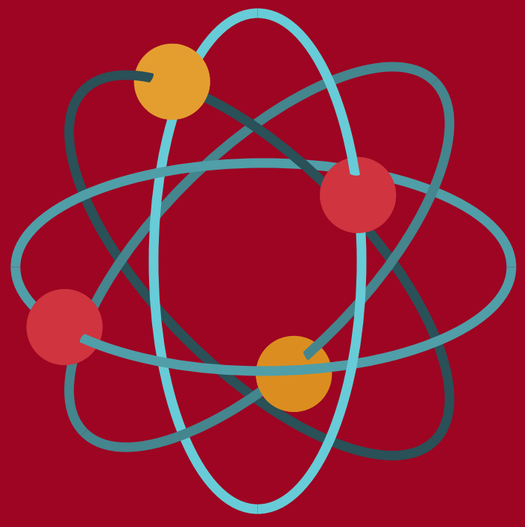
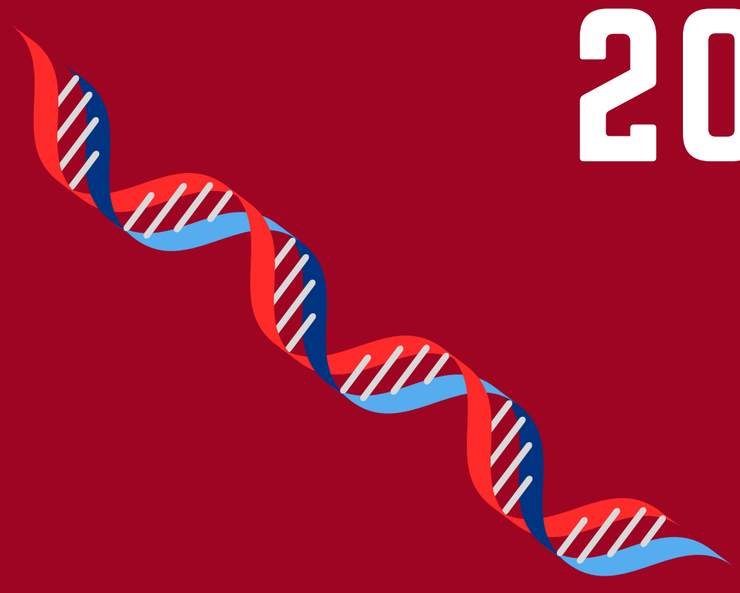
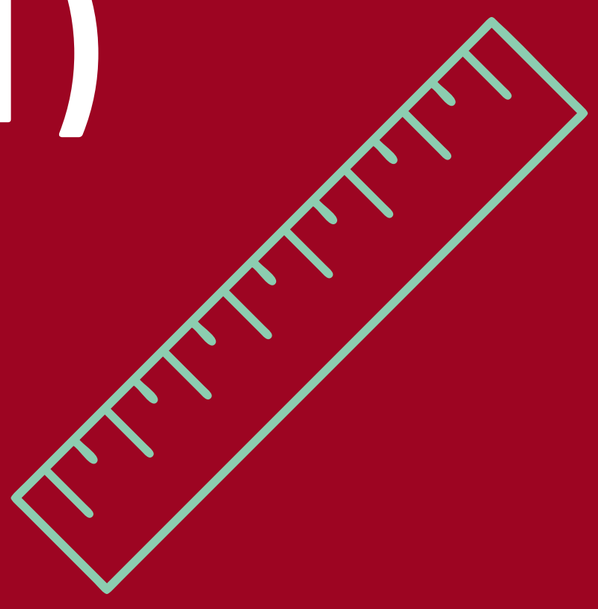


FUN SCIENCE EXPERIMENTS (SCIENCE RENDEZVOUS 2019 BOOKLET)





BROUGHT TO YOU BY LET'S TALK SCIENCE UTSC

Dear Science Rendezvous Participants!
Thank you for attending the 2019 Science Rendezvous hosted at the Toronto Zoo. This event couldn't have been completed without the hard work from our partners at the Toronto Zoo, the Office of Vice-Principal Research and the University of Toronto Scarborough, or without funding from the National Sciences and Engineering Research Council (NSERC) Student Ambassadors award.

We hope that you enjoyed your day at the Zoo and learned a lot about how science concepts relate to the different animals that you saw. We wanted to continue to encourage your STEAM (science, arts, technology, engineering, and mathematics) learning by providing an at-home booklet with easy experiments that are fun for the whole family. The activities in this booklet span a broad range of topics for you to try! Plus, on the last few pages you'll find links to some citizen science websites where YOU can get involved in science, helping to collect and share data for projects happening in your community.

We hope that you enjoy!

Follow us at:

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Website: www.torontozoo.com

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Youtube: 'NSERCTube'
Website: www.nserc-crsng.gc.ca

Booklet created by Amy Jenne
Booklet designed by Lucy Yam
With contributions from: Nicole Kaiser, Kassandra Boddie, Meghan Matthies, Heather House, and Rachel McLean.

TABLE OF CONTENTS

HOW DO I SEE COLOUR?

Build a sun catcher that allows you to see the various colours in light!

AGES: 5 – 11

TIME: 30 MINUTES – 1 HOUR

SUBJECT: PHYSICS

DEVELOPING SKILLS: OBSERVING, CONSTRUCTING

SETTING: INDOORS

What you need

- Paper plates or trays
- Clear acetate or other clear plastic sheet
- Permanent markers (various colours)
- Tape
- Scissors
- Small cookie cutters
- String or yarn
- Hole punch or a sharp pencil

What to do

1. Cut the edges off a Styrofoam plate or tray so that you have a flat surface.
2. Create holes in the foam with the cookie cutters.
3. Cut pieces of plastic large enough to cover the holes and colour them with various colours of marker.
4. Tape the coloured pieces of plastic behind the holes in the foam.
5. Punch a hole near the top of foam shape using a hole punch or a sharp pencil. Put a string or piece of yarn through and knot it so that it makes a loop.
6. Hang in a sunny spot or attach to a window.

Discovery

What's happening?

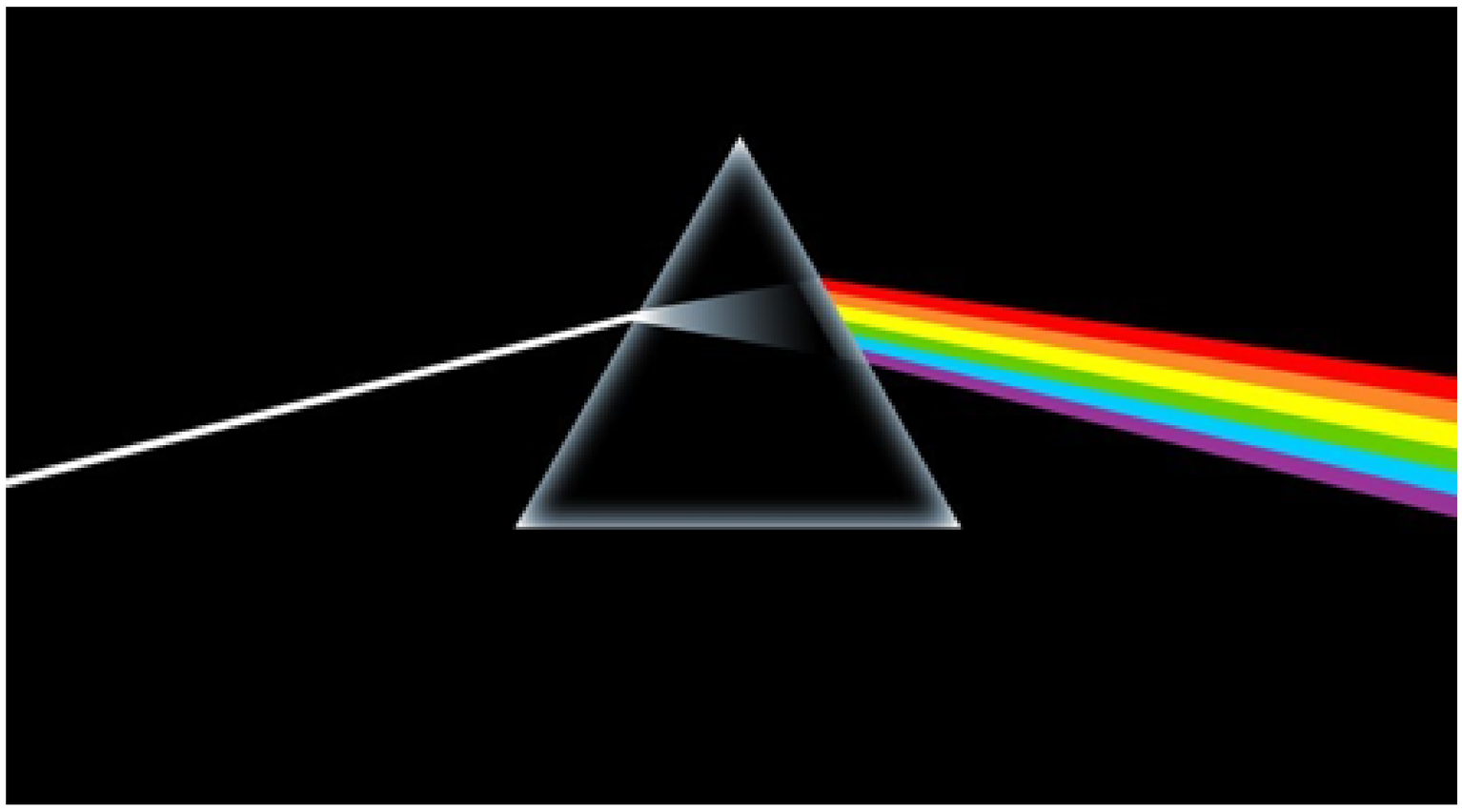
White light from the sun is made up of different colours. When you look at a rainbow, you can see white sunlight broken up into its components as a beautiful colour spectrum of red, orange, yellow, green, blue, indigo and violet. By using a filter such as the pieces of coloured acetate, you allow only light of a certain colour to pass through it. For example, if you coloured one of the pieces of acetate blue, you are only allowing the blue light rays to go through it. The filter will absorb all other colours of white light

Why does it matter?

Light is required for colour to exist. When white light hits an object that appears red, for instance, that object absorbs all the rays of coloured light except the red ones, which it reflects. When our eyes perceive the reflected light rays, they send a signal to our brain, which will interpret what we are seeing as the colour red.

The back of our eyes are covered in light-sensitive cells. Some transmit information about colours to the brain and some transmit only black and white information. The cells that perceive colours are not as sensitive as the others, making it much harder to see distinct colours in places where there is not a lot of light (like at dusk or in a dimly lighted room).

