Lab Handbook

A guide to Stile's practical activities

Contents

Last updated: 13 April, 2022

About the Stile Lab Handbook

The Stile Lab Handbook has been designed to provide you with a simple, easy-to-use overview of all the practical included in Stile's online, interactive library of lessons.

Produced in conjunction with a team of expert school science technicians, we've stripped each practical activity back to include only the necessary information required to help make it quick and easy to find exactly what you need when preparing or setting up for a prac.

Unit: Introduction to Science

Related Stile unit

Using a Bunsen burner

Activity name

Activity purpose:

Activity purpose

Give students the opportunity to obtain a Bunsen burner license and then perform a short practical activity involving heating ice and water.

stileapp.com/go/bunsenburner

URL link to view the complete version of the activity online

stileapp.com/go/rabunsenburner

Online, editable risk assessment

90 - 120 minutes

Timing

2 students

Suggested group size

Materials

Materials
>lab equipment
>chemicals

Each group of students will need:

Lab equipment

- Bunsen burner
- matches or gas lighter
- 250 mL beaker
- stopwatch
- heatproof mat
- tripod
- gauze mat

Chemicals

- 4 ice cubes

Using a Bunsen burner: Page 1/3 © Stile Education 2020 10

Preparation

Preparation required by lab-tech:

Prepare ice cubes in advance.

Preparation required by teacher:

Prepare the Bunsen burner licenses (included on the following pages) in advance.

Preparation required by the lab-tech or teacher, in addition to gathering and setting out the materials

Notes

Notes for the lab-tech:

If possible, set up the beakers before the class, with the appropriate amounts of water and ice. The practical activity is focused on how to use a Bunsen burner and is not designed to test students' measuring skills.

Notes for the teacher:

This practical activity follows directly on from the previous Stile lesson (Bunsen Burner: Teacher demonstration) and assumes that students have already learnt the sequence of steps for using a Bunsen burner, as well as the safety rules.

Notes for the lab-tech or teacher

Method

Method that students will follow:

Lighting the Bunsen burner

1. Safety first – put on a lab coat and safety glasses, tie back long hair and make sure your bench is clear of anything that might catch fire.
2. Place the Bunsen burner on a heatproof mat, a safe distance from the edge of the bench.
3. Check the rubber hose for cracks and attach it securely to both the Bunsen burner and the gas tap.
4. Make sure the air hole on the Bunsen burner is closed by turning the collar.
5. Light a match and hold it above the Bunsen burner.
6. Finally, turn on the gas by rotating the gas tap.

Melting the ice/evaporating the water

1. Working in pairs, you will each do one half of the experiment. The first student will melt the ice and the second student will evaporate the water.
2. Make sure you have a bright yellow safety flame. Place the tripod on the heatproof mat, centred on the Bunsen burner. Place the gauze mat on the tripod.
3. Carefully place the beaker containing ice on the gauze mat. Make sure it sits directly above the safety flame.
4. Change to a blue flame by opening the air hole and start the stopwatch.
5. When all of the ice has melted, or all of the water has evaporated, stop the stopwatch.
6. Change back to a safety flame by closing the air hole.
7. Do not touch any of the equipment. Your teacher will carefully remove the hot beaker and place it on the heatproof mat.
8. To turn off the Bunsen burner, turn off the gas at the gas tap.
9. Wait for the equipment to cool down before packing up.

Step-by-step method that students will follow

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Science Skills

Bunsen burner (teacher demonstration)

Activity purpose:

Introduce the proper method for setting up and using a Bunsen burner safely.

stileapp.com/go/using-a-Bunsen-burner

stileapp.com/go/rabunsen

45-60 minutes

N/A

Materials

The teacher will need:

Lab equipment

- Bunsen burner
- heatproof mat
- matches or gas lighter

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

A video demonstration of how to light a Bunsen burner safely can be found in the lesson, or at: stileapp.com/go/bunsenburner

In addition to the video, we suggest that you demonstrate how to set up and use the Bunsen burner safely using your own school equipment. Point out any differences between your school's equipment and that shown in the video.

If your school's Bunsen burners have an extra gas valve at the base then demonstrate how to adjust this valve before lighting the burner, and how it affects the height of the flame.

If you would like your students to light their burners with splints or flints, then demonstrate how to do this.

You might also like to demonstrate how to adjust the height of the flame by changing the position of the gas tap.

Method

Method that students will follow:

N/A

Method that teacher will follow:

1. Safety first – model putting on a lab coat and safety glasses, tying back long hair and making sure the bench is clear of anything that might catch fire.
2. Place the Bunsen burner on a heatproof mat, a safe distance from the edge of the bench.
3. Check the rubber hose for cracks and attach it securely to both the Bunsen burner and the gas tap.
4. Make sure the air hole on the Bunsen burner is closed by turning the collar.
5. Light a match and hold it above the Bunsen burner.
6. Finally, turn on the gas by rotating the gas tap.
7. Discuss the yellow "safety" flame as compared to the less visible blue "working" flame, when the air hole in the collar is turned to the opened or closed position.

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Using a Bunsen burner

Activity purpose:

Give students the opportunity to obtain a Bunsen burner license and then perform a short practical activity involving heating ice and water.

stileapp.com/go/bunsenburner

stileapp.com/go/rabunsenburner

90 - 120 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- Bunsen burner
- matches or gas lighter
- 250 mL beaker
- stopwatch
- heatproof mat
- tripod
- gauze mat

Chemicals

- 4 ice cubes

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Preparation

Preparation required by lab-tech:

Prepare ice cubes in advance.

Preparation required by teacher:

Prepare the Bunsen burner licenses (included on the following pages) in advance.

Notes

Notes for the lab-tech:

If possible, set up the beakers before the class, with the appropriate amounts of water and ice. The practical activity is focused on how to use a Bunsen burner and is not designed to test students' measuring skills.

Notes for the teacher:

This practical activity follows directly on from the previous Stile lesson (Bunsen Burner: Teacher demonstration) and assumes that students have already learnt the sequence of steps for using a Bunsen burner, as well as the safety rules.

Method

Method that students will follow:

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5. When all of the ice has melted, or all of the water has evaporated, stop the stopwatch.
6. Change back to a safety flame by closing the air hole.
7. Do not touch any of the equipment. Your teacher will carefully remove the hot beaker and place it on the heatproof mat.
8. To turn off the Bunsen burner, turn off the gas at the gas tap.
9. Wait for the equipment to cool down before packing up.

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Bunsen Burner Licence

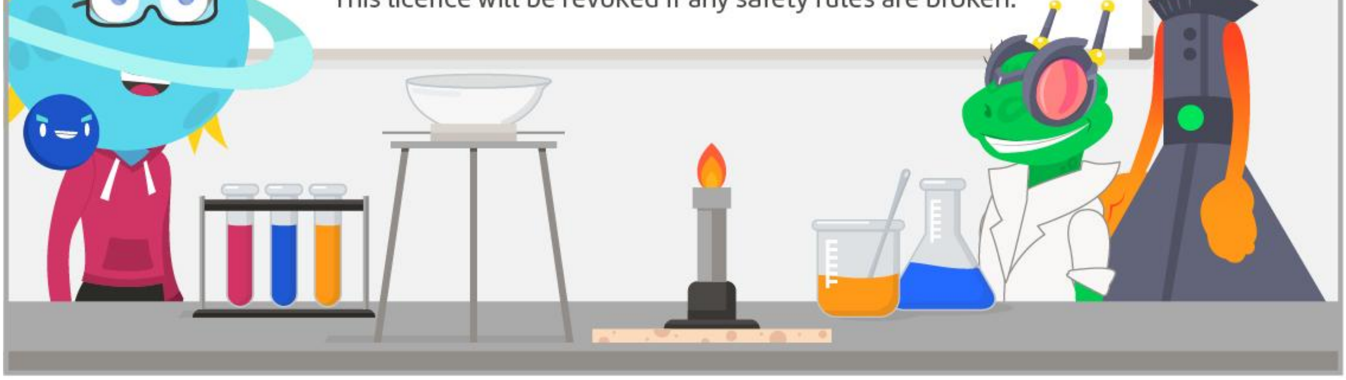
____

has demonstrated the ability to set up, light and use a Bunsen burner safely.

The holder of this licence can use a Bunsen burner when given permission by a teacher.

Awarded by: ________________________________

This licence will be revoked if any safety rules are broken.



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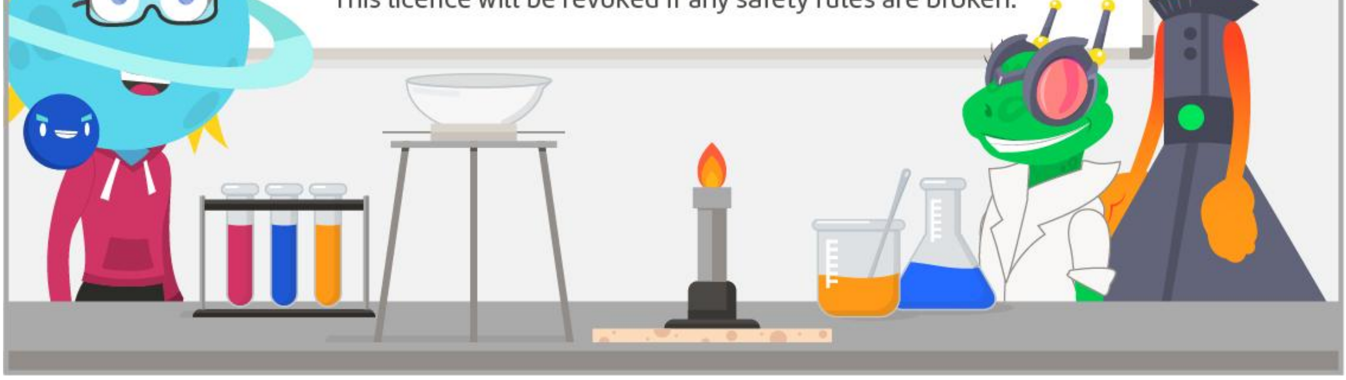

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Observing and inferring

Activity purpose:

Practise observing using different senses.

stileapp.com/go/observing

stileapp.com/go/raobserving

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 1 item that will either smell, squeeze, or make a noise when shaking
  eg:
  - balloon filled with marbles.
  - balloon filled with a squirt of deodorant
  - squeezable pet toy that squeaks or has a bell inside
- blindfold

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Hold the object for the blindfolded group member to touch with one finger. You may need to guide their hand.
2. Place the object in their hands.
3. Ask them to listen to the object. Does it make a sound? What if they shake it gently?
4. Ask them to smell the object.

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Measuring

Activity purpose:

Introduce the difference between qualitative and quantitative observations, the importance of accurate measurement and how to read common measuring equipment.

stileapp.com/go/measuring

stileapp.com/go/rameasuring

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 3 x 100 mL beakers
- test tube rack
- 6 x 30 mL test tubes or boiling tubes
- 3 mL plastic transfer pipette
- 10 mL measuring cylinder
- 25 mL measuring cylinder
- felt-tip marker

Chemicals

- 25 mL of strongly coloured red water in a 50 mL beaker
- 25 mL of strongly coloured yellow water in a 50 mL beaker
- 25 mL of strongly coloured blue water in a 50 mL beaker

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Preparation

Preparation required by lab-tech:

Prepare the different coloured water in advance, using food colouring, and make sure that the colours are strong and dark.

- Yellow: 5 mL of food dye per 100 mL water
- Blue: 1 mL of food dye per 100 mL water
- Red: 2 mL of food dye per 100 mL water

Measure out 25 mL into each beaker before the class so that each group is given one beaker of each colour.

Rinse the measuring equipment before using it to avoid contamination of colours.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

After students perform the activity, the final colours should be:
A - red
B - orange
C - yellow
D - green
E - blue
F - purple
It’s a good idea to test these results before the class to ensure that the colours are correctly prepared.

Notes for the teacher:

After students perform the activity, the final colours should be:
A - red
B - orange
C - yellow
D - green
E - blue
F - purple

Method

Method that students will follow:

1. Using the pipette, and the graduations on the side of the measuring cylinders, measure 17 mL of red water and pour it into test tube A.
2. Measure 21 mL of yellow water and pour it into test tube C.
3. Measure 22 mL of blue water and pour it into test tube E.
4. Measure 5 mL of water from test tube A and pour it into test tube B.
5. Measure 6 mL of water from test tube C and pour it into test tube D.
6. Measure 8 mL of water from test tube E and pour it into test tube F.
7. Measure 5 mL of water from test tube C and pour it into test tube B.
8. Measure 2 mL of water from test tube A and pour it into test tube F.
9. Measure 4 mL of water from test tube E and pour it into test tube D.
10. Mix the colours by gently swirling each test tube. Record the final colours in the results table below.
11. Measure the final volume of water in test tube A by pouring it into the measuring cylinder. Record this measurement in the table and pour the water back into the test tube. Repeat for the other test tubes.

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Measurement stations

Activity purpose:

Give students practice making measurements with a range of equipment.

stileapp.com/go/measurestations

stileapp.com/go/rameasurestations

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Activity 1: Length
- meter ruler
- cotton balls

Activity 2: Temperature
- 3 thermometers
- 100 mL beaker labelled ‘ice’
- 100 mL beaker labelled ‘hot’
- ice cubes
- hot water (boiled from a kettle)
- 250 mL measuring jug (for transporting hot water)
- felt-tip marker

Activity 3: Time
- 2 toy cars
- ramp (approx 1 m - 1.5 m)
- stopwatch

Activity 4: Mass
- 0.01 g electronic mass balance
- selection of toys: plastic dinosaurs, animals, lump of play dough, etc.

Activity 5: Volume
- 100 mL beaker
- 250 mL beaker
- 100 mL measuring cylinder
- 100 mL conical flask
- 250 mL conical flask
- 500 mL water

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Preparation

Preparation required by lab-tech:

This activity is best set up as a round robin, where students rotate between activity stations around the classroom.

Ice cubes should be made ahead of time.

Students will also need boiling water.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Activity 1:
1. Throw a cotton ball with your right hand.
2. Measure the distance it travelled.
3. Throw a cotton ball with your left hand.
4. Measure the distance it travelled.

Activity 2:
1. Measure the temperature of the following and record the results:
    - the room temperature of the classroom
    - cold water with ice cubes in it
    - hot water
    - your armpit.

Activity 3:
1. Set up a ramp and hold one of the cars at the top.
2. Time how long it takes for the car to roll down the ramp.
3. Repeat with the second car.

Activity 4:
1. Turn on the balance and wait for the screen to read 0.00 g. If it doesn't, press the "zero" or "tare" button.
2. Place one of the toys on the balance and wait for the reading to stop changing.
3. Record the mass of the toy in the table below.
4. Repeat steps 1 to 3 with three other toys.

Activity 5:
1. Without using the measuring cylinder, pour 52 mL of water into the 100 mL beaker. Use the measurement markings on the side of the beaker to guide you.
2. Pour the water from the beaker into the measuring cylinder to see how accurate you were. Record these results in the table below.
3. Repeat steps 1 and 2 with the 100 mL beaker, 50 mL conical flask and 100 mL conical flask.

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Using data

Activity purpose:

Provide an opportunity for students to apply the qualitative/quantitative distinction and learn how to analyze and communicate data.

stileapp.com/go/usingdata

stileapp.com/go/rausingdata

60 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- 30 cm clear plastic ruler
- 0.01 g electronic mass balance
- device to take photos
- calculator

Chemicals

- three different brands of gummy worms
- 3 worms of each brand per group (9 worms per group in total)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Gummy worms should not be eaten in a laboratory setting.

This activity is a great starting point to discuss:

- the differences between qualitative and quantitative data and how they are used
- how to make accurate measurements of mass and length
- the importance of repeating measurements to improve accuracy sample sizes and uncertainty

Method

Method that students will follow:

1. Divide worms into 3 species (sort by colour, should have 3 of each colour).
2. Collect qualitative observations.
3. Using the scales, weigh each worm and record its weight in the data table provided.
4. Using a ruler, measure the length of each worm recording its length in the data table provided.

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Conducting an investigation

Activity purpose:

Guide students through the steps required to plan and conduct an investigation, and communicate the results.

stileapp.com/go/investigating

stileapp.com/go/rainvestigating

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- Bunsen burner
- heatproof mat
- matches or lighter
- tripod
- gauze mat
- 100 mL measuring cylinder
- 2 x 250 mL beakers
- spatula
- stirring rod
- 2 stopwatches
- 0.1 g electronic mass balance
- weighing boat

Chemicals

- 50 g sugar
- water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

If an electronic mass balance is available, you may prefer students to measure out the sugar more accurately than simply using a spatula.

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

Every scientific investigation begins with a question. The possible questions are endless... Why are most plants green? What causes the tides? How can we make smartphones water-resistant?

To answer your question, you need to investigate! A scientific investigation has three main stages:

1. Planning the investigation: This usually involves making a prediction and designing a way of testing it. It is often time-consuming but very important. You need a detailed plan with a step-by-step method, a list of materials and a list of safety hazards.
2. Conducting the investigation: Following the method set out in your plan, you need to carefully gather and record results. Repeating this process several times will make your results more reliable.
3. Communicating the results: Just getting results is not enough. You need to find a way of analyzing what they mean and presenting them clearly to an audience.

In this activity you will be guided through all three stages of an investigation. Your question is a simple one:

Does sugar dissolve faster in cold water or hot water?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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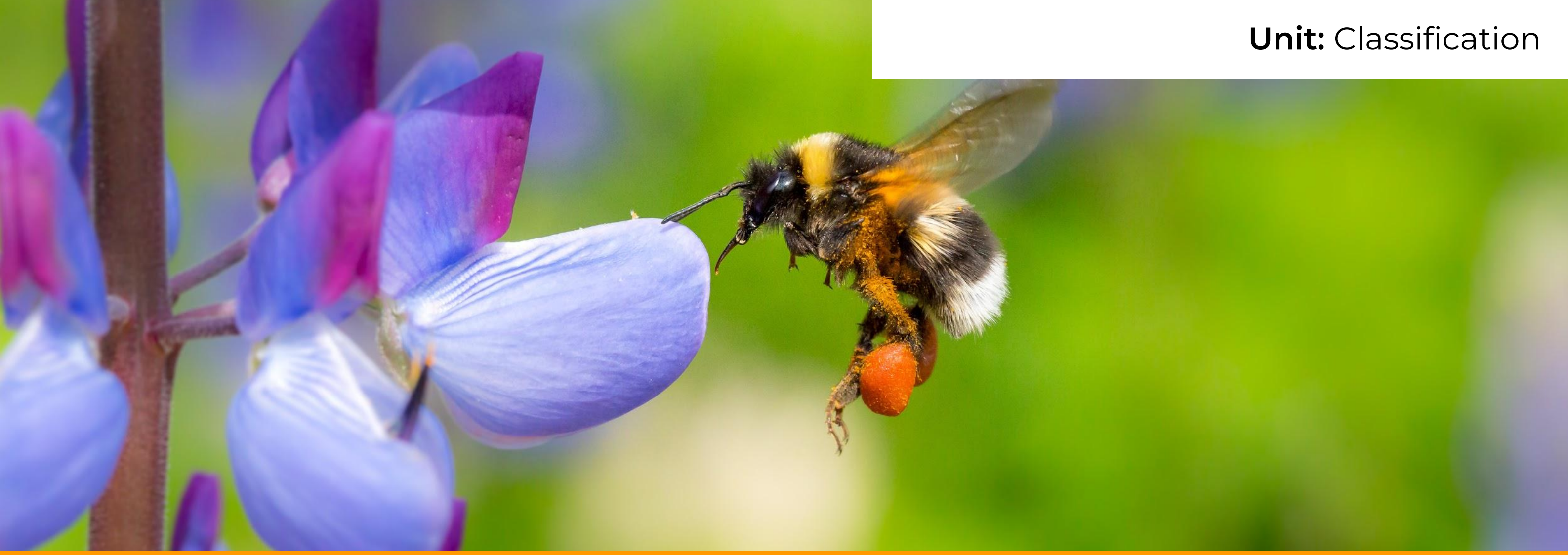
Biology



Living or non-living?

Activity purpose:

Compare living and non-living things.

stileapp.com/go/living

stileapp.com/go/raliving

45-60 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- corks
- shells
- live crickets, earthworms, bugs (optional)
- seeds
- plants or flowers (growing in pots of soil)
- plants or flowers (recently cut or picked)
- bark
- bones
- various pictures of lava, fruit and vegetables, water, plastic bottles, a cocoon, crystals, a penguin, yeast, mould, a flowing stream, cut logs, a smartphone, the Sun, a moth, a sea sponge, a drone, a hummingbird and Earth (a set of pictures is included on the following pages)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Photocopy the attached pictures. You may like to laminate them for future use.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Students classify each object as ‘living’ or ‘non-living’.

