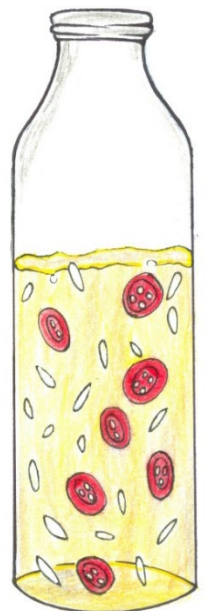
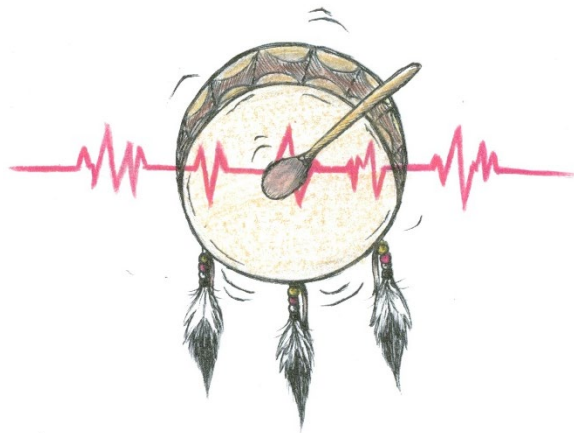
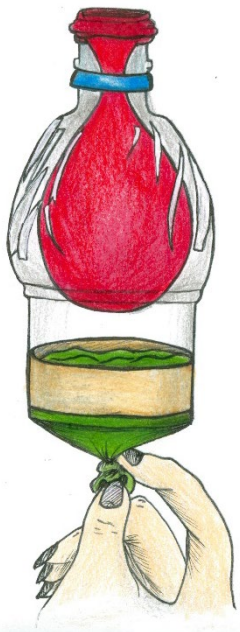


# STEM Activity Cards

Kindergarten – Grade 12



Parks Canada  
Parcs Canada



**FRONTIER**  
SCHOOL DIVISION

# Dedication

*This collection is dedicated to all of our teachers and educational staff who have led the way during this Covid-19 pandemic. You are respected and admired, and words cannot express our appreciation. On behalf of our youth worldwide, thank you.*



# Connecting with STEM

During the spring of 2020, we all felt incredibly helpless (even if just for a moment). How can we navigate Distance Education in an instant? How can we be teachers, parents, care-givers, friends, and more, all at the same time? How can WE be the leaders during this pandemic? How can we keep minds curious about Science? These questions came to the forefront like never before.

In early conversation about this project, all contributors agreed on one aspect: we had to act. We wanted to help students, teachers, and families. We wanted to create in a way we had never created before.

This project quickly became a passion project. It grew and evolved over the coming months. It took longer than anticipated to complete. It involved multiple contributors who all played a key role. Our standards for each and every STEM activity included achievable success, materials that can be easily found without a trip to the store, a family-friendly approach, connections to Indigenous Way of Life, connections to the natural world around us, tech independent activities, and more.

We hope you find these activities both useful and fun. Science is such an easy win when it comes to connecting with our youth, and this can be done in all curricular areas. Once again, thank you for all you do as educators.

Stay curious...

Stay clever...

Stay nerdy!

# CONTRIBUTORS



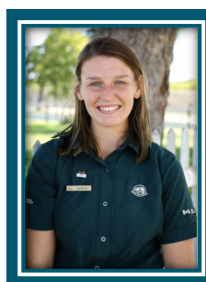
**Jacqueline Monteith, MDDE**  
Science Instructional Coach, Frontier School Division

Jacqueline's love of Science was sparked by her exposure to land-based learning and teachings in Northern Manitoba. Her passions include working with amazing educational partners on bigger-picture projects such as FSD Science Fair, the Manitoba Envirothon, Virtual Field Trips, Distance Education through a Science Lens, and much more. However, Jacqueline's greatest nerd-joy stems from opportunities to explore the majestic world of Science, to think freely, and to breathe new life into educational approaches.



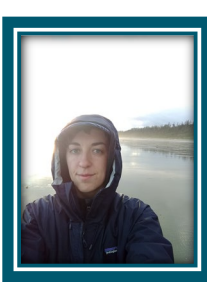
**Arif Kassum, B. Sc., B. Ed.**  
Science Instructional Coach, Frontier School Division

Arif is originally from Winnipeg and holds degrees in Microbiology & Immunology and Education. Arif has worked abroad teaching and is currently positioned with Frontier School Division as a Science Instructional Coach. He is a competitive chess player, drone operator, and former soccer and volleyball coach, musician and he spends a great deal of time outdoors. As a futurist, he believes that we can live sustainably on Earth for many millennia with the right technology and a strong conviction.



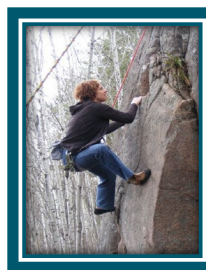
**Laurie MacDonell**  
Interpretation Coordinator II, Manitoba Field Unit, Parks Canada

Laurie is a heritage presenter for Parks Canada. She has a love for both natural and cultural heritage, but also for sharing that passion with the public. In her spare time she loves working in her backyard where she has a vegetable garden. This year she plans to plant a Manitoba Prairie Garden with all native plants!



**Marika Olynyk**  
Public Outreach / Partnering & Education Officer, Parks Canada

Marika is a Public Outreach and Education Officer with Parks Canada. She loves to explore the world around us, and works to find ways for people to connect with the earth.



**Louise Landygo**  
Researcher, IWOL Department, Frontier School Division

Louise believes Indigenous traditional knowledge and cultural values are key to peace and survival on Mother Earth. As a researcher, she hunts through archives, libraries and the Internet as well as consults with Elders and Knowledge Keepers. Louise also loves to climb rocks, hike trails and hug trees.



**Liz Halina, B. Ed., M. Sc.**  
Indigenous Education Consultant

Liz is a huge sci-fi fan and outdoor nerd who loves to be on the move. She can often be seen on her paddle board on Lake Ontario or hiking/running on trails in and around Toronto. When not on the move, Liz loves nothing better than a good dystopian-future novel.



**Amber Cure**  
Administrative Secretary, Frontier School Division

*"Being creative is not a hobby, it is a way of life"*  
This is the first thing Amber sees when she enters her home. It is a handmade sign hanging on the wall, gifted from her sister and nephew. Throughout her entire life Amber has been blessed with the ability to exercise creativity in some form or another, whether it be a personal project or a professional one.



**Rondaline Ducharme**  
Artist

Rondaline is an Indigenous artist and entrepreneur from Cormorant, Manitoba. She has been a licensed Esthetician for 10 years, and has a passion for both painting and drawing. Rondaline places great importance on learning more about her heritage and continuing her education, all while living a healthy lifestyle.

**THANK YOU TO OUR CONTRIBUTING PARTNERS:**  
**Frontier School Division's Science Department**  
**Frontier School Division's Indigenous Way of Life Department**  
**Parks Canada**

**Special Thanks to Parks Canada Outreach and Education Students:**  
Mylène Chabot, Valérie Georges, and Antonina Kandiurin



# Kindergarten

Rainbow Connection

Strength in Fibers

Yeah I'm Tree...Tree Falling



## CHALLENGE

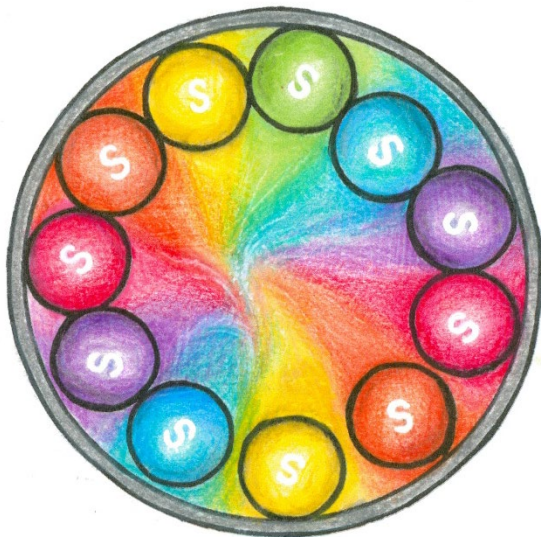
Make coloured rainbows in a dish.

### Materials

- Large dish
- Various coloured Skittles
- Water
- Paper
- Coloured pencils or water paints

### Method

- Pour water into a shallow dish.
- Place skittles in the water along the edge.
- Allow the colours to bleed into the middle of the dish creating a rainbow.
- Colour the paper with the same colour pattern seen in the dish.



### How it Works

Rainbows are typically produced by the diffraction of light in water droplets of the air. White light is made up of primary colours. Water splits the light into different colours, or wavelengths of light.



### Indigi-Tech

Storytelling is an important way of learning for Indigenous peoples. There are different stories that explain how life came to be. One Ojibwe story tells of fields of flowers that had no colour, so Nanabozho decided to paint them. While he was out painting, two little blue birds were zipping around chasing each other, having fun. When the birds dove down towards the earth, their little wings dipped into the paints, picking up the colours. The bluebirds were then chased away by Nanabozho over to a waterfall. As the birds flew through the mist caused by the waterfall, the paint colours washed off their wings, leaving brilliant streaks of colour behind. When the sun shone on the mist, the colours formed a rainbow. You can now see this any time the sun shines on the rain or mist.

### Bio-Links

A sundog is when 2 bright lights shine beside the sun. Sometimes a sundog is a circle around the sun. It can be white light but sometimes a sundog looks like a rainbow. It happens in cold places like Wapusk National Park in northern Manitoba because there is ice in the sky that the sun shines on.



## CHALLENGE

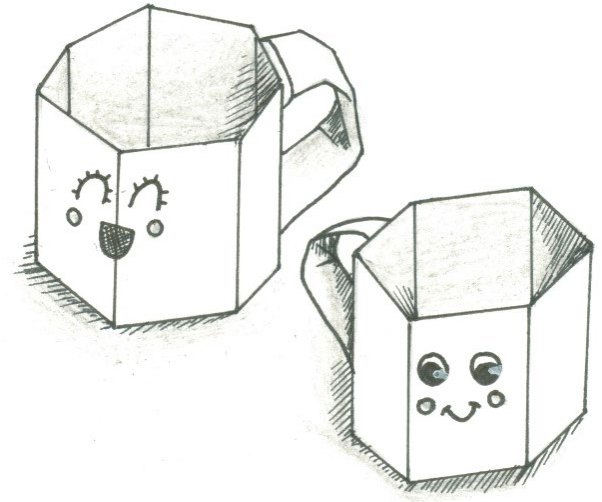
Use different kinds of paper to create the best paper cup.

### Materials

- Various paper: printing paper, paper towel, newspaper, construction paper
- Tape / Glue
- Small weights (e.g. marbles, pennies...etc.)

### Method

- Have each student/group use one kind of paper to create a cup (a template could be useful if you want the cup styles to remain the same).
- Only use tape/glue between pieces of paper (don't wrap your cup in tape!).
- Test the cup's durability by placing marbles into it.
- Record the number of marbles the cup can hold before it breaks or until it is full.
- Determine which kind of paper is strongest.



### Indigi-Tech



Indigenous peoples learned how to carefully harvest the bark to avoid killing the birch tree. This tree's bark is thin, strong, and can be folded like paper. Some artists make birch bark cups and baskets and decorate them with porcupine quills.

### *How it Works*

Paper essentially comes from plants – primarily trees. The fiber from the bark or grasses is processed chemically and mechanically to make thin sheets of paper.

### Bio-Links



Trees and other plants make paper and they can also be used to make string or rope. Some plants, like milkweed are very stringy. Milkweed is a very useful plant because it is also home for monarch butterfly caterpillars which eat the leaves before they turn in to beautiful butterflies. After the butterflies leave, you can let the milkweed stems dry out and break them apart into long strips. You can then twist and roll these into strings. To make a bigger rope, twist two strings together.

## CHALLENGE

Build a fall tree using various materials.

### Materials

- Popsicle sticks or collected twigs
- Clay
- Tape / Glue
- Coloured paper (green, yellow, orange, red)

### Method

- Use the popsicle sticks for the trunk and the branches.
- The clay can bind the trunk with the branches.
- Coloured paper can be cut out to form leaves (or use pre-made foam leaves) and attach onto the branches.



### How it Works

Trees grow and stand free using roots. Their branches grow to form leaves. Leaves use carbon dioxide in the air, water, and sunlight to perform photosynthesis and make energy for the tree. This allows it to grow taller, wider, and deeper. Leaves also release oxygen which allow other living things to thrive.

### Indigi-Tech



In Indigenous languages, many trees are named with the job they can help us do. For example, in Ojibwe, *Mitigwaabaak* (Hickory tree) means “the tree we make the bows from”. *Wiigobaatig* (Basswood) means “the tree that makes rope.”

### Bio-Links



There are different kinds of trees in Manitoba's forests. Some trees, like poplar and birch, have green leaves that they drop in the winter. Other trees, like pine and spruce, have special leaves called needles that they keep all year long. Trees are important homes for all kinds of animals. Some animals eat their seeds, bark, or leaves. Some animals use them to make nests and raise their babies. Some use them to stay safe and sheltered from bad weather or predators.



# Grade 1

Homey Homes

Shape Shifters

Soothing Sounds

Water, Water, Everywhere



## CHALLENGE

Build a shelter for a Manitoba animal. The shelter must stay dry in heavy rain and be able to support a heavy book without collapsing.

### Materials

- Variety of recycled and natural materials
- Optional: Lego

### Method

- Discuss what your chosen animal needs for a shelter: size, entrance, warmth, and more.
- Review the materials you have to work with. Optional: Draw your design on paper before building it.
- Build the shelter.
- Test the shelter for the ability to stay dry (pour water on it) and for its strength (place a small book on the shelter, then a medium book, then a large book).
- Decide if your shelter needs to be built again to meet the requirements. Keep going until you get it!



### Indigi-Tech

One way that Indigenous people learn is by watching nature. Have you ever seen a beaver lodge? What shape is it? What materials are used to build the structure? *Wigwams*, a traditional Indigenous house in Manitoba, used the same shape and materials as a beaver lodge. A wigwam is an upside-down dome made with tree parts. Sometimes these houses were covered in large pieces of birch bark harvested in a way that does not harm the tree.

### How it Works

The environment in which an animal lives is called its habitat. The habitat must provide water, food, shelter, and space. It must also make the animal feel protected from predators, harsh weather, and other threats.

Animal homes come in a variety of shapes and sizes. Some examples of animal homes are caves, hives, webs, burrows, holes and nests.

### Bio-Links

To keep warm in the winter, mother polar bears dig a hole in the snow, called a den, where they live for 5 or 6 months and give birth to their cubs. A den has 2 rooms: one for the mother and one for her cubs. The den is very warm because it's underground. There's only one small hole for air to keep them safe until they come out in the spring.

## CHALLENGE

Create shaped columns out of paper that can hold a heavy amount of weight.

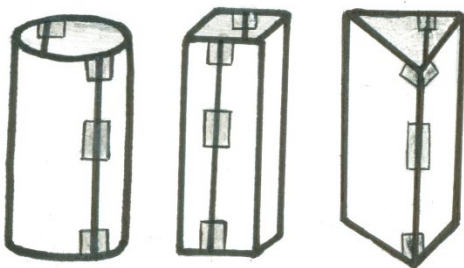
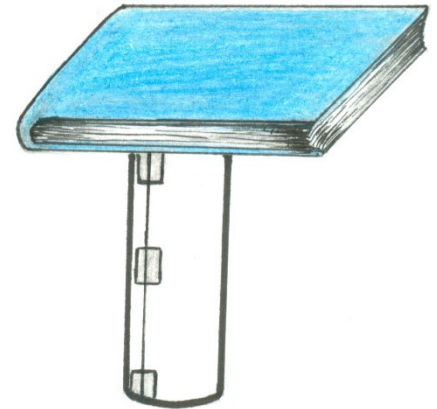
### Materials

- 3 sheets of printer or cardboard paper
- Tape

### Method

Create three columns:

- **Square Column:** Fold one piece of paper into four even sections. Fold the paper into a square and secure with tape.
- **Triangular Column:** Fold the second piece of paper into thirds to create a triangular column. Secure with tape.
- **Circular Column:** Tape the edges of the paper together to form a circular column.
- Stand each column up and carefully place books on top of each one. Use the same books in the same order until the column collapses.
- Record how many books each column holds.



### How it Works

Different shapes are used to help strengthen different structures. The circular column does not have any edges so the weight of the books is shared evenly. The square and the triangle support the books on their edges and corners, which means they could collapse.

### Indigi-Tech



Igloos were the traditional winter houses used in the Arctic by Inuit. They are often drawn as a half-ball shape, but they actually aren't!

Built from hard-packed, lightweight snow blocks, igloos are actually slightly oval in shape. This shape is very strong and stable. As a result, igloos are strong enough to hold up in hurricane force winds that can happen in the Arctic!

### Bio-Links



Why don't birds break their eggs when they sit on them? The dome shape (circular) actually makes the eggs very strong. It is easy to smash an egg if it is dropped. However, if you put a weight on the top of the egg, the circular shape keeps it strong so it won't break. This is just like the circular column in the activity. Strong eggs help protect the baby chicks as they grow until they are ready to hatch!

## CHALLENGE

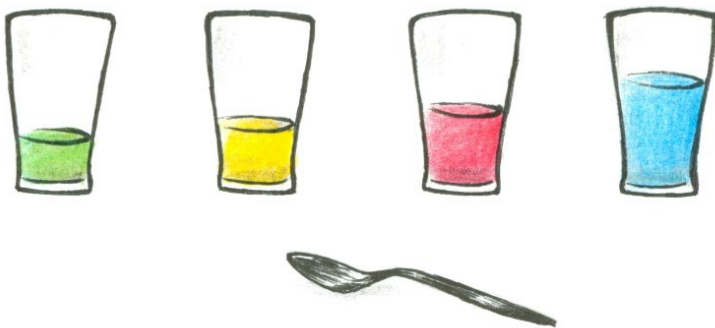
Create a set of musical water glasses.

### Materials

- 8 clear glasses
- Water
- Plastic and metal spoon
- Optional: Food colouring

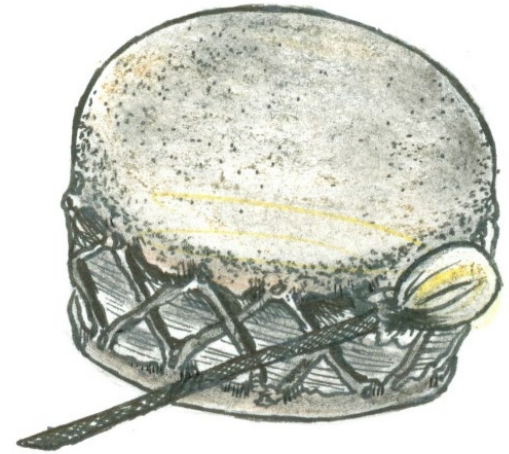
### Method

- Fill the first glass with a small amount of water.
- Fill the next glass with a little more water.
- Fill all 8 glasses with water, a little more in each glass. Glass 8 should be nearly filled with water.
- Use food colouring to create a unique colour in each glass.
- Use the plastic spoon to tap each glass. Notice the difference in sound that each glass creates.
- Use the metal spoon to tap on each glass. Notice the difference in sound that each glass creates.



### How it Works

When you tap on one of the glasses, the spoon creates a sound wave that travels through the water. The more water in the glass creates a slower sound wave and a lower frequency pitch. The less water in the glass creates a faster sound wave and a higher frequency pitch.



### Indigi-Tech

There are many types of drums used by Indigenous people including hand drums and the big drums you see at pow-wows. One lesser known drum, called a *Little Boy*, *water drum*, or *Midewewe'igan*, is used in a special ceremony. This drum is made by hollowing out a log and stretching hide over the top. Water is placed in the hollow inside of the drum to adjust the tone and pitch of the sound produced, just like in the activity you just tried.

### Bio-Links

When baby birds need something from their parents, they might use a high-pitched sound or a very loud sound. Great-horned owl chicks have an ear-piercing scream when they are asking for food. Baby crows are very noisy when they are waiting for food and sometimes it seems like they caw all day long. A young eagle will often make a high-pitched whiny chirping noise when it wants food from its parents.

## CHALLENGE

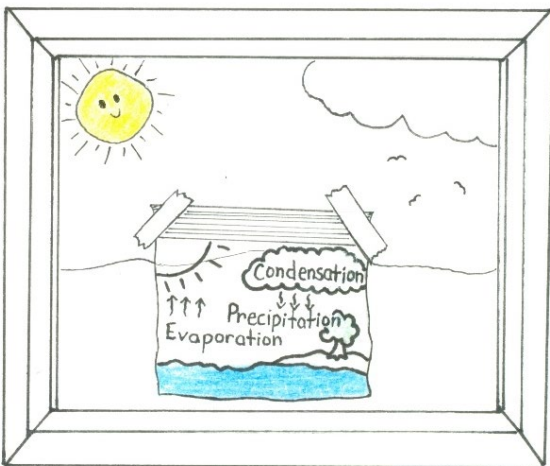
Create a working model of the water cycle.