Investigate further!
Shine a flashlight on a glass or Plexiglas triangular prism and see how light is split into the colours of the visible spectrum (red, orange, yellow, green, blue, indigo and violet). You could also use a crystal pendant from a chandelier to see what happens to the light that passes through it. Be sure to aim the light passing through the prism towards a white wall or white surface to best see the light spectrum. (Note that this will not work if your flashlight has an LED lightbulb.)



Did you know?
Museum workers analyze the pigments and dyes in works of art to determine how old the art is, where it comes from, and whether it's real or fake!

HOW DOES WATER MOVE UP A PLANT?

Explore how plants take up water using colours!

AGES: 3 – 11
TIME: 1 - 4 HOURS OR OVERNIGHT
SUBJECT: ENVIRONMENTAL SCIENCE
DEVELOPING SKILLS: OBSERVING, CONSTRUCTING
SETTING: INDOORS

What you need

- Celery stalk
- Clear cup
- Water
- Food colouring (Blue, red and purple work well)

What to do

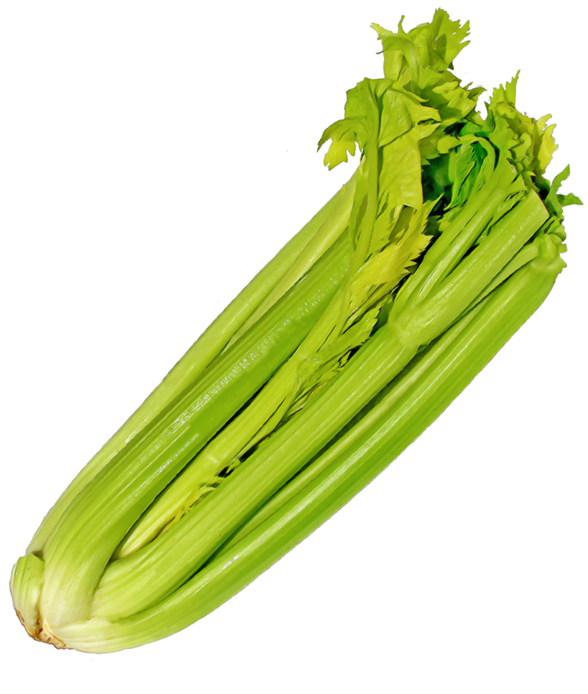
1. Cut a long stalk off of a head of celery.

***Safety First! Have an adult help cut the celery. Use caution with sharp knives.**

2. Fill a clear cup 3/4 full of water.
3. Add 10 drops of food colouring to the water.
4. Place the celery stalk in the cup. What do you think the celery will look like tomorrow? What about the water in the cup?
5. Put the cup in a safe place overnight and observe the following day. Does the celery look the same or different? Describe what you see. Explain what you think has happened.

Did you know?

Celery stalk is not a stem. It is actually the part of the leaf called the leaf stalk. This is why we call the part of the celery that we eat the stalk.



Discovery

What's happening?

Just like animals and humans, plants need water to survive. Plants get the water they need from their roots. Root systems are designed to go deep into the soil and absorb water and nutrients. Roots bring water into the plant and xylem (tiny tubes) carries the water to the rest of the plant. Xylem is a system of hollow tubes that act like straws in a plant. It allows the plant to draw water up its stalk or stem. Sometimes celery has "strings," which are several xylem tubes grouped together. Did you know that a celery stalk is not a stem? It is actually the part of the leaf called the leaf stalk. This is why we call the part of the celery that we eat the stalk.

When water gets to the leaves at the top of the plant, it evaporates through tiny holes in the leaves in a process known as transpiration. Transpiration results in evaporation of the water at the top of the xylem. More water is then pulled from the roots to keep the xylem full.

Why does it matter?

Xylem not only helps plants by providing them with the water they need, xylem also helps to provide structural support for the plant. The rings you can see in a cross-section of a tree's trunk are actually old xylem. They make wood hard enough to be used as a building material.

Investigate Further!

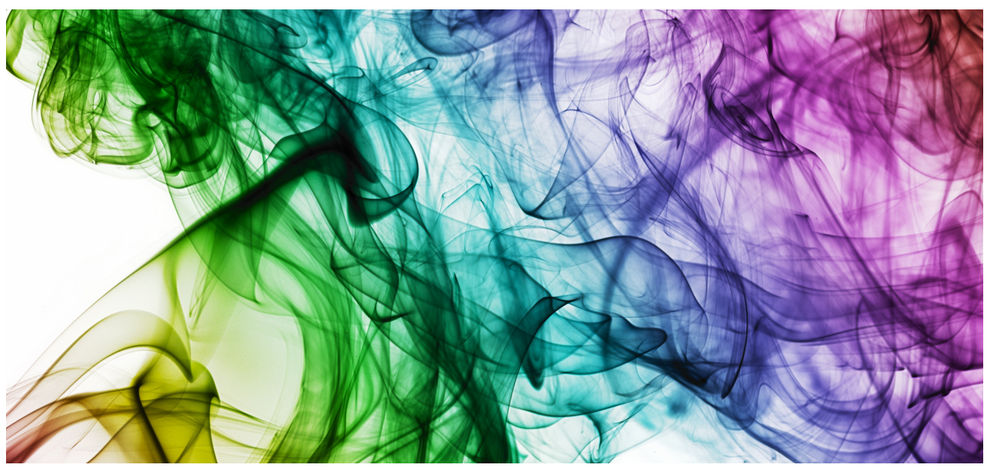
Observe the progress of the water in the celery stalk. Check it by peeling away part of the stalk after 1 hour, 2 hours, 4 hours, etc.
What is the depth of colour at different times? Does the water move faster or slower than you expected?

Try this experiment again. This time put one celery stalk (in water and food colouring) in a well-lit place and another celery stalk (in water and food colouring) in a dark place.
Is there any difference to what happens to the colouring? What could explain this?

Try this experiment again. This time put one celery stalk in a cup with water and food colouring and another celery stalk in cup with water and food colouring that you have added one spoonful of sugar to.
Is there any difference to what happens to the colouring? What do you think is going on?

Try the experiment with other types of plants. White flowers with long stems such as daisies and carnations work well.
Do flowers change colour as the celery leaves did? What do you think is going on?

Try other colours of food colouring. Which colours can you see the most clearly in the celery stalk?



MAKING RAINBOW PAPER

Learn about light and make a rainbow using paper!

AGES: 3 - 17
TIME: 20 - 30 MINUTES
SUBJECT: PHYSICS, ART

DEVELOPING SKILLS: OBSERVING, CREATIVITY
SETTING: INDOORS OR OUTDOORS

What you need

- Bowl
- Water
- Black construction paper
- Clear nail polish
- Paper towels
- Scissors

What to do

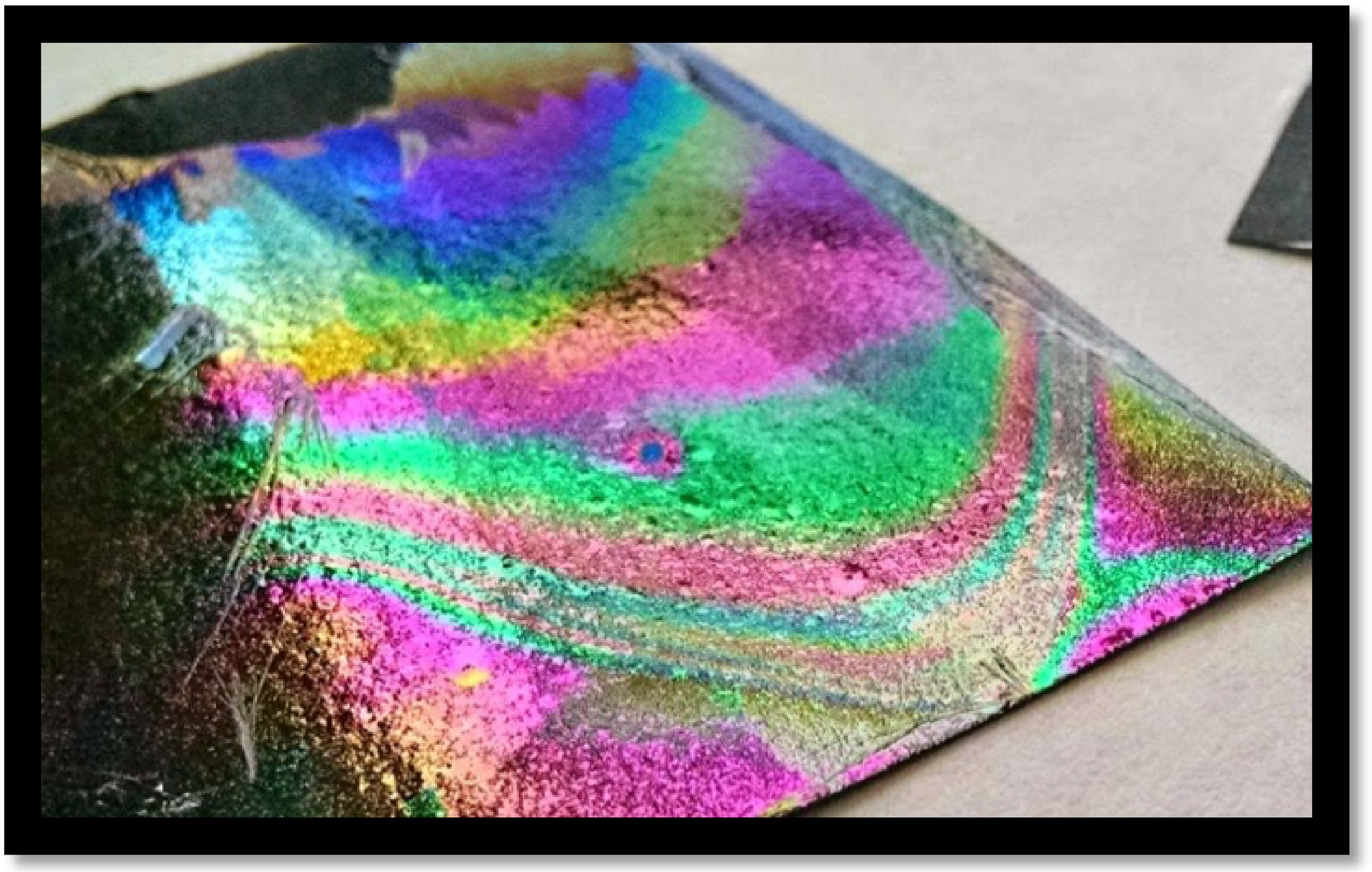
1. Fill the bowl with a bit of water (enough for the paper to be fully submerged).
2. Cut the construction paper into the shape you'd like to make your art.
3. The nail polish can be added either before or after the paper, it's up to the individual (try different variations and see what works better).

o Paper first: Place paper in the bowl and allow it to float to top, place 3-4 drops of clear nail polish on top and let spread for a couple seconds. Then pull the paper out.

o Nail polish first: Place 3-4 drops on top of water, allow for it to spread out for a few seconds. Place paper into water and lift out.