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Lava

Freshly picked fruit and vegetables

Water

Plastic bottles

A cocoon

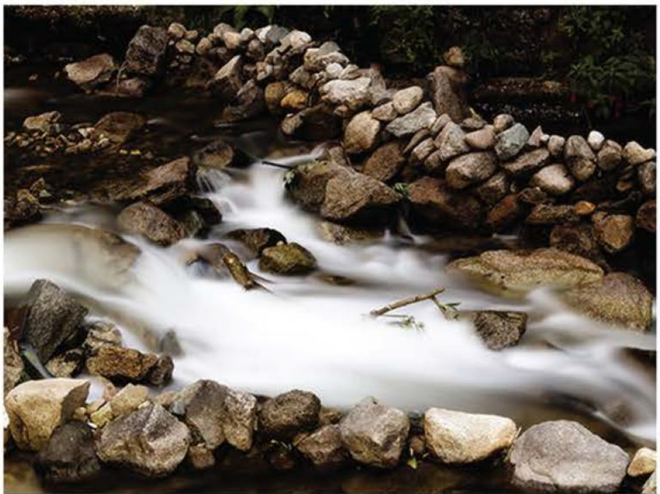
Crystals

© Stile Education 2020

A penguin

Yeast to grow bread

Mould on tomatoes

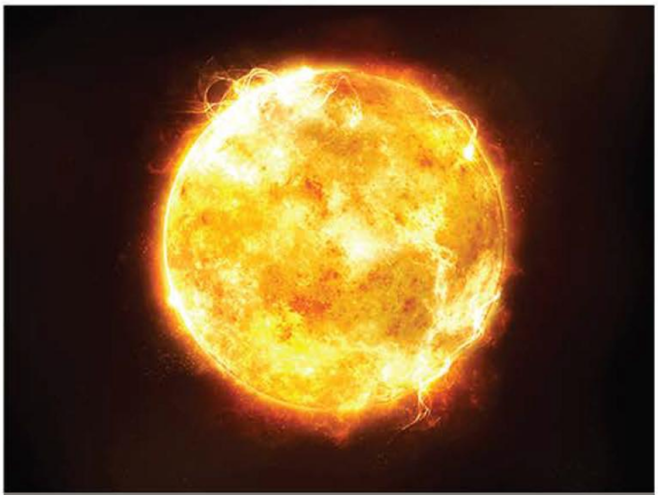


A flowing stream

Cut logs

A smart phone

© Stile Education 2020



The Sun

A moth

A sea sponge

A drone

A hummingbird

The planet Earth

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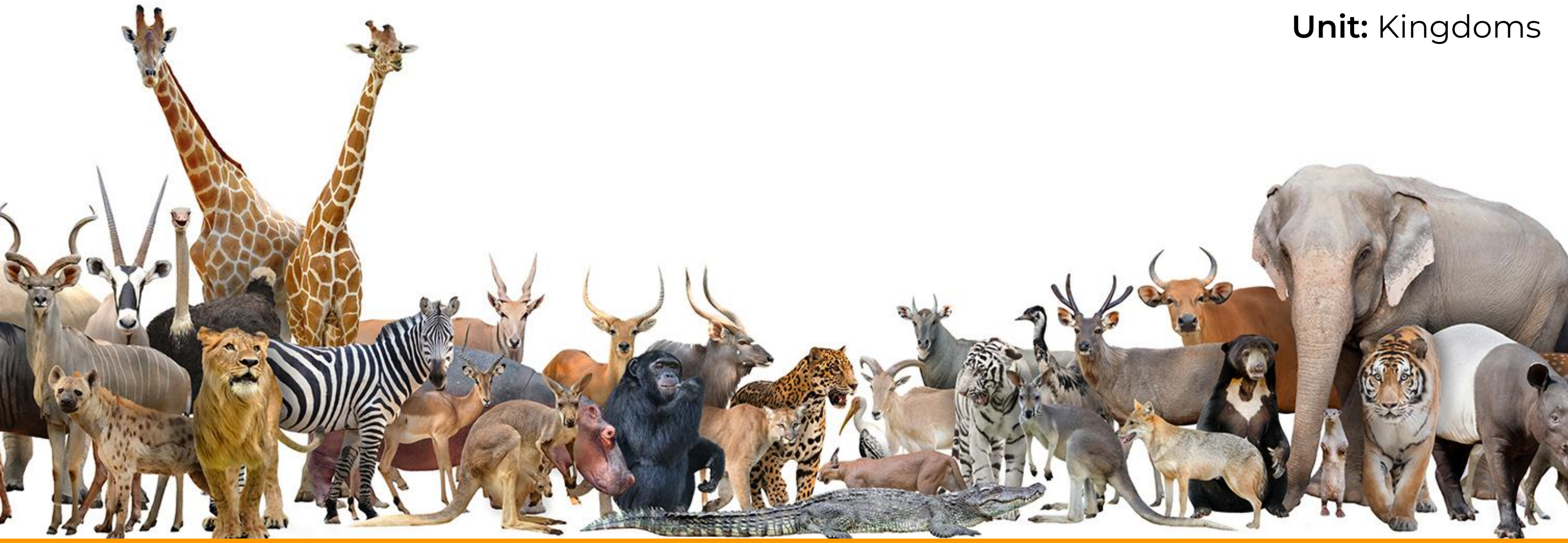

Creating kingdoms

Activity purpose:

Classify a collection of living things into kingdoms.

stileapp.com/go/kingdoms

stileapp.com/go/rakingdoms

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- set of kingdom cards (included on following pages)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Photocopy and laminate the card sets in advance.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Examine the cards that you have been given.
2. Using the information and images provided on the cards, group the organisms into *three new kingdoms.*
3. Name each of your kingdoms and explain your groupings.
4. Choose another organism to go on the blank card, or invent a new organism of your own. Classify the organism into one of the three kingdoms that you've created.
5. Add your own organism onto the blank card. This can either be an existing organism or one that you make up.
6. Which of your kingdoms does the organism belong to? Swap cards with a neighbour and identify which of your kingdoms their organism belongs to.

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kangaroo

Physical characteristic:
Has strong muscles

How it obtains energy:
Eats plants

Reproduction information:
Gives birth to live young

Additional information:
- Multicellular organism
- Can be red or grey in colour

acacia

Physical characteristic:
Has rounded leaves and thorns

How it obtains energy:
Absorbs sunlight

Reproduction information:
Releases seeds

Additional information:
- Has a cell wall
- Fire resistant and has long roots
- Multicellular organism

arman

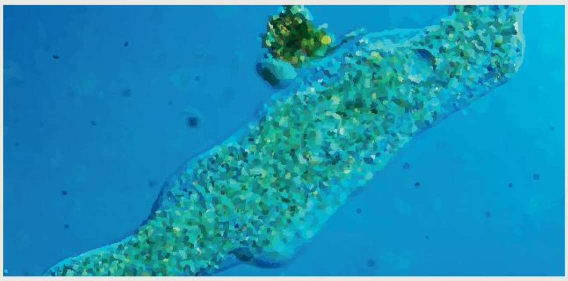
Physical characteristic:
Is microscopic

How it obtains energy:
Absorbs energy from its surroundings

Reproduction information:
Replicates itself

Additional information:
- No nucleus
- Has a cell wall

amoeba



Physical characteristic:
Is microscopic

How it obtains energy:
Eats plankton

Reproduction information:
Replicates itself

Additional information:
- Single cell

© Stile Education 2020

ebola

Physical characteristic:
Is microscopic

How it obtains energy:
Obtains nutrients from its host

Reproduction information:
Replicates itself

Additional information:
- No nucleus

martian

Physical characteristic:
Has weak muscles

How it obtains energy:
Absorbs sunlight

Reproduction information:
Replicates itself

Additional information:
- Likes high temperatures
- Communicates via telepathy
- Multicellular organism

lorikeet

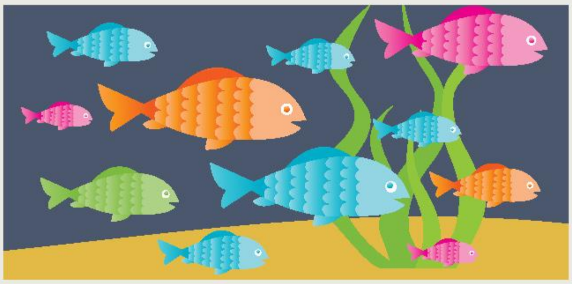
Physical characteristic:
Is highly colorful

How it obtains energy:
Eats nectar and soft fruit

Reproduction information:
Lays eggs

Additional information:
- Brush-tipped tongue
- Weights around 150g
- Multicellular organism

glofish



Physical characteristic:
Glows in the dark

How it obtains energy:
Eats spinach and glass worms

Reproduction information:
Lay eggs

Additional information:
- Streamlined colorful body
- Multicellular organism

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fern

Physical characteristic:
Has green leaves (fronds)

How it obtains energy:
Absorbs sunlight

Reproduction information:
Releases spores

Additional information:
- Can be several metres tall
- Multicellular organism

Physical characteristic:

How it obtains energy:

Reproduction information:

Additional information:

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Modelling a food web

Activity purpose:

Apply an understanding of food webs and the impact of removing a species from an ecosystem.

stileapp.com/go/foodweb

stileapp.com/go/rafoodweb

45-60 minutes

Whole class or large group

Materials

Each group of students will need:

Lab equipment

- ball of wool
- food web cards (included on following pages)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Photocopy and laminate the food web cards in advance.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This activity could also be used as a hook to start the unit, allowing students to appreciate the close links between organisms in an ecosystem.

On the other hand, you can have a much richer discussion if students have learned about food chains and food webs. For example, in Part 2 of this activity you could discuss which organisms would benefit or be harmed if one organism were to go extinct.

Method

Method that students will follow:

Part 1:

1. To begin, each person will get a card describing which organism they will represent in the food web.
2. Read your food web card to find out what your organism eats and what eats it
3. Stand up and form a circle.
4. Choose one member of the group to start with the ball of wool.
5. The person with the wool holds on tightly to one end and passes the ball to someone who represents an organism that they eat or are eaten by. While they pass the ball of wool, they should describe the connection out loud. For example, they might say, "I am a stingray and I get energy by eating the shrimp."
6. Repeat step 5 until every person in the circle has at least one or two connections to others in the group.

Part 2:

1. Nominate one organism in the group to become "extinct". That person should drop any pieces of wool they are holding on to.
2. Observe what happens to the appearance of the food web.
3. Identify the organisms that were directly connected to the one that went extinct. These organisms have been affected by the extinction. The people who represent these organisms should drop any pieces of wool they are holding on to.
4. Observe what happens to the appearance of the food web.
5. Repeat steps 3 and 4 once more.

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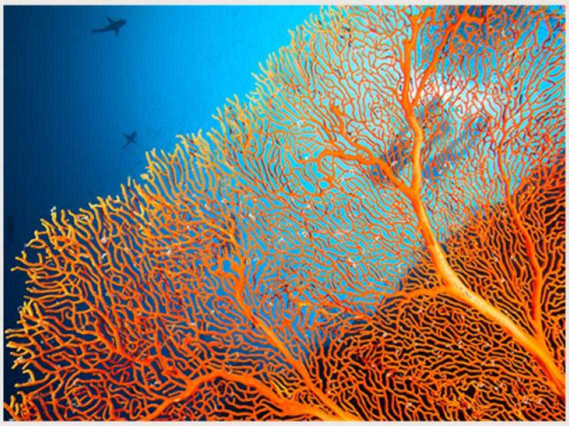
coral



I get energy from the algae that live with me. I also eat zooplankton.

I am eaten by sea snails, starfish and parrotfish.

seaweed

I am a producer.

I am eaten by jellyfish, sea urchins, sea turtles, butterflyfish and sea snails.

algae

I am a producer.

I am eaten by butterflyfish, clownfish, parrotfish and clams.

anemone

I eat zooplankton, shrimp and mussels.

I am eaten by starfish, eels, butterflyfish and crabs.

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clownfish

I eat algae, zooplankton, phytoplankton and shrimp

I am eaten by eels, reef sharks, lionfish and octopi.

sea turtle

I eat seaweed, jellyfish, crabs and sea cucumbers.

In the reef, I am safe from most of my natural predators, except for humans.

stingray

I eat clams, shrimp, sea snails and lionfish.

In the reef, I am safe from most of my natural predators, except for humans.

octopus

I eat clams, sea snails, shrimp and clown fish.

I am eaten by reef sharks and humans.

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parrot fish

I eat algae and dead coral.

I am eaten by eels and reef sharks.

eel

I eat clownfish, butterflyfish and anemones.

I am eaten by reef sharks and humans.

clam

I eat algae, phytoplankton and zooplankton.

I am eaten by crabs, starfish, octopi, stingrays and humans.

shrimp

I eat algae, phytoplankton and zooplankton.

I am eaten by butterflyfish, anemones, clownfish and lionfish.

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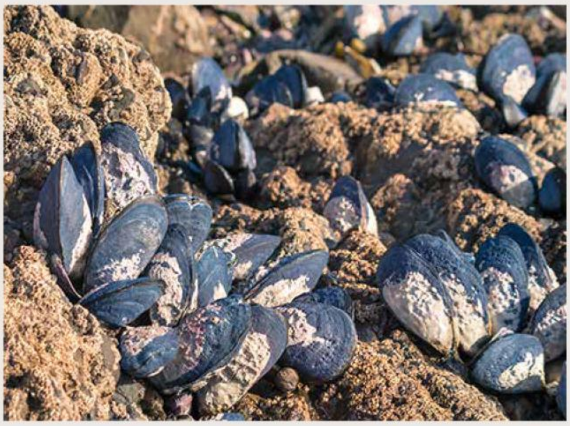
mussel



I eat phytoplankton and zooplankton.

I am eaten by anemones, starfish and humans.

lionfish

I eat shrimp, sea snails, clownfish, butterflyfish and crabs.

I am eaten by eels and stingrays.

sea urchin

I eat seaweed and dead animals like fish and jellyfish.

I am eaten by crabs, eels and humans.

jellyfish

I eat seaweed, phytoplankton, zooplankton and butterflyfish.

I am eaten by sea turtles.

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crab

I eat anemones, clams, sea snails, sea urchins, sea cucumbers and starfish.

I am eaten by butterflyfish, lionfish, sea turtles and humans.

butterflyfish

I eat seaweed, algae, zooplankton, small crabs and shrimp.

I am eaten by lionfish, eels, reef sharks and jellyfish.

phytoplankton

I am a producer.

I am eaten by zooplankton, clams, clownfish, shrimp and jellyfish.

zooplankton

I eat phytoplankton.

I am eaten by butterflyfish, clownfish, clams, corals, shrimp, mussels and jellyfish.

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human

I eat crabs, sea turtles, sea snails, reef sharks, sea urchins, mussels, clams, eels, octopi and stingrays.

In the reef, I don't have any natural predators.

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Using a microscope

Activity purpose:

Teach basic microscope skills, including how to prepare, view and draw dry mount slides.

stileapp.com/go/usingmicroscope

stileapp.com/go/rausingmicroscope

45-60 minutes

1-2 students

Materials

Each group of students will need:

Lab equipment

- microscopes
- flat microscope slide (for newspaper, wool, string etc)
- 2 x concave microscope slide (for sugar, salt, seeds etc)
- sticky tape
- 1 cm^2 squares of printed text containing the letter 'e'
- small chattaway spatula

Optional:
- a range of small objects to observe, e.g. sand, glitter, different fabric swatches, wool, string, pipe cleaners, tiny seeds, surfaces with interesting textures (provide just a few options to limit student choice if timing is an issue)
- a microscope camera to project microscope images for the whole class to see

Chemicals

- tip of a small chattaway spatula of table salt
- tip of a small chattaway spatula of white sugar

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Preparation

Preparation required by lab-tech:

Prepare 1 cm^2 squares of printed text containing the letter 'e' in advance.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

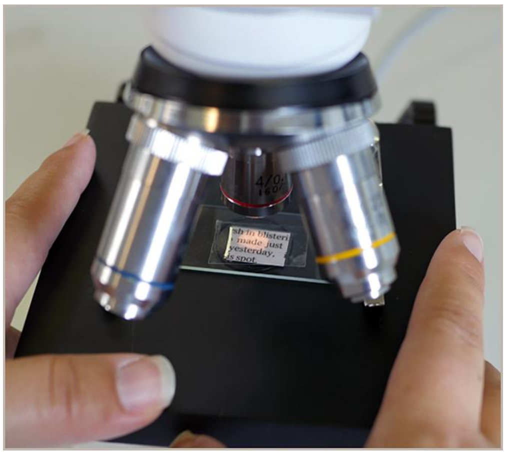
N/A

Method

Method that students will follow:

Part 1:

1. Use sticky tape to attach the square of printed text to the microscope slide.
2. Locate a letter 'e' and place it over the centre of the light on the microscope stage.
3. Rotate the slide so the 'e' is the right way up when you look at it without the microscope (as shown in the photo, right).
4. With the lowest power objective lens, locate the 'e'. Move it to the centre of the field of view and adjust the focus.
5. Zoom in to the next power objective lens and re-adjust the focus if necessary.



Part 2:

1. Observe sugar and salt without a microscope.
2. Record observations.
3. Observe sugar and salt with a microscope.
4. Record observations.

Part 3:

1. Explore which magnification is best to view your specimen. When you're ready, draw the specimen on paper with a pencil so you can erase any mistakes.

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Measuring with microscopes

Activity purpose:

Explain how to use a microscope’s field of view to measure the size of a specimen.

stileapp.com/go/measuremicroscope

stileapp.com/go/rameasuremicroscope

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- compound light microscopes
- 4 concave microscope slides
- small beakers or cupcake liners (to carry seeds)
- transparent metric rulers (without sloped or bevelled edges)
- tweezers (to transfer seeds from the beaker)
- variety of small seeds

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

We recommend poppy, sesame, fennel and mustard seeds as these are commonly found in supermarkets. You may also like to use flower or vegetable seeds from gardening stores, such as celery, basil and carrot seeds. Note that seeds like dandelion, radish and coriander are too big to measure with a microscope.

Notes for the teacher:

This activity requires students to have been introduced to micrometres and how to convert between different units of length (as covered in the Sizes of cells lesson).

Microscopic measurement size reference chart:

Item	Magnification used	Items/diameter	Calculation: field diameter /number of items	length of item (mm)	length (um)
Field diameter	40X	1	none	4 (direct measure)	4000
Field diameter	100X	1	none	1.5 (direct measure)	1500
Field diameter	400X	1	none	0.375	375
Hair	40X	45	4 mm/45 hair widths	0.089	89
Onion cell	40X	15	4 mm/15 cells	0.27	270
Onion cell	100X	6	1.5 mm/6 cells	0.25	250
Spinach cell	100X	10	1.5 mm/10 cells	0.15	150
Human cheek cell	400X	8	0.375 mm/8 cells	0.047	47
Poppy seed	40X	4	4 mm/4 seeds	1	1000
Black mustard seed	40X	3	4 mm/3 seeds	1.33	1330
Celery seed	40X	3	4 mm/3 seeds	1.33	1330
Basil seed	40X	2.5	4 mm/2.5 seeds	1.6	1600
Yellow mustard seed	40X	2	4 mm/2 seeds	2	2000
Carrot seed	40X	2	4 mm/2 seeds	2	2000
Sesame seed	40X	1.5	4 mm/1.5 seeds	2.67	2670
Dill seed	40X	1.25	4 mm/1.25 seeds	3.2	3200
Caraway seed	40X	1	4 mm/ 1 seed	4	4000
Fennel seed	40X	0.75	4 mm/0.75 seeds	5.33	5330
Dandelion seed	40X	too big to measure			
Radish seed	40X	too big to measure			
Coriander seed	40X	too big to measure			

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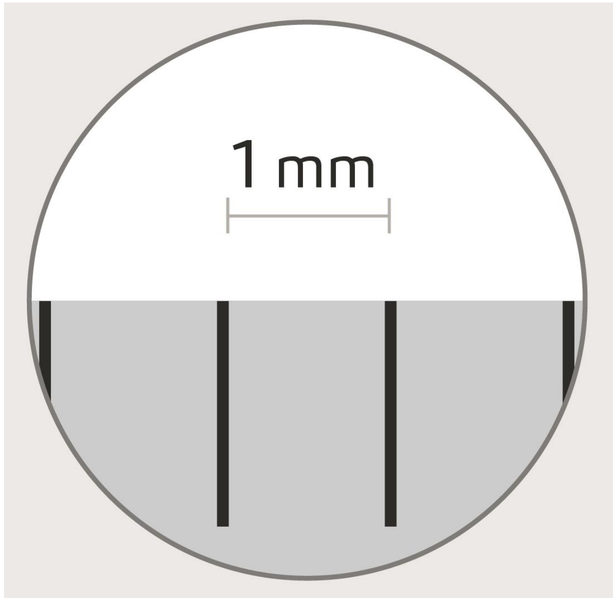
Method

Method that students will follow:

Part 1: Measuring the field of view

1. Set up the microscope with the lowest power objective lens. Calculate the total magnification and enter it into the first row of the results table below.
2. Place the ruler on the stage and focus the microscope on the ruler markings.
3. Line up the ruler so that it crosses the full diameter of the field of view, as shown in the diagram. Check that the left-hand marking is on the edge of the field of view.
4. Starting from the left-hand marking (zero), count the markings on the ruler. This is the diameter. Record the measurement (in mm) in the results table.(Note: If you can, use decimals to improve accuracy. e.g. 3.2 mm if there is an extra 0.2 mm in view)
5. Repeat Steps 1–4 using the other objective lenses.
6. Convert the measurements to µm and complete the results table.



Line up the ruler across the diameter of the field of view. Notice how the left-hand marking is right on the edge of the field of view.

Part 2: Calculating the sizes of specimens

1. Using the tweezers provided, place one poppy seed on your microscope slide. Use the lowest power objective lens to focus on the poppy seed.
2. If appropriate, select a higher powered objective lens. If the seed takes up the whole field of view after zooming in, zoom back out until the whole seed is in view.
3. Estimate the number of seeds that would fit across the diameter by imagining a row of them (right). Record this number and the total magnification in the results table below.
4. Repeat Steps 1–3 for the other types of seeds.

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Make a cell model

Activity purpose:

Build a physical model of a plant or animal cell, or create an analogy to illustrate the functions of the parts of a cell.

stileapp.com/go/cellmodel

stileapp.com/go/racellmodel

100-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

To be determined by students.

If this lesson is being completed in the classroom (rather than as a homework task), assorted materials will need to be provided for students to create their models. These may include craft materials, household items, food items, stationery, etc. Students could also be encouraged to gather their own materials which can be assessed by the teacher as suitable for this task.

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Linked within the Stile lesson are the following:

- examples of physical models: jelly cell model, plasticine cell model
- examples of analogies: amusement park, circus, restaurant, Harry Potter – you might like to suggest these to students who struggle to come up with their own ideas.