### Materials

- Plastic Ziploc bag
- Tape
- ¼ cup of water
- Marker
- Optional: Food colouring

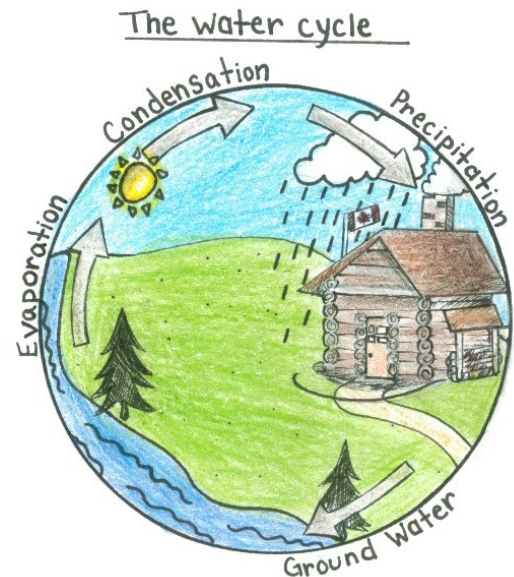
### Method

- Draw clouds around the top of the baggie, and water around the bottom of the plastic Ziploc bag.
- Fill the plastic bag with ¼ cup of water, and add about 4 drops of food colouring.
- Seal the bag shut, and hang it in a window that receives sunshine.
- Check on the bag periodically and notice how much condensation the baggie collects over time. Where does the condensation collect? How does it fall? What happens in the baggie on sunny days compared to cloudy days?



### How it Works

In nature, the sun's heat causes water to evaporate from streams, lakes, rivers and oceans. As the water vapor rises, it condenses to form clouds. When the clouds are saturated with water they release some of the water as rain. Then the cycle starts over again.



### Indigi-Tech

In your body, veins and arteries deliver important nutrients like oxygen and food to keep you healthy and strong. Rivers and streams are thought to be the veins of the Earth by Indigenous people.

As water moves through the water cycle and flows through waterways, it brings with it important nutrients to all living things along its path. This is why water is considered sacred to Indigenous people and must be protected. Women have a sacred duty to protect waterways and are called *water keepers*.

### Bio-Links

Just like rain, snow comes from clouds! Clouds are made of tiny water droplets that rise up to the sky where they are condensed back into water. When these tiny water droplets get bigger and become too heavy to stay in the sky, they fall to the ground. In the north, cold air makes the clouds freeze, so the water falling from the sky turn into snow.

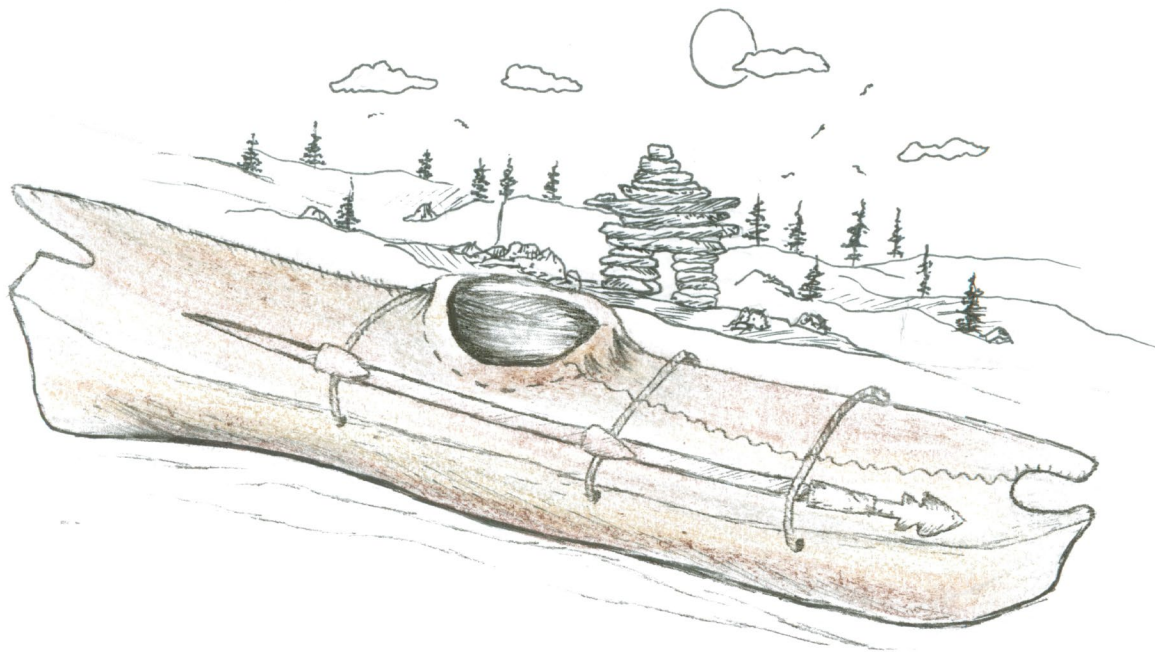
# Grade 2

**Fabulous, Friendly Frogs**

**Float Your Boat**

**Flower Child**

**Wind Makes the World Go Round**



## CHALLENGE

Create the best jumping origami frog.

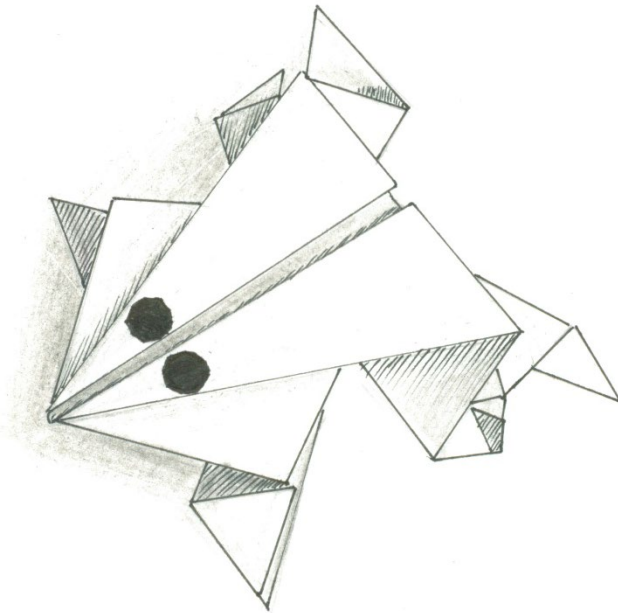
### Materials

- Paper
- Scissors
- Paper frog template

### Method

- See the Jumping Frog instruction sheet.

[https://web-japan.org/kidsweb/virtual/origami2/exploring01\\_06.html](https://web-japan.org/kidsweb/virtual/origami2/exploring01_06.html)



### *How it Works*

The origami frog jumps using the basic principles of physics. A downward force is applied with the finger increasing the elastic potential energy in the frog. Once it is released, the potential energy is converted into kinetic energy and an equal and upward force pushes the frog into the air.



### Indigi-Tech

One of the favourite games played by the Inuit is the One or Two-Foot High Kick. Players take off and land on one or two feet when jumping up to kick a small hanging target that is moved higher and higher. It takes a lot of strength and power to kick such a small target and land with precise balance. Just like the frog, the same physics principles apply! It takes a lot of time and practice to be good at these games. The One-Foot High Kick was highlighted at the 2010 Olympic Games in Vancouver.



### Bio-Links

Did you know that a group of frogs is called an army?! There are many different frog species in Manitoba. Wood Frogs are the only frog that can be found all over the province. Manitoba also has Gray Tree frogs that can be found on trees, and Boreal Chorus Frogs that are the smallest frogs in the province. Northern Leopard Frogs are the largest and are a *Special Concern* animal which means they need extra protection. Riding Mountain National Park is a place that protects these frogs and their habitats.

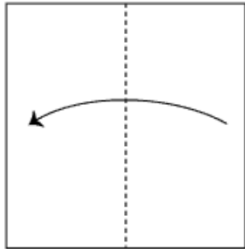




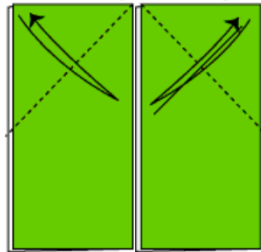
**Jumping Frog**

Level: Medium

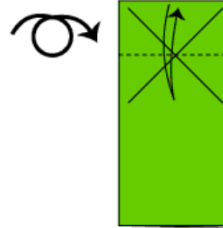
**1** Fold the paper in half sideways to make a rectangle.



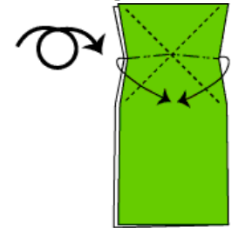
**2** Fold the corners down and unfold them right away, repeating this for both top corners of your rectangle.



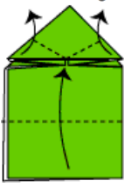
**3** Flip the paper over and fold the top of the paper down at the spot where the diagonal creases meet. Unfold right away.



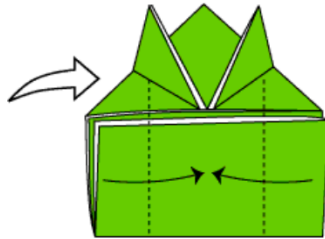
**4** Flip over once again, and fold the two edges toward you so they meet each other. The top of your rectangle will fold down to form a triangle.



**5** Fold the bottom of the paper up so that its edge meets the bottom of your triangle. Fold the two corners of the triangle up to form the "front legs" of the frog.



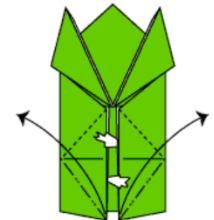
**6** Fold the sides inward to meet at the center.



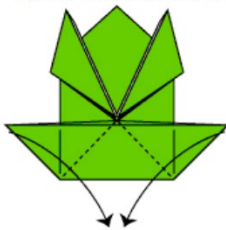
**7** Fold the bottom of the paper upward so its edge touches the bottom of the "legs," and unfold right away.



**8** Insert your fingers into the inside of the flaps, and pull the bottom corners outward to the sides, so that the bottom edge comes up to touch the bottom of the "legs."



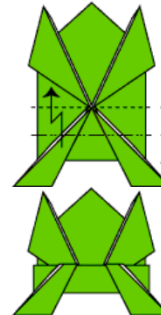
**9** Fold the corners down so they meet at the bottom of the figure.



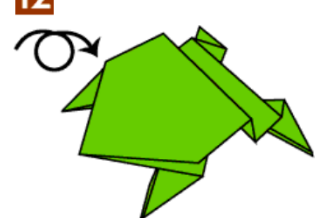
**10** Fold the bottom corners outward to form the "back legs" of the frog.



**11** Create a zigzag fold at the bottom of the figure, folding the bottom half up and then the bottom quarter back down.



**12** Your frog is ready to go.



Press its back and release to make it hop!



## CHALLENGE

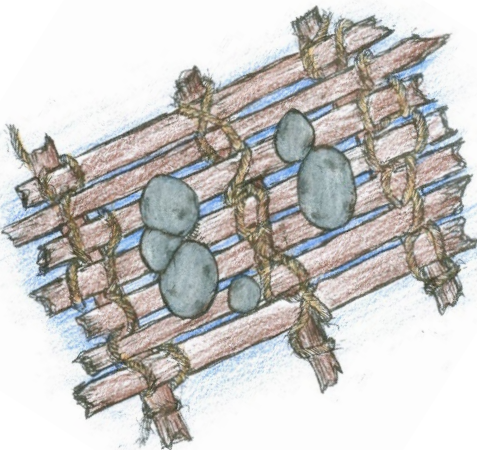
Build a miniature raft.

### Materials

- Popsicle sticks or twigs
- Straws or twigs
- Sponge, foam or Caribou moss
- Glue, string or strips of hide

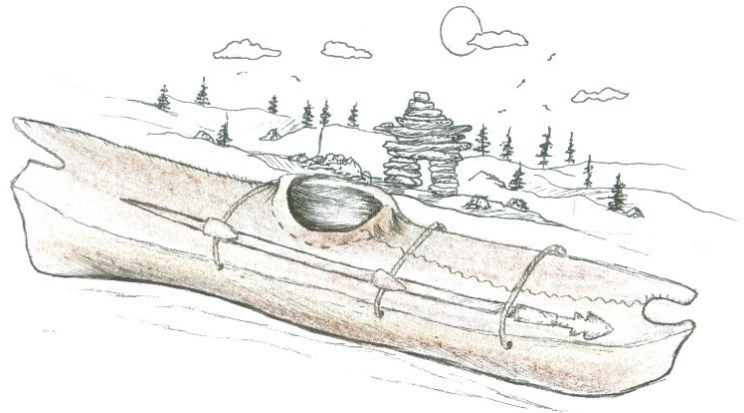
### Method / Restrictions

- On a flat surface, lay down several popsicle sticks/straws or twigs side by side until a square is achieved.
- Add a layer of popsicle sticks or twigs so that they are perpendicular to the first set.
- Continue until an optimal raft is built.
- Sponge, foam or Caribou moss may also be used to help with floatation.
- The raft must float and must also carry a small weight such as a handful of pennies or rocks.



### How it Works

Rafts and boats float due to water displacement. Surface area and volume play a huge role in keeping rafts and boats afloat. The more surface area and volume that a boat has, the more it displaces water. The weight of the water displaced is equal to the force pushing up on the boat, or buoyant force. If the buoyant force exceeds the weight of the boat, it floats. If the weight exceeds the buoyant force, it sinks.



### Indigi-Tech

Several different watercraft types were developed by the Indigenous peoples of Turtle Island. In the Arctic, the Inuit made *qajaqs* (single person kayak) and *umiaks* (large, open boats for multiple people) of driftwood or bones covered in seal skin. In the boreal forest, the lightweight birch bark canoe was perfect for the fast moving rivers of the area. On the west coast, huge dugout canoes were built to withstand large ocean waves. Each type of boat was well designed for its specific use, the local environment, and available materials.



### Bio-Links

Polar bears can use sea ice as their own raft! Floating sea ice is very important for polar bears on Hudson Bay and in the Arctic Ocean. The ice floats in large sheets on top of the water and the bears use it to hunt and travel in the winter. While on top of the sea ice, polar bears can track their favorite meal: ringed seals.

## CHALLENGE

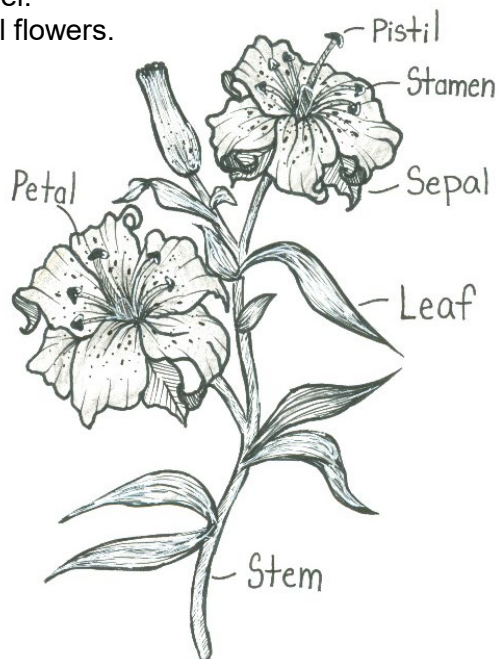
Create a flower book.

### Materials

- Notebook
- Tape
- Pencil
- Scissors
- Variety of flowers

### Method / Restrictions

- Pick/cut single flowers of your choice from the environment (*give thanks to Mother Earth for each flower picked*).
- Remove the *leaves, petals, and stamen*.
- Tape the *stem* into the middle of a page.
- Tape the remaining parts of the flower onto the page and label.
- Repeat for all flowers.



### How it Works

Flowers have petals to attract bees and other pollinators. The bees carry the pollen from the stamen of one flower to the pistil of the flower. This fertilizes the flower which may cause it to grow and produce a fruit.



### Indigi-Tech

Indigenous women have long been experts at using materials found on the land to provide food and medicines as well as to decorate handmade items. A variety of flowers could be used to dye wool sheared off sheep that were raised on Metis farms. The process of using flowers to dye and colour wool is long and difficult. Flowers that can be used include: camomile (gold), marsh marigold (yellow), sumac (red), yarrow (yellow), and coneflower (purple). All parts of these plants can be used to make dye, including petals, leaves, stems, and roots.

### Bio-Links

Flowers love bees and other insects! They need the bugs to help them grow new fruits and seeds. They have all kinds of ways to get insects to visit them: most have nectar to drink, some smell nice, and most have bright colours and patterns. Flower petals even look different to bees and butterflies than they do to you! These insects can see UV light, which means they sometimes see stripes or patterns on the flowers that people can't.



## CHALLENGE

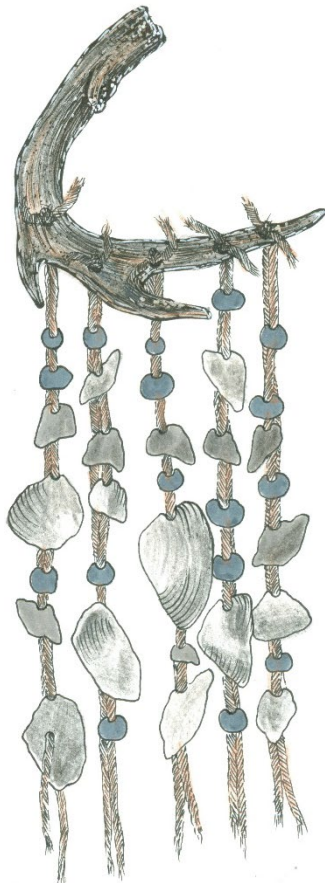
Create a set of wind chimes.

### Materials

- Natural or collected item to hang chimes from: antler, coffee tin, small tree cookie, driftwood
- Chime items: beads, sticks, stones, shells
- Twine / Thin rope
- Scissors
- Optional: paint and painters' tape

### Method

- Paint or use markers to decorate the chime pieces. Painters tape can be used to create fun patterns.
- Add a mixture of chime items to several strings of the same length. Tie off the ends to keep the items in place.
- Tie the strings of chime items so that the items will chime together in the breeze.
- Hang outdoors and chime on!



### Indigi-Tech



Wind is moving air. Moving air can be used to create sound using a whistle. One special whistle is made and used by the Dakota, Ojibway, and other Indigenous peoples in a sacred ceremony called the Sundance. This whistle is made from the hollow wing bone of a bald or golden eagle. When blown into, the whistle sounds like the cry of an eagle.

Many Indigenous people believe eagles are special animals that carry messages in their prayers to the Creator.

### Bio-Links



Have you ever noticed that the wind can sometimes make a howling or whistling sound? This happens when buildings or trees get in the path of the wind. When something is in the way, wind splits into two, and joins again after passing by. If one part of the wind is stronger when it joins up, the air moves around a lot making whooshes, whistles, or howls. This is why a windy forest can sound extra spooky.

### How it Works

Air particles move from areas of high concentration to low concentration. When this happens, it creates wind. The force of this wind will push the chimes against one another causing them to vibrate. The vibrations create a sound. The louder the sound of the chime, the stronger the wind.

# Grade 3

**Staying Positive**

**Sunshine & Seedlings**

**Super Structures**

**Where's My Soil-Mate?**



## CHALLENGE

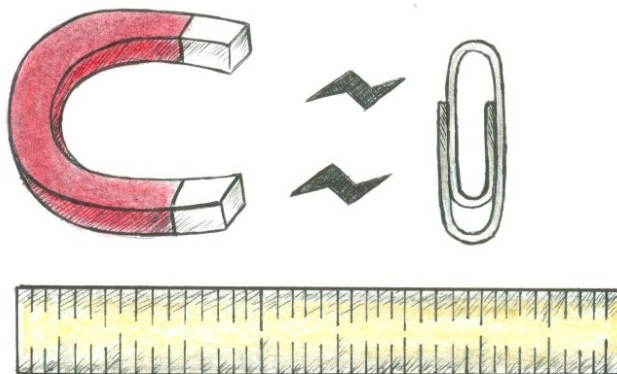
Experiment to see which magnets, and which magnetic objects, have the greatest force.

### Materials

- Variety of magnets from fridge, toys, crafts
- Variety of magnetic objects: paper clip, sewing needle, screws or nails, toys, bobby pins
- Measuring tape or object to measure with

### Method

- Collect a variety of magnets and magnetic objects from home.
- Hold a magnet and a magnetic object in each hand. Slowly bring the items together until you can feel the magnetic force pulling. Measure the distance between the objects.
- Record the results. The greater the distance when the force is felt, the stronger the magnet and magnetic object is.



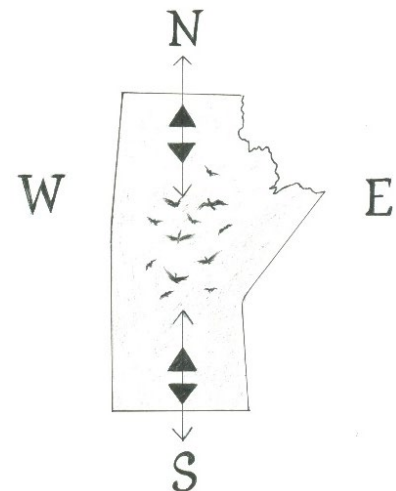
### How it Works

A magnet is a rock or a piece of metal that can pull certain types of metal towards itself. The force of magnets, called magnetism, is a basic force of nature like electricity and gravity. Magnetism works over a distance. This means that a magnet does not have to be touching an object to pull it.