4. Place paper on paper towel to dry. Once dry, the rainbows should be visible under normal light, but depending where you are you may want to look at it using a flashlight.

***When completed the pieces of paper can be used to create artwork.**

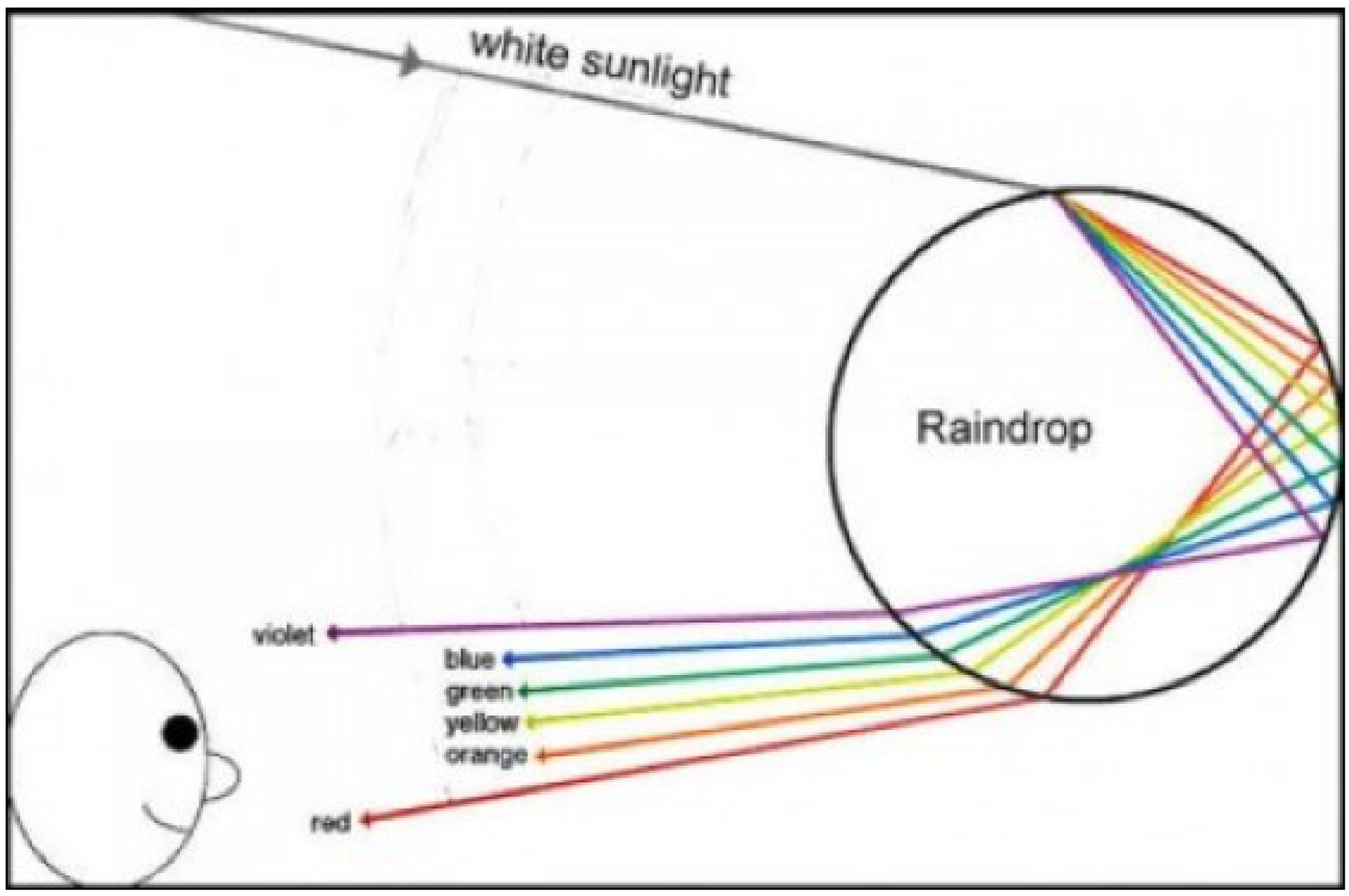


Discovery

What’s happening

The sun is composed of white light, this light is made up of all the different colours, but we can’t see these different colours until it moves through a special kind of medium that allows the light to scatter.

Rain droplets are this medium, it allows the light (and their different wavelengths) to scatter into the colours of the visible spectrum that our eyes can detect. This is called refraction. Once they scatter inside the raindrop, the light bounces (or reflects) out of the droplet creating the rainbows we see.



Why does it matter?

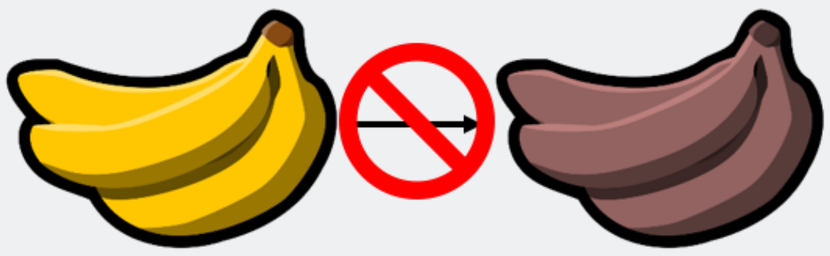
Light is required for colour to exist. When white light hits an object that appears red, for instance, that object absorbs all the rays of coloured light except the red ones, which it reflects. When our eyes perceive the reflected light rays, they send a signal to our brain which will interpret what we are seeing as the colour red.

The back of our eye balls are covered in light-sensitive cells. Some transmit information about colours to the brain and some transmit only black and white information. The cells that perceive colours are not as sensitive as the others, making it much harder to see distinct colours in places where there is not a lot of light (like at dusk or in a dimly lighted room).

Investigate further!

Did you know that two rainbows are always created (one fainter than the first), but the colours will be inverted because the light rays undergo a second reflection inside the droplet? Look carefully next time it’s raining and see if you can identify the second rainbow.

HOW CAN I STOP BANANAS FROM TURNING BROWN?



Explore the cause of fruit browning and discover how to prevent it!

AGES: 6 - 11

TIME: 1H 10 MIN - 1H 30 MIN

SUBJECT: CHEMISTRY

DEVELOPING SKILLS: OBSERVING, HYPOTHESIZING

SETTING: INDOORS

What you need

- Lemon juice
- Chewable Vitamin C tablet
- Water
- Spoon
- Plastic Cup
- Variety of fruit: apple, banana, peach or pear
- Knife (use with adult supervision only)
- Plate (3)
- Pastry Brush

What to do

1. Crush the Vitamin C tablet with the back of a spoon and dissolve it in half a cup of water.
2. With a parent’s permission/help, cut up one or more types of fruit into pieces of nearly-equal size.
3. Quickly put some of each fruit on three separate plates and label the plates with the word’s “water”, “lemon” and “Vitamin C.”
4. Using a pastry brush, paint the cut surfaces of the fruit with water, lemon juice or the vitamin C solution – according to the label on the plate.
5. Arrange the fruit so that the cut surfaces are exposed to the greatest amount of air.
6. Let stand at room temperature for an hour or more and observer what happens to the fruit on each plate.

Discovery

What's happening?

The cells making up the fruit contain many chemicals, some of which are called aldehydes. When you cut the fruit, many of the cells are damaged and they release aldehydes. When the aldehydes mix with the oxygen in the air, they oxidize and turn brown, and thus change the colour of the cut surface of the fruit.

Vitamin C, also known as ascorbic acid, is found naturally in citrus fruits, such as lemons and oranges. It can also be made artificially and put into vitamin pills. Either way, the chemical that slows down the oxidation of cut fruit is the mighty vitamin C! It is often added to foods as a preservative to interfere with the natural process of browng.

Why does it matter?
Compounds like vitamin C that slow down the oxidation reaction that we can observe on cut fruit can also slow down oxidation in the human body! Oxidation reactions can damage cells, proteins and molecules in plants, animals, and people. Getting enough vitamin C (ascorbic acid) can slow or prevent these oxidation reactions from happening. This is one of the reasons why vitamin C is so important. Ascorbic acid is often used in food manufacturing as a food preservative.

Investigate further!
Explore the effect of putting fresh fruit into other liquids, such as orange juice, apple juice, milk, water, soda water and other types of pop.
What liquids do a better job at preventing the fruit from going brown?
What liquids would you rather use to keep your fruit from browning? Why?

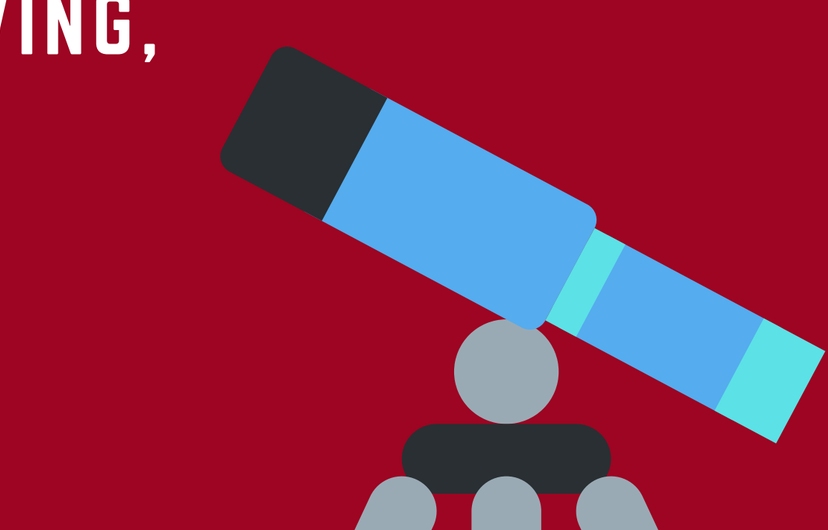
Look for different acids on labels of packaged foods that come from the grocery store.
What types of acids do you find listed on labels? Find out why these are included.

Did you know?
You probably think of soap as something to clean with. But in the past, people used soap for all kinds of things - even as medicine!

HOW TO MAKE A STAR WHEEL

Explore the night sky and learn how to create a star wheel!