Other alternatives to this activity:

- throw a class "cell party" and have each student bring along a food item that could be used as a model for a cell, e.g. a cell pizza, cell cupcakes, etc.
- prepare cupcakes and different coloured Icing in piping bags. Have students create "cell cupcakes" by decorating the cupcakes with different organelles and structures.

Method

Method that students will follow:

Students will create a model cell using materials of their own choice.

Instructions provided to students include:

Build a model of either a plant or an animal cell.

Your model can be 2D or 3D.

- All parts of the cell must be clearly labelled
- All parts of the cell must be accurately represented in terms of their size and shape
- For a *plant cell*, you must include the following parts: cell wall, cell membrane, nucleus, vacuole, mitochondria, chloroplasts, cytosol
- For an *animal cell*, you must include the following parts: cell membrane, nucleus, vacuoles, mitochondria, cytosol

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Observing plant and animal cells

Activity purpose:

Compare and contrast plant and animal cells using a microscope.

stileapp.com/go/plantanimalcells

stileapp.com/go/raplantanimalcells

100-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- light microscopes
- pre-prepared slide sets:
- slide 1, labelled "Meat sample" and containing animal cells (we recommend cheek cells)
- slide 2, labelled "Plant sample" and containing plant cells (preferably containing chloroplasts so they can easily be recognized as plant cells) *note: Leaf epidermis cells are not ideal for this activity because they tend to lack chloroplasts.*
- slide 3, labelled "Sample X" and containing plant cells (similar to Slide 2 and preferably containing chloroplasts)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This practical activity follows on from the previous lesson and assumes that students are familiar with the rules of scientific drawing, as well as the main structural differences between plant and animal cells.

We also assume that students are familiar with how to use microscopes safely and how to choose the best magnification for observing and drawing cells (as covered earlier in the unit). The 40x magnification is usually too weak for this practical. Cell features will be easier to observe at 100x or 400x magnification.

However, you may want to limit the students to 100x to avoid the risk of damaging the slides at 400x.

Method

Method that students will follow:

Part 1:

1. Use a microscope to observe Slide 1: Meat sample. Focus and zoom in until you can clearly see the structure of individual cells.
2. Draw a diagram of one or more cells, following the rules of scientific drawing. Write a detailed description of what you observe.
3. Repeat steps 1–2 for Slide 2: Plant sample.

Part 2:

1. Use a microscope to observe Slide 3: Sample X. Focus and zoom in until you can clearly see the structure of individual cells.
2. Draw a scientific diagram of what you observe and write a detailed description.

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Viewing leaf epidermis cells

Activity purpose:

Use a light microscope to observe leaf epidermis cells.

stileapp.com/go/leafepidermis

stileapp.com/go/raleafepidermis

100-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- suitable leaf - examples include common ivy, ribbon grass, spider plant, geranium, hibiscus, sweet pea, broad bean or most succulents, such as "Mother-in-law's Tongue"
- 1 mL artists' colourless water-based varnish or colourless nail varnish
- compound light microscope
- microscope slide
- forceps
- 1 cm2 of wax or grease-proof paper
- 10 cm colourless sticky tape
- small scissors

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

We highly recommend that you test this practical activity before doing it in class. Depending on the types of leaves and varnish that you use, you may need to adjust the method in order to get optimal results. For example, some varnishes will work best if they are pressed onto the leaf while still not fully set.

Prepare leaves by placing branches in water somewhere with good light.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

Artists' colourless water-based varnish usually yields better results than nail varnish.

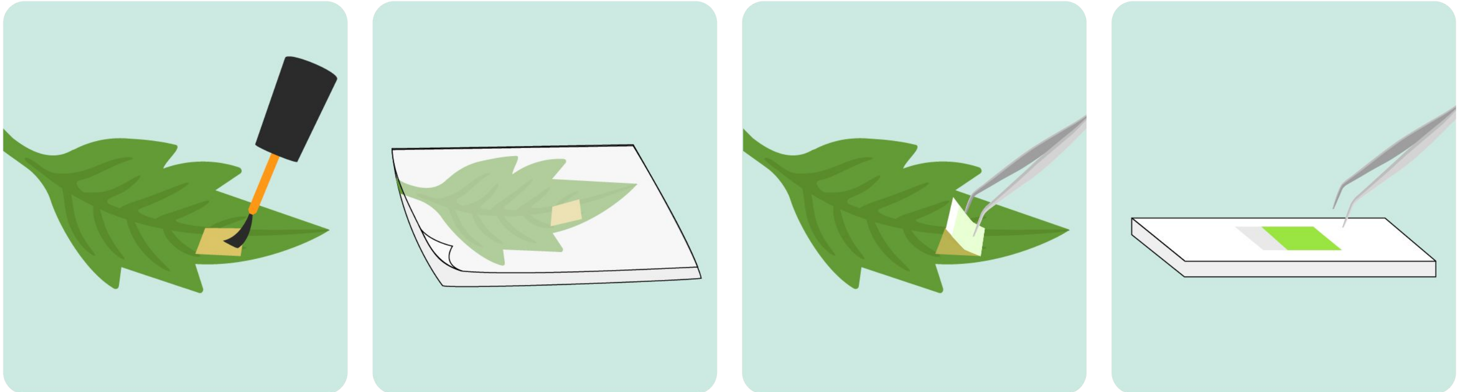
Notes for the teacher:

Most stomata are located on the lower epidermis of leaves. The dry leaf impress should reveal the stomata, guard cells and pavement cells. Students should be able to see the cell wall but are not likely to see the cell membrane.

Method

Method that students will follow:

1. Paint a thin patch of varnish approximately 1 cm^2 on the lower surface of your leaf and leave until the varnish is tacky but not completely dry. Avoid painting over major veins.
2. Place a sheet of wax paper over the varnish patch and press down on it for about 45 seconds. *Note: Depending on the varnish and leaves you may be able to skip this step; ask your teacher.*
3. Wait for the varnish to fully harden.
4. Optionally create a small handle to lift the dried varnish off the leaf:
    - cut a piece of sticky tape about 2 cm long. Fold the tape over on itself leaving a narrow sticky strip 2 or 3 millimetres wide.
    - place the sticky part of the tape along one edge of the varnish patch.
5. Use the forceps (and sticky-tape handle if you made one) to carefully peel the varnish from the leaf surface. If you need to, use the scissors to cut off the sticky tape handle.
6. Place the varnish patch on the microscope slide.
7. Examine the impression under low, medium and high magnification.



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Flower dissection

Activity purpose:

Examine the main parts of a flower and their roles in plant reproduction.

stileapp.com/go/leafepidermis

stileapp.com/go/raleafepidermis

100-120 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- 1 flower species
- scalpel
- tweezers
- magnifying glass or hand lens
- cutting boards
- *optional:* A3 paper, marker and sticky tape for poster activity

Chemicals

- glass of water

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Preparation

Preparation required by lab-tech:

We recommend that all students in the class use the same flower species for their first dissection. Not all flowers work well for this activity. The best flowers are *Alstroemeria* lilies, tulips, daffodils, carnations, petunias and gladioli. Flowers that should be avoided include daisies, asters, calla lilies, roses and irises, as their parts are more challenging to identify.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

A video of a flower dissection has been included to guide students. You will need to run through how to safely use a scalpel before students begin the dissection. Some main points to discuss include:

1. Students should never touch the blade.
2. Highlight that there is a sharp edge to the blade that will do the cutting.
3. All cutting needs to be done on a cutting board.
4. Cuts should be made in a slow, dragging back motion.

Extension: Students who are proficient at the first dissection can be given 2–4 additional flowers of different species to dissect. They can then identify similarities and differences between the species based on their observations.

Optional poster activity: Students can produce a poster of their dissections by taping their dissected flowers to A3 paper and labelling each part.

Method

Method that students will follow:

1. Gently remove the sepal and petals by pulling them away from the stem of the flower.
2. Use the tweezers to remove the male parts (anther and filaments) of the flower.
3. Closely observe the anther with the magnifying glass – you may see some pollen grains.
4. The female part should now be exposed. Carefully use the scalpel and cutting board to cut the ovary open.
5. Closely observe the ovary with the magnifying glass – you may be able to see the eggs.

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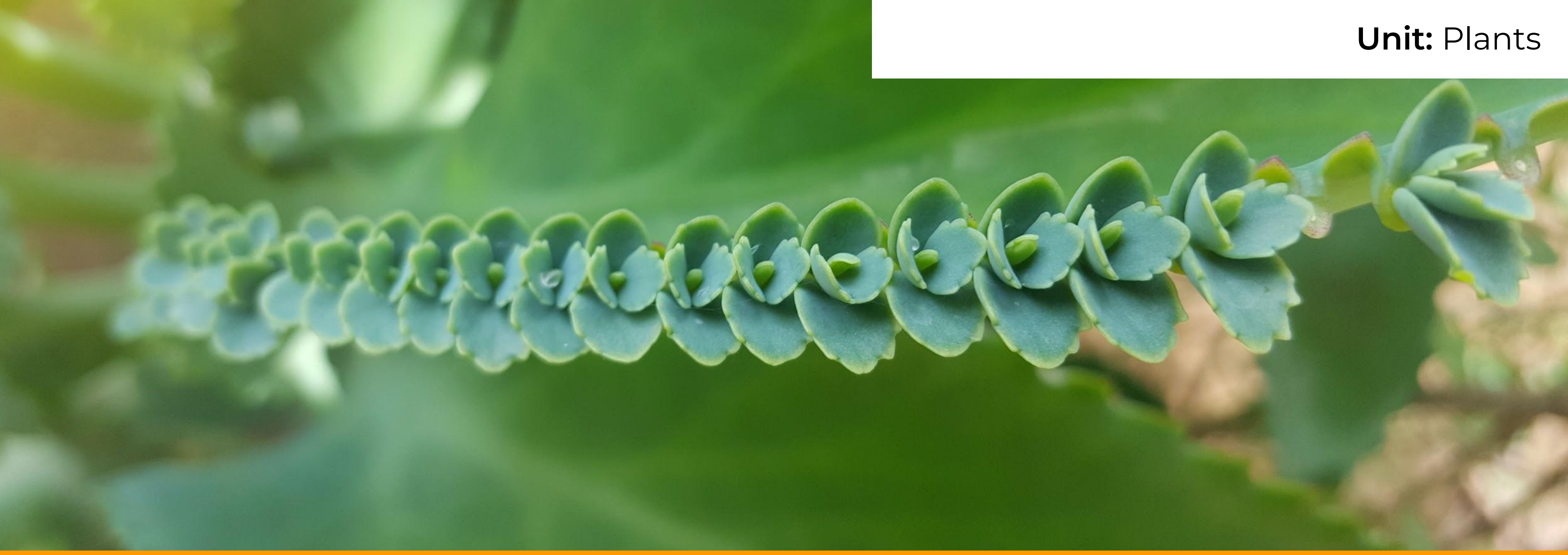

Asexual reproduction in plants

Activity purpose:

Research asexual reproduction in plants and propagate a plant.

stileapp.com/go/leafepidermis

stileapp.com/go/raleafepidermis

30 minutes to set up the project

2 students

Materials

Each group of students will need:

Lab equipment

- beaker or glass jar
- knife
- chopping board
- 1 bunch of spring onions

Chemicals

- water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Spring onions are some of the quickest growers so are a good option if you are short on time. Small shoots can start to grow in just 1-2 days. This could be easily done at home or in the classroom.

If you have more time, alternative plants your students could grow (with the approximate time before they start sprouting) include:

- spider plants (7–10 days)
- Devil's ivy (1–2 weeks)
- succulents (3 weeks)
- lavender (2–4 weeks)
- basil (2–4 weeks)
- African violets (3–4 weeks)
- strawberries (4–6 weeks)

Method

Method that students will follow:

Method for spring onion propagation:

1. Using a knife and chopping board, cut 2–3 cm cuttings of the spring onion bulbs. Make sure to keep all the roots on the cuttings.
2. Place cuttings in a glass beaker and pour in enough water to submerge the roots. Make sure at least 1 cm of the stem is above the water.
3. Place the glass beaker in sunlight and leave for several days. Top up the water if it starts to evaporate quickly.
4. When shoots start to grow out of the top of the cuttings, they are ready to plant in soil.

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Venus flytraps

Activity purpose:

A guided inquiry to plant and conduct a scientific investigation that models what causes Venus flytraps to shut.

stileapp.com/go/leafepidermis

stileapp.com/go/raleafepidermis

45-60 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- a Venus flytrap with at least 6 open traps
- stopwatch
- teaspoon
- thin paintbrush
- toothpick
- Human hair
- sugar solution
- thick cotton thread
- drinking straw
- sand

Chemicals

- tap water
- salt water
- sugar solution
- flour
- salt

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Students write their own method for this investigation.

Further scaffolding for students to plan, conduct and communicate a science investigation is provided for in the Stile lesson.

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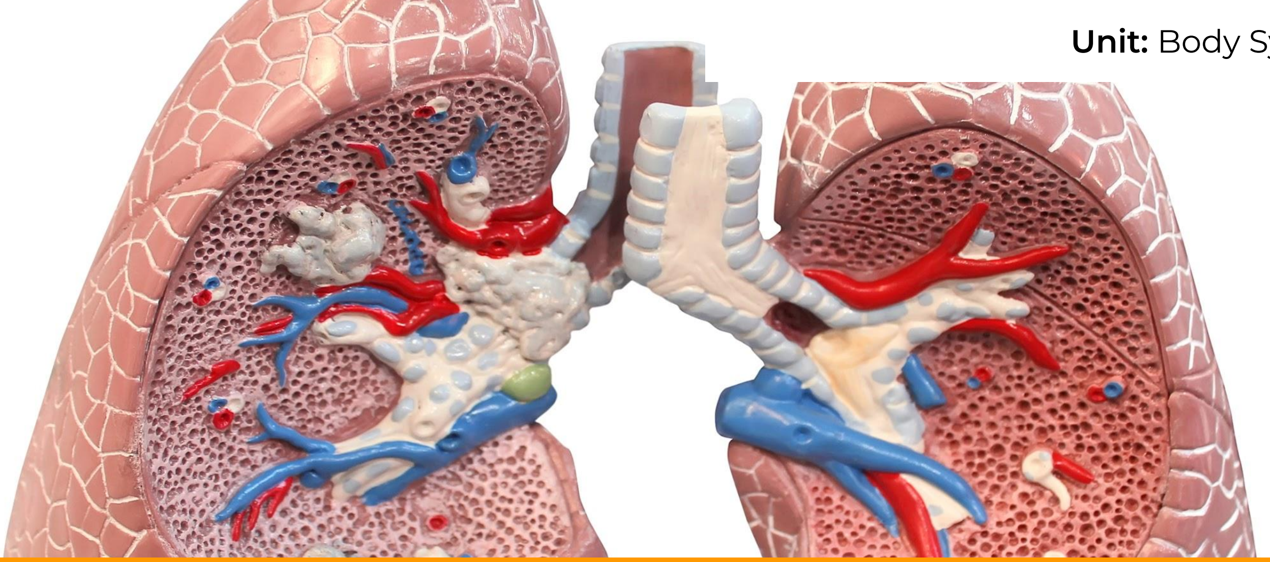

Make a model lung

Activity purpose:

Make a model lung to understand how the lungs inflate and deflate.

stileapp.com/go/modellung

stileapp.com/go/ramodellung

45-60 minutes | 3-4 students

Materials

Each group of students will need:

Lab equipment

- top half of plastic soda bottle (500 mL to 1 L)
- straw or thin plastic tubing
- rubber bands (1 to fit around bottom half of the plastic bottle, 1 to secure straw to balloon without crushing it)
- 2 balloons (1 to fit over the end of the plastic bottle, 1 to fit inside the plastic bottle)
- Blu-Tack, putty, or similar to seal the neck of the bottle
- scissors
- masking tape

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Cut the top halves off 500 mL - 1 L plastic bottles for students in advance.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

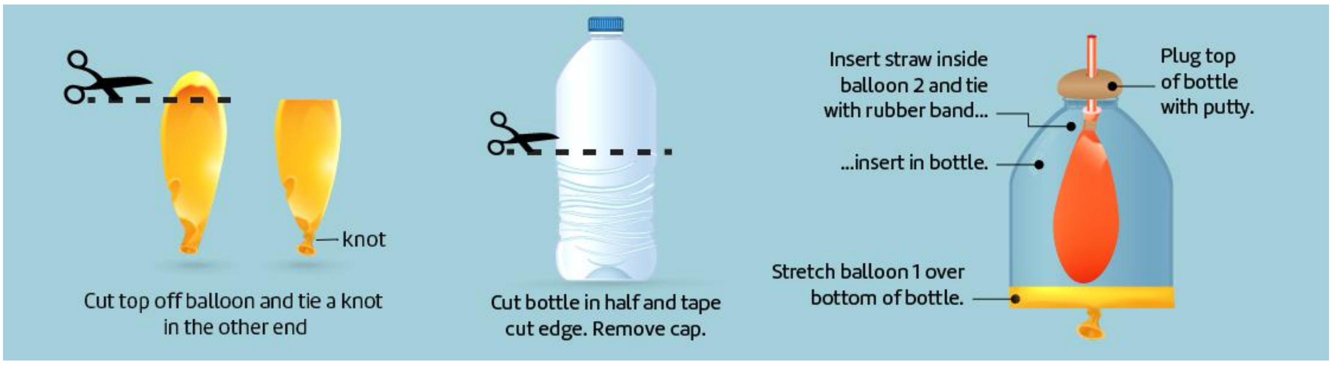
Notes for the teacher:

N/A

Method

Method that students will follow:

1. Tie a knot in the neck of a balloon then cut off and discard the other end.
2. Using the masking tape, tape around the rough edges of the plastic bottle.
3. Stretch the cut balloon across the bottom of the bottle to cover it. You may need to put
4. a rubber band around as well to help hold the balloon on.
5. Put the straw in the neck of the other balloon and secure it with the other rubber band. Do not crush the straw.
6. Feed the balloon and straw into the bottle so the straw sticks out. Seal the putty in the bottle neck around the straw, again without crushing the straw.



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Mean, median and mode for lung capacity

Activity purpose:

Practise calculating mean, median and mode through a hands-on activity.

stileapp.com/go/lungcapacity

stileapp.com/go/ralungcapacity

20-30 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- 2-3 spherical party balloons
- 30 cm ruler
- calculator (optional)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

You may like to widen the scope of this activity and turn it into a small investigation. You could ask students to come up with a question and hypothesis they would like to test using the class data. The class could be divided into groups based on:

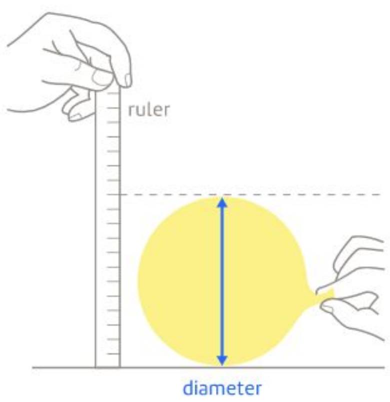
- age, e.g. 14-year-olds vs. 15-year-olds
- gender
- height
- sports played, e.g. swimmers vs. non-swimmers
- those who play wind instruments and those who don't

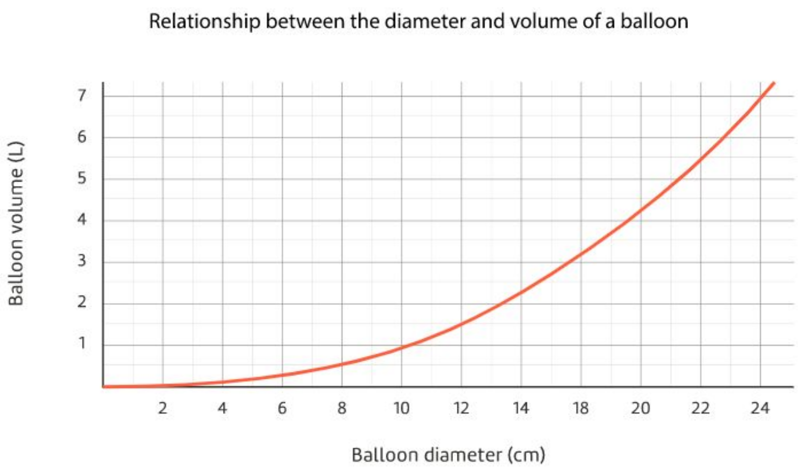
Method

Method that students will follow:

1. Blow up the balloon to a medium size and let the air out. Repeat two more times. This will stretch the rubber so that it is not too stiff for your test.
   Note: Make sure everyone completes this step the same to ensure a fair test.
2. Take the biggest, deepest breath you can manage.
3. Exhale once as fully as you can into the balloon. Tie a knot in the end, being careful not to let air escape.
4. As shown in the diagram, place the balloon alongside a ruler. Measure its diameter at the widest point, making sure your eyes are level with the top of the balloon.
5. Use the graph below to estimate the balloon's volume based on its diameter. Round to one decimal place.

The balloon's volume provides an estimate of your lung capacity.





