discuss what they seen, and ask them to explain what happened. (The water in the cup was able to rise above the rim and accommodate so many pennies due to the water’s surface tension.

2. Add a single drop of liquid soap or detergent to the surface of the water in the cup, then try the same process. Ask for student predictions regarding the number of pennies it will take for the water to spill out, and then carry out the demonstration. You should find that you need far fewer pennies this time. Graph the number of pennies used in each case (bar graph), and ask students to try to explain why the soap lowered the number of pennies needed.

3. Give student groups time and materials to try the penny demonstrations (with and without soap) on their own. Students should make predictions, collect data (number of pennies), and graph their own results using Activity Sheet - Surface Tension and

3. Soap. Students can then compare class results (averages) and try to answer these questions: “What effect did the soap have on the water? How do you know?”

4. As a final step, demonstrate the following for the class: Float some dust (any sort of colored dust will do) on water. Add a single drop of soap to the water. Ask students to observe what happens. (The dust particles will move quickly away from the drop of soap.) As students consider the effects caused by soap in this and the previous demonstrations, ask them if they can offer any explanations for why soap is using as a cleaning agent.

Discussion Questions:

1. What allows the water to rise above the rim of the cup or glass as pennies are added?

2. What effect did the drop of soap have on the number of pennies added to the water? How do you explain this?

3. Based on what you’ve observed about soap, water, and dust particles, why is soap able to get us clean?

Assessment:

1. Did student successfully carry out their own investigations of surface tension? (Use embedded observations during Procedure 3 as performance assessment.)

2. Were students able to successfully graph, analyze, and draw conclusion from their data? (Use your observations during Procedures 2 and 3 as embedded evidence, and use their responses to the Discussion Questions as prompts for science journal entires.)

3. Were students able to understand how soap affects surface tension? (Note their responses during Procedure 4 as embedded evaluation and use Discussion Question 3 as a prompt for a science journal entry.)

Rubric:

	Developing 1	Proficient 2	Exemplary 3
Did students successfully carry out their own investigations of surface tension?	Attempted investigations but not successfully	Carried out investigations successfully	Carried out investigations successfully and were able to clearly discuss the experience
Were students able to successfully graph, analyze, and draw conclusions from their data?	Attempted to graph, analyze, and draw conclusions but not successfully	Successfully graphed, analyzed, and drew conclusions from their data	Successfully graphed, analyzed, and drew extensive conclusion from their data
Were student able to understand how soap affects surface tension?	Attempted to understand but were unable to offer a reasonable explanation	Were able to explain soap's effect	Were able to draw extensively from their investigatory experiences as they explained soap's effect