## Indigi-Tech



A lodestone is a rock that has been magnetized. Magnetization sometimes happens when a rock is hit by lightning. Between 3,500 and 4,000 years ago the Indigenous people in Guatemala (the Monte Alto culture) and Mexico (the Olmec culture) used lodestones in large sculptures. Scientists believe that these Indigenous cultures understood magnetism hundreds or even thousands of years before anyone else in the world.



## Bio-Links



Many birds fly long distances to spend the summer in the north where they raise their young before flying back south in the winter. These trips, called migrations, can be very far. For example, a bird called a Red Knot flies all the way from South America to Wapusk National Park in northern Manitoba. They don't get lost because they can see the Earth's magnetic field, which is like a compass, in order to know which way is north and which way is south.

## CHALLENGE

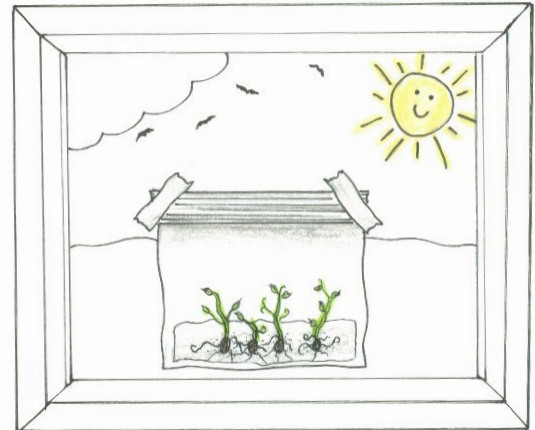
Grow seeds from your kitchen.

### Materials

- Variety of seeds from home: lentils, corn kernels, pumpkin, dried beans, apple, cucumber, oranges, etc.
- 1 plastic Ziploc bag for each seed
- 1 paper towel for each seed
- Tape
- ¼ cup of water
- Marker
- Optional: Food colouring

### Method

- Determine which seeds you have at home and which seeds you can use for this activity. You may want to ask another family member for additional seeds.
- Place each seed inside a damp paper towel.
- Place the damp paper towel with the seed into a Ziploc bag.
- Tape the baggie to a window that receives sun.
- Record seed growth (or lack of growth) every few days.
- If possible, transfer any growing seedlings to a pot and continue growing.



### Indigi-Tech



Indigenous people have been farming for thousands of years. They learned how to grow different plants together to get the best harvest, called *companion planting*. The most common companions planted together were corn, beans, and squash. These are known as the *Three Sisters*. Not only did these three plants help each other grow but cooking them together can give you a delicious vegetarian meal with nutritious proteins.



### How it Works

All plants start life as a seed. The seed itself is like a survival package. It contains the food the seed needs while it is growing roots and forming into a small plant. When seeds are planted, they first grow roots. Once these roots take hold, a small plant will begin to sprout. The scientific name for this process is germination.

### Bio-Links



Plants grow seeds in many different ways. Spruce tree seeds grow in a cone up high on the tree. When the cone dries out in late summer, the seeds fall and their “wing” lets them blow on the wind to land in a new place to start growing. Blueberry seeds grow inside the berry which gets eaten by animals like bears, rodents, or birds. The animals then poop out the seeds somewhere new. Wild licorice seeds are inside pods covered in hooked bristles. The pods catch on animal fur (or people’s clothes) and hitch a ride until the pod dries out and the seeds fall out in a new area.

## CHALLENGE

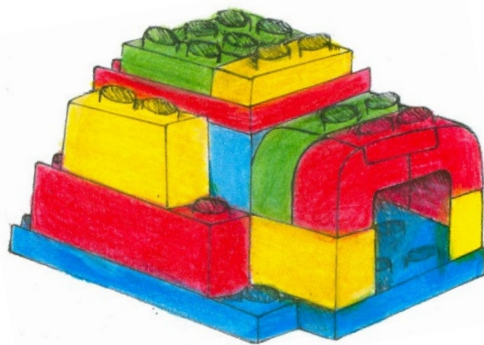
Re-create a famous structure using found materials and/or Lego.

### Materials

- Variety of natural and recyclable materials: sticks, clay, rocks, leaves, Play-Doh, hide, Lego.
- Variety of fasteners: elastics, string, long grass, glue, zip-ties

### Method

- Choose a familiar famous structure to re-create:  
**Traditional Structures:** Igloo, Tipi, Wigwam, Lodge  
**Manitoba Structures:** Provencher suspension bridge, Fort Garry Hotel, Churchill Northern Studies Centre, UCN in Thompson and The Pas.  
**World Structures:** Eiffel Tower, the Leaning Tower of Pisa, the Pyramids, San Francisco Bridge.
- Look closely at how the structure was made.
- Choose the best materials to recreate the structure.
- Recreate the structure as closely to the original as possible.




### How it Works

Buildings are the product of very clever engineering. Stacking Legos, creating card towers, making a lean-to in the forest, and making sandcastles on the beach are all ways that people become architects, builders, and engineers. Many considerations need to be made: design and look, where the center of gravity is, the best materials for the job, and the type of foundation needed to support the weight of the building.




### Indigi-Tech



Igloos are the traditional winter shelters used in the Arctic by Inuit. They are often drawn as a half-ball shape (aka half-sphere), but they actually are not! Built from hard-packed, lightweight snow blocks, igloos are slightly oval in shape. This is called a *catenary*. This shape is extremely strong and stable. As a result, igloos are strong enough to hold up in hurricane force winds that can happen in the arctic! Where else do you see this shape in nature or in construction?

### Bio-Links



Many birds fly up north to Wapusk National Park in Manitoba to build their nests and raise their young in the summer. One type of duck called the Common Eider comes to Wapusk National Park in the summer to build nests on the ground and close to water. Their building materials are plants and down (the layer of soft feathers).

## CHALLENGE

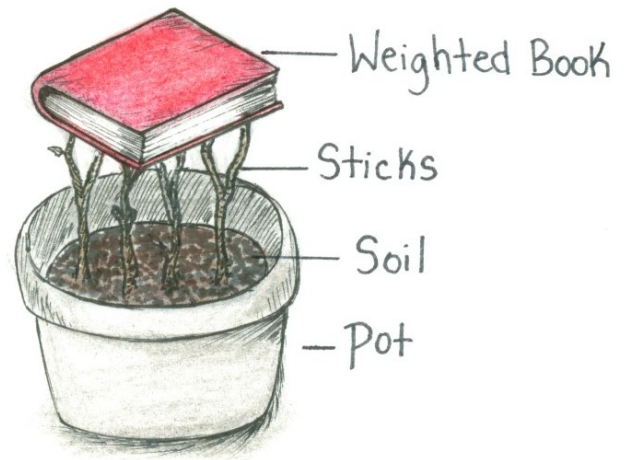
Test the stability of a variety of soils.

### Materials

- Variety of found soils: garden soil, soil from the forest, sand, clay (option to also use snow in the winter)
- Container to hold soil (can re-use one container for all soils)
- 10 thin sticks of the same length – about 30 cm long
- Books to use as weights

### Method

- Fill the container with soil.
- Place the sticks evenly throughout the soil so that  $\frac{1}{4}$  of each stick is buried, and  $\frac{3}{4}$  of each stick is standing up vertically.
- Ensure that the tops of all sticks are level.
- Place one book on top of the sticks. Continue placing books to see how much weight the sticks can hold.
- The greater the stability of the soil, the more weight will be supported.
- Repeat the process with a variety of soils. Record results.



### Indigi-Tech



Clay is an important part of soil. It is often found on the banks of rivers and creeks. Indigenous people have used clay taken from the ground to make bowls, pots, and other containers. The clay vessels need to be heated to a high temperature for a long time to make a pot that will not fall apart when wet. These methods have been in use for many thousands of years.

### Bio-Links



Did you know that some kinds of soil in northern Canada are frozen? Permafrost is made of a combination of soil, rocks and sand that are held together by ice. The soil and ice in permafrost stay frozen all year long and only the very top layer can melt in the summer. Places where plants can grow on top of the permafrost are called tundra. Usually trees cannot grow on the tundra because the top layer of soil isn't big enough for tree roots to grow.

### How it Works

Soil structure is an essential part of soil health. Soil with a good structure is able to hold a healthy amount of water, helps plants access nutrients, and creates a stable base for plants and trees. Soil is made up of four key elements: minerals like sand or clay, water, air, and organic material such as decomposed plants and animals.



# Grade 4

Drum Roll Please...

Eagle Eye Engineer

Pupil Protectors

What a Soap Opera



## CHALLENGE

Build a balloon drum.

### Materials

- Old pot or tin can with lid
- Large balloons (or fabric if desired)
- Scissors, ruler, glue
- Paper (construction paper is ideal)
- Elastic bands, electrical tape (if possible)
- Decorations (ribbon, stickers)
- Wooden sticks or dowels

### Method / Restrictions

- Cut a piece of paper to fit the can or pot.
- Glue or tape the paper to the can/pot as siding.
- Cut off the mouthpiece of the balloon. Make sure you only cut off the mouthpiece and not the body of the balloon!
- Secure the can/pot between your knees. Stretch the balloon over one side of the can/pot, then carefully stretch it over the entire top. Secure the balloon on the can/pot using several rubber bands or tape.
- Decorate your drum with ribbons or stickers.
- Use lightweight wooden sticks to play the drum!



### How it Works

Striking the head of the drum changes its shape and compresses the air inside the shell. The compressed air presses on the bottom and changes its shape. These changes are transmitted to the drum shell and reflected back causing the whole action to repeat causing a vibration. These vibrations in the air, or waves, create the sound of a drum. The pitch of a drum depends on how tight its skin is. The loudness of a drum depends on how hard you strike it.



### Indigi-Tech

In Manitoba, there are generally three types of Indigenous drums. The largest, sometimes called a *Grandfather* is a large drum placed on a stand on the ground. It is played by several people at once. You will often see these drums at events like the Manito Ahbee Pow-wow.

The second type of drum is a *hand drum* which is much smaller and has a higher pitch. As its name implies, it is held in one hand while the other hand strikes.

The third drum, called a *Little Boy* or *water drum*, is only used in special ceremonies. It is medium sized and partly filled with water. To change the pitch, you change the amount of water in the drum. Drums are considered to make the heartbeat of Mother Earth.

### Bio-Links

Animals use sound in many ways to communicate and to survive. Beluga whales use echolocation to move around and find food. Echolocation means the whales make clicking sounds that bounce back from the underwater environment showing them where objects and food can be found. Belugas also communicate with each other by making many different noises including squeaks, whistles, chirps, and squeals. Baby belugas start making sounds when they are only a few weeks old and learn more as they get older.

## CHALLENGE

Build an eagle's nest.

### Materials

- Any objects naturally found outdoors: sticks, shrubs, mosses, grass, plant stalks, lichens, seaweed, driftwood.

### Method

- Consider all the objects you wish to obtain for the nest.
- Use smaller and thinner objects to intertwine larger objects.
- Try to fill as many gaps as possible to thicken the density of the nest.
- Build the nest larger as it becomes thicker.
- The nest should not collapse on any side or feel brittle.
- The nest must be able to fit a small school bag.
- The nest must include the *bole* (see "How It Works").

Tip for building: Use several objects with various sizes, shapes, and textures.



### Indigi-Tech



Eagles are special birds for Indigenous peoples. Eagles are seen as messengers to the Creator as they are able to fly incredibly high. The eagle represents the teaching of love, which is a reminder to everyone to always try to live with a good heart towards everyone and everything. Eagle feathers are considered a sacred gift from the Creator and must be treated with deep respect.

### Bio-Links



There are two kinds of eagles that live in Manitoba. Bald Eagles live all over the province and Golden Eagles only nest in the north in the summer. Golden Eagles prefer to nest on cliffs, but in Wapusk National Park in northern Manitoba, there are no cliffs. Instead, they build their big stick nests on the spruce trees and raise 1-3 chicks. They are called raptors because they use their sharp claws and beaks to hunt. Golden Eagles like open habitats for hunting where they can find prey.

### How it Works

The bald eagle builds the largest nest of any North American bird: up to 13 feet deep, 8.2 feet wide, and 1.1 tons in weight. The male and female eagle pair build the nest together in the largest trees typically along shorelines. The nest cavity, called the bole, is where the eggs are laid. The bole will be about 30 to 40 centimeters in diameter and about 10 centimeters deep. It is usually made of softer materials and eagle feathers. The deep cavity and thick walls of the nest protect the eggs and young from harsh conditions and hide them from predators.

## CHALLENGE

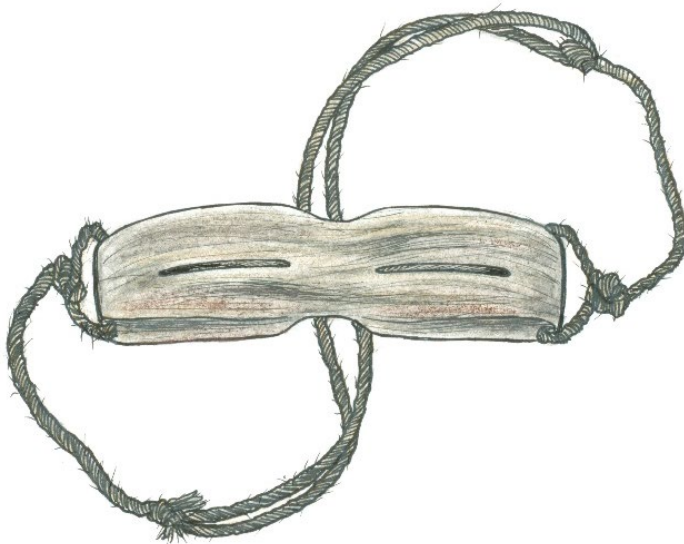
Build a pair of snow goggles.

### Materials

- Cardboard / Duct Tape / Birch Bark
- Scissors
- Cord: String / Yarn / Elastics

### Method / Restrictions

- Cut out a rectangle of your goggle material to fit well and wrap comfortably over your eyes (if you are using duct tape, be sure to fold it in half so neither side is sticky).
- Cut two extremely narrow slits that will sit over the eyes.
- Punch holes at each end of the goggles.
- Measure your cord so that they fit comfortably around the ears.



### Indigi-Tech

The Inuit invented snow goggles (*iggaak* in Inuktitut) to help prevent snow blindness. Snow blindness occurs when extra light from the sun is reflected off white snow, enters the eye, and then damages the retina (inner lining) of the eye. Because snow goggles have a narrow slit carved into a piece of bone or driftwood to cover the eyes, the amount of light entering the eye is reduced. You can still see everything around you because enough light can enter through the slit. The wider the slit, the more peripheral view you will have.

### Bio-Links

Snow blindness is caused when too much UV light hits the eye and can cause pain and difficulty seeing. Since they can't make snow goggles, many northern animals have special ways to protect their eyes from the bright light that reflects off snow. Caribou can actually see UV light, which humans and most mammals can't, but their eyes are adapted so they don't get damaged by it. Other animals may have different substances or pigments in their eyes to shield them from the extra UV. For most Arctic animals, we just don't know yet how their eyes are protected!

### How it Works

Snow goggles emulate the squinting of the eye. Light travels through the pupil (a hole in the eye) to the retina (a group of cells at the back of the eye) that captures the light energy. When the retina obtains too much light (if the light is too intense), the image can be distorted. The muscles around the pupil will contract to bring in less light. This causes the eyes to strain. Snow goggles block extra reflected light from the snow to reduce the incoming light to the pupil. This causes one's vision to be clearer and to have less strain.

## CHALLENGE

Carve an arrowhead from a soap bar.

### Materials

- Soap Bar
- Plastic knife
- Paper clip
- Sheet of paper
- Scissors
- Paint brush or old toothbrush
- Pencil

### Method

- Design an arrowhead on a sheet of paper the same size as the bar of soap. Cut it out.
- Place the arrowhead design on the bar of soap.
- Use the plastic knife to remove large chunks of the soap and a paper clip to shave off smaller pieces.
- When you finish the shape, use the pencil to carve details.
- Use the paintbrush or old toothbrush to brush away any soap dust.



### Indigi-Tech



Traditionally, arrowheads were made by Indigenous peoples from a few specific types of rock. The rocks used were usually flint, obsidian, or chert. These rocks were chosen because they are fine-grained and uniform, with few cracks or fissures. The process of shaping a piece of flint into an arrowhead is called *knapping*. The rock is struck at an angle with a hard, blunt tool. Another technique is to apply pressure to the stone with a softer material, such as antler. It takes years of practice to learn to be consistent in creating an arrowhead using traditional or modern knapping implements. Either way, they are so beautiful that it is almost more art than science!

### Bio-Links



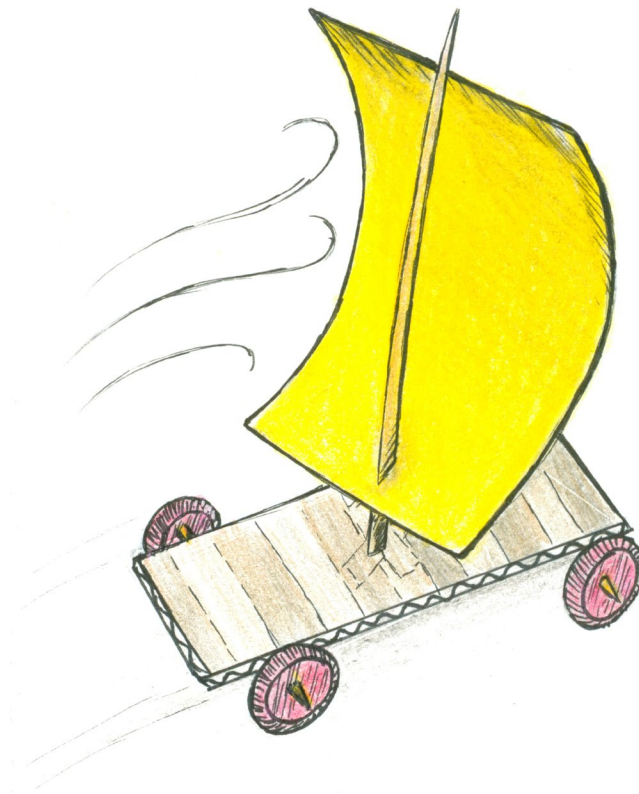
Plants can help with “carving up” rocks as part of the process called weathering. One way trees can do this is by growing a root into a little crack. When the root keeps growing it pushes on the rock until it makes a big enough crack that the rock breaks apart. This can take a long time! Small plants like moss can also break down rocks by releasing chemicals that slowly wear down the rock that they grow on.

### How it Works

Soaps are made from fats and oils which are treated chemically with a strong base. Solid fats like coconut oil, palm oil, or lard, are used to form bars of soap that stay hard but dissolve with lots of water. Oils such as olive oil, soybean oil, or canola oil are used to make softer soaps. The process of making soap is called *saponification* which can take weeks to complete.

# Grade 5

**Beat This!**  
**On the Run**  
**Sail On!**  
**The Yolk's On You**



## CHALLENGE

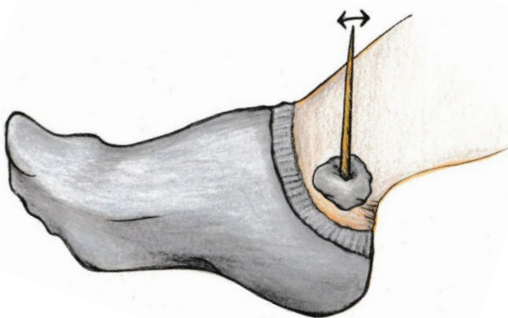
Create and use a working heart rate monitor.

### Materials

- Clay / Play-Doh
- Straw, toothpick, or thin twig about the same size as a toothpick
- Optional: stopwatch or timer

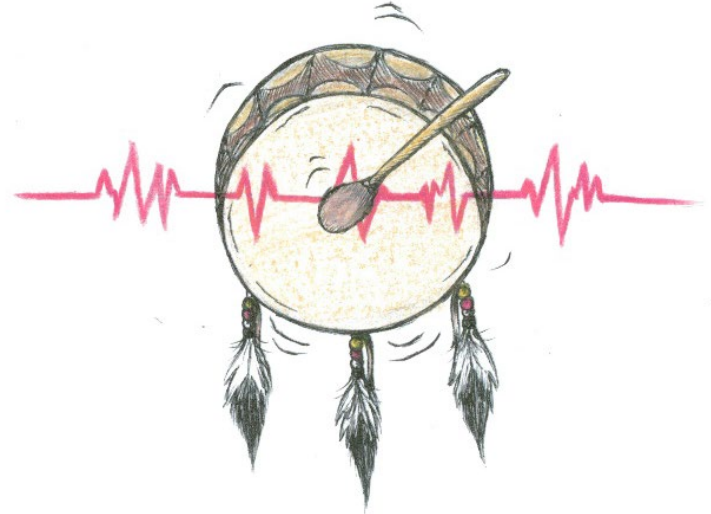
### Method

- Pinch off a small ball of clay. Insert the toothpick securely into the ball of clay.
- Turn your wrist or ankle over and find your pulse on the side of your wrist or ankle.
- Once you find the pulse, place the clay ball directly over the area where you found the strongest pulse.
- Press down on the ball just enough for it to remain secure without you holding it.
- Watch the toothpick vibrate back and forth.
- Using a stopwatch, count the number of vibrations the toothpick makes over a period of 60 seconds.
- Record results.
- Repeat the steps after exercising and with different people. Record all results.