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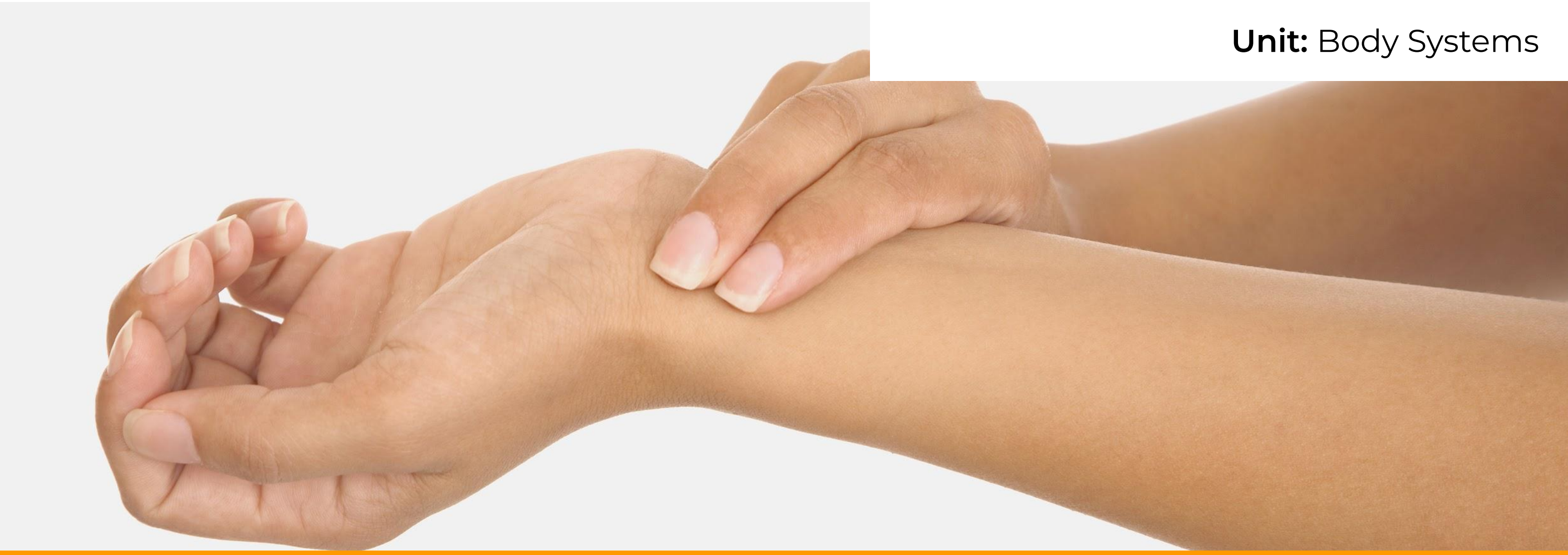

Effect of exercise on heart rate

Activity purpose:

Investigate the effects of short bursts of low and high intensity exercise on heart rate and blood circulation.

stileapp.com/go/heartrate

stileapp.com/go/raheartrate

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- stopwatch
- data logger with pressure probe (optional)
- heart-rate app on your phone or tablet (optional - there are several free ones)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Measure your resting heart rate by placing your index and middle fingers on the inside of your wrist – don't use your thumb because it has a pulse of its own. Using the stopwatch, count the number of beats in 15 seconds.
2. Multiply this number by 4 to get the number of beats per minute (bpm). If you have a data logger or heart-rate app then take a reading and compare it with the value obtained from your wrist pulse measurement.
3. Perform low-intensity exercise, such as moderate walking, for 2 minutes and then immediately measure your heart rate.
4. Rest for about 5 minutes to allow your heart rate to return to its resting level.
5. Perform high-intensity exercise, such as running on the spot or doing jumping jacks, for 2 minutes and then immediately measure your heart rate.
6. Measure your heart rate at 1-minute intervals another five times.

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Taste and smell

Activity purpose:

Investigate the difference between taste and smell.

stileapp.com/go/tastesmell

stileapp.com/go/ratastesmell

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- blindfold
- 4 x variety of foods supplied in plastic cups or plates (e.g. salt and vinegar chips, mint lollies, cooking chocolate, jellybeans, cocktail onions)
- toothpicks or paddle pop sticks or spoons as required
- pen
- paper

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Students should not be encouraged to consume food in the laboratory. It is best to arrange a room swap to a normal classroom or the food technology space if available.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Your teacher will provide food for you to test, but you're not allowed to see them so move away from the table and apply your blindfold!

1. Put your blindfold on.
2. Hold your nostrils closed and open your mouth. Your partner will place a piece of food from plate 1 in your mouth.
3. Record what you initially taste.
4. Open your nostrils and remove your blindfold. Record down what you taste.
5. Repeat for each of the remaining plates of food.

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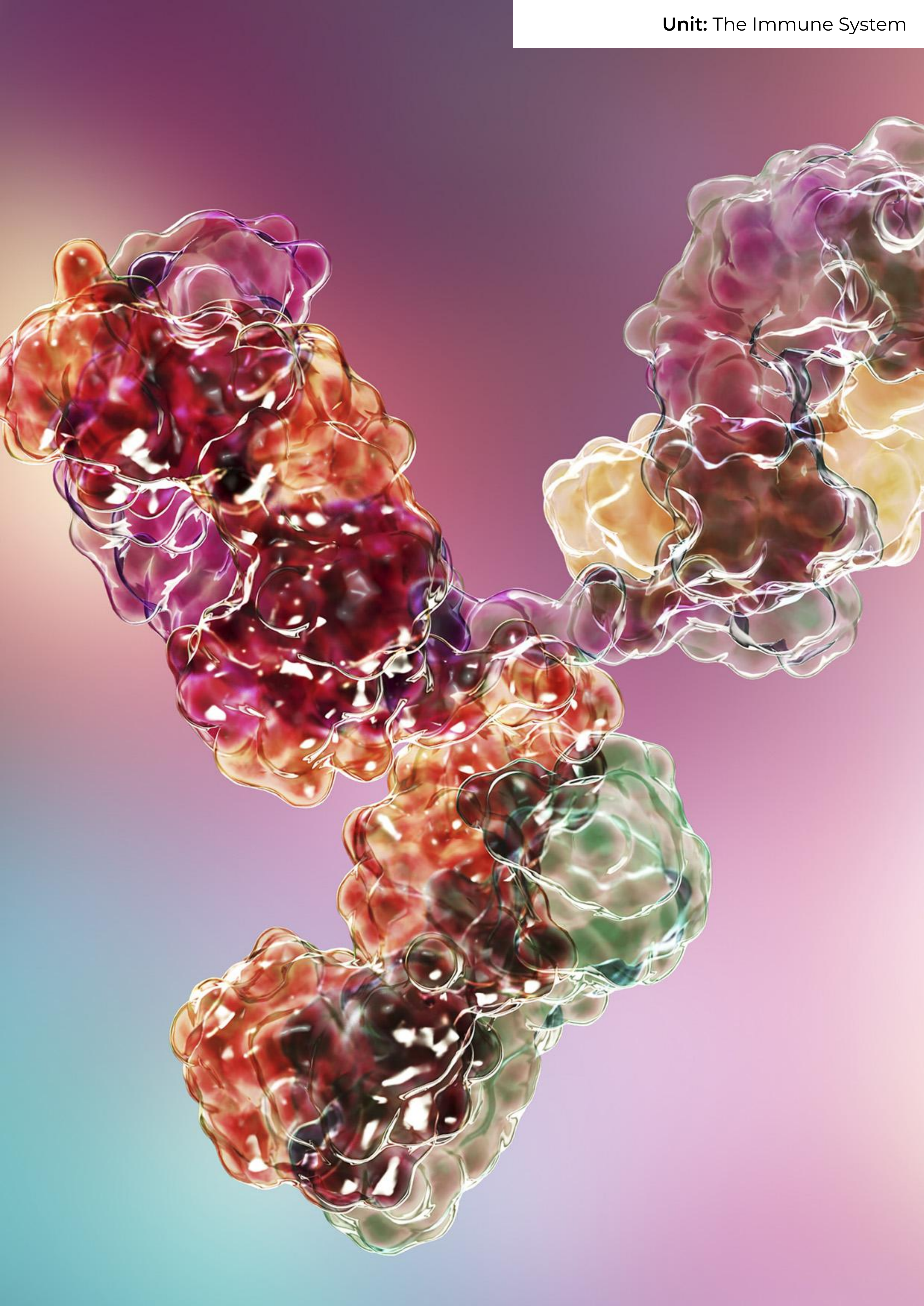

Stop the spread

Activity purpose:

This challenge simulates a real-life challenge affecting communities in Kenya. Students are required to design, build and test a simple hand sanitizer device.

stileapp.com/go/immune-spread

stileapp.com/go/raimmune-spread

180-240 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- K'NEX, Meccano, Lego or a similar construction kit (including pulleys)
- skewers
- straws
- string
- plastic bottles of different sizes
- scissors
- Blu-Tack
- paper clips
- split pins
- card of varying thicknesses
- sticky tape
- plastic cups
- PVA glue
- hole borer
- any other modelling materials, e.g. milk bottles with handles, yoghurt pots, cotton reels
- small watering can with sprinkle attachment (for testing)
- retractable craft knives (for teacher use only)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This engineering challenge was originally developed by Practical Action, an organization that uses technology to challenge poverty in developing countries.

Teacher notes, student worksheets and more background information can be found on their website.

Method

Method that students will follow:

Students will follow the engineering design process to create a simple hand-washing device to assist people living in poverty.

Instructions provided to students include:

We need your help to design a simple hand-sanitizing device for a school in Kisumu. You will need to design, build and test a model that can collect and dispense rainwater for students to wash their hands. Your model will need to meet the following criteria:

- an collect rainwater
- can dispense water for hand washing
- prevents cross-contamination between users
- costs less than $125 to build (the materials and their costs will be provided)

Your design will be tested by pouring water through it using a watering can.

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The first line of defence

Activity purpose:

Examine the role of the first line of defence by making a snot-like mixture and observing its properties.

stileapp.com/go/makingsnot

stileapp.com/go/ramakingsnot

10-15 minutes | 2-3

Materials

Each group of students will need:

Lab equipment

- 100 mL beaker
- 50 mL measuring cylinder
- teaspoon

Chemicals

- tap water
- 1.5 tsp psyllium or Metamucil (original or unflavoured)

For the class:
- hand basin or roll of paper towel to wipe hands

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Students will also observe the mixture at the end of the lesson and may add another ½ tsp psyllium to thicken the mixture.

Method

Method that students will follow:

1. Using the measuring cylinder, measure 30 mL of tap water. Pour the water into the beaker.
2. Add 1 tsp of psyllium to the beaker. Stir.
3. Leave for 2–3 minutes. The mixture should thicken to the consistency of runny snot.
4. Feel the mixture between your fingers. Note the properties that you observe.

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The effect of fever on pathogens

Activity purpose:

Design an experiment to investigate the optimal temperature range for baker's yeast to carry out fermentation. The experiment is intended to model the response of a microbe to fever.

stileapp.com/go/microberesponse

stileapp.com/go/ramicroberesponse

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 7 g baker's yeast
- 1 tablespoon (15 g) sugar
- 500 mL beaker
- tablespoon
- thermometer
- stirring rod
- heatproof mat or wooden board
- ruler
- marker
- stopwatch

For the class:

- kettles
- measuring jugs to transport hot and cold water

Chemicals

- water (various temperatures)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

The second part of this lesson is designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template in the Stile lesson by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method or allowing students to generate their own questions for investigation.
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analysing data
- adding extra scaffolding to support less experienced students

Method

Method that students will follow:

Part 1 - Observing yeast in ideal conditions:

1. Place the beaker on the heatproof mat.
2. Add a combination of hot and cold water to the beaker to prepare 150 mL water that is between 35–55°C.
   Note: You may need to add more than 150mL first to get the right temperature, then pour away the excess.
3. Add 1 level tablespoon (15 g) of sugar to the beaker. Gently stir with the stirring rod until the sugar has dissolved.
4. Add 7 g of baker's yeast to the beaker. Stir briefly.
5. Start the stopwatch and measure the temperature inside the beaker. Record this as the initial temperature.
   Note: Try not to move the thermometer after placing it in the beaker as this can pop the fermentation bubbles and affect your results.
6. Use a marker to draw a small line on the outside of the beaker in line with the liquid level. This will make it easier to measure the thickness of foam produced.
7. After 5 minutes, mark another small line on the outside of the beaker in line with the top of the foam. Use the ruler to measure the thickness of the foam layer. Record this measurement to the nearest millimetre (e.g. 2.4 cm).
8. After 10 minutes, mark another line at the top of the foam. Measure the thickness of the foam layer and record it in the table.

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Method (cont.)

Part 2 - Investigating the effect of fever:

Students will design their own method, which will require teacher approval before commencement.

The inquiry questions students are expected to address are:

- What temperatures should you test the yeast at? Remember that you want the model to show how pathogens respond to fever. Baker's yeast is most active between 35°C and 55°C. Above 55°C its fermentation slows down dramatically and above 60°C it dies.
- How will you make sure that your investigation is controlled? That is, how you will keep the conditions the same for all tests to ensure the reliability of the results?
- Will you measure the amount of foam at different time intervals or only once at the end of the investigation?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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Modelling the effect of vaccination

Activity purpose:

Model the effect of vaccination on the spread of an infectious disease.

stileapp.com/go/vaccination

stileapp.com/go/ravaccination

45-60 minutes

N/A

Materials

Each student will need:

Lab equipment

- 75 x small test tubes (3 per student)
- 75 x 1 mL dropping pipette (3 per student – alternatively, 1 pipette per student and have students carefully flush with water between each round)
- 3 x large test tube racks
- lab coats
- safety glasses
- gloves

Chemicals

- 45 mL 0.1 M sodium hydroxide ($NaOH$) solution (approx. 15 mL for 1 "infected" test tube for 3 rounds of the activity)
- 450 mL 0.1 M hydrochloric acid (HCl) solution (approx. 15 mL for 30 test tubes)
- 630 mL deionized water (approx. 15 mL for 42 test tubes)
- phenolphthalein indicator in a small dropper bottle

Note: The quantities for sodium hydroxide, hydrochloric acid and deionized water are approximate. They have been calculated assuming a class size of 25 students and that 15 mL is enough to half-fill a small test tube. All test tubes in this activity should be approximately half-filled. Adjust the quantities according to the size of the test tubes you use and the number of students in the class.

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Preparation

Preparation required by lab-tech:

Set up a class set of test tubes in test tube racks for each round of the activity in advance. Each batch of test tubes should be numbered (e.g. 1–25). All test tubes should be half-filled with a clear liquid and therefore indistinguishable.

For a class of 25 students:

- Round 1 (0% vaccination): 1 test tube is "infected" (NaOH), 24 are "unvaccinated" (deionized water)
- Round 2 (50% vaccination): 1 test tube is "infected" (NaOH), 12 are "vaccinated" (HCl), 12 are "unvaccinated" (deionized water)
- Round 3 (75% vaccination): 1 test tube is "infected" (NaOH), 18 are "vaccinated" (HCl), 6 are "unvaccinated" (deionized water)

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

Contents of the test tubes should be neutralized with 0.1 M hydrochloric acid and disposed of down the sink.

hydrochloric acid + sodium hydroxide → salt (NaCl) + water (H_2O)

Notes for the teacher:

When handing out the test tubes before each round, the "infected" test tube should be given to a different student in each round.

When phenolphthalein is added to a test tube containing sodium hydroxide it will turn pink, revealing the “infection”. The other test tubes will remain clear.

Collect all test tubes and their contents at the conclusion of the lesson for correct disposal.

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Method

Method that students will follow:

Your teacher will have set up a test tube for each of you at the front of the class. In the model, this represents your blood sample and it will be tested after each round for infection. You can then figure out how the disease has spread through the class through bodily contact – in this model, by walking around the room meeting people.

Round 1 – No vaccination:

1. When instructed, you will have 1 minute to walk around the room randomly. For every person you meet, use the dropper to add 5 drops of the liquid from your test tube into their test tube and allow them to do the same for yours. The drops represent droplets in the air when you sneeze.
2. When 1 minute is up, your teacher will test each test tube. If it turns pink, you've been infected with the virus!
3. Record the number of infected people in the results table.
4. Your teacher might then reveal who started the spread of infection.

Round 2 – 50% vaccination:

1. In this round, half of the test tubes have been "vaccinated". Again, one of the test tubes is "infected".
2. Repeat the steps for Round 1. This time, your teacher might also reveal who was protected by vaccination.

Round 3 – 75% vaccination:

3. In this round, three quarters of the test tubes have been "vaccinated". Again, one of the test tubes is "infected".
4. Repeat the steps for Round 1.

Use the data you collect to complete the questions in Stile.

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Properties of plastics

Activity purpose:

Sort different types of plastic by their recycling numbers and observe their properties.

stileapp.com/go/propertiesofplastics

stileapp.com/go/rapropertiesofplastics

30-45 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- a range of plastic objects, including at least one of each type of plastic (see note below)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

You might encourage your students to bring empty plastic containers with recycling numbers from home.

Notes

Notes for the lab-tech:

Examples of plastic objects include:

- PET plastic (Polyethylene terephthalate plastic code 1), e.g. soft drink or water bottle, vegemite & peanut jars
- HDPE plastic (High density polyethylene plastic code 2), e.g. milk & juice containers or shampoo bottles,grocery bags
- PVC plastic (Polyvinyl chlorine plastic code 3), e.g. vinyl tablecloth or shower curtains, cling wrap
- LDPE plastic (Low density Polyethylene plastic code 4), e.g. bread, grocery bags or ziplock bags, bin liners
- PP plastic (Polyethylene plastic code 5), e.g. take away or margarine containers or polystyrene rope, bottle caps, straws
- PS plastic (Polystyrene plastic code 6), e.g. yoghurt containers, coffee cup lids or plastic cutlery, foam cups, plastic lids, packing peanuts)

Each group of students will need at least one object made from each type of plastic, but preferably more than one of each type.

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Sort the plastic objects into six groups by finding their recycling numbers.
2. **Transparency:** Record whether the objects in each group are see-through, or transparent.
3. **Flexibility:** Record whether you can bend the objects in each group.
4. **Brittleness:** Record whether the plastic objects break when they are bent.
5. **Softness:** Record whether you are able to scrunch each plastic object into a ball.

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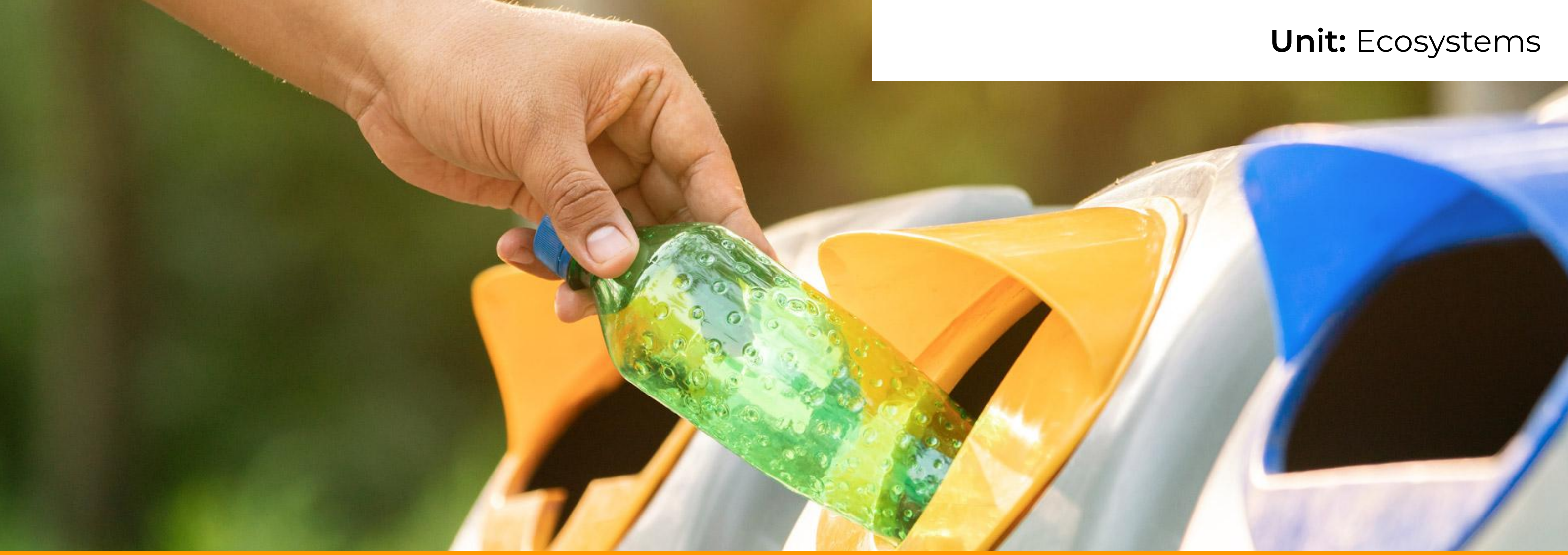

Sorting plastics by density

Activity purpose:

Test the densities of different types of plastic in order to understand how they can be separated for recycling.

stileapp.com/go/sortingplastics

stileapp.com/go/rasortingplastics

45-60 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- 1 object made from each type of plastic (see note below)
- scissors
- 30 cm ruler
- permanent marker
- 6 x 100 mL beakers
- stirring rod
- gloves
- waste container for used plastics

Chemicals

- 50mL isopropyl alcohol pure liquid
- 50 mL vegetable oil
- 50 mL distilled water
- 50 mL salt water (see note below)
- 50 mL honey

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Preparation

Preparation required by lab-tech:

The salt water should be prepared by dissolving 120 g of salt per 1 L of water to give it a density of approximately 1.08 g/mL.

Students are also asked to cut the plastic items into small pieces to test their densities. To save time and minimize plastic waste, you could create a class set of pre-cut plastic pieces. Each piece would need to be labelled with its recycling number (1–6) using a permanent marker. At the end of the practical activity, these could be washed and then reused by other classes.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

Examples of plastic objects include:

- PET plastic (Polyethylene terephthalate plastic code 1), e.g. soft drink or water bottle, vegemite & peanut jars
- HDPE plastic (High density polyethylene plastic code 2), e.g. milk & juice containers or shampoo bottles,grocery bags
- PVC plastic (Polyvinyl chlorine plastic code 3), e.g. vinyl tablecloth or shower curtains, cling wrap
- LDPE plastic (Low density Polyethylene plastic code 4), e.g. bread, grocery bags or ziplock bags, bin liners
- PP plastic (Polyethylene plastic code 5), e.g. take away or margarine containers or polystyrene rope, bottle caps, straws
- PS plastic (Polystyrene plastic code 6), e.g. yoghurt containers, coffee cup lids or plastic cutlery, foam cups, plastic lids, packing peanuts)

Lab-techs could label beakers or glass jars for a class set of this activity and keep solvents to re-use for subsequent classes.