AGES: 4 - 11
TIME: 10 - 30 MINUTES
SUBJECT: ASTRONOMY
DEVELOPING SKILLS: OBSERVING, EXPLORING
SETTING: OUTDOORS



What you need

- Print outs of the star disk and holder (on next page)
- Stapler or glue sticks

What to do

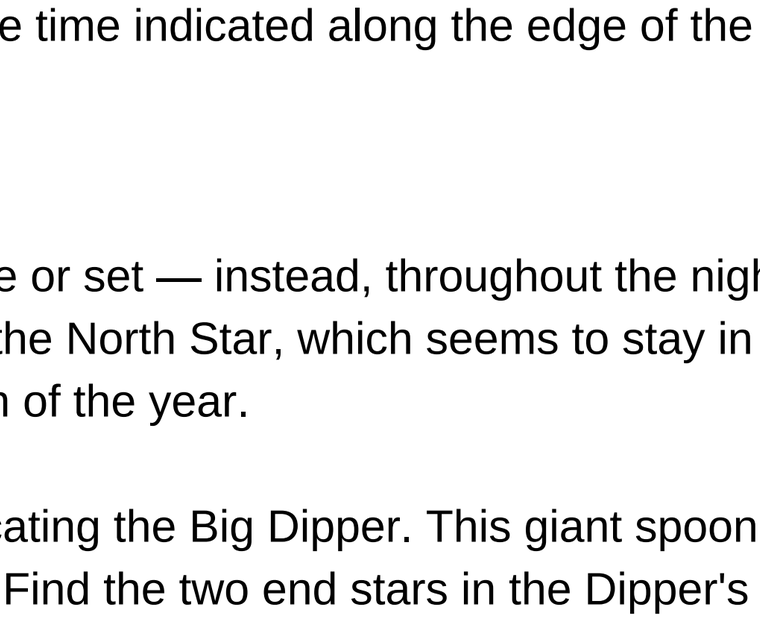
1. Print out the wheel and holder from the next two pages.
2. Cut out the parts. For the sky map (star disk), trim away the gray corners so that you're left with a circle 8 inches across. For the outer sleeve (holder), make sure you keep the large white rectangle at the bottom; also, cut out the white oval in the middle.
3. To make a Star Wheel, fold the white rectangle at the bottom of the holder so it's underneath the front. Then staple the rectangle to the front at the locations marked by short white lines to either side of the oval. Now slip in the star disk so it shows through the oval.
4. To use the finder, pick the date and hour you want to observe, and set the Star Wheel so this date (on the rim of the star disk) matches the time indicated along the edge of the outer sleeve.

Discovery

What's happening?

Stars in the northern sky do not rise or set — instead, throughout the night they seem to slowly turn counter clockwise around Polaris, the North Star, which seems to stay in the same place in the sky no matter what time of night or season of the year.

To find the North Star, begin by locating the Big Dipper. This giant spoon is part of a larger constellation called Ursa Major, the Great Bear. Find the two end stars in the Dipper's bowl — look opposite the handle. They're known as the "pointers." Why? Because a line drawn between them and extended away from the bottom of the bowl leads you to Polaris, the North Star. Now that you know how find Polaris, you also know how to find due north no matter where you are in the Northern Hemisphere!

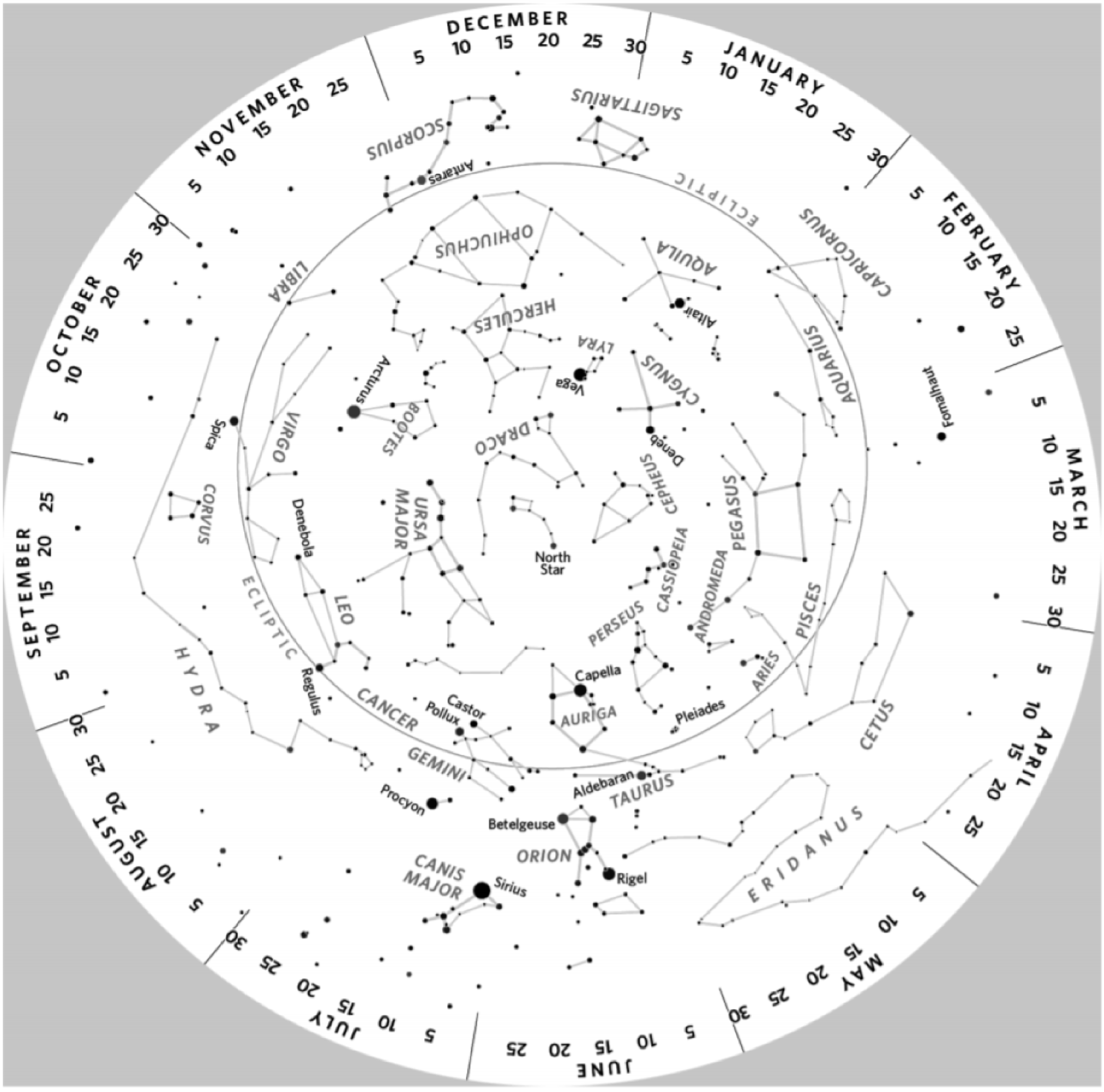


Why does it matter?

We see different views of the Universe from where we live as Earth makes its yearly trip around the solar system. Also, as Earth rotates on its axis toward the east throughout the hours of the night, the whole sky seems to shift toward the west. Learning about the solar system and the stars around the Earth is a good way to learn about the rotation of the planet around the sun, and because the planet tilts along its axis throughout the year the stars we see in the winter are different from those we see in the summer.

Investigate further!

All of the stars in the sky are named from stories and characters in history, to learn more about these stories, check out this **constellation guide.**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Antares
OPHIUCHUS
LIBRA
AQUILA
Altair
CAPRICORNUS
AQUARIUS
HERCULES
LYRA
Vega
CYGNUS
Deneb
Fomalhaut
Arcturus
BOÖTES
Spica
VIRGO
DRACO
CEPHEUS
CORVUS
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PEGASUS
ANDROMEDA
CASSIOPEIA
PERSEUS
PISCES
ARIES
LEO
ECLIPTIC
Regulus
CANCER
Capella
Castor
Pollux
AURIGA
Pleiades
CETUS
HYDRA
GEMINI
Procyon
Aldebaran
TAURUS
Betelgeuse
ORION
Rigel
CANIS MAJOR
Sirius
ERIDANUS

STAR WHEEL

Midnight
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3 am
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7 am
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8 am
8 pm
9 pm
9 pm
10 pm
10 pm
11 pm
11 pm
Midnight

Standard time
Daylight-saving time

Facing North
Facing West
Facing East
Facing South

HORIZON
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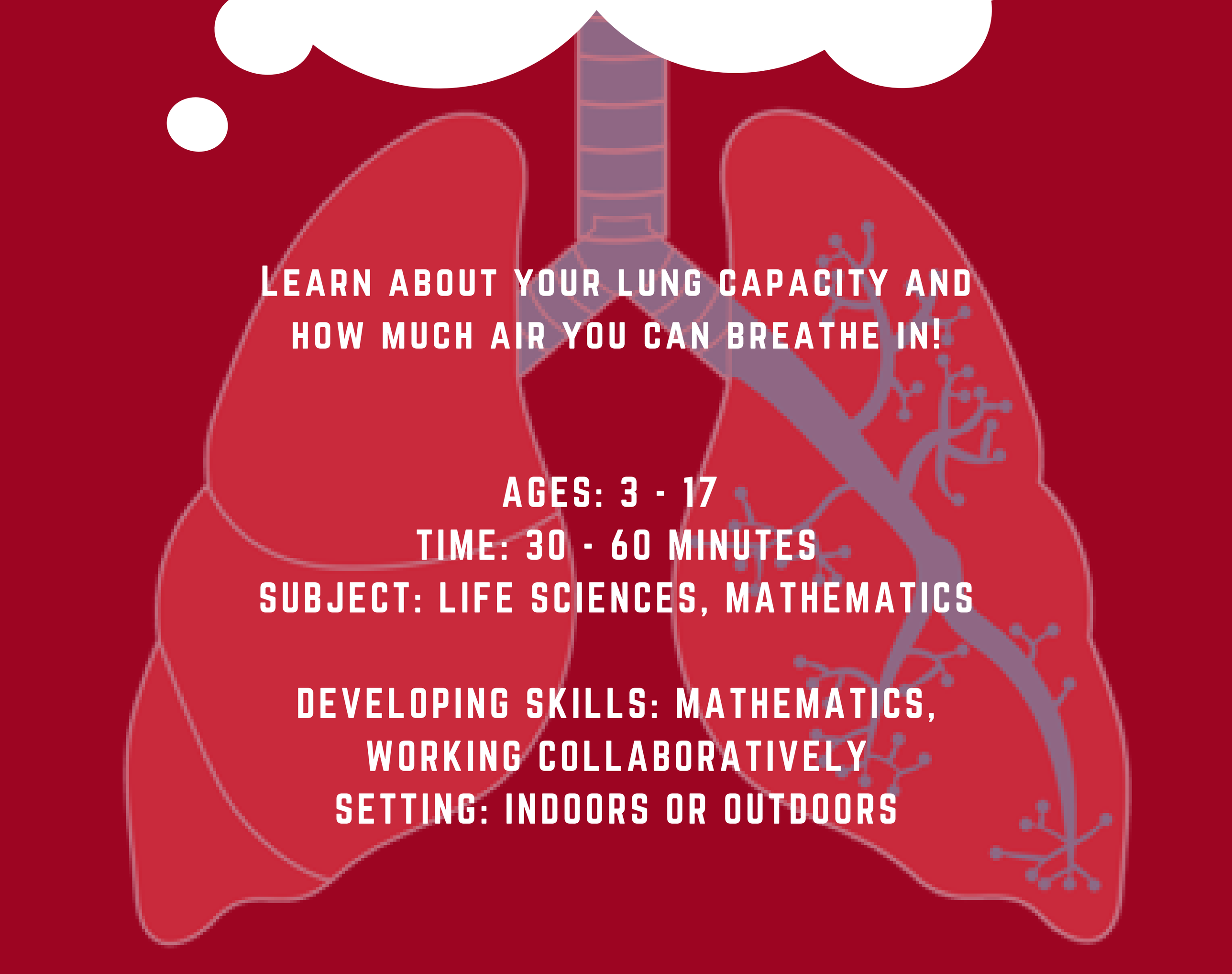
HOW MUCH AIR DO I BREATHE?