### How it Works

Children have about 60 million meters of blood vessels in their bodies and adults have over 150 million meters of blood vessels. The heart pumps blood through every meter of those vessels. Our pulse is the result of the rush of blood forced out of the heart with each and every beat.



### Indigi-Tech

To Indigenous people, the sound of the drum is the voice of the Earth's heart. The drum connects the hearts of people to the heartbeat of Mother Earth. The circular shape of the drum represents balance, wholeness, equality, and connection. Try listening to the heartbeat of a relative. Can you make these same rhythms and sounds on a drum, or by clapping your hands?

### Bio-Links

The heartbeat of an animal usually depends on its size: bigger animals have slower heart rates and smaller animals have faster heart rates. For example, here are three animals found around Wapusk National Park in northern Manitoba:

**Beluga Whales** (1,400 kg) have a resting heart rate of 33 beats per minute.

**Female Polar Bears** (150-250 kg) have a resting heart rate of 46 beats per minute.

**Weasels** (29-250 g) have a resting heart rate between 300 and 400 beats per minute.

## CHALLENGE

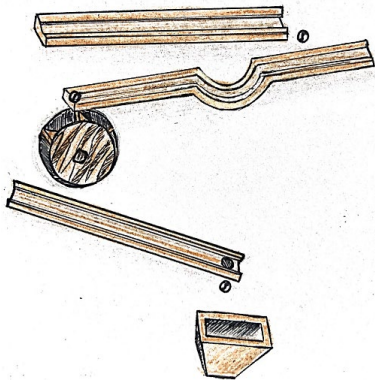
Create a vertical marble run.

### Materials

- Variety of natural and recyclable materials: toilet paper or paper towel rolls, paper, cloth, hide, fur, twigs and sticks, rocks
- Long piece of cardboard or plywood (Option: use a closet door, fridge, or wall that you are allowed to use tape on)
- Marble or similar round object.

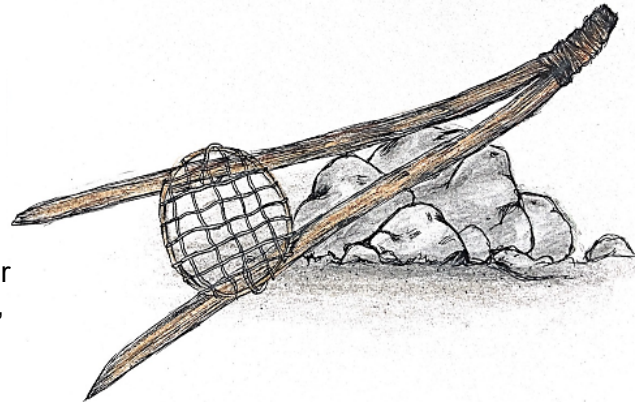
### Method

- Review the collected materials you have to use to make your marble run.
- Design a path for the marble to follow on its own, without falling off, from the top of the marble run to the bottom.
- In the design, include the use of as many simple machines as possible. Create or use a lever, pulley, wedge, screw, inclined plane and wheel & axle.
- Test the marble run to see if the marble can reach the bottom without falling off. Continue to revise the design until it works.



### How it Works

Simple machines have few or no moving parts. They make work easier by changing the direction of a force or by changing the amount of force needed. Basically, the amount of work to complete a job is decreased by using one of these machines. Simple machines can be found all around us: at home, in school, and in our communities.



### Indigi-Tech

Many Indigenous peoples traditionally moved from place to place each season to fish or hunt wherever the greatest number of animals could be found. Entire families would make the move with all of their possessions. To make travelling easier, a *travois* was used to carry most of the household goods, and sometimes people as well! A travois is made by placing two long poles in the shape of a V with a small platform attached at the mid-way point to place items on. The narrow end of the travois was attached to dogs and/or horses and the wide end was dragged along the ground to move the heavy load. A travois is an example of a lever - a simple machine.



### Bio-Links

Similar to a marble run, many animals create paths in the forms of tunnels or burrows. For example, Richardson's Collared Lemmings, a small animal found in Wapusk National Park in Northern Manitoba, make runways through the plants in order to avoid predators. They continue this in winter when they dig burrows in the ground above the permafrost (a thick layer of frozen soil), and also burrow under the snow in order to protect themselves.





## CHALLENGE

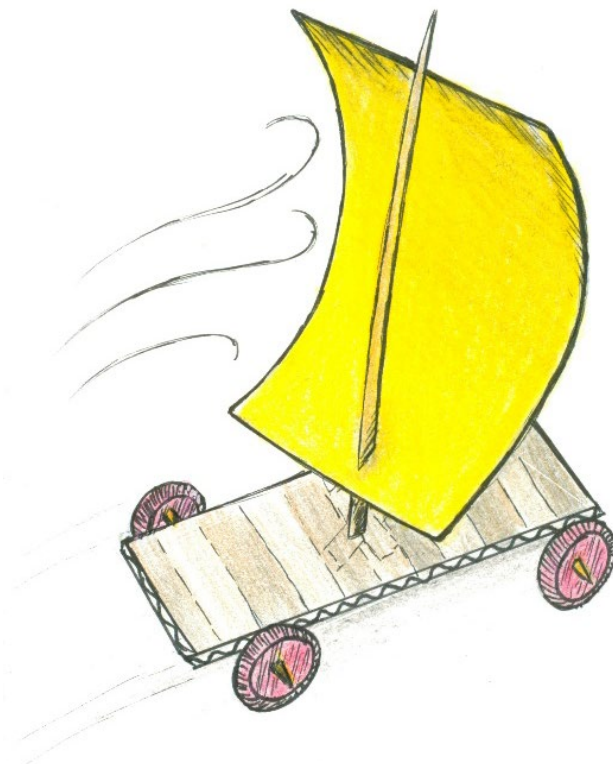
Create a car that can travel using wind power.

### Materials

- Variety of natural and recyclable materials: twigs, boards, paper, cardboard rolls, etc.
- Circular objects to use as wheels (Option: create wheels out of cardboard)
- Optional: create a car using Lego
- Optional: fan or blow-dryer

### Method

- Design a car that has parts that can capture wind energy (such as sails).
- Build the car out of collected materials.
- Test the car to see if it can travel using only wind power. Use your own breath to blow on it or use a blow-dryer or fan.
- Measure the distance that the car traveled.
- Redesign the car so that it can travel the greatest distance possible with the same amount of wind energy. Record results.



### Indigi-Tech



York boats are very large vessels once used to transport furs up to Hudson Bay during the fur trade. They were used instead of smaller birch bark canoes because they could carry more furs and were tougher as they were made entirely from solid and heavy wood. York boats could be fitted with a large sail to take advantage of wind energy to propel the boat, especially on large lakes such as Lake Winnipeg. This made the journey both faster and easier for the 8 rowers of the boat.

### Bio-Links



Have you ever noticed that birds often fly together in a "V" shape? They do this in order to save energy. When one bird is a little bit in front of another, the bird in back has less wind blowing on it so it's easier to fly. For example, Snow Geese, after spending the winter in the south of the United States, travel in very large flocks to Wapusk National Park in northern Manitoba. While flying, the large groups stay together in "V" formations and take turns being the bird in front so they can fly for a long time before needing to rest.

### How it Works

Wind energy (or wind power) refers to the process of creating mechanical energy or electricity using the wind, or air flows that occur naturally in the earth's atmosphere. Wind energy is one of the most commonly used types of renewable energy today, and also happens to be one of the fastest-growing sources of electricity. Wind is a clean, renewable energy source, and is very cost-effective.

## CHALLENGE

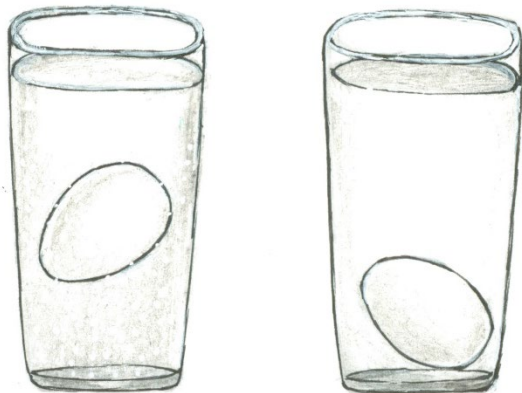
Create solutions that can float, sink, and suspend an egg.

### Materials

- 3 eggs (or reuse 1 egg)
- 3 tall, clear glasses or containers about 500mL in size
- Salt

### Method

- First glass: fill with water only. Place the egg into the water and observe what happens.
- Second glass: fill the glass  $\frac{3}{4}$  full with warm water. Slowly add 1 tsp of salt, stir until it is dissolved. Continue to add and dissolve salt 1 tsp at a time until the egg can suspend in the water (remove the egg after each trial).
- Third glass: fill the glass  $\frac{3}{4}$  full with warm water. Slowly add 1 tsp of salt, stir until it is dissolved. Continue to add and dissolve salt 1 tsp at a time until the egg can float in the water (remove the egg after each trial).



### How it Works

Density describes how much space an object or substance takes up (its volume) in relation to its mass. If an object is heavy and compact, it has a high density. If an object is light and takes up a lot of space, it has a low density. Saltwater has a higher density than water. This is because the water is holding the salt particles within it. An egg will float in dense saltwater but sink in pure water.

### Indigi-Tech



Indigenous peoples have used nets for traditional fishing for thousands of years. To make a net, long plant fibers are woven and tied together. If you place the net in the water as is, it will not catch fish as it will simply ball up and float away. How do you get the net to sit up and down in the water to catch fish? On the top of the net, you need to tie a material less dense than water, such as wood, to make it float. On the bottom of the net, you need to tie a material more dense than water, such as rocks, to both sink and hold the net in place.

### Bio-Links



A layer of fat on polar bears' bodies not only keeps them warm, it also helps them float! To help them swim faster, polar bears' front paws are webbed like ducks and beavers. They can swim for hours and they use their front paws to paddle like dogs. Floating sea ice can also be used by polar bears when hunting. However, with climate change, more sea ice is melting and bears have to swim longer distances, making it harder for polar bears to find their next meal.



# Grade 6

**Adaptation Alterations**

**Catch a Spark**

**Chase that Chopper**

**Seeing Stars**



## CHALLENGE

Create a novel animal with new adaptations.

### Materials

- Pencil crayons & paper
- Modelling clay
- Buttons
- Sticks
- Construction paper
- Fabric
- Various materials

### Method

- Describe the animal including its:
  - name, habitat (i.e., environment, climate), type (e.g. bird/reptile...etc.), movement (e.g. fly, walk...etc.), diet, predators?
- Describe its adaptations (at least 6)
  - What adaptations help the animal GATHER or EAT food?
  - What adaptations help the animal BREATHE?
  - What adaptations help the animal DEFEND itself?
- Sketch the animal.
- Build the animal using the materials provided.



### Indigi-Tech



One method of learning for Indigenous peoples is to observe the behaviours and physical attributes of animals. Each animal has its own unique adaptations to help it survive in its habitat. These careful observations have led to many innovations and inventions by Indigenous people over time.

Have you ever seen the feet of a hare (a type of big rabbit) or lynx? The feet of these animals are very large, which allows them to travel very fast on the top of freshly fallen snow without sinking into it. These observations led to the development of the snowshoe that distributes weight over a large area and stops the shoe from sinking into deep or soft snow.

### Bio-Links



Polar bears live in the north where it is very cold, such as in Manitoba's Wapusk National Park. They have many adaptations that help them survive. To stay warm they have two layers of fur, black skin to absorb the sun's rays, and a thick layer of body fat. Polar bears even have fur between their toes and on their foot pads to help keep them warm. They also have shorter limbs, small rounded ears and a short tail to save the most heat possible by having less areas to lose heat from. Finally the papillae, soft bumps on their paws, help them grip the ice and avoid slipping.

### How it Works

Animals have evolved to be best suited to their current natural environments. Evolution is driven by natural selection when animals, whose random adaptations are best suited to their environments, survive. These adaptations can be physical (part or appearance of an animal's body) or behavioral (something the animal does).

## CHALLENGE

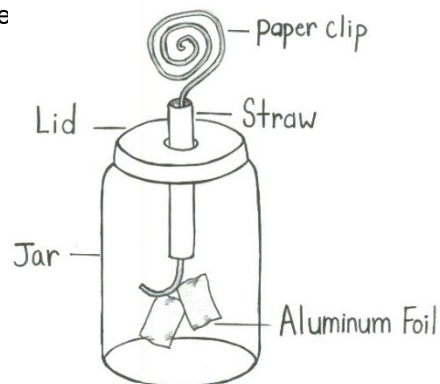
Build an electroscope (a device to detect electrical charge).

### Materials

- Clear glass jar with lid
- Electrical tape, paper clip, straw
- Scissors, gloves
- Aluminum foil or gold leaf
- Rubber soled shoe, carpet, balloon or any other material you want to test!

### Method

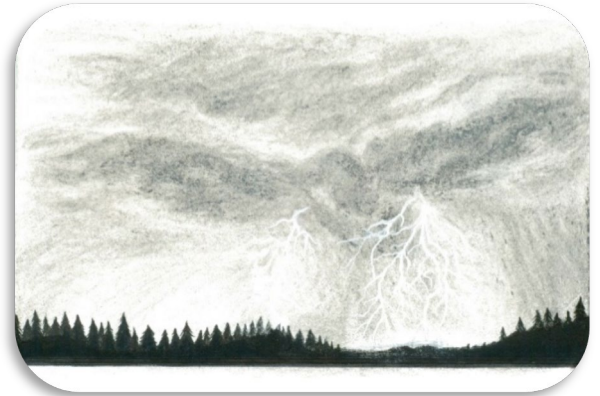
- Uncoil a paper clip and feed it through a straw cut in half.
- Hook one end of the paper clip and re-coil the other end.
- Punch or cut a hole through the jar lids (teacher should do this) so a straw can feed through it.
- Tape the straw to the lid using electrical tape.
- On the hooked end of the paper clip, use gloves to fold a piece of aluminum foil over so the foil flaps are flat, smooth and touching (or as close as you can get).
- Close the lid to the jar allowing the hooked end to suspend inside.
- Generate some electric potential energy (static) by rubbing two materials together – rubber and carpet, balloon and carpet...etc.
- Bring the charged item near paper clip coil but not touching. Observe the behaviour of the foil.




### How it Works

When a charged object is brought near the electroscope, the charged particles in the object affect the particles in the foil. The negative particles in the object and in the foil **repel** (move in opposite directions). Since the negative particles are all in the bottom of the foil pieces now, the foil separates to push them even further away, repelling each other too!

The stronger the charge of the object, the stronger the force of repulsion. The foil will separate more and more!




### Indigi-Tech



Anishinaabe people believe Thunderbirds (*Animikii* in Anishinaabemowin) are powerful animals that live in storm clouds and make thunder by beating their wings and cause lightning by opening their eyes. Thunderbird nests, built from large, round rocks, can be found in many areas across the Canadian Shield. Anishinaabe believe that Thunderbirds bring important messages from the Creator to the people.

### Bio-Links



Did you know that lightning starts with static electricity? The static charge builds up as water and ice droplets in clouds bump and rub up against each other. When the charge gets big enough, the charged particles will travel in a lightning bolt either to another cloud or to the ground. Lightning strikes are the main cause of forest fires in Manitoba. Communities and people in them have to be careful of these fires, but they are also important for healthy forests: fires can release nutrients, allow new growth, and create new habitats for wildlife.

## CHALLENGE

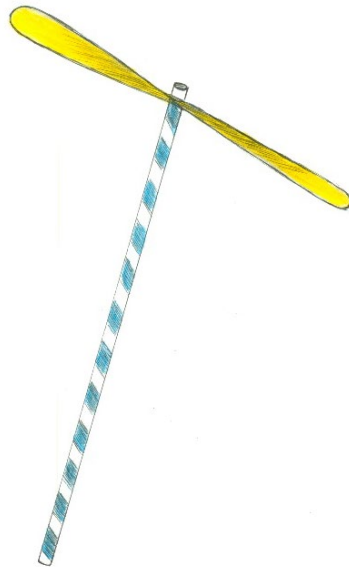
Build a hand-powered helicopter.

### Materials

- Cardboard / empty cracker or cereal box
- Bendy straws
- Scissors
- Ruler
- Hole punch

### Method

- Start with a strip of cardboard about 2 inches wide and 9 inches long.
- Fold in half to find the middle.
- Punch a hole in the center.
- Fit the straw through the hole until it catches the ridges of the bendy straw.
- Launch the helicopter by spinning the straw in between both palms.
- Experiment with wing size and shape to find the best flight based on height and time.
- Pro Tip! Each side of the blade should be an opposite mirror image.
- Record the measurements of the final prototype.



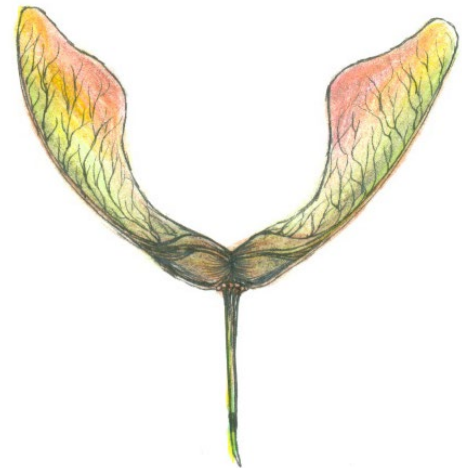
### How it Works

As air flows over wings or blades as found on a helicopter, it can slow down or speed up based on the shape of the blades. As the rotors on a helicopter spin the blades with force, the shape of the blade pushes air down. Newton's third law states that for every action there exists an equal and opposite reaction. Therefore, as the air pushes down, the blades push up with the same force to cause the helicopter to lift.

### Indigi-Tech



The bow and arrow are a traditional hunting tool used by Indigenous people. Have you ever noticed that arrows always have feathers attached to one end of the shaft? The feathers create a small amount of drag which causes the arrow to spin, similar to how a rifle bullet spins when fired. This spinning action gives the arrow stability and helps it fly straighter.



### Bio-Links



The seeds of maple trees act like helicopters due to their asymmetrical shape. These seeds fall more slowly than most other seeds because of a spiral of air that develops on top of each falling seed's wing. That vortex of air acts like a miniature tornado that sucks the seed up and causes it to spin. By falling more slowly and staying in the air as long as possible, the seeds are able to travel far. This allows the seeds to find a good place to grow into a new tree.

## CHALLENGE

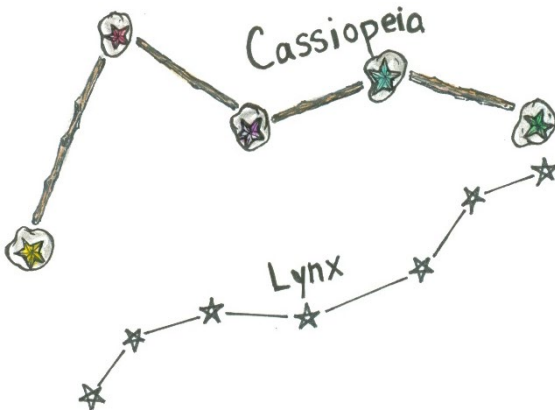
Create a winter star chart.

### Materials

- Various household or outdoor materials to represent stars: buttons, clay, rocks
- Items to create lines between stars: string, thread, sticks

### Method

- Observe a detailed image of the Winter Sky.
- Start the map with a specific star like Polaris (also known as the North Star or the Going Home Star).
- Branch out from Polaris to complete Ursa Minor (the Little Dipper).
- Use Polaris to properly position Ursa Major (the Big Dipper).
- With the reference map, complete 4-5 other constellations including Cassiopeia and Lynx.



### How it Works

Stars are giant balls of gas burning at extremely high temperatures. They have life cycles which can last millions of years as they burn. The energy in a star is created through a process called “nuclear fusion”. Because stars are so big, they have a lot of gravity which pushes particles together. This fusing of the particles releases energy in the form of light and heat. As these particles fuse, they get more dense. Our closest star is the sun. The stars of the night sky are mapped out on star charts. Astronomers will often use star charts to reference the positions of other celestial bodies including new stars, galaxies, nebulae, planets, and comets.



### Indigi-Tech

Indigenous people have a deep understanding of the night sky. The constellations are used to help tell time, direction, and to predict weather changes. Each constellation has its own name and accompanying stories. For example, the Big Dipper is *Ojiig* (Fisher) in Ojibwe, or *Mista Mukwa* (Big Bear) in Cree. The Pleiades is *Bugonagizhig* (Hole in the Sky) in Ojibwe, or *Pakone Kisik* (Hole in the Sky) in Cree. Can you find a star map with Indigenous constellations?



### Bio-Links

Many birds use the stars to find their way around, especially when they are migrating between their southern winter homes and their northern summer homes. White-throated sparrows are a common forest bird that migrates at night. They take off around sunset and use the position of the stars in the sky to help keep themselves on track.