Notes for the teacher:

At the conclusion of the practical activity, collect the plastic pieces to be washed and reused by other classes.

Keep solvents in their containers for re-use.

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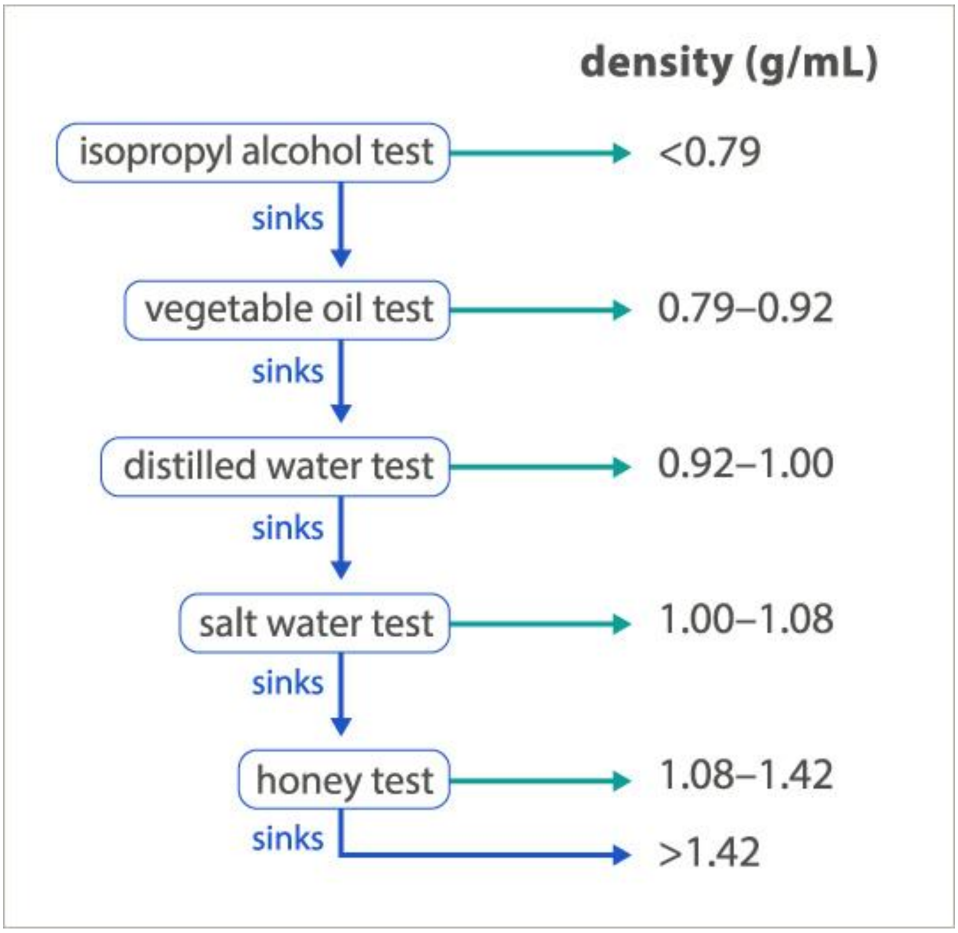
Method

Method that students will follow:

1. Carefully use scissors to cut out 5 small samples of each type of plastic. Each piece should measure 2 cm x 2 cm.
2. Use a permanent marker to label each sample with its recycling number.
3. Add 50 mL of each liquid to different beakers and clearly label each one: isopropyl alcohol, vegetable oil, distilled water, salt water and honey.
4. Place the sample of Type 1 plastic into the beaker with isopropyl alcohol. Use a stirring rod to gently push down on the plastic to break the surface tension. Observe whether the plastic sinks or floats. Remove the plastic.
5. Repeat Step 5 with the other types of plastic. If a piece of plastic floats then it must be less dense than isopropyl alcohol (0.79 g/mL). **Record this in the results table and stop testing this type of plastic.**
6. For the types of plastic that sank in isopropyl alcohol, use new samples to test whether they sink or float in the vegetable oil. If a sample floats, use the flow chart to determine its density range. As before, record this in the results table and stop testing this type of plastic.
7. Follow the flow chart until each type of plastic floats, allowing you to determine its density range. If a sample sinks in all tests then its density must be greater than 1.42 g/mL.

Flow chart used to determine plastic density:



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Cleaning our oceans

Activity purpose:

Challenge students to design and test a device that removes plastic waste from the ocean.

stileapp.com/go/cleaningouroceans

stileapp.com/go/racleaningouroceans

180-240 minutes

3-4 students

Materials

Each group of students will need a range of materials such as:

Lab equipment

- a selection of used plastic bags, plastic containers and cups
- rubber bands
- rope or string
- cardboard
- icy pole or craft sticks
- bamboo skewers
- wire or pipe cleaners
- corks, styrofoam or bubble wrap
- small weighted objects, such as pebbles
- fabric or net-like cloth, such as hessian
- scissors
- sticky tape
- staples
- Blu-Tack or play dough
- ruler

Chemicals

N/A

For testing the devices:

- large plastic container, filled with water
- floating plastic waste items in a range of sizes, such as small straws, plastic food wrappers and bottle caps

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

To simulate an ocean environment we recommend filling a large container with water and floating plastic waste items in a range of sizes, such as small straws, plastic food wrappers and bottle caps. The same items can be used for multiple classes to minimize waste.

Notes for the teacher:

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

At the conclusion of the challenge, collect the plastic waste items used to test the devices for recycling.

Method

Method that students will follow:

Students will follow the engineering design process to create a new and innovative product.

Instructions provided to students include:

How can we efficiently remove plastic waste from a river or ocean? Your task is to design a device to help do this. You will need to design, build and test a small-scale model that meets the following criteria:

- has a maximum height of 30 cm and a maximum length of 30 cm
- is able to collect floating plastic from the ocean
- is constructed from the materials supplied by your teacher

Your model will be tested in the classroom by placing it in a large tub of water with floating pieces of plastic of different sizes. Your device does not need to target all sizes of plastic waste. Waves and currents may be simulated by gently shaking the tub. A river current could be simulated by gently running your hand through the water in one direction.

As an engineer, you may also like to consider the following questions in your design:

- What conditions is your device best suited to? For example, will it float in the open ocean, be tied to a pier in a sheltered bay or be fixed to the bank of a river?
- How will you empty the plastic waste that is collected by the device?
- How will you protect wildlife from being trapped by the device?
- Can you make your device without using plastic at all? Or by using recycled plastic?
- How durable and long-lasting will your device be?

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Make an ecosystem model

Activity purpose:

Students make a terrarium as a model of an ecosystem and identify the biotic and abiotic factors operating within it.

stileapp.com/go/ecosystemmodel

stileapp.com/go/raecosystemmodel

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- large glass jar (min. height 12 cm) with lid
- trowel/scoop/spoon
- approx. ½ cup gravel
- approx. ½ cup sand
- 1-2 cups soil or potting mix
- small plant or seedling such as moss, fern or flowering lobelia
- 20 mL water
- masking tape (5 rolls per class)
- gloves
- optional: wide-mouthed funnel

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

An alternative to glass jars is to use large plastic soft drink bottles (method described here). If plastic bottles are used, we recommend that they are cleaned and recycled after the activity.

Cheap flower seedlings are suitable for this activity. However for longer-lasting terrariums, we suggest plants that tolerate low light and high moisture, such as ferns, mosses and other small tropical or "indoor" plants.

Notes for the teacher:

We recommend that students collect their own glass jars, such as those used for jam, peanut butter, olives or pickles.

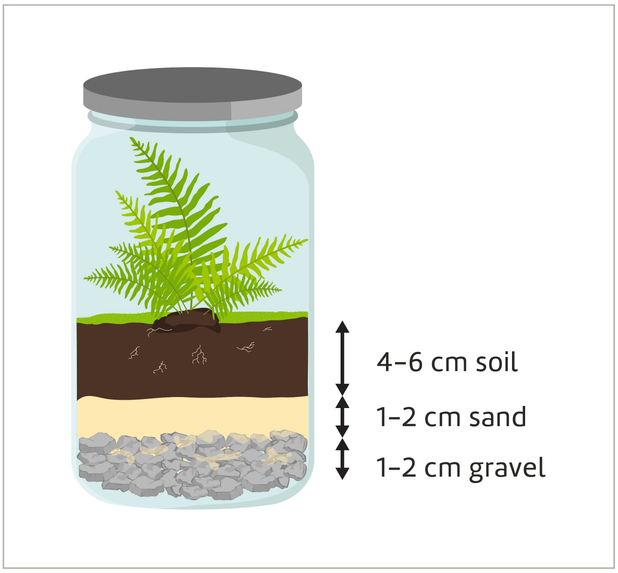
Assumed prior knowledge for this activity includes a basic understanding of the water cycle. You may wish to review this concept with your students in order to help them answer the discussion questions.

Method

Method that students will follow:

Note: If your jar is about 12 cm tall, use the smaller measurements in the steps below. If your jar is taller, you can add more accordingly.

1. Wearing gloves, use the trowel to add 1–2 cm of gravel to the bottom of a clean, dry glass jar.
2. Add 1–2 cm of sand in a flat layer on top of the gravel.
3. Carefully add 4–6 cm of soil or potting mix. Use a funnel if possible to prevent soil sticking to the sides of the jar.
4. Use the trowel to scoop a small hole in the soil. Plant the seedling in the hole. Gently press the soil around its roots.
5. Sprinkle a small amount of water to dampen the soil. Be careful not to soak the soil with too much water. This may stop air getting to the roots and drown the plant.
6. Secure the lid on top of the jar and seal it with masking tape.
7. Place the terrarium near a window with plenty of indirect sunlight. Observe any changes over a number of days or weeks.



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Abiotic factors and plant growth

Activity purpose:

Students conduct an open inquiry to investigate the impact of an abiotic factor on plant growth.

stileapp.com/go/abioticfactors

stileapp.com/go/raabioticfactors

120-180 minutes

3-4 students

Materials

The materials needed will depend on the experimental design that each group of students comes up with. It is likely that each group will need:

Lab equipment

- at least 3 seedlings or small plants
- at least 3 small pots with labels
- different types of soil or potting mix
- fertilizer
- trowel/scoop/spoon
- thermometers
- lamps or torches
- sticky tape or glue
- scissors
- ruler
- marker
- gloves
- other assorted materials (see note below)

Chemicals

- fertilizer
- water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

Abiotic factors that students may choose to investigate include temperature, the amount of sunlight, the amount of water or the type of soil.

Depending on the abiotic factor, you may also need to provide:

- 3 x cups of different types of growth medium (e.g. clay, sand, pine bark, coconut husk, soil or potting mix)
- 1 x cup fertilizer (with packet instructions for dilution for students to work with) , water, spatula, measuring jug
- 3 x thermometers
- 3 x lamp or torch
- 3 x differently coloured cellophane
- 3 x cardboard boxes
- water, measuring cylinder

Notes for the teacher:

We recommend that you run this investigation over the course of 1–2 weeks to allow sufficient time for the plants to grow.

This template is designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analyzing data
- adding extra scaffolding to support less experienced students

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to the student include:

Choose one abiotic factor and conduct an investigation to find out how it affects plant growth.

The design of the investigation is up to you, but here are some questions to help guide you.

- How will you vary your chosen abiotic factor from one plant to another?
- How will you measure the growth of the plants?
- How long will you run your investigation for, and how frequently will you collect your results?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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Photosynthesis

Activity purpose:

Demonstrate that carbon dioxide is absorbed by plants for photosynthesis and investigate how light conditions affect the rate of photosynthesis.

stileapp.com/go/photosynthesis-investigation

stileapp.com/go/raphotosynthesis-investigation

90-120 minutes

3-4 students

Materials

The materials for Part 2 will depend on the experimental design that each group of students comes up with. Each group of students will need:

Lab equipment

Part 1:

- 250 mL beaker
- 2 x test tubes
- 2 x rubber stoppers
- 10 mL measuring cylinder
- test tube rack
- stirring rod
- paper or metal straw
- 4-5 cm piece of pondweed or leaf (see note below)
- light source, such as a white light lamp or bright sunlight

Part 2:

- 3 x extra test tubes and stoppers
- 3 x 4-5 pieces of pondweed or leaf
- extra white light lamps
- 10 m measuring tapes
- materials of different transparency, such as black paper, cotton gauze, muslin cloth, tissue paper or coloured cellophane
- masking tape
- stop watch

Chemicals

- 50 mL distilled water
- 40 drops universal indicator in dropper bottle and colour chart

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

For this activity we recommend using a variety of pondweed, such as *Cabomba*. Note that *Cabomba* may be considered an invasive weed in your country and should be disposed of responsibly. Alternative plants should have fast-growing leaves and a high photosynthetic rate, such as *Paspalum*, flax, corn, weeping willow, geranium, ivy, or spinach.

Keep the plant in sunlight prior to class so that the leaves are busy photosynthesising. This will help to give a faster colour change with the indicator.

The indicator that will provide the most obvious colour changes is bicarbonate indicator. Other indicators that are suitable for this activity are red cabbage indicator and phenol red. However, the activity has been written based on the use of universal indicator because this is more readily available. If a different indicator is used, you will need to provide different colour charts for students to refer to.

Notes for the teacher:

This activity relies on a change in acidity to show that carbon dioxide is being used for photosynthesis. Prior knowledge of acids and bases is not required, but if your students have already covered this topic in chemistry then this lesson will serve as great revision and reinforcement.

Part 2 of this lesson is a template designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analyzing data
- adding extra scaffolding to support less experienced students

Method

Method that students will follow:

Part 1:

1. Add 100 mL distilled water to the beaker. Mix in 40 drops of universal indicator to make a solution.
2. Using a straw, blow into the solution until you see a distinct colour change. **Do not suck through the straw or you will bring universal indicator into your mouth.**
3. Rinse the test tubes with a small amount of the indicator solution. Measure 10 mL of indicator solution into each.
4. Place the small piece of pondweed in one of the test tubes. Push it gently to the bottom of the solution with a stirring rod. The test tube with no pondweed is the control.
5. Seal the test tubes with rubber stoppers and place them under a white light source or sunlight. If using a lamp, make sure the test tubes are exactly the same distance from it.
6. Wait at least 20 minutes to observe a noticeable colour change in the test tube with pondweed.
7. Record the colour changes in your results. Use the universal indicator scale (see next page) to determine whether carbon dioxide has been added or removed from the solution.

Note: It may help to take the pondweed out of the test tube before comparing the colour to the indicator chart. This is because reflected light from the pondweed makes the solution look a bit greener than it actually is.

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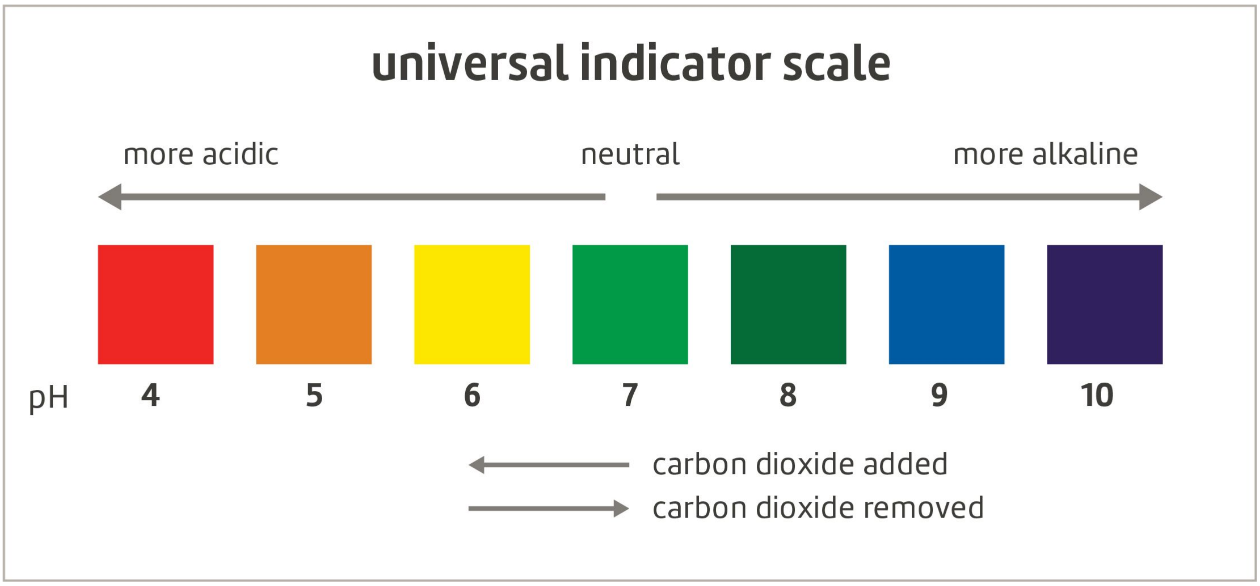
Method (cont.)



Part 2:

Students will design their own investigation, which will require teacher approval before commencement.

Instructions provided to the student include:

Use the indicator and pondweed to conduct an investigation that tests the effect of different light conditions on photosynthesis. For example, you might choose to investigate light intensity, light colour or the number of hours of light per day.

The design of the investigation is up to you, but here are some points to help guide you.

- How will you change your independent variable? For example, will you increase distance from a lamp, cover the test tubes with different materials or something else?
- You should have at least three different conditions for your independent variable. For example, if you were changing distance from a lamp, your conditions might be 0.5 m, 1.0 m and 1.5 m.
- Which other variables will you keep constant so that it is a fair test?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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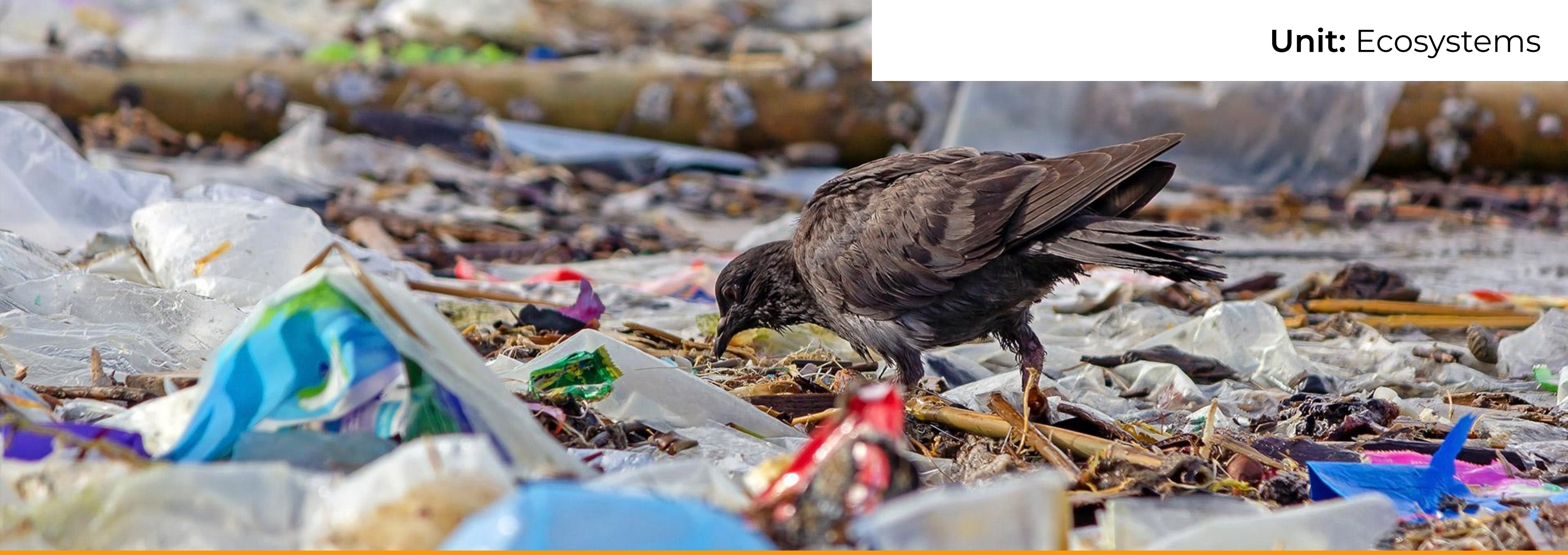

Make plastic from milk

Activity purpose:

Students make a biodegradable plastic out of casein and evaluate its properties.

stileapp.com/go/plasticfrommilk

stileapp.com/go/raplasticfrommilk

45-60 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- Bunsen burner
- tripod
- gauze mat
- heatproof mat
- matches or lighter
- 2 x 250 mL beakers
- 250 mL measuring cup
- 50 mL measuring cylinder
- stirring rod
- thermometer
- paper towels
- cloth strainer
- butcher's paper
- *optional:* cookie cutters

Chemicals

- 150 mL full fat milk
- 10 mL white vinegar

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

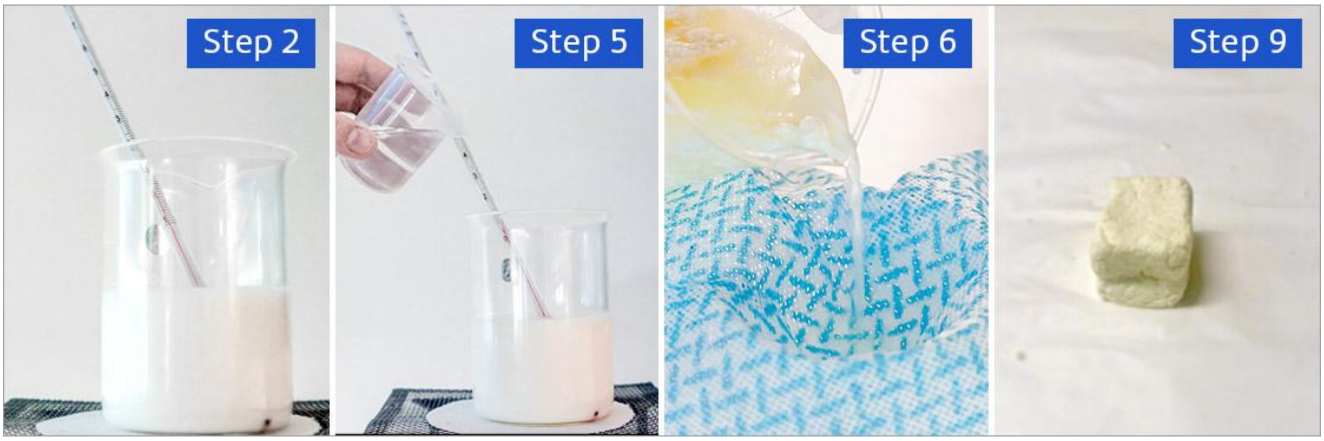
Notes for the teacher:

Please note that the casein plastic made in this practical activity will take 3–4 days to harden enough for students to test its properties. The exact drying time depends on the size and thickness of the object made. The casein plastic will continue to dry and harden over several weeks.