Learn about your lung capacity and how much air you can breathe in!

AGES: 3 - 17
TIME: 30 - 60 MINUTES
SUBJECT: LIFE SCIENCES, MATHEMATICS

DEVELOPING SKILLS: MATHEMATICS, WORKING COLLABORATIVELY
SETTING: INDOORS OR OUTDOORS

What you need

- 2 people – You may need to ask an adult for help!
- 2L pop bottle or 4L vinegar bottle filled with water (marked in 100 mL increments)
- Deep tray – filled to about 3 cm deep with water
- Bendy straw

*Recycling Matters! Plastics in the environment are a concern, please dispose of these properly.

- Small piece of plastic wrap, aluminum foil, or thick card stock
- Water

What to do

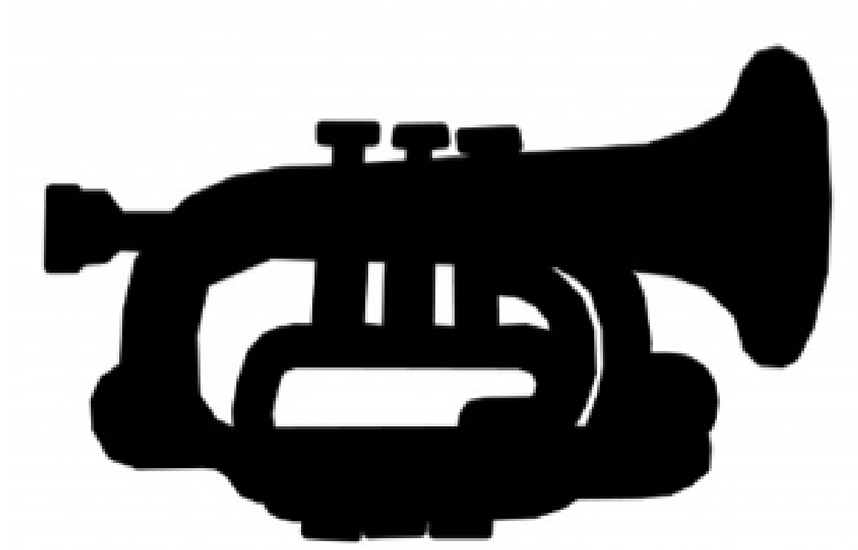
1. Fill the pop bottle with water.
2. Place the small piece of card stock over the top of the bottle.
3. Invert the bottle and put it in the water tray and remove the card. Make sure no air enters the bottles at this stage.
4. Thread the short end of the straw up into the mouth of the bottle then bend the straw up so that the other end is out of the water (see photos below).
5. Take a breath, and then blow as much as possible into the straw, displacing the water. You can determine how much air you can breathe out by the amount of water you displaced.

Discovery

What's happening?

Both air and water can be measured in litres. One litre of air (gas) is equal in volume to one litre of water (liquid). They take up the same amount of space. If the bottle is completely full of water, any amount of water that is displaced by the air being blown into the bottle is equal in volume to the water that has been displaced. Therefore, if after blowing into the bottle, there is one litre of space in the bottle, then your lung capacity equals one litre.

The greater your lung capacity, the more likely you will do well in sports that require good stamina. But this is not always the case. There are other factors that may affect your stamina. Runners, both long distance and short distance, generally have large lung capacity, as do swimmers. Males tend to have a larger lung capacity than females. Taller people may have larger lung capacity than shorter people. There is even a difference in people living at high altitudes and people living at low altitudes.



Why does it matter?
Lung capacity is important if you do activities like singing, playing an instrument, playing a sport, running, jogging or swimming. The capacity of your lungs to take in air, and keep it in, affects how long you can play a single note, how long you can hold your breath under water or how well you can breathe while moving. It can be important to know if you are someone who does scuba or deep-sea diving, or if you travel between high and low altitudes.

A person’s lung capacity can be seriously altered by allergies or asthma, or other health problems that affect how much air you breathe in and out.

Investigate further!
Try this experiment with multiple people. Compare the lung capacity between different people: males/females, tall/short individuals, athletes/non-athletes, swimmers/non-swimmers, musicians/non-musicians, etc.
Do these differences affect lung capacity?

Try this activity again, but practice breathing deeply beforehand. Compare your lung capacity from this time to the first, "regular" way.
Do you notice a difference?

HOW DO HOVERCRAFTS MOVE?

Learn about physics concepts like friction by creating your very own hovercraft!

AGES: 3 - 12
TIME: 30 - 60 MINUTES
SUBJECT: SPACE, PHYSICS
DEVELOPING SKILLS: WORKING COLLABORATIVELY, CONSTRUCTING
SETTING: INDOORS

What you need
- An old CD or DVD
- A balloon
- A pop-up cap from a water bottle or soap container
- Hot glue gun

What to do
1. Use the hot glue gun to glue the cap to the middle of the CD hole, make sure to get help with this if you need it. Be sure that the glue covers the entire center of the CD so that no air can get through the top of the disc.
2. Once this is dry, blow up the balloon, and hold it closed, and then place it over the top of the cap. This is often easier with two people.
3. Now lift open the cap and watch as your hovercraft travels across the table.

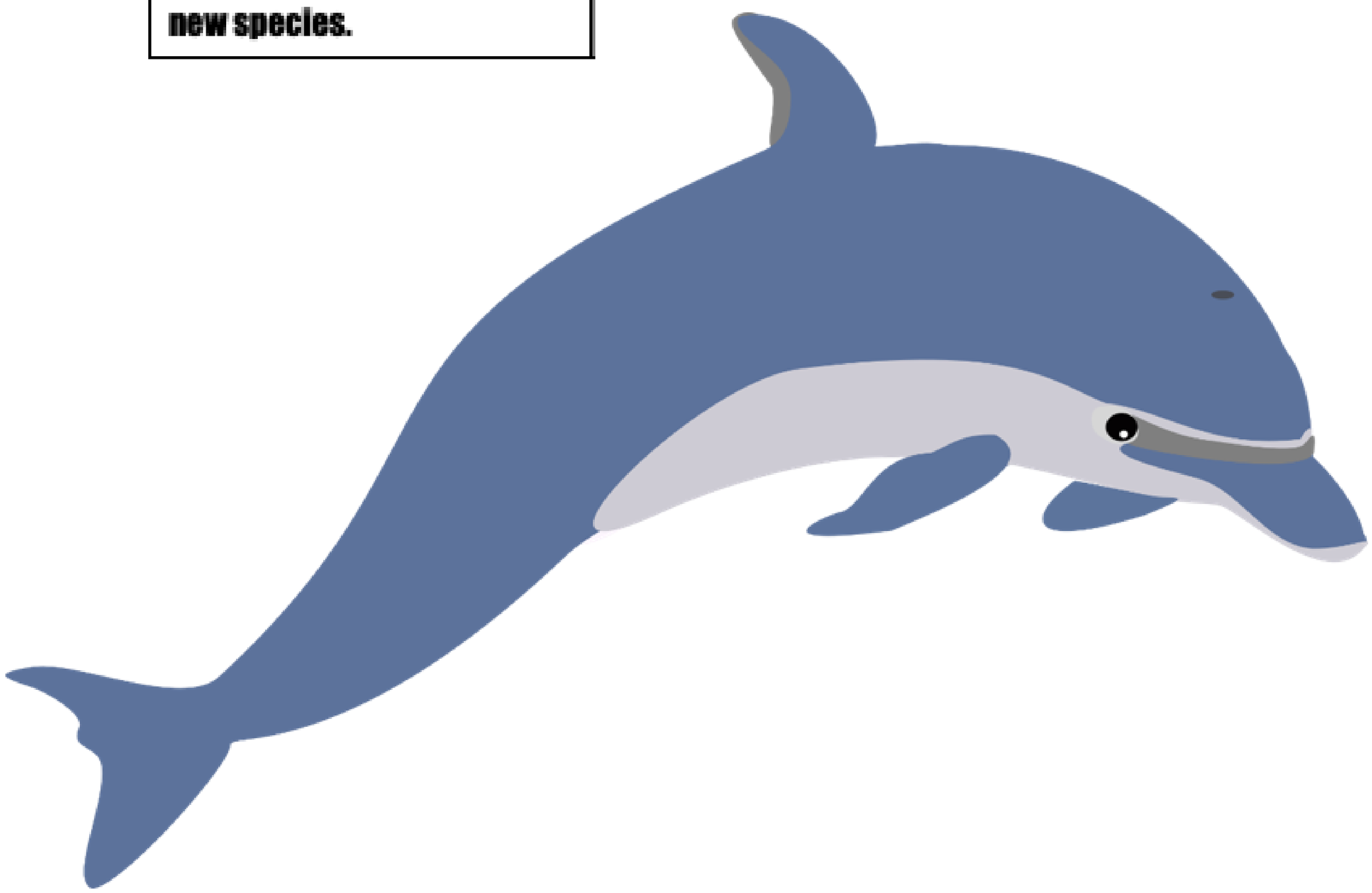
Discovery
What's happening?
The airflow caused by the balloon releasing air causes a cushion of moving air to flow between the disc and the table surface in all directions. This lifts the CD and reduces the friction, which allows the disc to hover freely. Friction is the force felt between two solid objects. Large-scale hovercrafts can travel over land, snow and water.