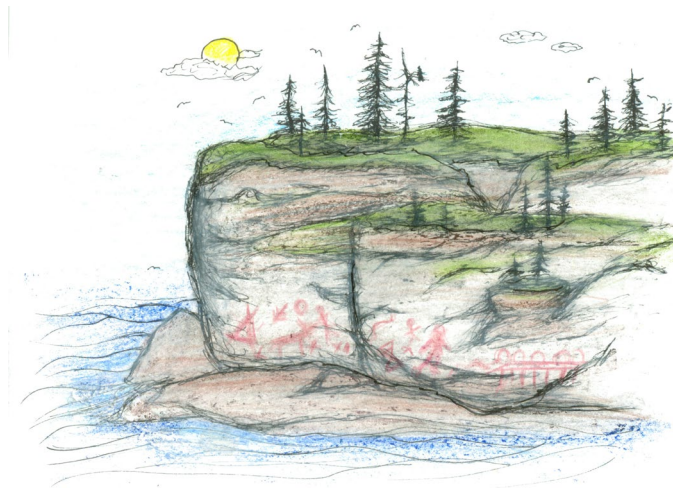
# Grade 7

**Below the Surface**

**Colourful Chromatography**

**Not-So-Simple-Machines**

**The Sacred Circle**





## CHALLENGE

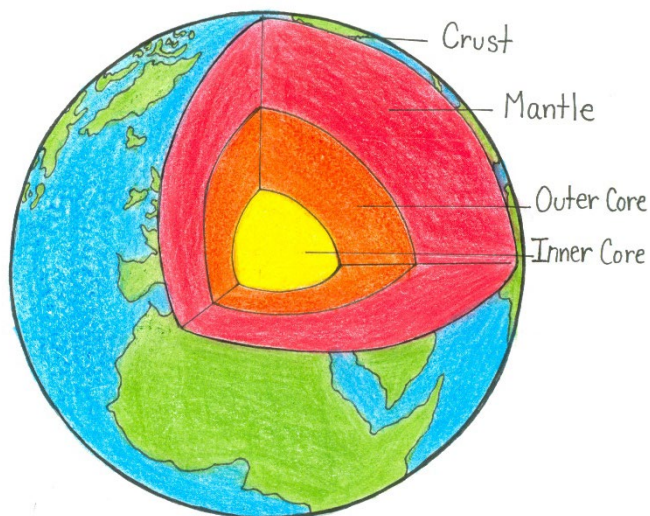
Create a model of Earth's crust.

### Materials

- Variety of Lego, clay, Play-Doh, natural or recyclable materials

### Method

- Observe the diagram which depicts Earth's layers.
- Observe the relative size of each layer – some are quite large while others are very small.
- Review the materials you have collected, and how they will be used in your model.
- Create the model which includes the following layers: crust, mantle, outer core and inner core.
- For an added challenge research and create a model which includes the following layers: crust, lithosphere, asthenosphere, mesosphere, outer core, and inner core. The size of each layer should be reflected in the model.
- Label each layer.



### Indigi-Tech

On Vancouver Island in BC, the Nuu-chah-nulth Indigenous people tell a very old story about a group of mountain dwarves who were playing a drum and invited a person to join in and dance with them. The person got *earthquake foot* after kicking the drum accidentally, and with each dance step they took, it caused an earthquake. The land shook and the ocean receded. It came back as a tsunami, destroying everything in its path.

This story coincides with an enormous earthquake that occurred on January 28<sup>th</sup>, 1700 in California. Oral storytelling is a way to record and transmit history to the next generation.

### Bio-Links

On the very surface of the earth's crust is the soil, which is where most plants and other living things are able to live. In most of northern Manitoba, the soils are very thin and, in many places, the bedrock is visible with no soil at all on it. The soils in this area are also often acidic and there aren't a lot of nutrients. The plants, fungi and lichens of northern Manitoba are adapted to need very low amounts of nutrients in order to survive in these tough circumstances.

### How it Works

The layers of Earth provide geologists and geophysicists clues to how Earth formed, the layers that make up other planetary bodies, the source of Earth's resources, and much more. Modern advances have allowed scientists to study what lies beneath our feet in more detail than ever before and yet there still remain significant gaps in our understanding. This is an ongoing study and information is likely to become more refined in the coming years and decades.

## CHALLENGE

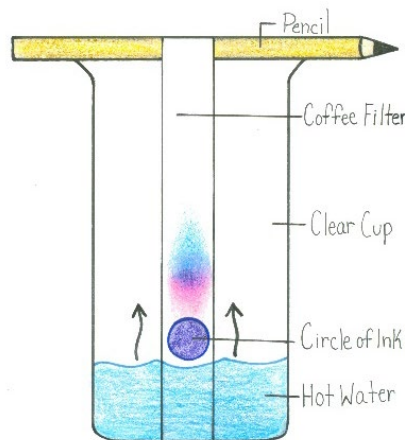
Discover what colours and particles are found in markers.

### Materials

- Clear cup or container
- Coffee filter
- Water
- Pencil or similar sized stick
- Tape
- Scissors
- Variety of markers

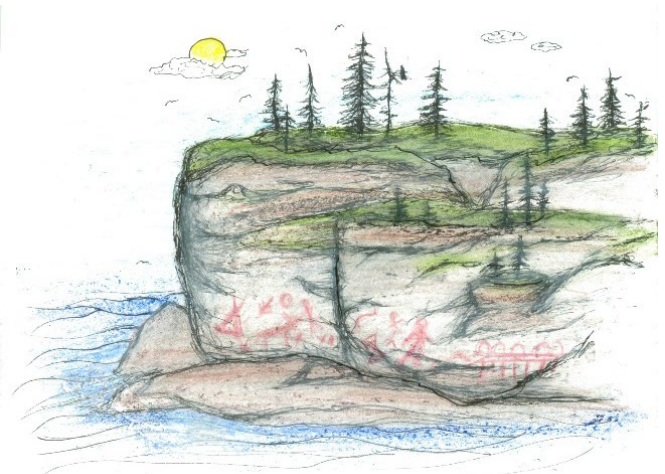
### Method

- Cut coffee filter into a long strip about an inch wide. You will need one strip per marker colour.
- Tape the strip onto a pencil or stick.
- Draw a circle about the size of a nickel with one of the markers about halfway up the strip.
- Hang the strip in the glass of warm water so that the coffee filter touches the water, but the circle is above the water.
- Watch the colour spread as the water travels up the paper.



### How it Works

Chromatography is a way of separating out a mixture of chemicals, which are in gas or liquid form, by letting them creep slowly past another substance, which is typically a liquid or solid. The liquid ink dissolves in water which enables it to creep over the surface of the solid filter paper. Chromatography is actually one of the most useful analytical techniques chemists have at their disposal, helpful in everything from identifying biological materials to finding clues at crime scenes.



### Indigi-Tech

Traditionally, Indigenous people recorded their stories by painting on rock faces. Paint ingredients found in nature made the very long-lasting pigments (paint colours) used to paint the rocks. Pigments were usually made from a combination of red ochre (a red rock ground into fine powder), a fat and/or an oil.

Each painting has a story to accompany it, but many have been forgotten. These paintings are now known as pictographs. Manitoba has some of the best pictographs located in an area called Pimachiowin Aki on the east side of Lake Winnipeg.

### Bio-Links

Northern lights can be seen in the sky in the north. These are caused by collisions between gas particles in the Earth's atmosphere with charged particles that travel from the sun's atmosphere. Different types of gas particles will cause different colours in the northern lights. The most common yellow-green colour is produced by oxygen molecules. Other colours can be red, blue, and purple.

## CHALLENGE

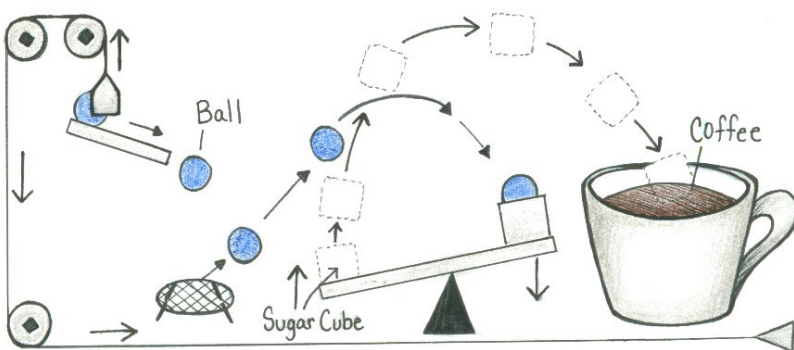
Use simple machines to create a Rube Goldberg machine. A Rube Goldberg machine is any complex contraption that uses a chain reaction to perform a simple task.

### Materials

- Variety of natural and recyclable materials: anything you can imagine! String, clay or Play-Doh, tape, glue, craft supplies, sticks, toilet paper rolls, magnets, dominoes, toys, and more.

### Method

- Identify the simple task you want to achieve: turn off a light, open a door, or pop a balloon. Be creative!
- Brainstorm a series of actions that will complete your task. Make a pin pop a balloon. Send a toy car down a ramp. Make dominoes fall.
- Draw a blueprint plan for what you expect to happen. The most important action will be the first step – that's what starts the entire machine.
- Follow your blueprint and place your materials where you think they need to be. There will be plenty of trial and error – and that's OK. Adjust your materials and keep at it.



### Indigi-Tech

The Metis people invented the Red River cart using readily available materials such as timber and leather. These carts are a combination of two simple machines: the wheel and axle, and a lever. Simple machines make work easier.

Red River carts made travelling across the prairies with bulky, heavy materials, such as household materials or hunted animals like buffalo, easier. Do you think you could carry a buffalo to Winnipeg?

### Bio-Links

A type of chain reaction in nature is a trophic cascade. Imagine a food chain where the small fish get eaten by bigger fish, which get eaten by seals, which get eaten by polar bears. If something causes there to be fewer polar bears, then there will be more seals (because fewer will get eaten by polar bears), which means there will be fewer bigger fish (because more will get eaten by seals), which means there will be more smaller fish (because fewer will be eaten by bigger fish). This is called a top-down trophic cascade, which means that changing one animal at the top of the food chain affects all the other animals in that food chain.

### How it Works

Rube Goldberg was a scientist and cartoonist who produced satirical work on people's overly complex problem-solving methods. In his comical cartoons, he linked together chain reactions with simple machines to complete basic tasks, like turning on a lamp or frying an egg. Designing and building a Rube Goldberg machine requires innovation and patience. While every machine is different, many builders include versions of other people's ideas, tweaking them or linking them in exciting ways.

## CHALLENGE

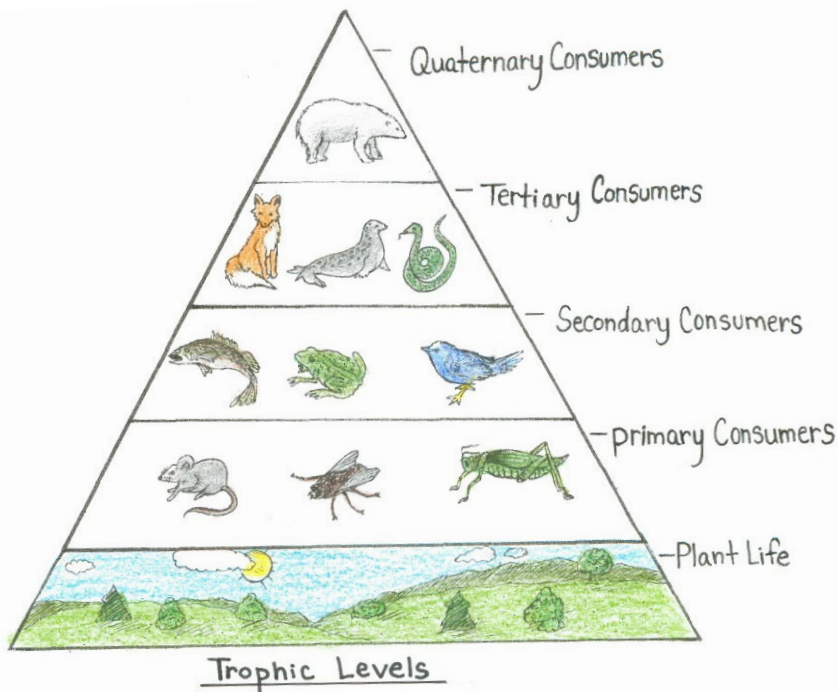
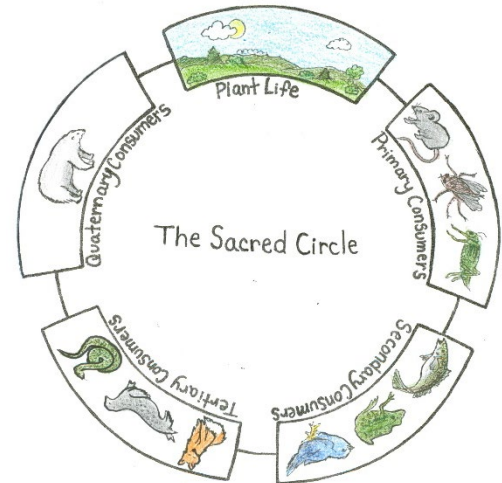
Create a natural trophic level poster.

### Materials

- Collected natural materials
- Old magazines
- Paper, cardboard, opened cereal box, etc. to use as poster background

### Method

- Review the 5 trophic levels.
- Select and/or create several items or pictures that represent each trophic level. Be creative!
- Create a poster to represent the different trophic levels.



### How it Works

The trophic level of an organism is the number of steps it is from the start of the food chain. A food web starts at trophic level 1 with primary producers such as plants, can move to herbivores at level 2, carnivores at level 3 or higher, and typically finish with apex predators at level 4 or 5.

### Indigi-Tech

Rather than seeing life in a linear manner, Indigenous peoples see life in a circular or cyclical repeating pattern. The Sacred Circle represents that everything on Earth is connected. It also represents that there is a continuous process of growth, renewal, and energy transfer in nature.

Hoop dancing, an intricate dance using small circles similar to hoola-hoops, is a way to tell the story of interconnectedness by creating different shapes with the hoops while dancing.

### Bio-Links

Polar Bears are an example of apex predators at the top of the Arctic food chain! In Manitoba's Wapusk National Park, our polar bears' favorite meals are ringed seals, which are their main food source. If seals aren't available, polar bears are left to hunt other marine animals like whales or walrus, or even birds or other animals, which can be harder to find. Polar bears aren't prey for other animals, but young bears are sometimes killed by older males.

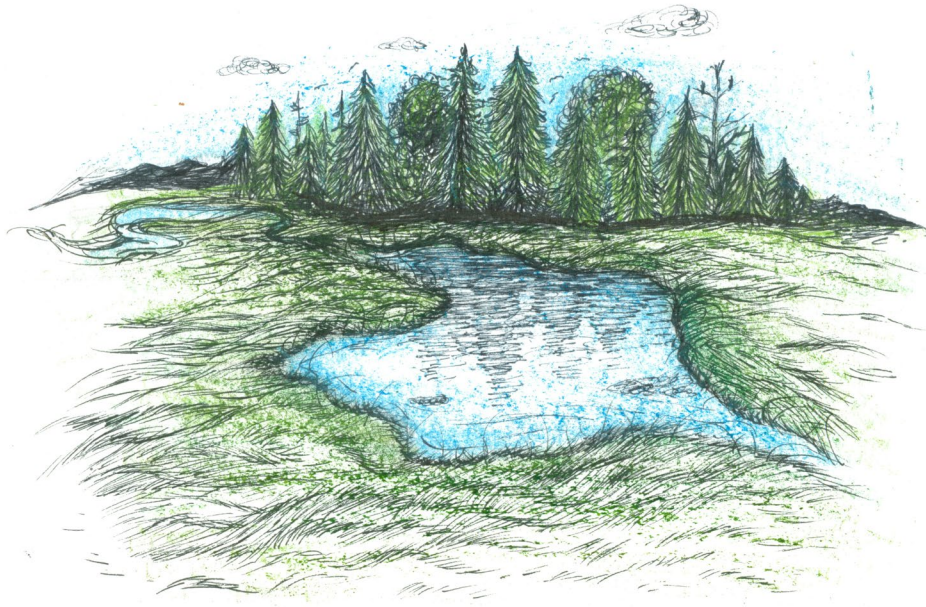
# Grade 8

**Bottle Lung**

**Selfie Time**

**Shoe Shopping**

**Water is Life**



## CHALLENGE

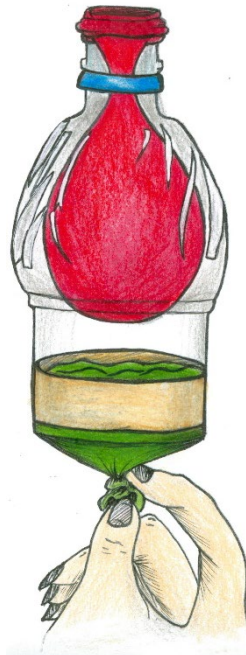
Create a bottle lung.

### Materials

- Plastic bottle
- Straw
- Tape
- Scissors
- 2 balloons

### Method

- Carefully cut the bottle to about half the size.
- Tie a knot in one end of one balloon and cut off the fat end.
- Stretch the balloon around the bottom of your plastic bottle and tape.
- Invert the other balloon in the neck of the bottle and seal around the cap opening.
- Hold the bottle and pull the knot of the balloon at the bottom.
- Observe!
- Alter your bottle lung to simulate different health situations (i.e. cough, asthma, lung puncture, chest cavity puncture...etc.).



### How it Works

As the knotted balloon is pulled it creates more space inside the bottle. Air then comes down the straw and fills the balloon! When you let go of the knot the space no longer exists, so the air from the balloon is expelled making it deflate. The lungs work the same way. The muscle under our lungs, called the *diaphragm*, pulls our lungs down to create more space. Air is *pushed* into our lungs to fill the space. As the diaphragm relaxes, it creates less space in the lungs which pushes the air out.

### Indigi-Tech

One biological concept is homeostasis, or balance within the body. When cells and systems work together and receive everything they need (like oxygen and food), your body is healthy.

One model used and applied by Indigenous people to maintain balance and health is the Medicine Wheel, which has many lessons, or teachings. The Medicine Wheel is divided into four quadrants: East, South, West, and North. Each direction includes the four elements needed for life: Earth - to harvest food from; Fire - to provide heat and light; Water - essential for our bodies and all other life; and Air - a life-giving force we cannot see. The Medicine Wheel reminds us to find balance in all aspects of our life for health and wellness.



### Bio-Links

Do you know how long beavers can hold their breath? Their lungs are large compared to the size of their bodies, and they have a big liver that can store oxidized blood. Their circulation is also fairly slow, meaning they use up their oxygen more slowly than other animals. All these adaptations allow beavers to dive under water for up to 15 minutes at a time!

## CHALLENGE

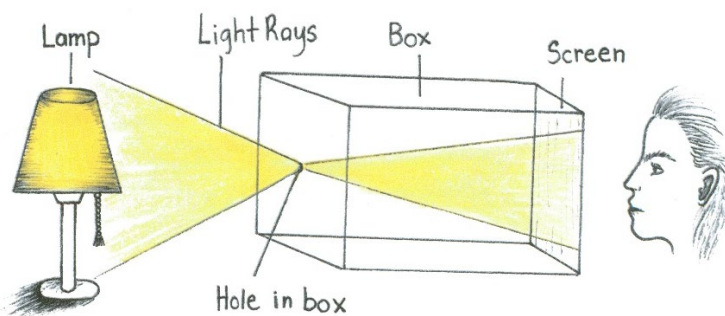
Build a pinhole camera.

### Materials

- Shoebox
- Scissors (or X-Acto knife with the help of an adult)
- Wax paper, ruler and tape
- Blanket

### Method

- Use the point of a sharp pencil to punch a hole in one of the shorter ends of the shoe box.
- Use scissors or have an adult use the X-Acto knife to cut a square in the opposite end of the box, directly across from the hole. The square should measure 2 inches on each side.
- Use scissors to cut a square of wax paper that measures 3 inches on each side.
- Place the wax paper directly over the square you cut in the box. Tape the edges of the wax paper to the box.
- Take the camera box to a dimly lit room and turn on a lamp. Stand about 5 feet from the lamp.
- Cover your head and pinhole camera with a blanket! Be sure that the end with the wax paper is facing you and the end with the pinhole is facing the lamp.
- Hold your pinhole camera at arm's length from your face and aim it at the lamp. Keep it steady until you see an upside-down image of the lamp.




### How it Works

In a real camera, the lens is like a tiny hole you made in the box and creates a backward, upside-down image. Like the little hole, the lens lets in light (which travels in a straight line). The wax paper is like film in a real camera, which has special chemicals on it. When the light hits the film, the chemicals start changing and turn the image into a photograph.

[kids.nationalgeographic.com/explore/books/pinhole-camera](http://kids.nationalgeographic.com/explore/books/pinhole-camera)


## Indigi-Tech



The Inuit invented snow goggles (*iggaak* in Inuktitut) to help prevent snow blindness. Snow blindness occurs when extra light from the sun is reflected off of white snow, enters the eye, and damages the retina (inner lining) of the eye. Because snow goggles have a narrow slit carved into a piece of bone or driftwood to cover the eyes, the amount of light entering the eye is reduced. You can still see everything around you because enough light can enter through the slit for you to see. The wider the slit, the more peripheral view you will have.