Method

Method that students will follow:

1. Set up the Bunsen burner and tripod on the heatproof mat. Place the gauze mat on the tripod.
2. Using the measuring cup, pour 150 mL of milk into a beaker.
3. Place the beaker of milk on the gauze mat and heat it using the safety flame. Stir the milk gently with the stirring rod.
4. When the milk reaches 50°C, turn the Bunsen burner off.
5. Using the measuring cylinder, add 10 mL of vinegar to the milk and stir. Small solid pieces will be visible floating in the mixture.
6. Carefully pour the mixture through a cloth strainer into a second beaker. Gently squeeze the cloth to remove as much of the liquid as possible.
7. Place the solids left in the strainer onto a paper towel and pat them dry.
8. Gather the solids and knead them together. Use a cookie cutter or your fingers to shape the solids into something you could use – for example, dice, jewellery, buttons or a small trinket dish.
9. Leave the object on butcher's paper to dry. This will take about 2 to 3 days.
10. Once the object is dry, observe the material's properties. Identify whether it is transparent, flexible, brittle or soft. Record these properties in the results table.



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Extracting DNA

Activity purpose:

Extract DNA from strawberries.

stileapp.com/go/extractingDNA

stileapp.com/go/raextractingDNA

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- ziplock bag (15 x 10 cm)
- 60 mL test tube
- 20 mL measuring cylinder
- square of fine gauze or cheesecloth (15 x 15 cm)
- small funnel
- 15 cm long skewer
- black cardboard

Chemicals

- 1 small strawberry
- 20 mL ice cold 70% ethanol or isopropyl rubbing alcohol
- 2 teaspoons (10 mL) DNA extraction buffer (see below)

DNA extraction buffer: makes 500 mL (enough for 50 extractions)

- 50 mL shampoo or 25 mL liquid dishwashing detergent
- 7.5 g kitchen salt (about 1 teaspoon)
- 450 mL water

Combine and stir gently until mixed.

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Preparation

Preparation required by lab-tech:

Dilute the ethanol and refrigerate the day before, making sure you have enough ice to keep it ice cold.

Prepare the extraction buffer ahead of time.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Collect all test tubes and their contents at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

1. Wash the strawberry and remove the green leaves, which are called sepals.
2. Place the strawberry in a ziplock bag, seal it and crush it with your hand.
3. Add 2 teaspoons of the DNA extraction buffer to the bag, seal it and squeeze to mix for about 1 minute.
4. Place a funnel in the test tube. Place the strip of gauze in the funnel.
5. Pour the strawberry buffer mixture into the funnel so it is filtered into the test tube.
6. Carefully pour ice cold ethanol into the test tube until it is about half full. The ethanol will form a layer on top of the liquid that came through the gauze. **Do not shake the test tube.**
7. Keep the tube still and hold it at eye level. Watch what happens and record your observations below.
8. Scoop out the DNA carefully using the cocktail stick.
9. Spread the DNA out on a piece of black card to view it and record your observations below.

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Modelling evolution

Activity purpose:

Model the process of evolution by natural selection through a hands-on competition.

stileapp.com/go/EvolutionExp

stileapp.com/go/ramodellingevolution

80-90 minutes

5 groups

Materials

Lab equipment

To set up the traits:

- blindfolds or eye patches for ⅓ of the class
- slings (optional) for ⅓ of the class

For the final challenge, each group will need:

- newspaper or waste paper
- sticky tape
- glue

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Blind folds and slings should be provided to the teacher for distribution. The remaining materials per group should be provided in stations or in groups for student collection.

Preparation required by teacher:

Detailed instruction is required for this practical activity. Reading the practical in its entirety before commencing is recommended.
The Round 2 task will need to have letters assigned to each column. To avoid students jumping ahead, it is recommended that the letters are written on the whiteboard.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Students are randomly divided into five groups by the teacher.
2. Read the special instructions related to the defining trait for each group before taking part in the activities.
3. At the end of each round, the members of the eliminated group are reassigned randomly to the surviving groups. They represent the offspring from reproduction and take on the trait of the group to which they're assigned.
4. Complete the puzzle in Round 1 on each individual device. The shapes cannot overlap and every shape must be used. The last group to have all team members complete the puzzle is eliminated.
5. Complete the table in Round 2 on one device for each group. The last team to complete this task is eliminated.
6. Create a free-standing tower in Round 3 using only the materials provided. The tower must be able to stand unassisted for at least ten seconds. The tallest tower is the winner!

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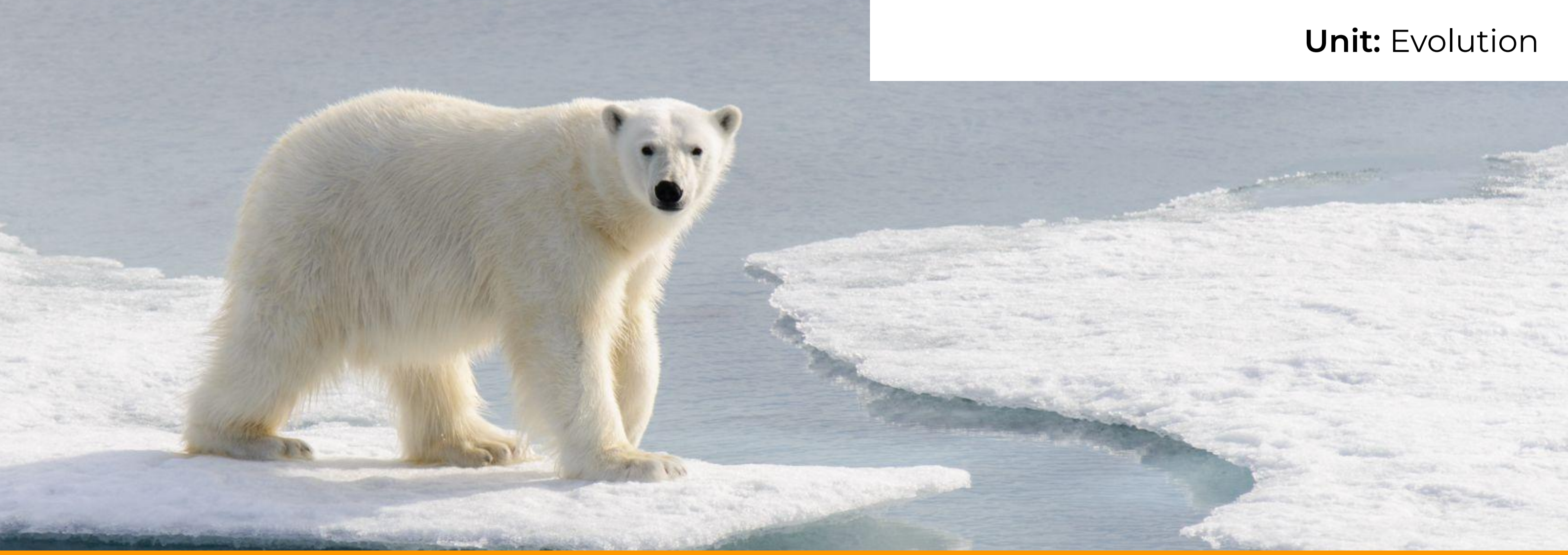

Modelling the formation of species

Activity purpose:

Model how a single starting population could form new species.

stileapp.com/go/evolution-prac-formation

stileapp.com/go/raformationspecies

40-60 minutes

Individual activity

Materials

Each student will need:

Lab equipment

- a coin per student or a coin toss website
- paper
- pencils for drawing

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Students will require the paper and pencils for the second half of this activity only.

Method

Method that students will follow:

Part 1:

1. Flip a coin and record heads or tails in the first table. The result of the coin flip will determine the selection pressure that the organism must survive.
2. Create an adaptation that will help the animal survive the new selection pressure and record this in the right hand column of the first table.
3. Repeat this process for all rows in the table (10 times).
4. Draw an organism that represents the adaptations that are common in the final population and upload this into the lesson.
5. Pair with another classmate and compare drawings.

Part 2:

1. Transfer the same 10 coin tosses from Part 1 to the table.
2. Use the outcome of your coin tosses to calculate the number of individuals in your population after every million years.
3. Construct a graph of your population numbers.

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Chemistry

Making emulsions

Activity purpose:

Conduct a simple experiment to explore the concept of emulsions.

stileapp.com/go/emulsions

stileapp.com/go/raemulsions

45-60 minutes

5 students

Materials

Each group of students will need:

Lab equipment

- measuring spoons:
  2 tablespoons (oil and water)
  4 teaspoons (mustard, salt, honey, detergent)
- 5 numbered specimen jars with lids
- stirring rod
- stopwatch
- laminated “DO NOT pour down sink” signs
- tubs for used specimen jars

Chemicals

- 15 tablespoons (225 mL) vegetable oil, e.g. canola oil
- 5 tablespoons (100 mL) water
- 1 teaspoon (5 g) dijon mustard
- 1 teaspoon (4 g) table salt
- 1 teaspoon (7 g) honey
- 1 teaspoon (5 mL) dishwashing detergent

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Preparation

Preparation required by lab-tech:

This activity works best set up as a round robin, with 2-3 of each item with its correct measuring spoon spaced around the work benches.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

Household cooking oil can be stored in a sealable jar or bottle, to then be placed in your general waste bin.

If you wish, you can separate the water from the oil by filtering it and washing the filtrate down the sink.

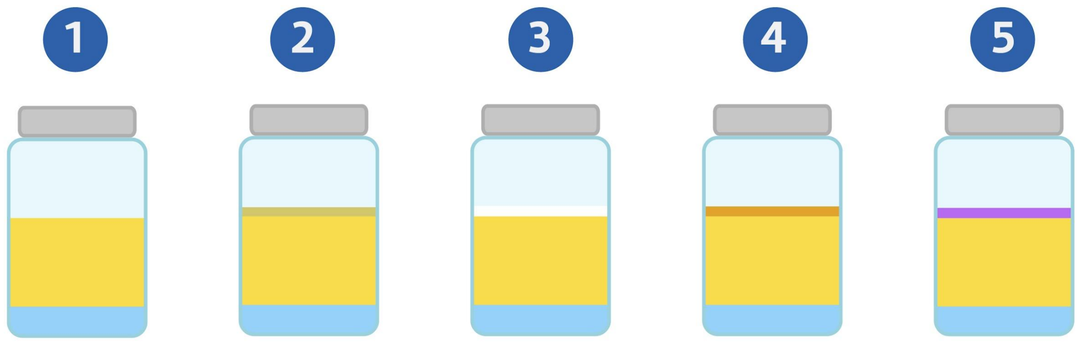
Notes for the teacher:

Collect all specimen jars and their contents at the end of the lesson for correct disposal.

Method

Method that students will follow:

1. Measure out the ingredients and add them to the jars as shown in the diagram below.
2. Screw on the lids firmly and shake jars 1–4 for 1 minute, preferably at the same time. Mix jar 5 by stirring for 30 seconds. (This jar is not shaken to avoid creating a large amount of froth.)
3. Leave the jars to stand. Record your observations after 5, 15, 30 and 60 minutes.



1	2	3	4	5
3 tbsp oil 1 tbsp water	1 tsp mustard 3 tbsp oil 1 tbsp water	1 tsp salt 3 tbsp oil 1 tbsp water	1 tsp honey 3 tbsp oil 1 tbsp water	1 tsp detergent 3 tbsp oil 1 tbsp water

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Dissolving and heat

Activity purpose:

Design an experiment to investigate the effect of temperature on the time it takes for sugar to dissolve in water.

stileapp.com/go/dissolving

stileapp.com/go/radissolving

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- 200 mL beaker
- glass stirring rod
- spatula
- 0.01 g electronic mass balance
- weighing boat
- hot plate
- retort stand
- retort clamp or thermometer clip
- thermometer
- stopwatch
- heatproof mat

Chemicals

- distilled water
- table sugar

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This lesson is designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template in the Stile lesson by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method or allowing students to generate their own questions for investigation.
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analysing data
- adding extra scaffolding to support less experienced students

Contents in the beaker can be washed down the drain at the conclusion of the lesson.

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

Aim: To investigate the effect of temperature on the time it takes for sugar to dissolve in water.

Discuss within your group how you can use the materials provided to meet the aim of the experiment. Write a clear, simple procedure – in numbered steps – to describe how you plan to carry it out. You will need to make at least 4 trials at different temperatures.

Some questions to consider:

- How will you make sure your controlled variables stay the same for each trial?
- How will you subtract the mass of the beaker? (*Hint: Remember how to tare a mass balance.)*
- If you stir the mixture as the sugar dissolves, how will you make sure this is a controlled variable as well?
- How and when will you measure the temperature of the water?
- How will you be able to tell when all of the sugar has dissolved?
- How will you measure the time this takes?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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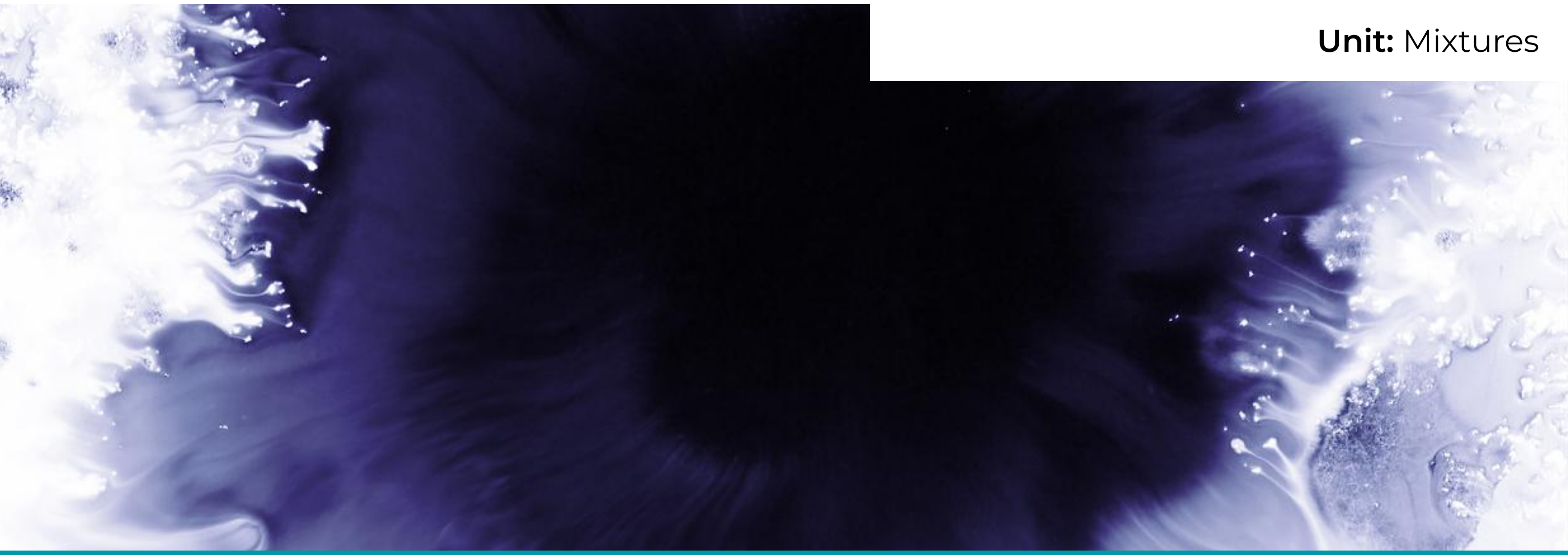

Chromatography

Activity purpose:

Separate the mixture of coloured pigments present in black inks using paper chromatography.

stileapp.com/go/separation

stileapp.com/go/raseparation

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 1 medium flow rate filter paper disc (approx 15 cm)
- 250 mL beaker (to rest the filter paper on)
- 4 different brands of water-soluble black felt-tip pens (labelled A, B, C, D)
- pencil

Chemicals

- 10 mL distilled water in a dropper bottle
- optional extension: 10 mL salt water solution (10%) in a dropper bottle

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Preparation

Preparation required by lab-tech:

Label the felt tip pens A, B, C, and D according to brand.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Using clean hands, fold the filter paper in half, then in half again, to make quarters.
2. Unfold the filter paper onto a clean, dry and flat surface – this will give you 4 fold lines on your paper.
3. Using the black coloured felt-tip pens place a small dot (about 2 mm diameter each) on each of the four fold lines approximately 2 cm from the centre.
4. Write the letter corresponding to each black felt-tip pen at the edge of the filter paper using the pencil.
5. Place the filter paper on top of the beaker.
6. Very carefully, place one drop of water using the dropper bottle provided onto the centre of the filter paper and watch what happens. Record your initial observations in the project space below.
7. Once the water has stopped spreading, add another drop and record your next set of observations.
8. Add further drops of water, one drop at a time, waiting in between each drop for the spreading to stop. Record your final observations.

Optional: If you have time, you could repeat the experiment in exactly the same way but using salt water instead of distilled water.

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Evidence for the particle model

Activity purpose:

Observe and explain evidence for the particle model of matter.

stileapp.com/go/particlemodel

stileapp.com/go/raparticlemodel

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 10 mL syringe
- marble (must fit in the syringe)
- 2 beakers, labelled ‘hot’ and ‘cold’
- stopwatch
- flask (for ice water)
- kettle (for hot water)

For whole class:

- 1 L conical flask (for ice water)
- kettle (for hot water)
- large plastic measuring jug (for hot water)

Chemicals

- 10 mL water (to fill the syringe)
- hot water
- cold water

For whole class:

- ice
- 2 different coloured food dyes
- bottle of perfume

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

The activities in this lesson could be set up as a round robin, where students rotate between activity stations around the classroom.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Part 3 is also suitable as a whole class activity.

If the students find it difficult to keep their thumb on the syringe tip, press the tip into a large rubber stopper when compressing.

Method

Method that students will follow:

Part 1:

Solid
1. Place a marble in the empty syringe.
2. Press down on the stopper. Can you compress the marble?

Liquid
1. Fill the empty syringe with water and place your thumb over the opening.
2. Press down on the stopper. Can you compress the water?

Gas
1. Pull the stopper on an empty syringe back to fill it with air and place your thumb over the opening.
2. Press down on the stopper. Can you compress the air?

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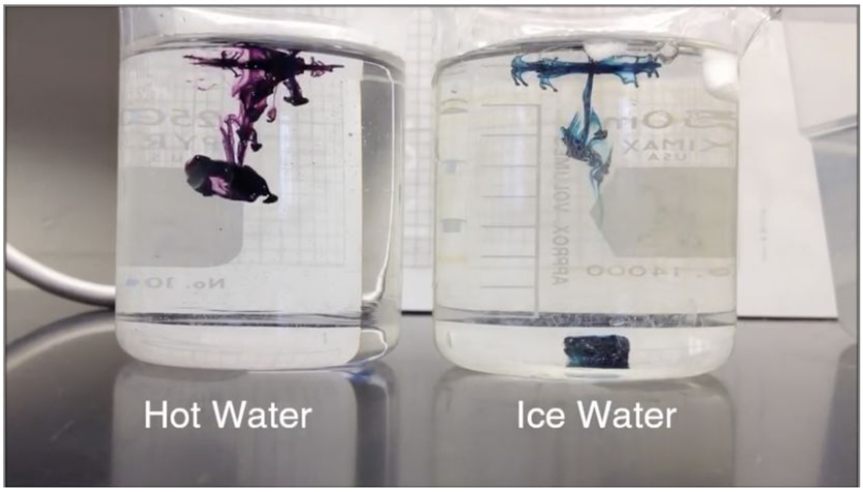
Method (cont.)

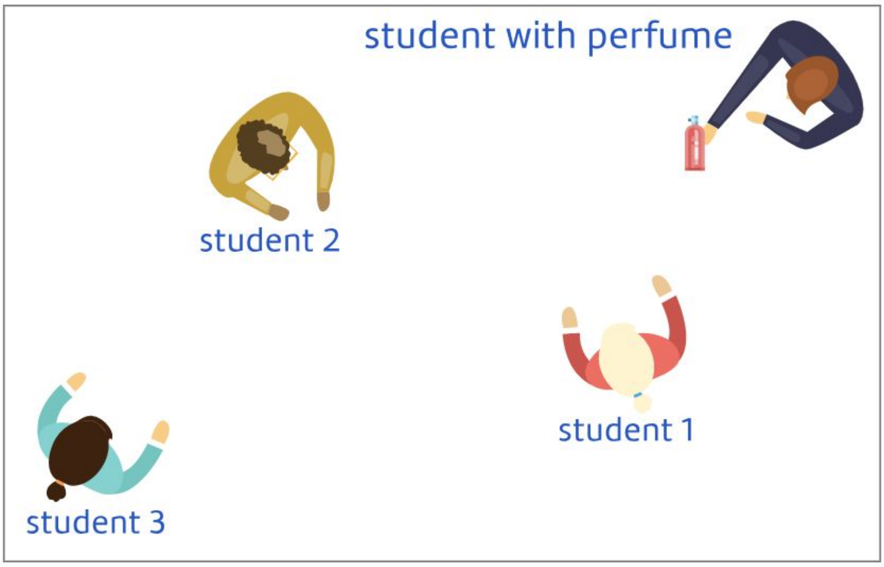
Part 2:

1. Fill one beaker with hot water. Fill the other one with cold water. Rest the beakers on a bench.
2. Add a few drops of food dye to each beaker.
3. Observe what happens initially and again after 2 minutes.