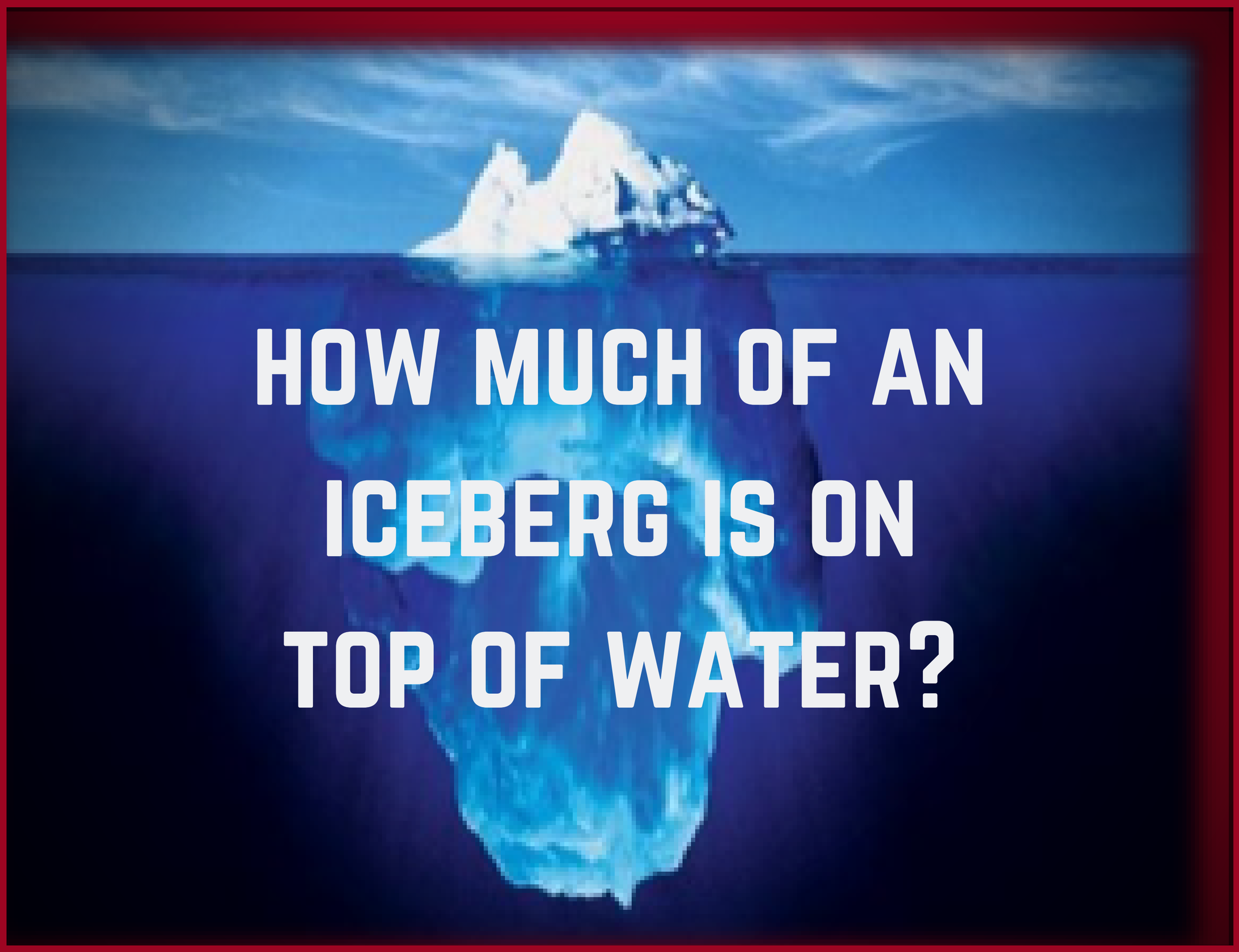
Why does it matter?
When considering creating machines and vehicles, friction is a big component of creating strong and effective structures. By having too much friction between two objects, they are unable to move as effectively, and they wear out faster. Engineers work hard to build structures that have less friction acting on them using concepts like those used in the hovercraft. Fun fact: Air hockey tables work the same way as the hovercraft experiment. The puck has very little friction between it and the table.

In space, where there is no atmosphere like on Earth, there is no friction between objects, which means that movement in space is much easier.

Investigate further!
Now that you've explored the concepts of gravity and movement, change the system and explore what happens. **For example, does the size of the balloon affect the CDs ability to hover? Does a helium balloon work better than an air-filled balloon? Do larger discs make better hovercrafts (plastic picnic plates, old record albums)?**

Did you know?
The Census of Marine Life has identified over 6,000 new species.





HOW MUCH OF AN ICEBERG IS ON TOP OF WATER?

Learn about physics concepts like friction by creating your very own hovercraft!

AGES: 9 - 17
TIME: 24 HOURS (Most of this time is waiting for water to freeze)
SUBJECT: PHYSICS, MATHEMATICS
DEVELOPING SKILLS: COLLECTING DATA, MATHEMATICS
SETTING: INDOORS

What you need

- Balloon
- Plastic zip bag
- Rubber band
- Large bowl, bucket, or fish tank
- Tray of ice cubes
- Ruler
- Calculator

What to do

1. Fill the balloon with water until it is about the size of a grapefruit. Tie off the end of the balloon and put it in the freezer.
2. Repeat step 1 with the plastic bag. Be careful not to overfill. Use the rubber band to tie off the top.
3. Wait 12-24 hours to fully freeze your “icebergs”.
4. Fill the bowl, tank, or bucket with cold water.
5. Add the tray of ice cubes and stir until they have melted.
6. Take your icebergs from the freezer and remove the plastic bag and balloon.
7. Place your icebergs on the sink and measure their height.
8. Place the icebergs in the bowl, bucket, or tank. Measure how much of the iceberg is floating on top of the water.
9. Calculate how much of the iceberg is above the water:

Height above water ÷ total height x 100 = percentage of iceberg above water.

Discovery

What’s happening?

Density is the amount of weight in a specific volume. An object is buoyant (floats) if its relative density is less than that of the fluid it is resting in. Ice has a slightly lower density than seawater, so we see ice floating above the surface of oceans. However, because the difference in relative density between ice and seawater is small, only some of the iceberg floats above the water. In fact, on average only 1/10th of an iceberg is above the surface of the water.

Why does it matter?

The expression "just the tip of the iceberg" is often used to describe a situation where what you see isn't all you get. The same goes for real icebergs! Icebergs can project 7-9 times more underwater than they do above water. Because most of the underwater iceberg is unseen, it poses a risk for sailors and navigators. One famous crash with an iceberg occurred on the RMS Titanic on April 15, 1912. Since that tragedy, an organization known as the International Ice Patrol was founded to monitor icebergs in the Atlantic Ocean and report their movements for safety reasons.

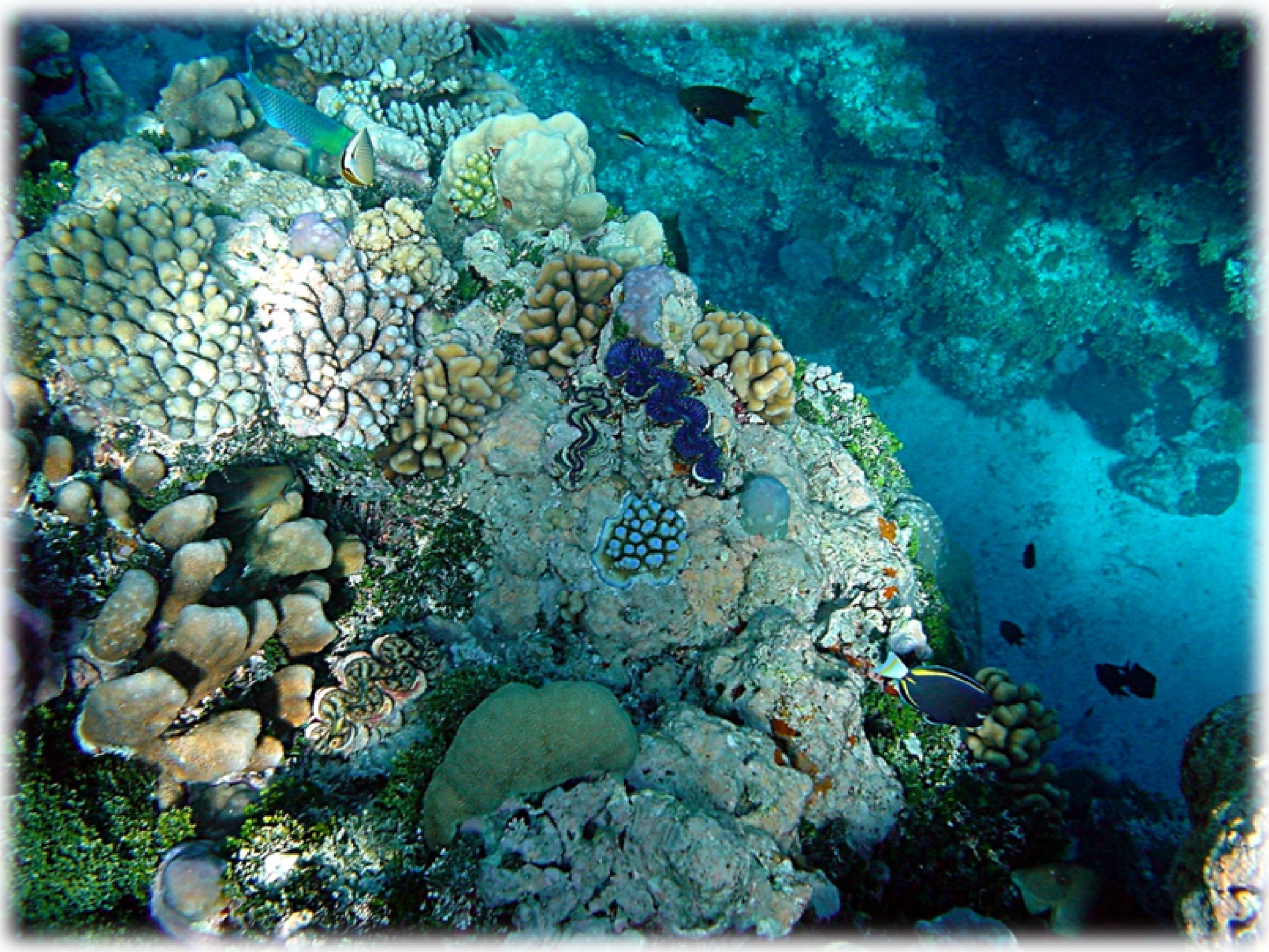
Investigate further!

Add salt or sugar to the water. **Does more or less of the iceberg float on top of the surface?**

Try creating icebergs of different sizes. Does a smaller iceberg float more?

Did you know?

Most coral reefs on earth were formed after the last glacial period, between 110,000 and 10,000 years ago.



IS IT A SOLID OR LIQUID?

Explore the different states of matter by making Oobleck !

AGES: JK - 13
TIME: 20 - 40 MINUTES
SUBJECT: CHEMISTRY

DEVELOPING SKILLS: EXPLORING, CONSTRUCTING, FEELING
SETTING: INDOORS

What you need
- 1 cup Water
- Bowl
- 1.5 – 2 cups Cornstarch
- Food colouring

What to do
1. Start by putting water into the bowl.
2. Add a few drops of your favourite food colouring.
3. Add in the cornstarch to the water with a spoon at first but start mixing with your hands when you hit the 1.5 cup mark.
4. Add in cornstarch slowly at this point, the goal is to get the consistency where it is both a liquid and a solid.
5. Now that it's made, play with the Oobleck, and learn what you can about how it acts.