## Bio-Links



Researchers in Wapusk National Park in northern Manitoba use remote cameras to learn about its animals. Cameras are attached to fences and trees and take pictures of animals like polar, grizzly and black bears, caribou, foxes, moose, and wolverines. By using cameras, there is less disturbance to the animals and researchers can cover large areas within the Park. These pictures can show the size of the animals, which can indicate their health. Photos can also indicate their path, which lets us know their migration and denning patterns and how climate change may be affecting their routines.

## CHALLENGE

Create a pair of functional snowshoes.

### Materials

- Cardboard / Plastic
- Rope / Twine
- Scissors
- Duct Tape
- Glue

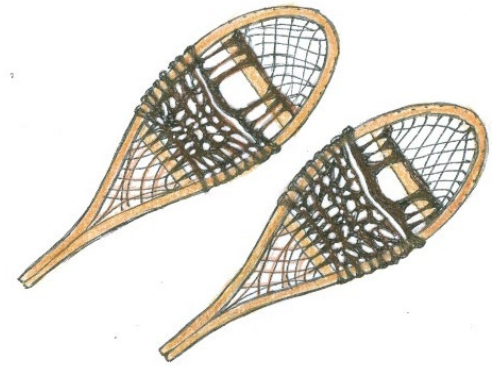
### Method

- Trace your foot on a large piece of cardboard or plastic.
- Draw an outline of a larger foot or oval around the trace.
- Cut out this large oval or trace. If the cardboard or plastic is flimsy, be sure to create 2-3 layers of the same cut-out.
- Glue the layers together (if applicable) and seal the edges with duct tape.
- Punch 4 holes in a square shape where the foot will sit.
- Feed the twine/rope over the boot and around the heel tightly.
- Test them out!



### How it Works

Snowshoes work by using a large surface area to redistribute your weight on the bottom of a boot or shoe. That extra surface area helps maximize a measurement known as pounds per square inch, or PSI (a common measurement for the pressure of a fluid). In this case, it is the amount of pressure that your body puts on the snow. In a shoe or boot, there is a lot of body weight distributed over a few inches (high PSI). However, on a snowshoe, the body weight is spread out over many more inches (lower PSI). We use the same measurement for pressure of fluids that we use for pressure against a surface.



### Indigi-Tech

One method of learning for Indigenous peoples is to observe the behaviours and physical attributes of animals. These careful observations have led to many innovations and inventions by Indigenous people over time. Have you ever seen the feet of a hare (a type of big rabbit) or lynx? Both of these animals' feet are very large, which allows them to travel very fast on the top of freshly fallen snow without falling into it.

This observation led to the development of the snowshoe that distributes weight over a large area and prevents sinking into deep or soft snow. Traditional snowshoes are made from bent ash wood and rawhide that is intricately woven into star-shaped patterns.

### Bio-Links

An animal that definitely needs to stay on top of snow is the caribou. Their feet are large to help them stay on top of the snow (and also on top of soggy tundra in the spring and summer). They walk on two toes which can also spread apart to help make a bigger surface to spread their weight on. An extra bonus of their hoof shape is that it is concave (spoon-shaped) underneath. This works as a scoop to dig in the snow when they need to find food.



## CHALLENGE

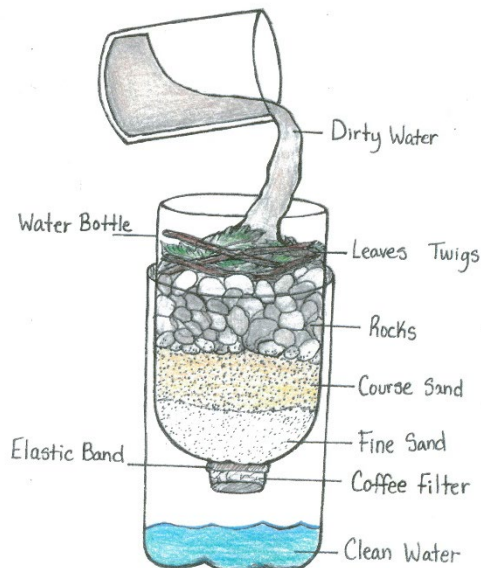
Create a water filter.

### Materials

- 3 plastic bottles
- 3 clear cups
- Scissors
- Various household items: fabrics, papers, anything *porous*
- Various outdoor items: sticks, mosses, leaves

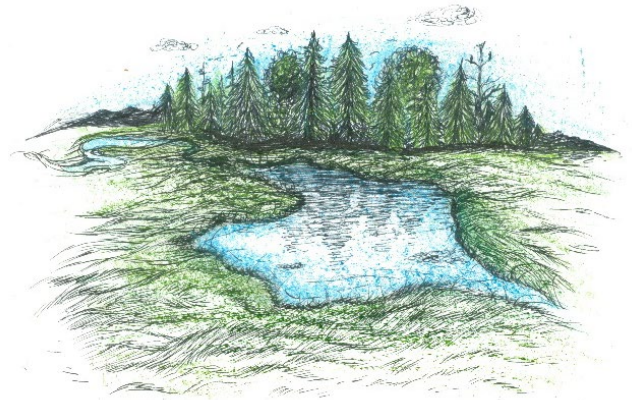
### Method

- Cut the bases off each plastic bottle.
- Choose a combination of materials to act as a filter for each bottle.
- Layer the combination of materials in your bottles.
- Obtain a large bucket of dirty water. If you cannot find dirty water, then add soil and sand to a bucket of water.
- Place a cup under each bottle.
- Pour dirty water through the water filter so it drains into the cup.
- Observe the results (i.e. clarity of the water)
- Repeat for the other two bottles and observe.



### How it Works

Water carries a lot of living and non-living debris as it moves through our rivers and lakes. In order to safely drink water, it must undergo a filtration process. Water particles are much smaller than the debris it carries. So, most water separates out from the larger particles as it moves through a fine mesh or filter. This helps to purify the water.



### Indigi-Tech

Marshes and wetlands act as an important environmental filtering system. The roots of marsh plants, such as cat tails, trap sediments and pollution as water passes through on its way to larger bodies of water, like lakes. If you look at water before and after it enters a marsh, you will notice that the water is clearer afterwards, just like in your experiment.

Indigenous peoples have always understood the important nature of marshes and not just for providing food such as ducks, plants, and fish. Protecting marshes and other waterways is seen as a sacred responsibility, especially for women who are called *water keepers*.

### Bio-Links

In the far north, such as in much of Wapusk National Park in Manitoba, most of the soil is frozen year-round, except for the very surface layer. Permafrost keeps water on the surface instead of letting it filter into the soil. This means that lakes and ponds have a "fill and spill" when snow melts or it rains. The water runs along the surface of the land into each new body of water before it eventually reaches the ocean.

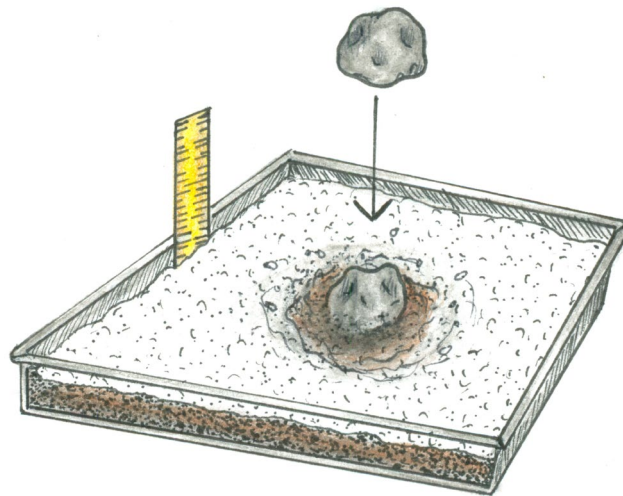
# Grade 9

Extreme Organisms

Feeling Electric

I'm Not Dense!

Pleased to Meet-eor You!



## CHALLENGE

Create an alien extremophile based on given reproductive traits.

### Materials

- Dice or coin
- Drawing materials OR a variety of natural and recyclable materials

### Method

- Roll the dice or flip a coin and follow the Traits guide to find out the genetic traits that your extremophile has.
- Draw or create your alien extremophile to match the traits given.
- Create several alien extremophiles to compare the similarities and differences in the species.



Traits	Dice: Even Numbers Coin: Heads	Dice: Odd Numbers Coin: Tails
Trait 1: Head	1 head	2 heads
Trait 2: Hair	Short & spiky	Long & curly
Trait 3: Body Segments	3 body segments	2 body segments
Trait 4: Tail	Long with polka dots	Short with stripes
Trait 5: Legs	2 legs per body segment	3 legs per body segment
Trait 6: Colours	Monochromatic: use shades of only one colour	Go colour crazy! Whatever you like!

## Indigi-Tech



The Anishinaabe or Ojibwe people have an intricate clan or family system. Originally, there were seven clans: loon, crane, fish, bird, bear, marten, and deer. Today, those original clans have divided into many more. In Ojibwe culture, your clan is inherited patrilineally from your father. In some other Indigenous cultures, clan is inherited matrilineally, or from your mother. People are not allowed to marry someone from the same clan. Why do you think that is?

## Bio-Links



Genes can be linked to each other in some strange ways. In northern Manitoba, a common bird is the White-throated Sparrow. These little birds have two different colours on their heads: some have a tan stripe, and some have a white stripe. These differences, called “morphs”, aren’t just in color. White-striped birds are more aggressive: they sing more and chase away intruders more often. Tan-striped birds are more nurturing: they bring more food to their babies than the white-stripes. Scientists have found that several genes are all linked together, which means that the genes that decide what colour the bird will be are linked with how they behave.

## How it Works

Genes play an important role in determining physical traits. Each parent has two copies of each gene, and each parent passes along just one copy to make up the genes of the offspring. Genes that are passed on determine many traits, such as hair colour, long or short legs, and even how someone laughs. Each cell in the human body contains about 25,000 to 35,000 genes.

## CHALLENGE

Create three phenomena using static electricity.

### Materials

- Comb and balloon
- 1 tsp each of salt and pepper
- ¼ cup each of corn starch and vegetable oil

### Method

#### Activity 1

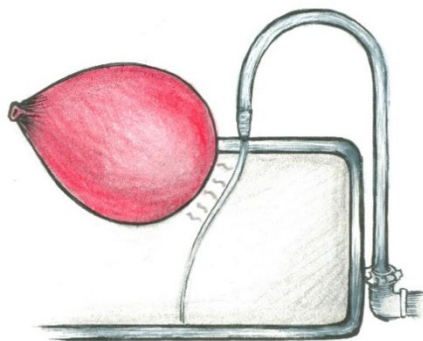
- Use the comb to brush your hair, thus creating static electricity. Run a small flow of water from a tap. Hold the comb close to the running water to see if you can bend the water.

#### Activity 2

- Combine the salt and pepper in a small dish. Use the comb to brush your hair, thus creating static electricity. Hold the comb close to the salt and pepper to see if you can separate them.

#### Activity 3

- Mix the cornstarch and vegetable oil to create a goeey blob. Use the comb to brush your hair. Hold the comb close to the goeey blob to see if it will be attracted to the comb. Repeat using a balloon.



### How it Works

All physical objects are made up of atoms with protons, electrons and neutrons. Therefore, all objects are made up of charges. Opposite charges attract each other and like charges repel. Static electricity is the result of an imbalance between negative and positive charges in an object. These charges can build up on the surface of an object until they find a way to be released or discharged.

### Indigi-Tech



Thunderbirds (*Animikii* in Anishinaabemowin) are very powerful animals that make thunder from the beating of their wings and lightning when opening their eyes. Their nests, made from round rocks, can be found in many areas across the Canadian Shield. The Anishinaabe believe that Thunderbirds bring important messages from the Creator to the people. There are many stories about Thunderbirds. This winter ask an Elder to share a story!



### Bio-Links



Static electricity is found all over. Flowers have a negative static electricity charge on their surface. Bumblebees can sense the electrical charge on the flower and it helps the bee find the pollen when they land. Also, when they fly around bumblebees build up a positive static charge. When the bee lands, its positive charge partly cancels out the flower's negative charge for a few minutes. If a new bumblebee comes along, it won't be as likely to visit the flower with a lower static charge because it knows that there won't be as much food (pollen) on that flower.

## CHALLENGE

Create a density tube!

### Materials

- Clear, tall glass or vase that can hold 800ml of water
- 200ml measuring cup
- 20 tsp sugar
- 4 Teaspoons
- 4 smaller microwave-safe cups that can hold 200ml of water each
- Food colouring

### Method

- Fill the smaller cups with 200ml of hot tap water. Colour each one a different colour.
- Follow the chart for amount of sugar in each cup.
- Use a separate spoon to stir each cup and stir until the sugar is COMPLETELY dissolved. **It's crucial that all of the sugar be dissolved in each cup.** If the sugar will no longer dissolve, heat the water for 20 seconds in the microwave and continue to stir. Repeat until all sugar is dissolved. Be careful with the heated cup and water and be sure to have a parent working with you.
- Begin to layer the coloured water into the larger glass in this order: blue, red, green and yellow. Do not rush! Pour very slowly, use a pipette or turkey baster if possible.
- You may need to repeat these steps a few times before it works. Keep trying!

Coloured Water	Tsps of Sugar
Yellow	2
Green	4
Red	6
Blue	8



### Indigi-Tech



Indigenous peoples have been using nets for traditional fishing for thousands of years. Long plant fibers are woven and tied together to make the net. If you place the net in the water as is, it will not catch fish as it will simply ball up and float away. How do you get the net to sit up and down in the water to catch fish? On the top of the net, you need to tie a material less dense than water, such as wood, to make it float. On the bottom of the net, you need to tie a material more dense than water, such as rocks, to both sink and hold the net in place.

### Bio-Links



Fat is less dense than water and is one of the ways that animals can float when swimming. Many marine mammals have a layer of fat under their skin called blubber. This special type of fat not only helps with buoyancy while swimming, it also helps many northern animals stay warm in cold Arctic waters. Polar bears particularly love to eat blubber from seals and other animals that they hunt. A successful polar bear can build up enough fat that it makes up half of their total body mass! This body fat has another important role: it is energy storage for times of year when animals can't find a lot of food. In these harder months, animals metabolize their stored-up fat to keep from starving.

### How it Works

Density is the measurement of how much "stuff" is packed into a measured space. Nearly every substance and material imaginable has a different density. By increasing the amount of sugar but keeping the amount of water constant, you created solutions that have increasing densities. The cup containing 8 tablespoons of sugar will be the most dense, and the cup with 2 tablespoons will be least dense. A solution with a lower density stacks on top of a mixture with a higher density.

## CHALLENGE

Observe the effects of meteor size and velocity upon a surface.

### Materials

- 3 rocks: a large pebble, a rock about the size of a toonie, and a rock about the size of a child's fist
- Tray such as a cake pan
- Sand or loose soil: enough to fill most of the tray
- Flour: enough to create a thin layer on top of the sand
- Ruler or alternative measuring device

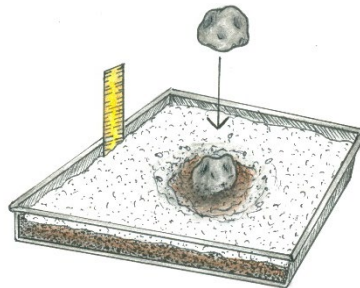
### Method

Pour the sand or soil into the tray so that it is mostly filled. Create a smaller layer of flour on top of the sand/soil. Re-create these flat layers after each meteor is dropped.

**Activity 1:** Observe the effects of meteor size. Drop each rock from the same height. Measure the widest diameter of the impact crater. Record and compare results.

**Activity 2:** Observe the effect of velocity on impact size. Choose one rock for this activity. Drop the rock from a measured height and record the widest diameter of the impact crater. Repeat from increasingly greater heights. Record and compare results.


Option: repeat this process for each rock size.



### How it Works


When a large object impacts the surface of the Earth, the rock at the site of impact is deformed. Some of it is ejected into the atmosphere to eventually fall back to the surface. This results in a bowl-shaped depression with a raised rim. The size of the impact crater depends on such factors as the size and velocity of the impacting object and the angle at which it strikes the surface of the Earth. The velocities at which small meteorites have impacted Earth range from 4 to 40 km/sec. Objects with sizes greater than 1 km are considered to produce effects that would be catastrophic.

### Indigi-Tech



In the 1800s, a meteorite landed in an area called Iron Creek, Alberta. The Cree people in the area named the stone Papamihaw Asiniy or *Flying Rock*. The stone, and the area where it landed, is considered sacred and was meant to be shared by all people. In 1866 the stone was stolen by a missionary. The stone now rests in The Royal Albert Museum. The rock, now called Manitou Stone, needs to be repatriated (returned) to the Indigenous people that it originally belonged to. The museum will be stewarding (caring for) Manitou Stone until a new facility can be built to hold the stone. The removal and theft of sacred items from Indigenous peoples is a result of colonialism. What is your stance on museums holding onto these items for education and preservation vs. repatriation to the original Indigenous stewards?

### Bio-Links



Did you know that you actually weigh less in parts of northern Manitoba than in other places on Earth? Just as the Earth's gravity pulls meteorites down to the surface, it pulls on you. But gravity isn't exactly the same everywhere on Earth! Around Hudson Bay, there is actually less gravity. This is because the weight of huge glaciers tens of thousands of years ago pushed the land down in this area, and this, combined with shifts below the earth's crust, means that the land has less mass in this area. The area is slowly "rebounding" each year, but for now you would weigh just a tiny bit less in this area than the rest of Canada.

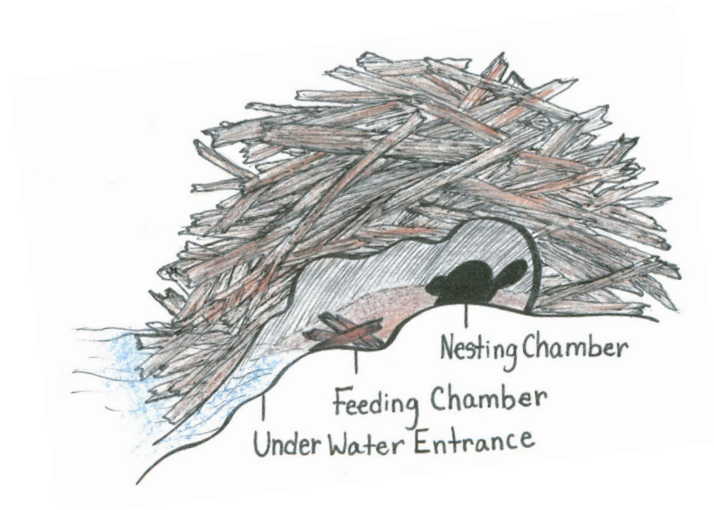
# Grade 10

Catching Wind

Dam! This is Awesome!

Ouch! It's Raining!

Wagon Wheels – My Fave



## CHALLENGE

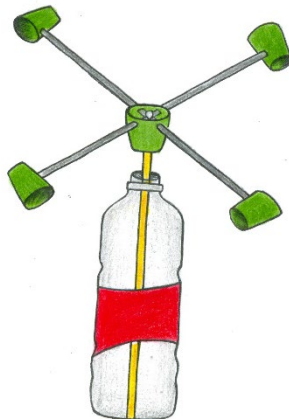
Build an anemometer.

### Materials

- 5 small objects that capture air: small paper cups, kinder surprise capsules.
- Hole punch, scissors, duct tape
- 3 wooden skewers
- Empty water bottle
- Stopwatch / timer

### Method


- Use the hole punch to make a hole in the side of each of the 4 paper cups (or small object).
- Use the hole punch to make 4 holes spaced evenly around the rim of the last cup. This will be the center of the anemometer.
- Slide 2 of the wooden dowels through the holes in the center cup. They should cross in an "X".
- Insert the ends of the dowels into the holes of the other cups and tape them into place. Make sure the cups are all facing the same direction.
- Take the last wooden dowel and make a hole in the bottom of the center cup.
- Push the dowel up until it meets the X and tape everything together. This will be your rotation axis.
- Put the center dowel into an empty water bottle and begin testing!



### How it Works

An **anemometer** is a device that is used to measure wind speed. There are many different types of anemometers suited for different environments, situations, and measurements. A **cup anemometer** is a basic type of measuring device. It uses cup-like shapes to catch the wind, causing the device to spin. How many times it spins in a given time interval can tell you how fast the wind is moving. Newer, more accurate anemometers can make use of lasers and ultrasonic measuring technology.


### Indigi-Tech



Observing the wind on water and resulting waves is one traditional Indigenous method of determining if it is safe to travel. When winds blow strong, and over a long period of time, it is generally not safe for travel as the resulting waves are too high for most traditional boats. Whitecaps begin to form at 11 - 17 km/h winds, and larger, more dangerous waves form at 28 km/h. Once whitecaps begin to form, it is safer to delay water travel in smaller boats such as canoes. Larger vessels, such as York boats, needed to be cautious in waves over 3 feet/1 meter.



### Bio-Links



Imagine living your whole life out in the wind with no buildings for shelter. Wind is a serious concern for animals that live out in the open in cold places like Wapusk National Park. Arctic foxes live on the open tundra without a lot of shrubs or trees for shelter and need to find ways to stay warm. They dig dens into the snow or underground to stay out of the cold wind. These foxes also have the warmest fur of any mammal. If they get caught out in a cold wind, they will curl up into a ball with their thick tail wrapped around and their head and paws tucked inside. This ball is the warmest position because it leaves the least surface area exposed.