Part 3:

1. One student in the group takes the perfume bottle to one corner of the classroom.
2. The rest of the group spreads out, all at different distances from the person with the perfume.
3. The first student sprays the perfume towards the rest of the group.
4. As soon as a group member can smell the perfume, they should raise their hand.
5. Wait for a few minutes or until everyone can smell the perfume. Record your observations.



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Observing changes of state

Activity purpose:

Observe changes of state from solid to liquid to gas when water is heated.

stileapp.com/go/observingchanges

stileapp.com/go/raobservingchanges

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 250 mL conical flask
- party balloon
- Bunsen burner
- heatproof mat
- tripod
- gauze mat
- matches or gas lighter

Chemicals

- 5 ice cubes

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Preparation

Preparation required by lab-tech:

Make ice cubes ahead of time; each group of students will need 5 cubes.

Preparation required by teacher:

N/A

Notes

Notes for the lab-tech:

Make sure that the ice cubes will fit through the neck of the conical flask.

Notes for the teacher:

Get the students to blow into the balloon prior to inserting it over the mouth of the conical flask. This will stretch the balloon and make it easier for the balloon to expand.

It's important that the students are reminded that if cold water is run over the hot glass there is a risk of the glass cracking, so it's important to allow the glass to cool.

Method

Method that students will follow:

Part 1: Heating

1. Place five ice cubes into the conical flask.
2. Stretch the end of the empty balloon over the top of the conical flask. It should be sealed so that no air can flow in or out.
3. Place the conical flask above the Bunsen burner as shown in the photo. Heat the flask until the ice cubes melt.
4. When the water begins to boil rapidly, turn off the Bunsen burner. Allow the flask to stand for a few minutes while you record your observations.

Part 2: Cooling

1. Once the flask is cool enough to touch, take it off the tripod.
2. Run cool water over the conical flask. Observe what happens to the balloon.

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Burning magnesium

Activity purpose:

Measure the change in mass when magnesium burns in air and determine which compound is produced.

stileapp.com/go/magnesium

stileapp.com/go/ramagnesium

45-60 minutes

2+ students

Materials

Each group of students will need:

Lab equipment

- 0.001 g electronic mass balance
- matches or gas lighter
- crucible with lid
- heat resistant mat
- metal tongs
- tripod
- clay triangle
- Bunsen burner
- sandpaper or steel wool (to clean the magnesium ribbon)

Chemicals

- 15-20 cm magnesium ribbon

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

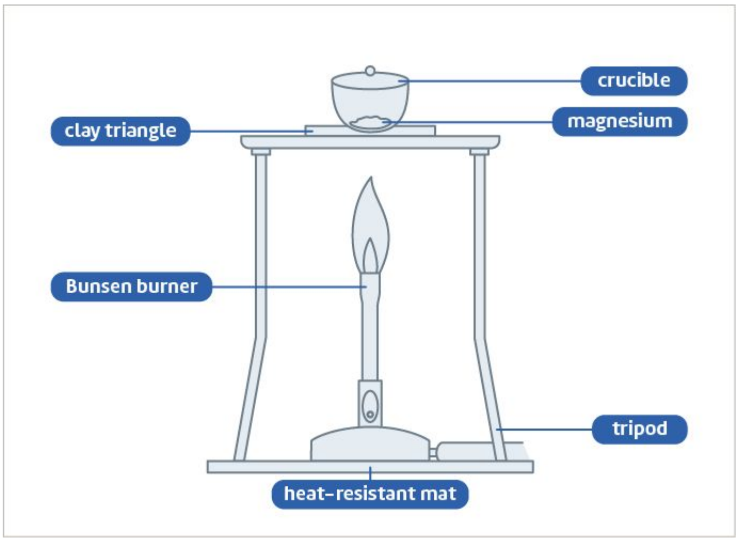
Students must wear safety glasses at all times.

Collect all crucibles and their contents at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

1. Set up the equipment as in the diagram below.
2. If the magnesium strip is dull or black then clean it using the sandpaper or steel wool. Loosely wrap around finger to create a small coil, small enough to fit inside the crucible.
3. Use the 0.001 g balance to weigh the empty crucible and lid. Record the mass of the crucible and lid.
4. Place the strip in the crucible, add the lid and reweigh. Record the weight of the crucible + lid + magnesium strip.
5. Light the Bunsen burner and heat the crucible with a gentle blue flame.
6. As the crucible heats up, fully open the air hole on the burner to produce a roaring blue flame. Gently lift the lid with the tongs to allow some oxygen to get in. Don't leave the lid off for too long or some of the product might escape.
7. Continue heating the crucible and regularly lift the lid until you observe no further change. Allow the crucible to heat for a few minutes after reaction is complete, prior to removing from flame.
8. Turn off the Bunsen burner and allow to cool. Record the weight of the crucible + lid + contents.



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Chemical change

Activity purpose:

Identify signs of chemical change when two powders and a liquid are mixed together.

stileapp.com/go/chemicalchange

stileapp.com/go/rachemicalchange

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- at least 4 ziplock bags (10 cm x 14 cm)
- 2 teaspoons
- plastic vial
- gloves

Chemicals

- 3 teaspoons anhydrous calcium chloride, labelled “Chemical A”
- 3 teaspoons sodium bicarbonate, labelled “Chemical B”
- at least 60 mL universal indicator solution (10% v/v in water)

Preparation

Preparation required by lab-tech:

Each group of students will require two lots of all materials listed in order to complete Parts 1 and 2 of the investigation.

Preparation required by teacher:

Nil

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Notes

This investigation is divided into two parts:

Part 1:
Students will combine two white powders (sodium bicarbonate and calcium chloride) and a coloured liquid (universal indicator) in a ziplock bag. The mixture will undergo a number of colour changes and a temperature change, and bubbles of gas will be produced.

Part 2:
Students will design an investigation to determine which combination of reactants was responsible for each of the chemical changes they observed in Part 1. As this is an open inquiry, some groups will need more of the materials than other groups.

This lesson is designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template in the Stile lesson by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method or allowing students to generate their own questions for investigation.
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analyzing data
- adding extra scaffolding to support less experienced students

To minimize plastic waste, we recommend washing and reusing the plastic vials and ziplock bags after use.

Method

Method that students will follow:

Part 1:

1. Carefully observe the two powders and the coloured liquid. Record your observations..
2. Add one spoonful of Chemical A into one corner of the bag as demonstrated below.
3. Add one spoonful of Chemical B into the other corner of the bag.
4. Carefully place the vial of coloured liquid into the middle of the bag, between the two powders.
5. Being careful not to spill the liquid, press the air out of the plastic bag and zip it closed.
6. Shake the bag so that the coloured liquid mixes thoroughly with the powders.
7. Make as many observations as you can and record these in the table below.

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Method (cont.)

Part 2:

Students will design an investigation to determine which combination of reactants was responsible for each of the chemical changes they observed in Part 1. As this is an open inquiry, some groups will need more of the materials than other groups.

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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Identifying types of change

Activity purpose:

Distinguish between physical and chemical changes by careful observation in a series of simple experiments.

stileapp.com/go/identifytypes

stileapp.com/go/raidentifyingtypes

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 5 large test tubes
- small test tube
- small chattaway spatula
- spatula
- teaspoon
- 3 x 10 mL measuring cylinders
- 100 mL beaker
- 2 Bunsen burners
- 2 heatproof mats
- tripod
- gauze mat
- 2 x metal tongs
- stopwatch
- tub for used beakers
- 10 labelled test tube racks
- 12 laminated "DO NOT pour down sink" signs

Chemicals

- magnesium turnings
- 20 mL 0.5 M dilute hydrochloric acid (delivered in a 125 mL dropper bottle)
- 1 teaspoon of baking soda
- 5 mL vinegar (delivered in a 125 mL dropper bottle)
- small piece of steel wool
- 10 mL 0.5 M copper sulfate solution
- 10 mL 0.1 M barium nitrate
- 10 mL 0.1 M sodium sulfate
- cube of butter
- container of cold water
- 2 spatulas of anhydrous copper sulfate powder
- deionized water in a 60 mL dropper bottle

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Preparation

This activity is best set up as a round robin, where students rotate between activity stations around the classroom. Gloves should be worn. Divide the materials into the following activities (quantities of chemicals per group):

Activity 1:
- small test tube
- magnesium turnings
- chattaway spatula
- 20 mL 0.5 M dilute hydrochloric acid (delivered in a 125 mL dropper bottle)
- 2 labelled test tube racks
- 2 laminated "DO NOT pour down sink" signs

Activity 2:
- large test tube
- teaspoon
- 1 teaspoon baking soda
- 5 mL vinegar (delivered in a 125 mL dropper bottle)
- 2 labelled test tube racks
- 2 laminated "DO NOT pour down sink" signs

Activity 3:
- large test tube
- small piece of steel wool
- 10 mL 0.5 M copper sulfate solution
- 10 mL measuring cylinder
- 2 labelled test tube racks
- 2 laminated "DO NOT pour down sink" signs

Activity 4:
- 2 large test tubes
- 10 mL 0.1 M barium nitrate
- 10 mL 0.1 M sodium sulfate
- 2 labelled 10 mL measuring cylinders
- 2 labelled test tube racks
- 2 laminated "DO NOT pour down sink" signs

Activity 5:
- cube of butter (1 cm cube)
- 100 mL beaker
- Bunsen burner and heatproof mat
- tripod and gauze mat
- container of cold water
- metal tongs to remove beaker from water
- stopwatch
- tub for used beakers
- 2 laminated "DO NOT pour down sink" signs

Activity 6:
- 2 spatulas of anhydrous copper sulfate powder
- spatula
- deionized water in a 60 mL dropper bottle
- metal tongs
- large test tube
- test tube holder
- Bunsen burner and heatproof mat
- 2 labelled test tube racks
- 2 laminated "DO NOT pour down sink" signs

Notes

Notes for the lab-tech:

Put test tube racks onto the benches where the test tubes are being used, making sure there are enough for all the filled test tubes that will be used.

If students are not in the habit of writing on the test tubes what the reactants are, add a label to the rack, identifying the reactants.

Activity 5:
Allow the beaker of hot butter to cool down prior to placing in the cool water. A hot glass beaker placed into cold water will crack.

Notes for the teacher:

Collect all labelled test tubes and their contents at the conclusion of the lesson for correct disposal.

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Method

Method that students will follow:

Activity 1:

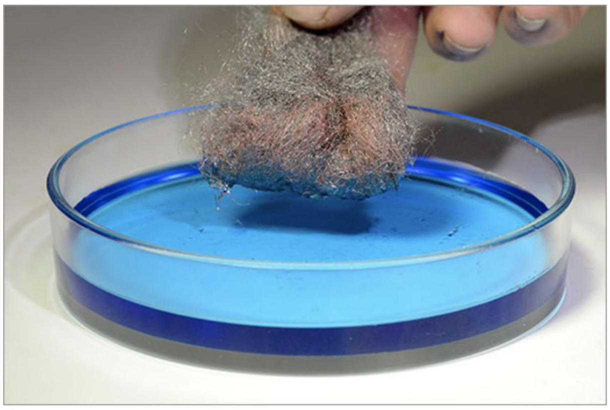
1. Place 2 cm worth of hydrochloric acid into the test tube.
2. Add 1 spatula of magnesium turnings.
3. Use the back of your hand on the bottom of the test tube to check for temperature change. Record your observations.
4. When you have completed your observations, leave the test tube in the test tube rack

Activity 2:

1. Place 1 cm worth of vinegar into the test tube.
2. Add 1 teaspoon of baking soda.
3. Use the back of your hand on the bottom of the test tube to check for temperature change. Record your observations.

Activity 3:

1. Use the measuring cylinder to measure out 10 mL of copper sulfate solution into the large test tube.
2. Place the steel wool into the copper sulfate solution. Record your observations.
3. When you have completed your observations, leave the test tube in the test tube rack.



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Method (cont.)

Activity 4:

1. Using the measuring cylinder, measure out 10 mL of barium nitrate into one test tube.
2. Measure out 10 mL of sodium sulfate into the other test tube.
3. Pour the sodium sulfate into the test tube containing the barium nitrate. Record your observations.
4. When you have completed your observations, leave the test tubes in the labelled test tube rack.

Activity 5:

1. Place the butter into the beaker.
2. Heat the beaker over the Bunsen burner for 1 minute with the blue flame.
3. Turn off the Bunsen burner. Using metal tongs remove your beaker from the bunsen burner and place onto the heatproof mat while you record your observations.
4. Gently dip the bottom of the beaker into the container of cold water for 1 minute. Record your observations.

Activity 6:

1. Place 2 spatulas of anhydrous copper sulfate into a test tube.
2. Add 3–4 drops of deionized water from the dropper bottle. Record your observations.
3. Using metal tongs, carefully heat the test tube over the blue Bunsen burner flame, being sure to point the mouth of the test tube away from your body. Stop heating when the powder has changed back to its original colour.
4. Leave the test tube to cool in the test tube rack. Record your observations.

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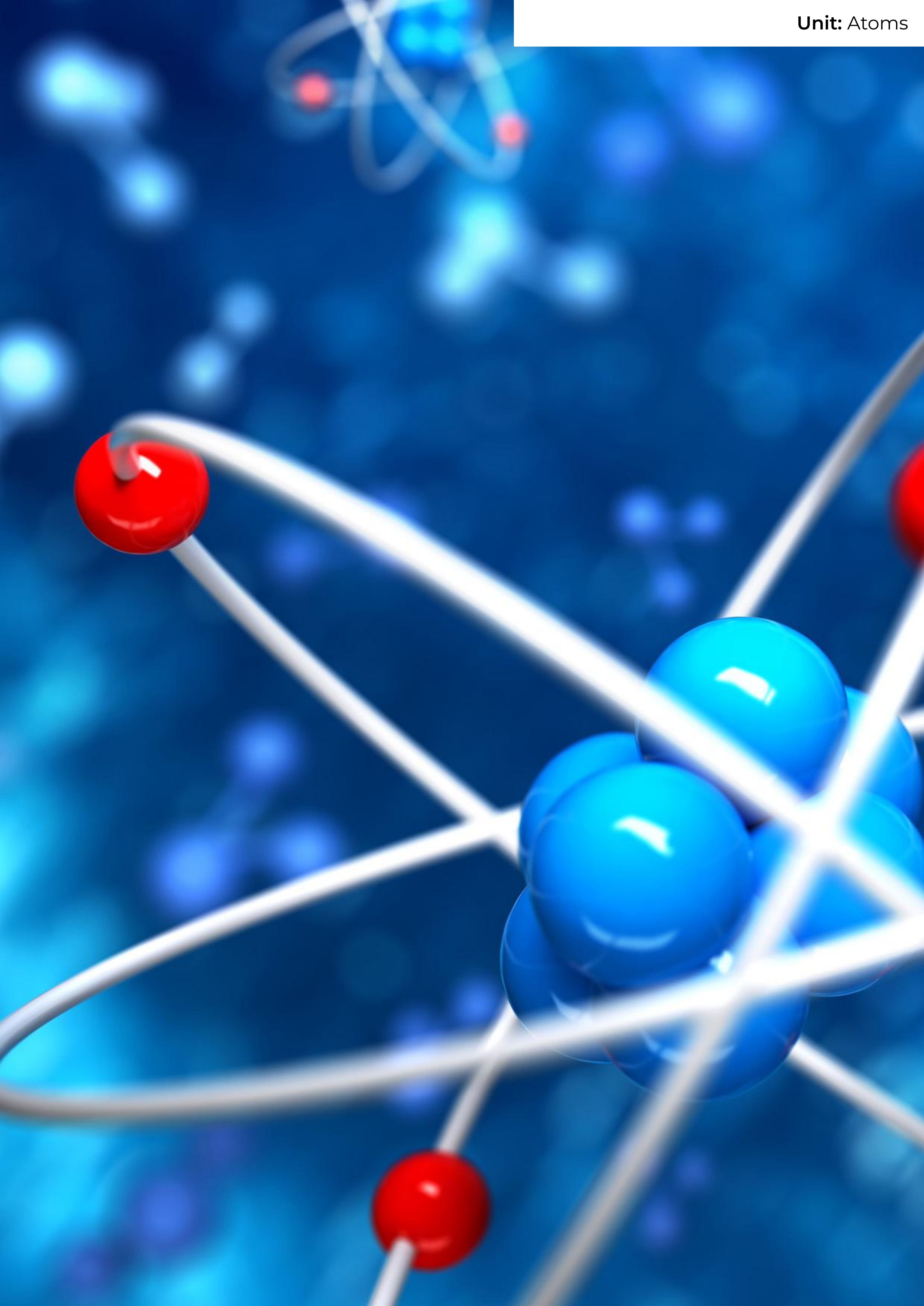

Brownian motion

Activity purpose:

Observe the random motion of particles in a suspension and consider how this serves as evidence for the atomic structure of matter.

stileapp.com/go/brownian

stileapp.com/go/rabrownian

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- stereo microscope
- microscope lamp
- glass Petri dish

For the whole class:

- sieve lined with paper towel (for disposal of Petri dish contents)

Chemicals

- pollen (if unavailable, chalk dust can be used but it may clump together in water and prove less effective)
- water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This activity aims to recreate a famous experiment by the botanist Robert Brown. Brownian motion was eventually used by physicists, including Einstein, to support the atomic theory of matter. You might like to use this example to discuss how scientists from different disciplines build on each other's work.

At the end of the activity, instruct students to empty the contents of their Petri dishes into a sieve lined with paper towel at the teacher's bench.

Method

Method that students will follow:

1. Half fill the Petri dish with water and place on the stage of a stereo microscope.
2. Focus the microscope on the surface of the water.
3. Wait a few minutes until the water becomes still. Be careful not to bump the dish or the desk while completing the experiment.
4. Sprinkle a very small amount of pollen on the surface of the water.
5. Carefully place the cover on the Petri dish.
6. Observe the pollen grains carefully.

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The electrical atom

Activity purpose:

Demonstrate that atoms are made of positively and negatively charged particles by investigating static electricity.

stileapp.com/go/electricalatom

stileapp.com/go/raelectricalatom

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- polystyrene balls (size of bean bag balls)
- glass Petri dish
- woollen cloth
- polythene rod
- retort stand
- boss head
- clamp
- 5 cm x 15 cm strip of aluminium foil
- water tap and sink

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

In this activity, we assume two main pieces of prior knowledge:

1. Electrons can be removed from atoms much more easily than protons or neutrons.
2. Like charged particles repel each other and unlike charged particles attract each other.

Method

Method that students will follow:

Part 1:

1. Fill the Petri dish with polystyrene balls.
2. Rub the polythene rod vigorously with the woollen cloth for about 5 seconds.
3. Hold the rod above the Petri dish, close to the polystyrene balls but without touching them.
4. Record your observations.

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Method (cont.)

Part 2:

1. Attach the clamp to the retort stand using the boss head.
2. Attach one end of the aluminium foil strip to the clamp so that it hangs down.
3. Rub the polythene rod vigorously with the woollen cloth for about 5 seconds.
4. Bring the rod close to the aluminium foil but without touching it.
5. Record your observations.

Part 3:

1. Turn on the tap so that a thin but steady stream of water is running.
2. Rub the polythene rod vigorously with the woollen cloth for about 5 seconds.
3. Bring the rod close to the stream of water but without touching it.
4. Record your observations.

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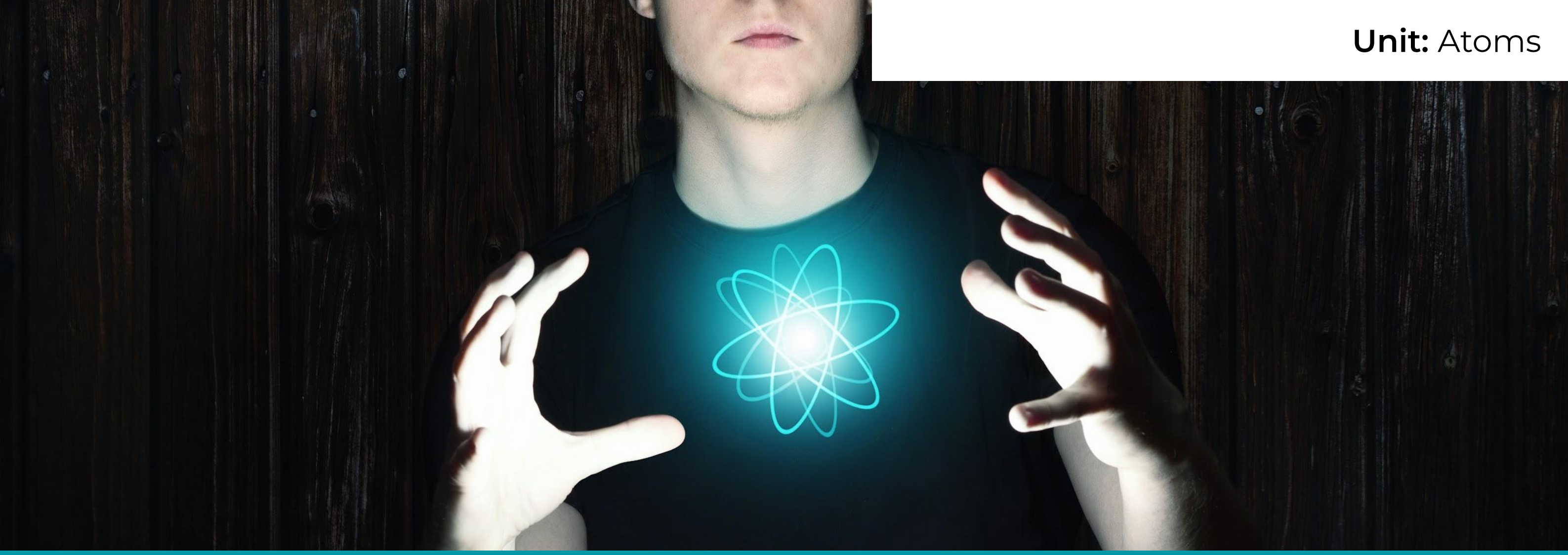

Modelling atoms

Activity purpose:

Build a physical model of an atom and describe its parts and properties.

stileapp.com/go/modellingatoms

stileapp.com/go/ramodellingatoms

100-120 minutes

3-4 students

Materials

Lab equipment

If being run as a class activity, various materials that could be supplied for the whole class include:

- play dough
- pipe cleaners
- ribbon
- plasticine
- beads
- seeds
- buttons
- popsicle sticks
- wool
- craft paper
- polystyrene balls
- wire
- balloons
- poster paper
- masking tape
- string
- paper plates

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Choose one of the first 20 elements in the periodic table. Your task is to make a model of one atom of this element and a poster to explain it.