'

Discovery
What's happening?
Oobleck is a very peculiar substance as it has the properties of both a solid and a liquid, it is a **Non-Newtonian Fluid.** When the mixture is squeezed or pressed the molecules line up in a regular pattern, as they do in a normal solid, and the water is forced away from the outer edges. This makes the Oobleck feel and act as a solid. When the pressure is released the molecules form the random arrangement of a liquid, and the water can mix with the outer edges again, and the Oobleck suddenly flows.

Why does it matter?
All fluids have a measurable viscosity. Viscosity is the thickness or resistance to flow of a liquid. Water, for instance, has a low viscosity because it pours easily. In comparison, honey is a very thick liquid and can take a long time to pour, so it has a high viscosity. Normal fluids, called Newtonian fluids, change viscosity only when the temperature changes. That is, when honey is warmed up it is easier to pour, but when it is cooled down it is much harder to pour.
Oobleck is an example of a non-Newtonian fluid. The viscosity of the Oobleck can be changed by temperature, and by pressure.

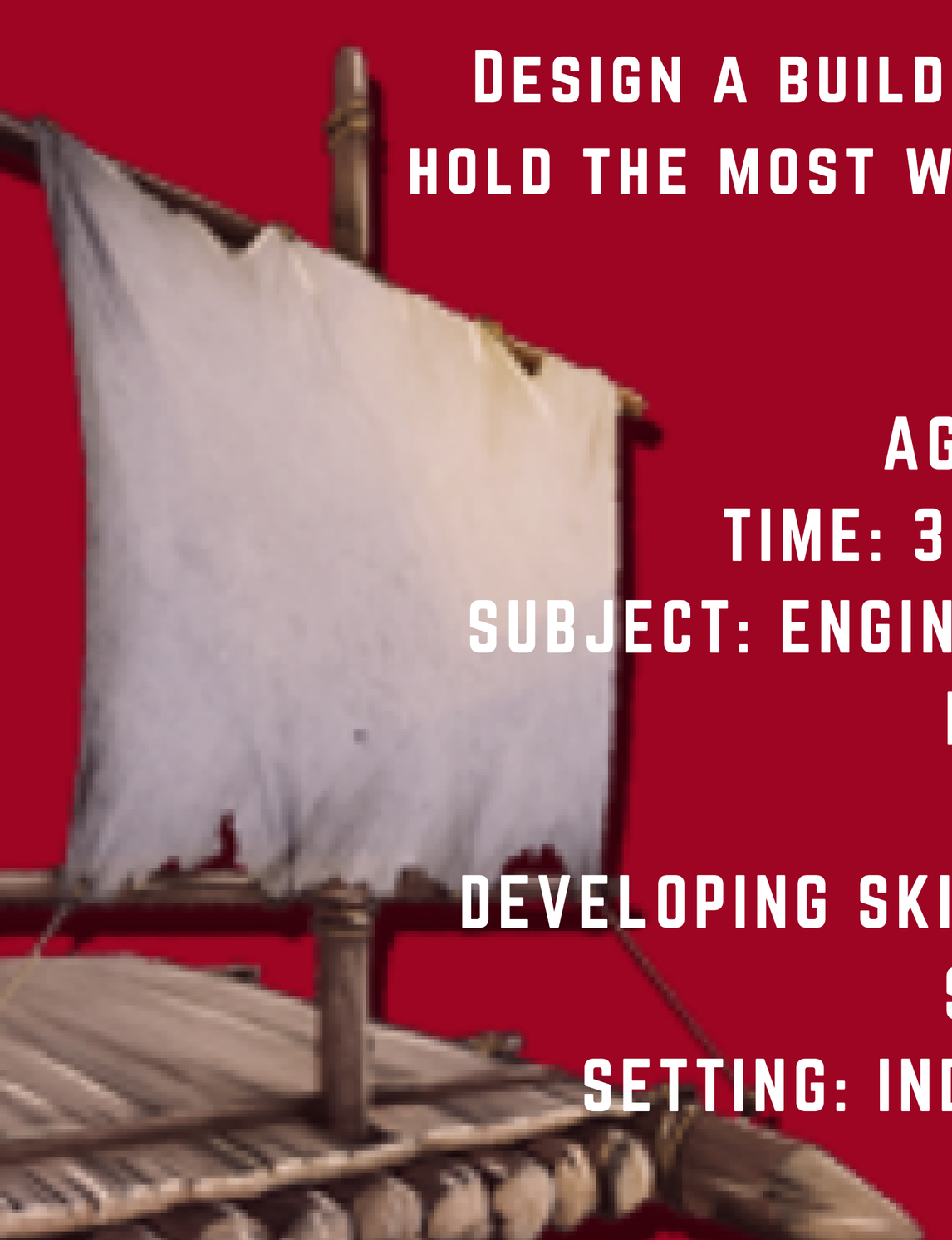
Investigate further!
Hold the mixture in your hands, squeeze it, let it go and find out what happens to the mixture in each case.

If possible, set the Oobleck in some Cling wrap and place it on top of a subwoofer, see what happens when a heavy base sound is played. This can be tough to set up, and you will need the help of an adult.

Did you know?

Most marine plastics in the world's oceans come from on land, but not from people littering. They escape out of sewer pipes and flow down rivers.

HOW CAN I BUILD A RAFT THAT HOLDS THE MOST WEIGHT?



Design a build a life raft that can hold the most weight and stay afloat!

AGES: 7 - 10

TIME: 30 - 60 MINUTES

SUBJECT: ENGINEERING & TECHNOLOGY, PHYSICS

DEVELOPING SKILLS: DESIGN, PROBLEM-SOLVING

SETTING: INDOORS OR OUTDOORS

What you need

- Large plastic container
- Water
- String
- Craft sticks
- Foam tray or packing pieces
- Pencils
- Paper or cardboard
- Wax paper
- Plasticine
- Tape
- Scissors
- Coins (or metal washers)

What to do

1. You are an engineer in a company that designs and produces life rafts. Your task is to design and build a mini life raft model that can hold the weight of several coins. The boat must float for at least one minute while carrying its load.
2. To begin, draw your design on paper.
3. Build your raft. Gradually add coins or small washers to the raft to see how much weight it can hold while staying afloat. If it does not meet the criteria in step 1, try again!

Suggestions:

- Keep in mind which materials float and which do not
- Balance is important so that the raft does not tip over
- Materials that soak up water may sink

Discovery

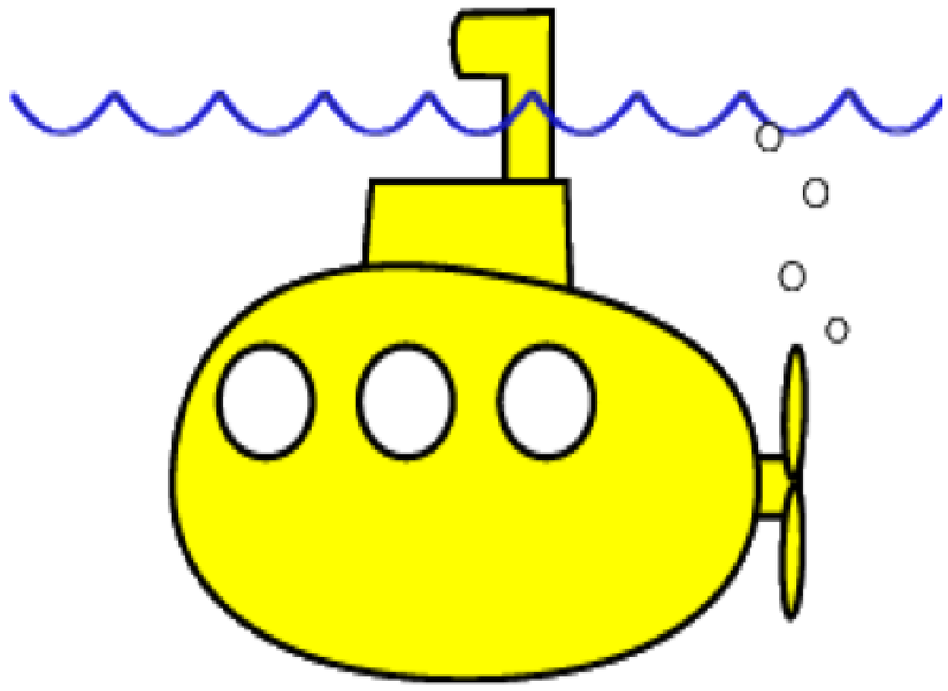
What's Happening

There are two forces acting on your raft: gravity and buoyancy. Gravity is working to pull the raft down and buoyancy is working to push the raft up. Gravity is dependent on the mass (or weight) of the raft. The heavier the raft, the more gravity it has. Buoyancy is dependent on the density (mass ÷ volume) of the raft. The less dense your raft is (with mass/weight more spread out), the more the water will push on the raft. The forces of gravity and buoyancy must be equal or balanced for the raft to float.

Why does it matter?

Engineers use the same principles illustrated above when building ships. Because gravity is pulling these ships down, large buoyant forces are needed to keep them afloat. This is achieved by constructing ships that have a lower density than water. In order to compensate for the weight of the steel hull, ocean liners are very large (increasing their volume) and have large air-filled cavities (decreasing their mass). When cargo is loaded onto these ships, they may float lower in the water because of an increase in mass and an increase in density. If a ship is too full, it might sink!

In contrast, engineers build submarines so that they do sink. To control the depth of a submarine, the crew controls the density of the ship. If the submarine crew wants to surface, they need to decrease the density of the ship. If the crew wants to sink, they need to increase the density of the ship. These changes in density occur by pumping water in and out of huge tanks onboard called ballast tanks. When the ballast tanks are filled with water, the ship will sink because of an increased density. To bring the submarine back up to the surface, the ballasts are emptied of water and filled with air, making the ship float!



Investigate further!
Watch this video by the Children's Museum of Houston: Science of Submerging (YouTube video, 4:41 min)

WHAT CAUSES OCEAN CURRENTS?

Explore the role of water temperature in the creation of ocean currents!

AGES: 6 - 8
TIME: 30 - 60 MINUTES
SUBJECT: EARTH SCIENCES, PHYSICS

DEVELOPING SKILLS: PREDICTING, OBSERVING
SETTING: INDOORS

What you need

- 2L pop bottle with top cut off
- String
- Baby food jar (or small plastic bottle with marbles for weight)
- Food colouring
- Cold water
- Hot water

Safety First! Be careful when using water from the hot water faucet. The factory setting on most hot water heaters is about 60C (140F). Skin contact with water directly from a hot water faucet can cause third degree burns after as little as 5 seconds of exposure.