## CHALLENGE

Build a beaver dam.

### Materials


- Any objects naturally found outdoors: sticks, shrubs, mosses, grass, plant stalks, lichens, seaweed, driftwood, ground clay.
- Various household items: craft sticks, pipe cleaners, glue, papers, napkins.
- Modelling clay or Play-Doh
- Large tub or tote
- Water

### Method

- Build a dam wall across the width of the tub/tote that is impervious to water (does not let water cross).
- Test the dam. Be certain no or minimal water can cross the dam wall.
- Use your materials to build a large mound on one side of the dam on which the beaver can sit.
- Build a lodge that covers the mound.
- Dig an entrance/tunnel to the mound from the base.
- Fill with water up to the mound height.




### Indigi-Tech



Beavers are an important traditional source of food and fur for Indigenous peoples. Beavers are typically harvested in the winter. This is when beaver have lots of fat on their bodies to provide essential nutrients and calories, and because their fur is very thick and warm. To trap and hunt these animals, trappers need to understand both how a beaver lodge is constructed and investigate a beaver's behaviour. Trappers watch for breathing holes made in the ice by the beaver, or they cut a hole in the top of the lodge and wait for the beaver to exit in order to make the catch.

### Bio-Links



Beavers are considered a keystone species. This means that having beavers around changes the whole ecosystem: removing them can affect all the other living things around them. This is because beaver dams create whole new habitats in a very short amount of time. They can turn a forest or grassland into a pond or wetland. This makes habitats for fish, insects, amphibians, and other water-loving plants and animals. Flooded trees can die but stay standing, which makes habitats for insects, woodpeckers, and other birds.

### How it Works

Beavers start construction by diverting the stream to lessen the water's flow and pressure. Branches and logs are then driven into the mud of the stream bed to form a base. Sticks, bark from deciduous trees, rocks, mud, grass, leaves, plants, and anything else available are used to build the superstructure. Beavers vary the type of dam built according to the speed, or flow rate, of the water. In slow-moving water, they build a straight dam. In fast-moving water dams tend to be curved.

## CHALLENGE

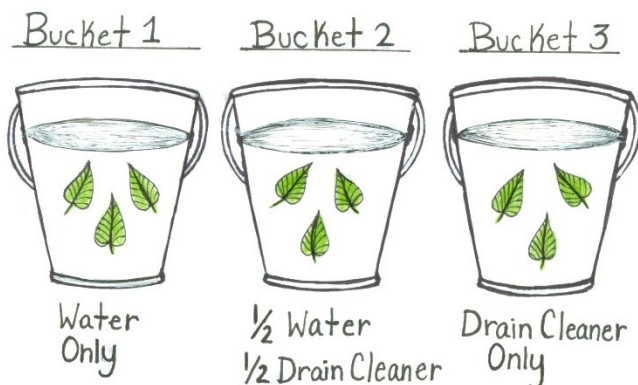
Simulate acid rain on vegetation.

### Materials

- Water
- Drain cleaner (handled by an adult)
- Various types of vegetation: grasses, leaves, shrubs, fruits
- Disposable stir sticks
- 9 buckets

### Method


- Obtain 3 groups of each vegetation.
- Add each group of vegetation to three buckets: 3 buckets of leaves, 3 buckets of sticks, 3 buckets of shrubs.
- Label the buckets: Leaf 1, Leaf 2, Leaf 3, Stick 1, Stick 2, Stick 3.
- To each bucket 1, add a given volume of water.
- To each bucket 2, add half the given volume of water and half the given volume of drain cleaner (adults only).
- To each bucket 3, add the given volume of drain cleaner (adults only).
- Let sit for 24 hours.
- Record the results in a table.



### How it Works

Common air pollutants and industrial aerosols include sulfur. If a large amount of pollutants contain sulfur (i.e. industrial pollution from smoke stacks), it will react with the air to produce sulfuric and nitric acid,  $H_2SO_4$  and  $HNO_3$ , respectively. This acid-heavy precipitation is known as "acid rain" which is extremely harmful to the environment.


### Indigi-Tech



Water (*nibi* in Ojibwe, *nipiy* in Cree) is considered sacred to Indigenous peoples. It is seen as the giver of life and because of this there is an obligation to steward and protect water. Women, in particular, hold this obligation and are called *water keepers*. In recent years, Indigenous activists have protested, calling for improved government action to help preserve and protect waterways, especially from pollution. These movements include the Lake Winnipeg Water Walk and the Standing Rock protests.



### Bio-Links



Some kinds of soils and water bodies are more at-risk from acid rain than others. This is because some soils and lakes contain calcium or limestone, which can neutralize some the acid and make it less of a problem. This is called buffering. Most of northern Manitoba is part of the Canadian Shield, and our soils and waters aren't able to buffer very well against acid rain. This means we need to be extra careful not to allow too much acid rain to fall in these areas.

## CHALLENGE

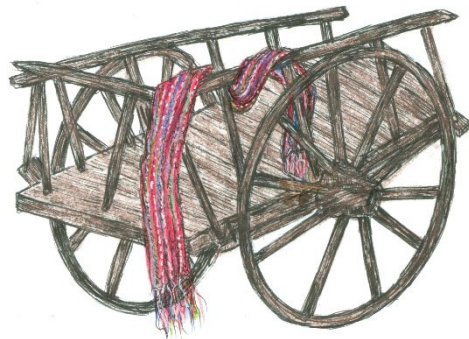
Build a wagon.

### Materials

- Cardboard
- Scissors
- Masking tape
- Glue
- Wooden skewers
- Straws

### Method

- Cut cardboard rectangles to create the box form of the wagon.
- Tape the wagon pieces together so they lie flat with masking tape.
- Bring the sides up and tape lightly from the outside. Glue the inside edges together with craft glue. Let dry.
- Insert wooden skewers through the straws.
- Adjust the wooden skewers/straws to the width of the wagon (with extra on each end).
- Punch each end of the skewers into 2" cardboard circles.
- Tape the straws to the bottom of the wagon.
- Build a pulling system for the wagon.
- Test the motion of the wagon with no objects.
- Test the weight capacity of the wagon with no pull.
- Test the motion with weight capacity.



### Indigi-Tech



The Metis people invented the Red River Cart using readily available materials such as timber and leather. Similar to wagons, Red River Carts only had two wheels rather than four. They were built this way in part because the wheels were the most difficult to build. Red River Carts were typically pulled by two oxen. These carts are a combination of two simple machines: the wheel and axle, and a lever. Red River carts made travelling across the prairies with bulky, heavy materials, such as household goods or hunted animals like buffalo, easier. They were also designed to come apart easily to replace broken parts using common local materials.

### Bio-Links



Flying birds are adapted to move through the air in ways that reduce friction, allowing them to fly without using up too much energy. Their bodies are streamlined to reduce air resistance. Their wings are also adapted to allow them to flap without pushing too hard against the air as they move the wing up. Basically, the shape of the feathers allows air to slip through the wing as the bird flaps up so it doesn't have to force its wings against the air as it raises them. But when the bird flaps down, the feathers push down against the air, allowing the bird to lift up into the sky.

### How it Works

Wagons are four-wheeled vehicles used to transport objects, materials, supplies and people. The bed of the wagon is usually flat and distributes the weight of the objects inside. The wheels significantly reduce the amount of friction required to pull the objects over a surface.

# Grade 11

Condense This!

Let's Reflect On This

Let's Solve-nt The Problem

Model Behaviour

On A Roll

You're Kidney-ing Me



## CHALLENGE

Create condensation in your kitchen.

### Materials

- 2 empty tin cans
- Crushed ice
- Salt
- Room-temperature water

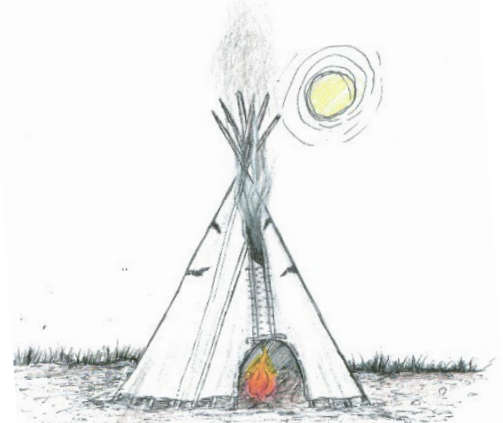
### Method

- Fill one can with room temperature water.
- Fill the other can with crushed ice.
- You may want to liberally sprinkle salt on the crushed ice to create an even lower temperature in the second can.
- Observe the cans every few minutes.
- Observe the development of condensation droplets in each can. Record/draw observations.



### How it Works

Condensation is the process where water vapor becomes liquid. It is the reverse of evaporation, where liquid water becomes vapor. Condensation happens one of two ways: either the air is cooled to its dew point or it becomes so saturated with water vapor that it cannot hold any more water. Dew point is the temperature at which condensation happens. (Dew is simply condensed water in the atmosphere). Air temperatures can reach or fall below the dew point naturally, as they often do at night.



### Indigi-Tech

Tipis, a traditional Indigenous shelter shaped like an inverted cone, were made with long poles for a frame and hides sewn together for the walls. As with all thin walled structures, condensation is a problem. This can eventually cause mold and mildew, ruining the tipi. Tipis have two design features that help prevent condensation. First, at the top of the tipi, there is a smoke hole. This allows smoke from the central fire to escape, and also acts as a *draw*, allowing moist air to be vented upwards through the tipi causing a slight drying effect. Second, the tipi is lined on the inside with a shorter second hide wall. This helps prevent the buildup of condensation by providing a small pocket of cooler air between the inside of the tipi and the outer wall.

### Bio-Links

When water in the air comes in contact with a frozen surface, the water vapor sometimes changes directly to a solid: ice! This is called deposition and it is usually what happens when we see frost on the ground, on leaves, or on windows. Light frosts and cool temperatures in the fall can trigger plants to start processes so they can survive the winter. This includes dropping leaves and storing nutrients in their roots.

## CHALLENGE

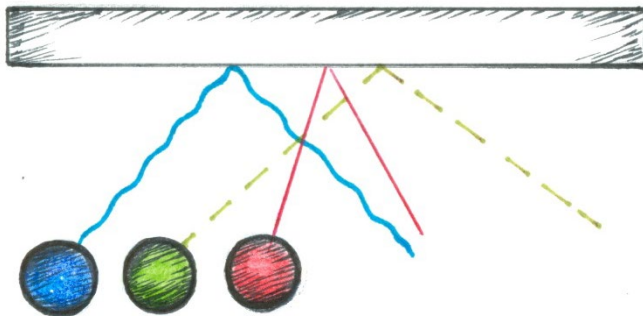
Replicate the motion of the particle model of light reflection.

### Materials

- Marked area of wall or small block of wood
- Small bouncy ball or marble
- Paper and pencil

### Method


- Choose an area of a wall or small block of wood to bounce the ball off of.
- Draw a similar set-up on paper.
- Roll the ball to the area on the wall on an angle. Record on paper the angle of the the roll, and the angle of the rebound.
- Repeat using a variety of at least 10 different angles. Record the path of the ball for each trial on the same paper.
- Observe the results of the path of the ball.



### How it Works


In physics, light is a type of electromagnetic radiation that is visible to the eye. Light has the unique property that it can be described in physics as both a wave and as a stream of particles called photons. One of the most important wave-like behaviors of light is reflection. It is reflected light that we see with our eyes. When light is reflected it obeys the law of reflection that is followed by waves. This means that the angle of the reflected wave of light will equal the angle of incidence of the incoming light wave.

### Indigi-Tech



When travelling in canoes or kayaks, traditional Indigenous boats, it is generally safest to travel close to the shore. One exception is when you are travelling near flat cliff faces, and not just because of the potential for falling rocks! When wind blows over water, the kinetic energy of the wind is transferred to the water, changing to the mechanical energy that causes waves. When the waves hit a hard, flat surface, like the cliff face, the waves are reflected, just like the ball in the activity. When two waves join one another, their heights are added together. This is called *wave interference*. The resulting rough water can easily tip a canoe or kayak. The potential for wave interference is the reason why traditional water routes avoid areas such as this during windy travel.

### Bio-Links



Light reflection is an important part of how heat cycles work in northern Canada. How much light a surface reflects is called *albedo*. A light-coloured surface has a high albedo because it reflects most light that hits it, while a dark surface absorbs most light that hits it. When a surface absorbs light, the energy becomes converted to heat. Therefore, when snow and ice reflect most of the light, this helps keep items cold in the wintertime. If climate change results in less snow and ice in the winter, then the lower albedo (more heat absorbed instead of reflected) might mean that the earth heats up even faster, affecting plants and animals that rely on long cold winters to survive.

## CHALLENGE

Explore the connection between solubility and solvent temperatures.

### Materials

- 5 microwave-safe coffee mugs
- Salt or sugar
- Teaspoon
- Microwave and oven mitts
- Optional: thermometer

### Method

- Fill the first mug  $\frac{3}{4}$  full with room temperature water.
- Stir  $\frac{1}{2}$  teaspoon of sugar or salt into the room temperature water. Stir until completely dissolved.
- Continue to add  $\frac{1}{2}$  teaspoon at a time until the sugar will not dissolve. Record results.
- Repeat with 4 additional water temperatures: refrigerated water, room temperature water heated in the microwave for 60 seconds, 90 seconds, and 120 seconds. Be sure to use all safety precautions when heating water in the microwave.
- Record all results. Create a graph which shows the connection between temperature and solubility.



### How it Works

As the temperature of a solution is increased, the average kinetic energy of the molecules that make up the solution also increases. This increase in kinetic energy allows the solvent molecules to more effectively break apart the solute molecules that are held together by intermolecular attractions.

The average kinetic energy of the solute molecules also increased with temperature, and it destabilizes the solid state. The increased vibration (kinetic energy) of the solute molecules causes them to be less able to hold together, and thus they dissolve more readily.

### Indigi-Tech



Extracting medicines from plants is a traditional Indigenous activity. To obtain the medicinal compounds from some plants, you must make either an infusion or decoction. To make an infusion, you let the plant parts sit in extremely hot water for a given time. This method is called steeping and is usually used for medicines from leaves. To make a decoction, different plant parts like roots or bark are placed in boiling water for a given time to extract the medicine. Both infusions and decoctions are examples of solutions. You would not be able to extract the medicinal compounds without the use of hot or boiling water. However, you should **NOT** try to make medicines on your own as some can be very harmful. Instead, ask an Elder or traditional Knowledge Keeper to teach you.

### Bio-Links



Natural water bodies have different amounts of salt dissolved in them. The place where a river meets an ocean is called an estuary and is where the freshwaters mix with salt waters. When the Churchill River water (fresh) meets the water from Hudson Bay (salt), the lighter fresh water rises up and over the denser salt water. Sea water flows into the estuary beneath the outflowing river water, pushing its way upstream along the bottom. This estuary mix, called brackish water, is very productive and provides essential habitat to many kinds of wildlife.

## CHALLENGE

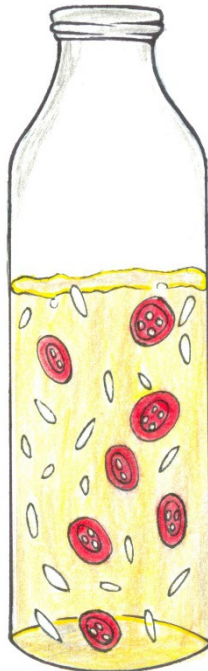
Create a model of human blood.

### Materials

- Clear plastic water or pop bottle
- 300 ml corn syrup or vegetable oil
- ½ cup of small red items: skittles, M&Ms, buttons, craft items, pony beads, or any items you can find.
- ¼ cup of slightly larger white items: pebbles, white dried beans, craft items, etc.
- ¼ cup of dried white rice, or white sprinkles

### Method

- Pour the corn syrup/vegetable oil into the plastic bottle, which represents plasma.
- Add in the red items which represent red blood cells.
- Add in the white items which represent white blood cells.
- Add in the dried rice which represents platelets.
- Observe the ratios of the elements, as well as the movement of the blood components in the plasma.



### How it Works

Blood is a specialized body fluid. It has four main components: plasma, red blood cells, white blood cells, and platelets. The liquid component of blood is called plasma: a mixture of water, sugar, fat, protein, and salts. Plasma helps transport blood cells throughout the body. Red blood cells are the most abundant cell in the blood, and they help carry oxygen from the lungs to the rest of the body. White blood cells protect the body from infection. Platelets help the blood clotting process (or coagulation) by gathering at the site of an injury.

## Indigi-Tech



Indigenous peoples have been making traditional medicines from plants to treat a variety of ailments for milenia. One such plant, willow (*nipisiy* in Cree), has naturally occurring acetylsalicylic acid (also known as aspirin) that can be extracted to relieve pain. However, this tea is never given to people who are bleeding as aspirin interferes with platelets and prevents clotting. Note: **DO NOT** attempt to make traditional medicines without the guidance of an Elder or Knowledge Keeper as many plants can be toxic.



## Bio-Links



Like other deer, caribou in Manitoba's Wapusk National Park grow a new set of antlers every year. Caribou are the only deer where both the males and females grow antlers: the males grow them earlier for fall mating season, and the females keep theirs all winter. Antlers are made of bone which starts growing in the spring and summer, and are covered at first with a soft tissue called velvet. Velvet is full of blood vessels which carry the nutrients needed to grow the antlers. Once the antlers are grown, they calcify (harden) and the bone dies, and the velvet falls off.



## CHALLENGE

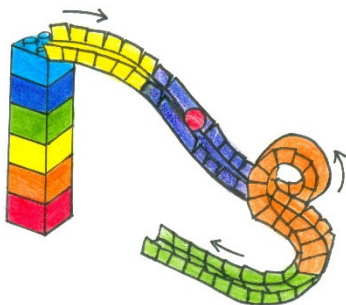
Create a roller coaster that can demonstrate acceleration and force.

### Materials

- Any materials that can create a semi-enclosed slope and loop-de-loop: connected paper towel or toilet paper rolls, cardboard, newspaper, cut plastic bottles, old pool noodles, etc.
- Tape
- Marble

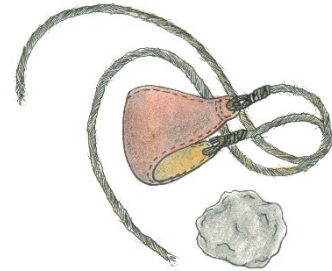
### Method

- Create about 4-5 meters of roller coaster ramp length. The roller coaster ramp needs to be semi-enclosed, or a semi-circle, so that the marble does not fall out.
- Secure one end of the ramp at a 10 degree angle.
- Release the marble and record the distance the marble travels. Time how long it takes the marble to reach the end of the ramp.
- Repeat while increasing the angle of the ramp 10 degrees at a time.
- Record all results for both distance and time. Graph results.
- Bend the ramp so that it creates a loop-de-loop towards the end. Test to find out what angle degree will create the most acceleration so that the marble completes the full loop-de-loop.



### How it Works

A roller coaster loop-de-loop is a sort of centrifuge. In a loop-de-loop, the intensity of the acceleration force is determined by two factors: the speed of the roller coaster car and the angle of the turn. As the car enters the loop, it has a maximum kinetic energy. It is moving at top speed. At the top of the loop, gravity has slowed the car down somewhat, so it has more potential energy and less kinetic energy. It is moving at reduced speed. In order to build an acceleration force strong enough to push the car into the track at the top of the loop, it must still have a fairly high rate of speed.



### Indigi-Tech

One hunting tool used by Indigenous peoples on Turtle Island (mostly in the southern areas) is the sling, or slingshot. Two pieces of cord (made from plant fiber or leather) were attached to a central pouch made of leather. A round stone projectile was placed into the pouch. One end of the cord was held or tied onto the wrist. The other end was looped around a *trigger finger* on the same hand. The stone was quickly whirled around in a circle. The trigger finger let go of the cord, launching the stone out at greater speeds and accuracy than could be done by throwing it by hand alone. The sling acts as a centrifuge, spinning the stone in a circle just like a roller coaster loop-de-loop. The increased speeds were achieved because the sling increases the length of the arm (lever). The stones, when released, have a LOT of kinetic energy!

### Bio-Links

Just like humans, ravens take advantage of the forces of acceleration for entertainment. Ravens have been seen flying upside down and doing barrel rolls and somersaults. They will also play with sticks in the air by dropping them and then diving to catch them. To adjust their flight, ravens not only use their wings, but also move and spread their tails to control turning and speed.

## CHALLENGE

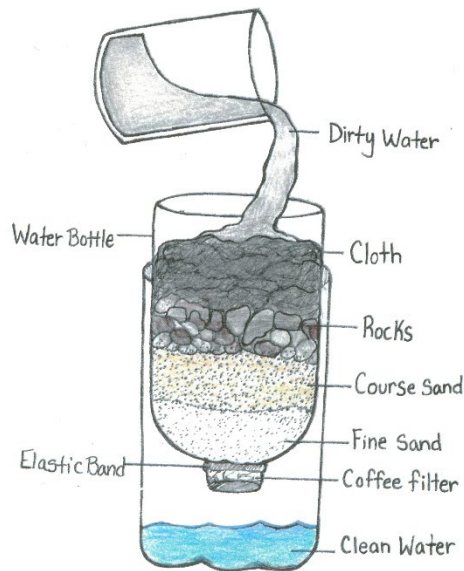
To create a filter system that works like a kidney.