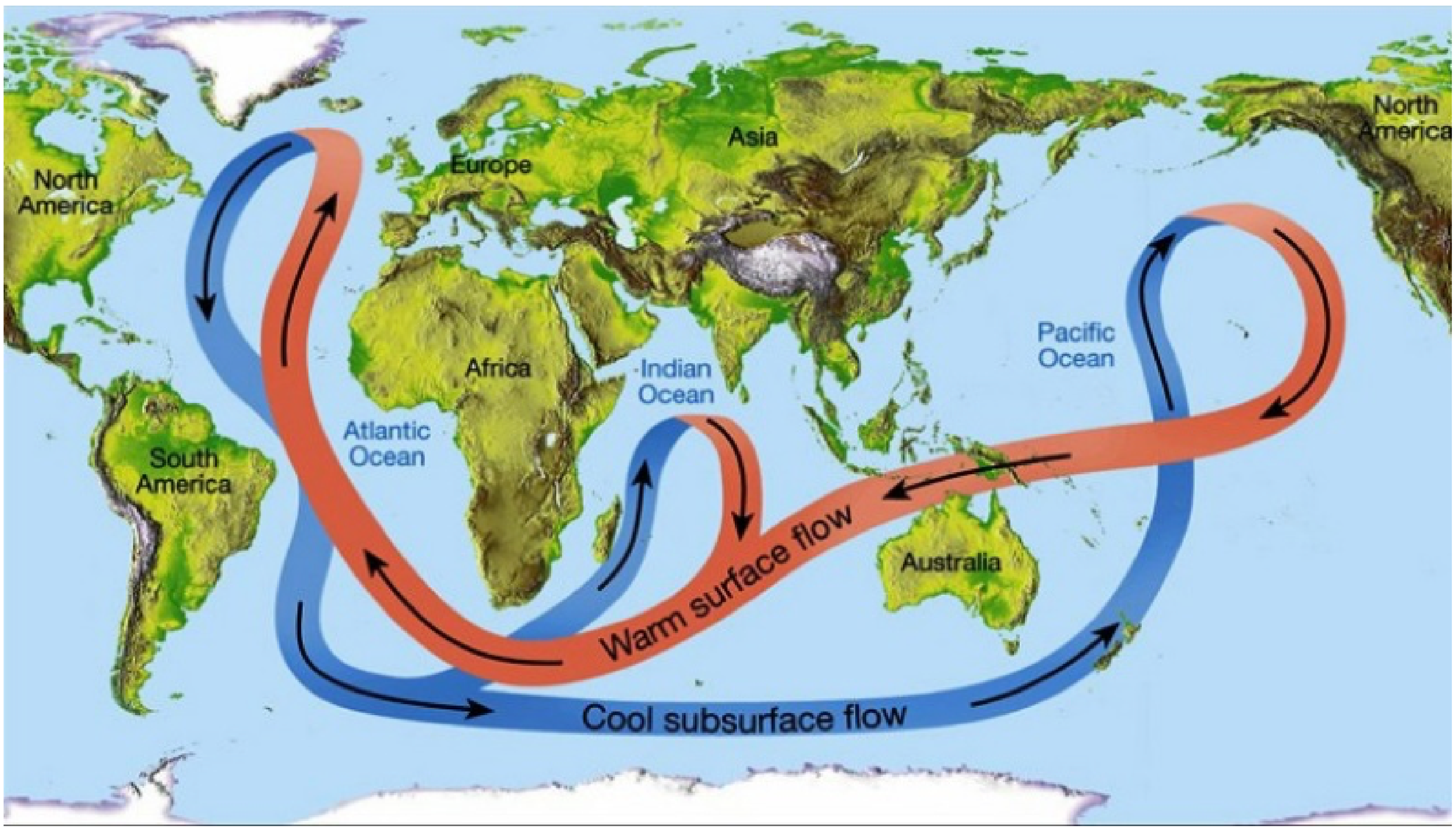
What to do

1. Fill the 2L pop bottle 2/3 full of cold water.
2. Tie string around the neck of the small bottle to form a handle. This will be used to lower the bottle to the bottom of the large container, so make sure it is long enough.
3. Add a few drops of food colouring to the small bottle and fill it with hot water from the tap.
4. Predict what you think will happen when you lower the small bottle of hot water into the pop bottle.
5. Gently lower the small bottle into the pop bottle and observe what happens. How would you explain what you are observing?

Discovery

What's happening?

Just as hot air is lighter (less dense) than cold air, hot water is lighter than cold water. The coloured hot water rises out of the small jar like lava rising from a volcano and floats to the top of the large container. As the water cools, it will gradually sink and mix with the cold water until eventually all the water will be the same colour.



Why does it matter?
Water in oceans behaves like the water in this experiment: hot water will rise to the surface and cold water will sink. The movement of different temperatures of water in oceans creates currents called convection currents.

Deep ocean currents generated by temperature gradients are important for the life cycle of many species, such as eels. They also affect the temperatures in water and on land all around the world.

Investigate further!
Try the experiment in reverse, this time filling the large bottle with hot water and the small bottle with cold water. **What do you think will happen?**

Check out this video: Colorful Convection Currents - Sick Science! #075 (Video – 1:01 min)

CITIZEN SCIENCE WEBSITES

Canadian Citizen Science
http://science.gc.ca/eic/site/063.nsf/eng/h_97169.html - This portal is where you can find all of the Canadian citizen science sites, if you are interested in all topics feel free to look through the options.

Below is a selection of sites that are relevant to the various plant and animal species that we talked about during Science Rendezvous.

Butterflies
Canada has a number of websites where you can learn about different species of butterflies, as well as track the movement of Monarchs and their food sources.

http://www.e-butterfly.org/ - an international, data driven project dedicated to butterfly biodiversity, conservation, and education

http://www.mission-monarch.org/ - a research project dedicated to monarch conservation through citizen science. Help scientists better understand the breeding habits of the butterfly!

https://www.naturewatch.ca/milkweedwatch/ - The Milkweed Watch program asks members of the public to assist researchers and citizen groups concerned with the health of monarch butterfly populations by identifying the location of milkweed plants, which are crucial for monarch reproduction in Canada.

Bats
Ontario bats have suffered population losses the last few years due to habitat loss and White Nose Syndrome. Keeping track of the population is important for their survival.

http://batwatch.ca/ - We are asking for the participation of citizens to locate bat colonies and count the number of bats living in them.

Plants
Ontario has a huge diversity of plant species, some of which are invasive. These sites allow for the tracking of various plants through their blooming times and monitoring invasive species.

https://www.naturewatch.ca/plantwatch/ - The PlantWatch program enables citizen scientists to get involved by recording flowering times for selected plant species and reporting these dates to researchers, who work to identify ecological changes that may be affecting our environment.

Birds
Have you ever wondered about the different birds in Ontario, and what their habitats and migration routes are? There are websites to help you track these things.

https://www.birdscanada.org/volunteer.jsp?lang=EN - Each year, tens of thousands of volunteers share their energy, skill, and bird sightings through Bird Studies Canada's research and monitoring programs.

Frogs
Much like butterflies, frogs and toads are very important to the diversity and health of ecosystems. Below is a site to help with tracking and monitoring of different kinds of frog and toad species.

https://www.naturewatch.ca/frogwatch/ - Worldwide, many wetland species are declining in numbers or have recently become extinct. Monitoring frog and toad populations is one way to check the health of wetland areas.

Earthworms
Earthworms are needed as part of a healthy soil ecosystem. Keeping track of the number of worms in different soil types is important to maintain a healthy ecosystem.

https://www.naturewatch.ca/wormwatch/ - WormWatch is a science-based education program that makes learning about the soil ecosystem fun.

Climate Change
With global warming an ever-present issue in the news and around the world, scientists are coming together to participate in tracking these changes and monitoring ice events.

https://www.naturewatch.ca/icewatch/ - IceWatch is part of a national volunteer monitoring programs designed to help identify ecological changes that may be affecting our environment

Hello Parents!
Let’s Talk Science is a national charitable organization committed to inspiring and empowering Canadian youth to develop the skills they need to participate and thrive in an ever-changing world. To accomplish this, Let’s Talk Science offers a comprehensive suite of science, technology, engineering and math (STEM) based programs to support youth, educators and volunteers across Canada.

Through Let’s Talk Science Outreach, we engage more than 3,500 enthusiastic post-secondary student volunteers at over 49 universities and colleges across Canada, inspiring discovery in more than 230,000 children and youth annually.

Help bring more Let’s Talk Science hands-on programs into your school and community! Encourage a classroom teacher to visit http://letstalkscience.ca/ and explore our suite of programs:

let's talk science

How do you build a stomp rocket and make elephant toothpaste? Ask your child’s teacher about inviting Let’s Talk Science Outreach programs into their classroom to explore other exciting STEM activities.
Contact us at outreach@letstalkscience.ca

Windows on Wildlife Sciences at the Wildlife Health Centre!

Catch a glimpse into the sciences involved in caring for our 5,000 different species of animals by visiting our state-of-the-art Wildlife Health Centre. This facility is the first of its kind in Canada and further enhances the Toronto Zoo as a centre of excellence in high-quality animal care through veterinary and reproductive sciences, nutritional physiology, and conservation and wildlife research.

Inside our viewing gallery take a closer look at all the behind-the-scenes work we're doing in our efforts to help save and protect species and their habitats. Viewing gallery features the following rooms:
Diagnostic Imaging room, Treatment, Surgery, Clinical Lab and
Endocrinology Lab.

Wildlife Health Centre Hours: Open 10:00 am to 4:00 pm daily.
http://www.torontozoo.com/WildlifeHealthCentre/

http://www.torontozoo.com/FightingExtinction/

Looking for a fun experience to quench your thirst for wildlife knowledge?

Go WILD this summer and connect with nature at Zoo Camp, a unique opportunity to explore wildlife from around the world. A variety of themes are offered unique to the Zoo setting including baby animals, careers, adaptations, and more! Adventures include indoor/outdoor activities, behind-the-scenes opportunities, games, crafts, and safe, rewarding FUN!

Zoo Camp is a wild week-long animal adventure for ages 4-16 where you will:

• See and learn about hundreds of amazing animals including our polar bears, penguins and Amur tigers!

• Enjoy exclusive opportunities to meet Zoo keepers, go behind-the-scenes, and have close encounters with our outreach animals!

Register today! Limited spaces available.

http://www.torontozoo.com/EducationAndCamps/CampsandPublicPrograms/?pg=ZooCamp

Toronto Zoo also offers a wide range of educational activities throughout the year for all ages!

See what is upcoming here:

http://www.torontozoo.com/Events/

http://www.torontozoo.com/EducationAndCamps/CampsandPublicPrograms/

OR, … to be the first to be notified of our upcoming programs add your email to our Zoo Programs Alert List by emailing: **programs@torontozoo.ca**