### Materials

- Funnel (or top half of a plastic bottle)
- Mix of sand, soil, and pebbles
- Variety of cloth materials

### Method

- Mix the sand, soil and pebbles together. Add water to the mixture.
- Layer the cloth in the funnel or top half of the pop bottle.
- Run the water/sand/soil/pebbles mixture through the cloth and through the funnel.
- Observe what comes out of the funnel: is it clear? Is it the same amount of water that was poured?
- Repeat using different cloths, more or less layers of cloths, and with varying ratios of the mixture.
- Record all results.



### How it Works

The kidneys belong to the excretory system. This is an important body system because it helps to remove any harmful substances from the body. The kidneys actually work as a filtering system for blood. They take blood in from the bloodstream, remove waste products (such as salt, minerals and any toxins, or bad stuff) and combine them with water. Then the body gets rid of this water and waste combination, known as urine. The kidney in a healthy adult can process as much as 45 liters of water a day, releasing only 1-2 liters in the form of urine.

### Indigi-Tech

Marshes and wetlands act as an important environmental filtering system, much like your kidneys do for your body. Marsh plants like cattails use their roots to trap sediments and pollution as water passes through on its way to larger bodies of water, such as lakes. If you look at water before and after it enters a marsh, you will notice that the water is clearer afterwards, just like in your experiment. Indigenous peoples have always understood the important nature of marshes, and not just for providing food for animals such as ducks, geese, and fish. Protecting marshes and other waterways is seen as a sacred responsibility, especially for women, who are called *water keepers*.

### Bio-Links

Most humans need extra filtration of our water to make it safe and clean to drink. We also add chemicals like chlorine to help remove diseases and bacteria from our drinking water. So why can animals drink water from lakes or rivers if most people can't? The answer is a mix: many animals develop resistance to the pathogens that can make them sick by building up their immune systems as they get exposed. One way that animals can avoid getting sick is from resistance passed along from their mothers. If an animal gets exposed to an illness and fights it off, she can often pass along an immune system boost to her babies. But many animals also have parasites and diseases that they have to live with, many of which they can get from unfiltered water.

# Grade 12

Dynamic Duo

Getting Cheeky

Ice Lattice

Slip and Slide

Something's Fishy

Spilling Tea



## CHALLENGE

Build a matchstick crossbow.

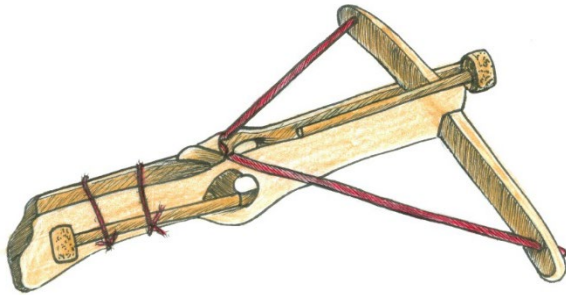
### Materials

- Lollipop sticks, matchsticks and/or twigs (various sizes)
- Ruler, scissors, pencil and string
- Basic metal hair clips
- Glue gun or Gorilla Glue (adult assistance if applicable)

### Method

Visit [SonicDad.com](http://SonicDad.com) for complete instructions, or create your own design.

[Free Sonic Builders Club Library](http://FreeSonicBuildersClubLibrary.com) | [SonicDad.com](http://SonicDad.com)



### How it Works

As the string is pulled back and stretched, it creates a “tension force”. This force, an example of stored potential energy, is released as the string is triggered and pushed forward to its resting state. The tension force is transmitted to the matchstick which is propelled in the same direction of the force. The matchstick obeys the rules of projectile motion with horizontal and vertical components at various angles. Velocity, position, height, range and time of flight are all components of the projectile motion of the matchstick.

## Indigi-Tech



Bows and arrows are a traditional Indigenous tool used in hunting. Bows need to be constructed from a material that could bend, but not break, when pulled. The materials used depended on what was available in the local environment. There are three main types of bows, based on how they are constructed: a *self-bow* which is constructed from one piece of wood, *backed-bows*, which are made from wood that has sinew glued to the back for reinforcement, and *composite-bows*, which are made from several layers of wood, antler or horn, and sinew glued together to take advantage of the physical properties each material had to offer. This makes for a very strong, flexible bow that could shoot arrows farther than the other two types. This means a hunter doesn't have to get as close to the animal being hunted, lessening the chance of spooking the animal and improving the chances for dinner! Very few people know how to make traditional bows today, but there are some master bow makers who continue to create these beautiful bows.

## Bio-Links



Ever wonder why a spider's web can catch a large insect, instead of getting a hole ripped in it? Part of the reason is the very strong spider silk, but part of the reason is how the web is made. The radial threads, which go out from the center of the web, capture most of the kinetic energy from the flying insect, allowing for a flex so that the insect doesn't rip a hole. The spiral threads also change in how much tension they have from the center to the edge of the web. This means that the web can equally absorb the energy from an insect that flies into it, no matter where on the web the insect hits.

## CHALLENGE

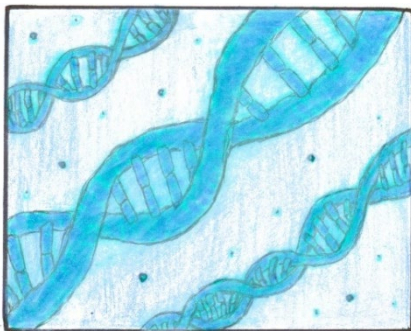
Extract your DNA!

### Materials


- ½ L of water
- Ice-cold rubbing alcohol
- Dishwashing liquid
- Salt
- Clear plastic cups
- Pineapple juice
- Glass rod or wooden skewer

### Method

- Pour the water into a plastic cup.
- Dissolve one tablespoon of salt in the water.
- Gargle saltwater and spit it into a second cup.
- Add one teaspoon of clear dishwashing soap and stir.
- Add one teaspoon of pineapple juice and stir.
- Carefully pour the ice-cold alcohol down the side of the cup to produce a distinct alcohol layer over the mixture.
- By gently stirring the alcohol layer with the rod, a precipitate becomes visible and can be spooled out. It will be stringy and white.
- Remove this precipitate if possible and transfer/suspend in another cup with a mixture of salt and rubbing alcohol.




### Indigi-Tech



With the popularity of DNA testing kits, questions surrounding Indigenous identity have increased. While these tests can show that someone has Indigenous ancestry or ethnicity, it cannot verify Indigenous *identity*. Indigenous worldviews are based on relationships, including one's identity. As an individual, you do not have the right to *claim* to be part of an Indigenous community: the community must recognize and claim you first. The federal government created colonial rules as to who is and isn't a status Indian under the Indian Act, rather than upholding the tradition of communities deciding who is and isn't a community member and accompanying Indigenous identity.

### Bio-Links



Wapusk National Park, in northern Manitoba, is home to all three of North America's bear species: black bear, grizzly bear, and polar bear. Scientists have used DNA analysis to learn more about the history of these bears, particularly the relationship between grizzlies and polar bears. Among other differences, grizzly bears are omnivores with mainly brown coats, while polar bears are carnivores with white coats. Despite their differences, DNA shows that the two types of bears are closely related and they can even mate and have offspring. DNA also shows some fun surprises. For example, grizzly bears have some DNA from extinct ancient cave bears!

### How it Works

Cheek cells will shed from the lining of your mouth as you gargle. Once they are captured, the detergent breaks down the cell and nuclear membranes. This is called "lysing" the cell. Your deoxyribonucleic acid, or DNA, is now exposed. However, it is still coiled up around proteins and difficult to see. Pineapple juice contains a protease, an enzyme that breaks down proteins, which helps separate the DNA and filter out the cellular debris. DNA is soluble in water but insoluble in the presence of salt and alcohol and it will precipitate out of solution. DNA is the molecular blueprint to every living thing on Earth.

## CHALLENGE

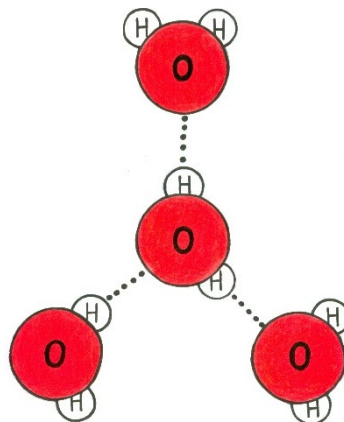
Create a model ice lattice.

### Materials

- Choice of various household items to represent:
  - Hydrogen Atoms:** aluminum cans, tennis balls, styrofoam balls, etc.
  - Oxygen Atoms:** items smaller than hydrogen items
  - Covalent Bonds:** items to go between hydrogen and oxygen such as toothpicks, sticks, paperclips, pen cases, etc.
  - Hydrogen Bonds:** toothpicks, sticks, paperclips, pen cases, etc.
- Protractor (if possible)

### Method

- Construct a water molecule
  - Use one oxygen atom and two hydrogen atoms
  - An outstretched thumb and pinky will form a bond angle of approximately 100 degrees.
  - Bind the oxygen to both hydrogen atoms with the correct bond angle.
- Construct at least 12 water molecules
- Bind the water molecules together using the material for hydrogen bonds according to the diagrams below.



## Indigi-Tech



The Inuit have depended on snow and ice for survival in the Arctic since time immemorial. As a result of this relationship, they developed an extremely deep knowledge base of the various physical characteristics associated with snow and ice. This knowledge is embedded into the Inuit language, Inuktitut, and is very specific. For example *siku* is the word for ice in general, and *sikuaq* refers to newly formed thin ice over bodies of water. *Qanik* refers to falling snow in the air and *qanittaq* refers to freshly fallen snow on the ground. *Maujajak* is snow that you sink into, and *illusaq* is snow that can become a house. No one knows for sure how many words for snow there are in Inuktitut, but there are a lot!

## Bio-Links



Ice crystals can be incredibly dangerous to living things. Because most plant and animal cells have lots of water, the formation of ice crystals can rupture the cell and kill it. To survive cold winters, plants and animals have evolved in ways to prevent ice crystal damage. For example, wood frogs have a natural antifreeze called a cryoprotectant, which chemically binds to water molecules and prevents them from forming ice. Many fish, plants and insects have special antifreeze proteins that bind to ice crystals and stop them from growing.

### How it Works

Water molecules are composed of a large oxygen atom and two smaller hydrogen atoms bonded covalently. The electrons between the atoms are shared instead of donated. Water is found as a liquid at room temperature. The molecules are moving around quickly causing it to flow. As water freezes, it exhibits peculiar behavior as it freezes into formation. It forms into a crystal lattice which takes up more volume than the original water.

## CHALLENGE

Build the fastest toboggan.

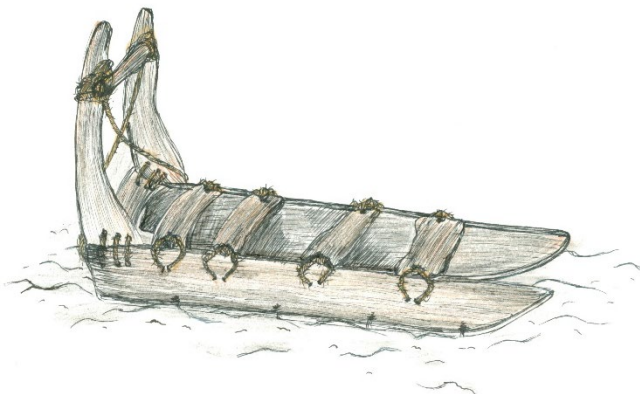
### Materials

- Cardboard
- Duct tape
- Windshield
- Runners / skis
- Superglue / staples (optional)
- Exacto-knife (to be used by an adult) or scissors

### Method

#### Design Tips

- Basic shapes are rectangular cubes with a point or chisel-shaped nose.
- Use duct tape, staples, and water sealant to connect any cardboard and keep it water free.
- The sled may have side panels but they are not required.
- Skis should have an upturned front lip to prevent digging.
- Decorations should be completed on the final prototype.
- Sled should be able to go down a hill carrying at least one person.
- Modify the prototype until a max speed has been attained.



### How it Works

Sleds use the physics of kinematics, dynamics and momentum to slide. There are several forces acting on a sled as it slides down a hill. These forces include gravity, force (as a function of mass) and friction (air and snow). Aerodynamic sleds have high acceleration due to decreased air friction. Sleds with skis have high acceleration due to minimized snow friction from the skis' wax coating. When the sled reaches a flat surface, the force of the ground on the sled increases thereby increasing its friction and decreasing its speed to a stop. The opposite occurs as the angle of incline increases.

### Indigi-Tech



Toboggans are an Indigenous invention! In the Arctic, the traditional sled of the Inuit (pulled either by people or dogs) is called a *qamatiq* (ko-ma- tik). Traditionally, several frozen fish such as arctic char, were placed nose to tail in a line and wrapped in hide. The fish and hide were then covered in water that was allowed to freeze in thin layers. Layer by layer, long runners were shaped. Two were placed side by side a couple of feet apart and were strung together with either driftwood or bones using cordage from plant fibers or sinew. This formed a flexible, strong sled that was efficient at both sliding over packed snow and over icy pressure ridges. Today, *qamatiqs* are made from imported wood planks and rope with thin plastic runners attached to the bottom to reduce friction and are attached to snow machines with a rigid metal hitch.

### Bio-Links



If you're a northern animal, it's usually more important to have a good grip on snow than it is to slide. To increase friction and maintain their grip, polar bears have small bumps on the bottom of their paws called papillae. The papillae themselves are rough with a softer skin behind them. This allows them to be flexible while still catching the ice and snow, for maximum slip-resistance. Many other animals, including dogs also have papillae on their paws.

## CHALLENGE

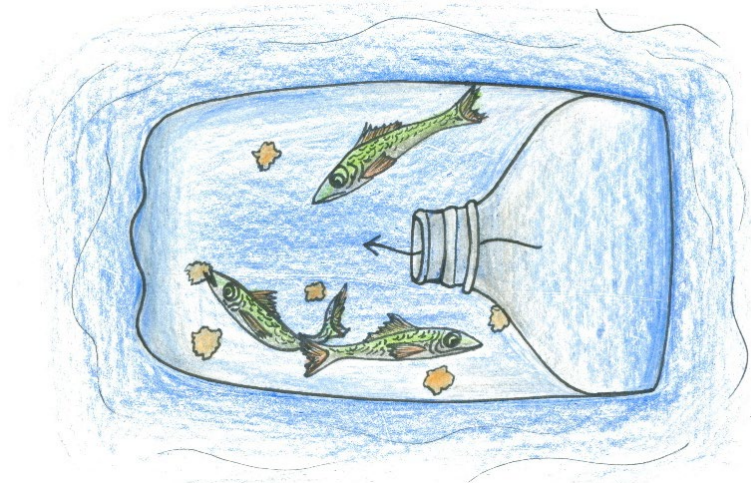
Design and build a fish trap.

### Materials

- 2 identical plastic bottles
- String / line / zip ties
- Scissors
- Marker

### Method


- Mark a line around the plastic bottle just below the base of the cone area.
- Carefully and precisely cut along the line.
- Cut the bottom off the second bottle just as you had cut the top off the first.
- With the nozzles pointing in the same direction, insert the top cut into the second bottle.
- Punch holes in the larger bottle and four holes at the base of both bottles together.
- Tie the bottles together through the four holes at their base.
- Record all results.



### How it Works


Fish are not terribly clever creatures. The trap is based on a fish's likelihood of encountering the same hole twice. Due to the inverted cone shape, the fish funnel into the large bottle. On the inside, the opposite occurs. They cannot funnel. Rather they are trapped because they are less likely to find the hole. It is mostly a matter of probability of entering and exiting the bottle. The entrance probability is high because there are more possibilities.

### Indigi-Tech



Fish traps are one traditional method of catching fish by Indigenous peoples, but there are many others. For example, spears were made with a barbed end to ensure that the fish don't just slide off the end of the spear. When fishing at night, a torch was held over the water to attract fish to the light where they were easily speared. Hooks made from bone or natural copper were attached to lines that were trolled behind canoes. Nets, made from weaving plant fibers into a diamond pattern were used in summer and in the winter under the ice. In the winter, holes were chopped in the ice, and a "jigger" was used to pull the net along under the ice, and then through another hole. The net ends were attached to ropes that were left out of the holes. To prevent the holes from freezing over, snow and spruce boughs were laid over top to act as an insulator against the cold.

### Bio-Links



Many species of fish live throughout Manitoba and are protected by our national parks: Riding Mountain National Park and Wapusk National Park. Most fish share the same basic life cycle, although some may have more or less stages:

**Egg Larvae:** after they hatch, most fish survive by eating a part of their egg called the yolk sac

**Fry:** once they are ready to eat other foods  
**Juvenile:** once they look like an adult fish and experience many physical changes

**Adults:** once they can reproduce.



# Spilling Tea

## CHALLENGE

Make an herbal tea.

### Materials

- 2 L water
- 4 tsp mint tea
- 4 tsp labrador tea
- Wekeese (i.e. ginger root)
- 3" x 3" balsam tree bark
- Filter
- 2 heat-safe jars or mugs

*Note: Tobacco offerings are necessary when obtaining the tea, water, wekeese, or balsam bark from Mother Earth.*

### Method

- Pour 1L of water into a pot.
- Add mint tea.
- Add labrador tea.
- Add balsam bark.
- Bring to a boil and simmer for 30 minutes.
- Remove from heat.
- Filter out tea leaves and bark.
- Pour contents into two heat-safe jars or mugs.
- Add 500 ml of water to each jar to dilute.

If you wish not to use your tea, please return the mixture to Mother Earth cleanly.



### How it Works

Teas have a type of *flavonoid*, or plant chemical, called *catechins* that may boost metabolism and help your body break down fats more quickly. The caffeine in many teas increases your energy use, causing your body to burn more calories. Balsam Bark is traditionally used for pain or skin problems. When teas or bark is boiled, the flavonoids diffuse into the water to create a homogenous mixture which can be used orally or topically at your guardian's discretion.



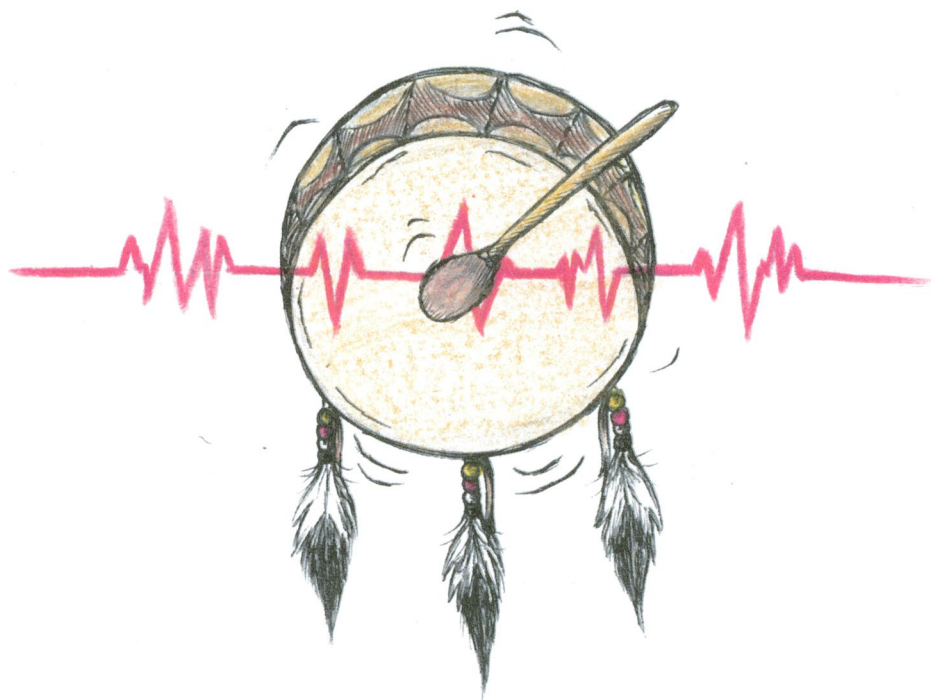
### Indigi-Tech

Extracting medicines from plants is a traditional activity of Indigenous peoples for thousands of years right up to today. In some cases, obtaining the medicinal compounds from the plants requires making either an infusion or decoction. To make an infusion you let plant parts sit in extremely hot water for a given time. This is called steeping. This method is usually used for medicines from leaves like cedar (*giizhik* in Ojibwe). To make a decoction, other plant parts like roots or bark are placed in hot water for a longer period of time to extract the medicine. You would not be able to extract the medicinal compounds without the use of hot or boiling water. It is best to learn from an Elder or traditional Knowledge Keeper as some medicines can be harmful.



### Bio-Links

Finding and picking medicinal plants means knowing where to find them and respecting the habitats where they live. Labrador tea is especially easy to find in wet areas, but can be found all over the boreal forest. It's one of the first plants to grow back after a forest fire. Wild mint also likes wetter areas, and can be found along streams and near beaver dams.



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