Your model could be:

- A 3D model built using clay, polystyrene balls and wire, balloons, 3D printing or any other materials you have handy
- A simple computer animation, using a program such MS PowerPoint, Scratch or Minecraft
- In another format (check with your teacher first)

Your poster could be:

- Drawn or printed on paper
- Created on a computer and uploaded to Stile

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Combustion of charcoal and steel wool

Activity purpose:

Observe and explain what happens during the combustion of two household products: charcoal (Part 1) and steel wool (Part 2).

stileapp.com/go/combustion

stileapp.com/go/racombustion

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- gauze mat
- paintbrush for cleaning the gauze mat
- metal tongs
- tripod
- heatproof mat
- butane kitchen lighter (or Bunsen burner)
- 9 V battery
- 0.01 g electronic mass balance
- chemical discard container

Chemicals

- approx. 1 g chunk of charcoal
- approx. 3 g ball of fine–medium steel wool (free of oil and soap)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

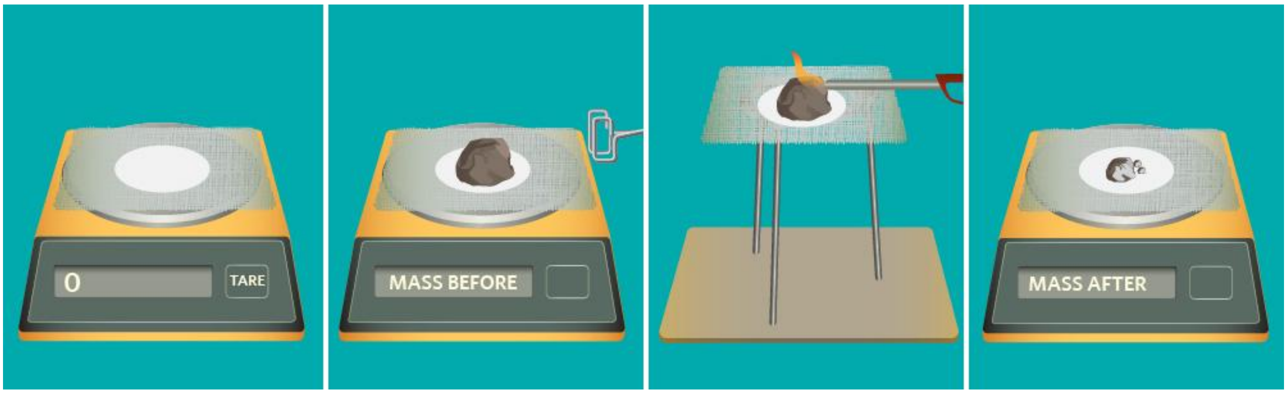
Method that students will follow:

Before each part:

1. Brush any dirt, dust or contaminating chemicals from the gauze mat using the paintbrush provided, into a chemical discard container, as directed by your teacher.
2. Place the gauze mat on the mass balance and tare, or zero, the reading.

Part 1:

1. Using the tongs, place a chunk of charcoal onto the gauze mat. Record its initial mass and your observations of it in the Results table.
2. Set up the tripod on the fireproof mat on a cleared bench. Use the tongs to transfer the gauze mat along with the charcoal to the tripod. Heat the charcoal with the hand-held butane kitchen lighter for a couple of minutes or until it starts to burn.
3. Watch closely what happens and record your observations in the Results table.
4. After the chemical reaction has stopped, and the gauze mat and reaction products have cooled down, return the gauze mat and reaction products to the mass balance and record the final mass reading in the Results table.
5. Record your final observations of the reaction products and then dispose of them into a chemical discard container, as directed by your teacher.
6. Brush any dirt, dust or contaminating chemicals from the gauze mat into the chemical discard container.
7. Place the gauze mat on the electronic mass balance and tare the reading.



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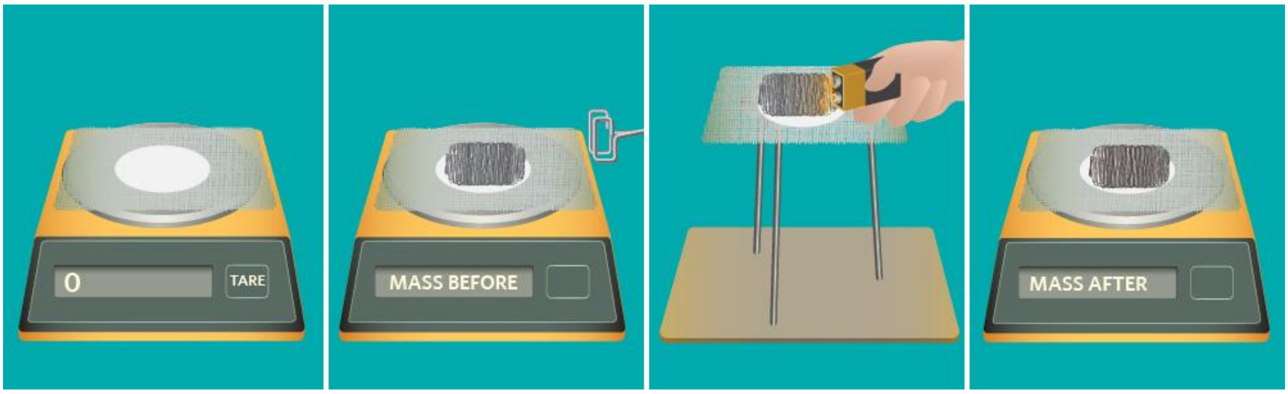
Method (cont.)

Part 2:

1. With clean hands, tease apart the steel wool into a loose ball and place onto the gauze mat. Record its initial mass and your observations of it in the Results table.
2. Using metal tongs to hold the steel wool, very lightly touch the 9 V battery to the steel wool then gently but quickly pull it away.
3. Watch the display! Record your observations in the Results table.
4. After the chemical reaction has stopped, return the gauze mat and reaction products to the mass balance and record the final mass reading in the Results table.
5. Record your final observations of the reaction products and then dispose of them into a chemical discard container, as directed by your teacher.



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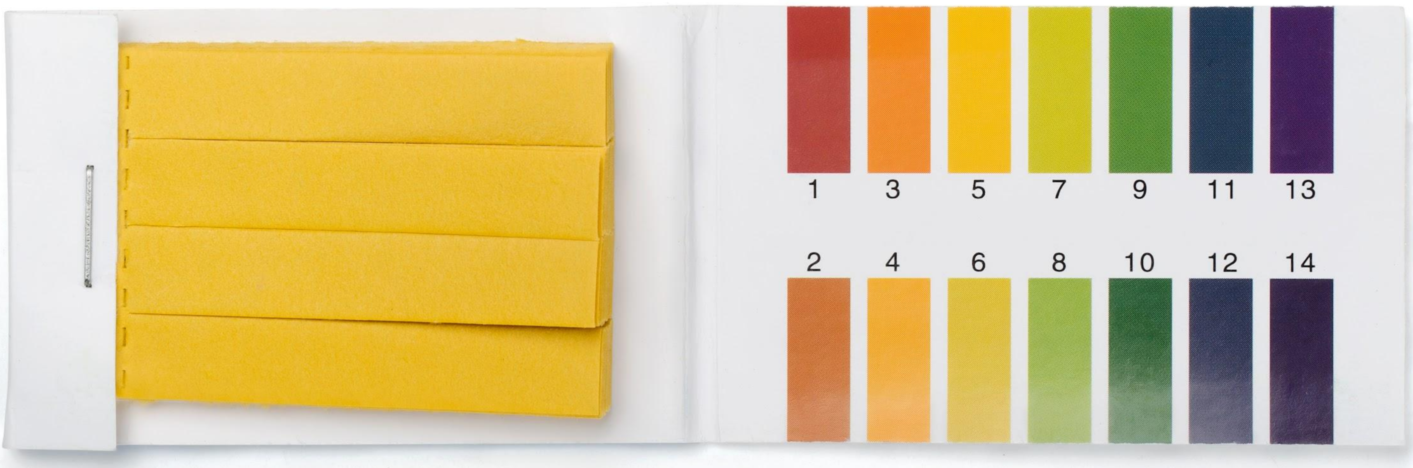

Indicators

Activity purpose:

Test a range of substances using litmus and universal indicator.

stileapp.com/go/indicators

stileapp.com/go/raindicators

25-30 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Part 1:

- 12 pieces of red and blue litmus paper (tear one strip into thirds, therefore 4 strips will make 12 pieces)
- 3 watch glasses

Part 2:

- test tubes
- test tube rack
- stirring rod
- universal indicator colour chart

Chemicals

Part 1:

- 10 mL 0.1 M hydrochloric acid (acid) in a dropper bottle
- 10 mL 0.1 M sodium hydroxide (base) in a dropper bottle
- deionized water in a dropper bottle
- approx. 10 mL each of a range of samples to test such as: tap water, salty water, vinegar, detergent, milk, baking soda, fruit juice, tomato juice, laundry bleach, clear soft drink (lemonade, tonic or soda water)

Part 2:

- dropper bottles of:
  10 mL 0.1 M hydrochloric acid
  10 mL 0.1 M sodium hydroxide
  10 mL deionized water
  30 mL universal indicator (aqueous alcoholic)
- approx 10 mL each of a range of samples to test such as: tap water, salty water, vinegar, detergent, milk, baking soda, fruit juice, tomato juice, laundry bleach, clear soft drink (lemonade, tonic or soda water)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Collect all test tubes and their contents at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

Part 1:

1. Add 10 drops of dilute hydrochloric acid in a watch glass.
2. Place a piece of red litmus paper and a piece of blue litmus paper in the watch glass.
3. Observe the colour changes and record in the table below.
4. Repeat steps 1–3 for sodium hydroxide (base) and distilled water (neutral).
5. Use the red and blue litmus paper to test each of the samples.
6. Record the colour changes in the table below.
7. Decide if the solution is an acid, a base or neutral.

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Method (cont.)

Part 2:

1. Place 5 drops of dilute hydrochloric acid in a test tube.
2. Add 5 drops of universal indicator solution to dilute hydrochloric acid. Swirl the solution using the stirring rod.
3. Observe the colour change, compare it to the colour chart and record the pH value.
4. Repeat the process for sodium hydroxide (a base) and distilled water (a neutral solution). Be sure to rise the stirring rod between samples using tap water.
5. Record your results in the table below.
6. Use the universal indicator to test each of the samples.
7. Observe the colour change, compare it to the colour chart and record the pH value in the table below.

Natural pH indicators

Activity purpose:

Create a pH indicator and colour chart from a natural material.

stileapp.com/go/pHIndicators

stileapp.com/go/rapHindicators

90-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 50mL measuring cylinders
- 2x 250mL beaker (one to extract the chemicals out of the sample and the other to strain the sample into)
- blender or mortar and pestle
- spatula
- cutting board
- knife
- strainer
- test tubes
- test tube racks
- kettle (if boiling water is needed to extract the indicator)
- plastic measuring jug
- plastic dropping pipettes
- sieve lined with a coffee filter/ paper towel

Chemicals

- samples to extract indicators from such as: beetroot, carrots, strawberries, blueberries, rose petals, violet petals, pansy petals, poppy petals, black tea, turmeric, curry powder, thyme
- samples to test the indicators against: 0.1 M hydrochloric acid, 0.1 M sodium hydroxide and distilled water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

You may also like to have the students test their indicator solutions on other substances - milk, fruit juices, vinegar etc.

Ensure students use the sieve provided to filter their indicators before washing down the sink.

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

1. Choose a plant/food sample from the materials supplied by your teacher.
2. Extract the chemicals that give that sample its colour and test whether it is a good indicator of pH.
3. Create a colour chart to use with your indicator.

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Acid-base reactions – making sherbet

Activity purpose:

Observe an acid-base reaction by making and tasting sherbet.

stileapp.com/go/sherbet

stileapp.com/go/rasherbet

25-30 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- ziplock plastic bag (10x14cm)
- 4 teaspoons
- icy pole stick (for tasting)

Chemicals

- 1 teaspoon citric acid
- 1 teaspoon bicarbonate of soda
- 6 teaspoons icing sugar
- 3 teaspoons flavoured jelly crystals

Note:

- 1 tsp citric acid= 4.1 g
- 1 tsp bicarbonate of soda = 6.6 g
- 1 teaspoon icing sugar= 4 g
- 1 teaspoon jelly= 4.9 g

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Students should not be encouraged to consume food in the laboratory. It is best to arrange a room swap to a normal classroom or the food technology space if available.

Notes

Notes for the lab-tech:

The ingredients listed make enough for one pair of students to share.

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Open the ziplock plastic bag.
2. Add one teaspoon of citric acid.
3. Add one teaspoon of bicarbonate of soda.
4. Add six teaspoons of icing sugar.
5. Add three teaspoons of jelly crystals.
6. Mix the ingredients together in the plastic bag.
7. Take a teaspoon of your mixture and place on your tongue.
8. Observe the reaction.

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Modelling ocean acidification

Activity purpose:

Model how carbon dioxide can decrease the pH of water.

stileapp.com/go/oceanacid

stileapp.com/go/raoceanacid

25-30 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- 250 mL beaker
- 100 mL measuring cylinder
- paper drinking straws
- universal indicator colour chart

Chemicals

- universal indicator (aqueous-alcoholic)
- 3.5% salt water

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Preparation

Preparation required by lab-tech:

Prepare the 3.5% salt water solution in advance. To do this, weigh 35 g of table salt and add it to a beaker. Add fresh water until the total mass is 1000 g. Stir with a stirring rod until all of the salt has dissolved.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Add 100 mL of salt water to a 250 mL beaker
2. Add 10 drops of universal indicator to the water.
3. Using the universal Indicator colour chart record, record the initial pH of the salt water.
4. Using a straw, blow into the water until you have a colour change.
5. Observe and record your result in the table below.

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Effect of acids and bases on shells

Activity purpose:

Investigate the effect of acids and bases on shells.

stileapp.com/go/effectonshells

stileapp.com/go/raeffectonshells

45-60 minutes | 3-4 students

Materials

Each group of students will need:

Lab equipment

- 3 x 250 mL beakers
- felt-tip marker
- universal indicator and colour chart or pH probe
- 1 x large desert or plastic spoon (to remove eggs from beakers)
- paper towel (to pat egg dry)

Chemicals

- 3 hard-boiled eggs
- 150 mL vinegar
- 150 mL distilled water
- 150 mL sodium bicarbonate solution (1 teaspoon of bicarbonate soda in 150 mL distilled water)
- 1 dropper bottle containing universal indicator (aqueous-alcoholic)

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Preparation

Preparation required by lab-tech:

Sodium bicarbonate solution:
Add one teaspoon of bicarbonate of soda to 150 mL of water and mix well.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

You could use a broader range of acids and bases to test the impact of changed pH on shells.

The eggshells are intended to represent seashells. If you have seashells you could test the effect of acids and bases directly on them.

Method

Method that students will follow:

1. Collect three 250 mL beakers and label them acid, base, distilled water.
2. Using the graduations on the side of the beaker, measure 150 mL of vinegar and pour this into the beaker labelled acid.
3. Use universal indicator to test the pH of the vinegar and record the result in the table below, using the universal indicator colour chart.
4. Repeat steps 1–3 for sodium bicarbonate solution and distilled water.
5. Place the eggs in the beakers.
6. Leave the eggs overnight.
7. Remove the eggs from the beakers and observe each egg. Record your observations in the table below.

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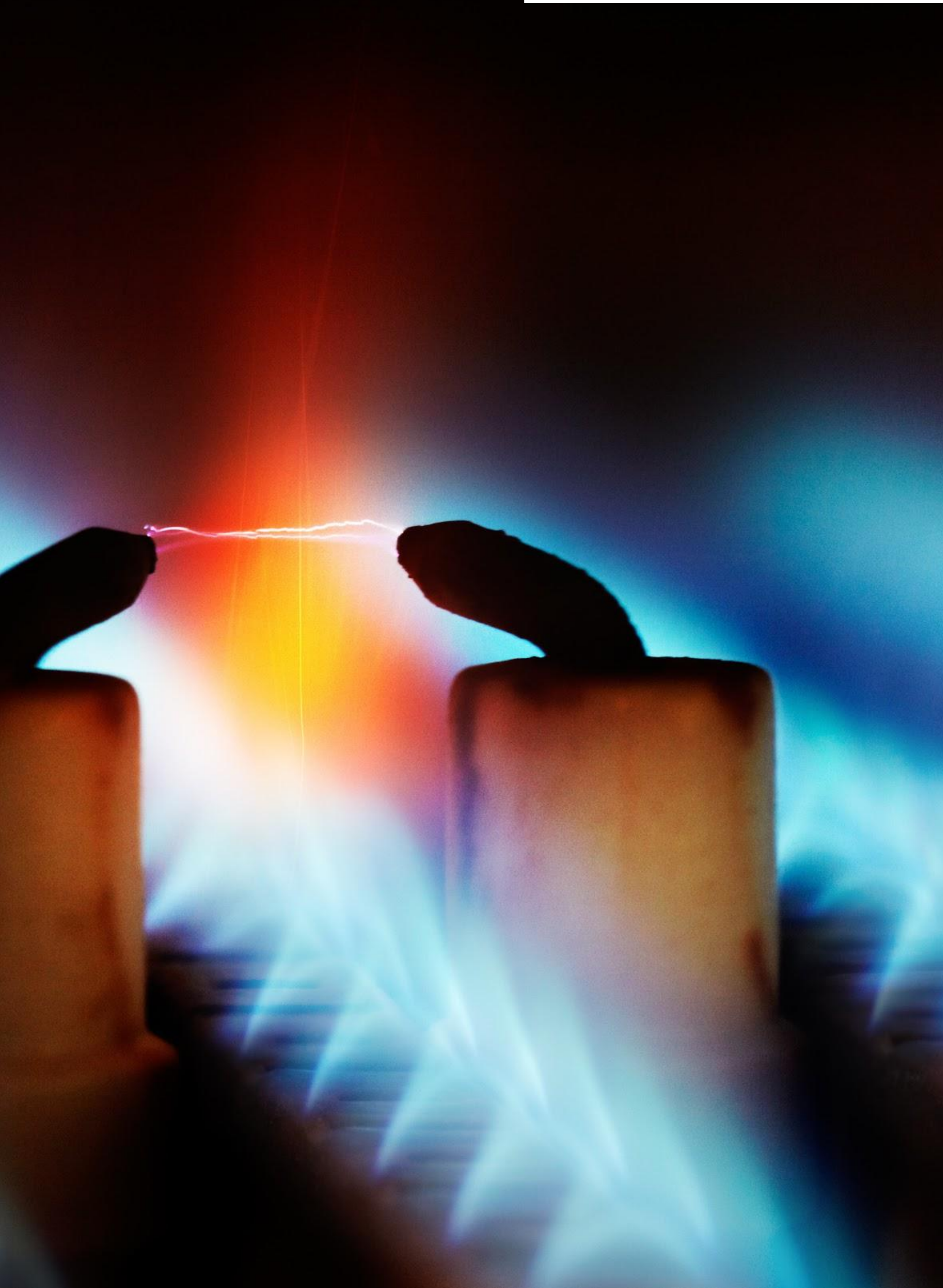

Putting out fires

Activity purpose:

Explore three different methods of extinguishing a candle.

stileapp.com/go/fires

stileapp.com/go/rafires

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Part 1:
- 500 mL plastic measuring jug with lid and stoppered pouring hole
- 1 birthday or tealight candle
- matches or lighter

Part 2:
- large, shallow glass bowl
- 1 birthday or tealight candle
- matches or long-necked gas lighter (good as you'll need to relight the candle several times)
- 3 or 4 beakers of known volume, e.g. 250 mL, 500 mL and 1000 mL
- stopwatch

Chemicals

Part 1:
- 3 teaspoons of sodium bicarbonate (baking soda)
- 50 mL white vinegar

Part 2:
- cold water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Part 1 (Invisible fire extinguisher):

1. Place 3 teaspoons of sodium bicarbonate in the jug.
2. Add 50 mL of vinegar (acetic acid) and quickly put on the lid. Wait for the foam to subside.
3. Light the candle.
4. The jug is filled with carbon dioxide. Carefully pour this heavy gas, but not the liquid in the bottom of the measuring jug, over the candle.
5. Record what happens.

Part 2 (Slow suffocation):

1. Put a few centimetres of cold water in the bowl.
2. Light the candle, wait a minute for the flame to grow strong, then place it in the water.
3. Place the first beaker over the candle and start the stopwatch.
4. Record the time it takes for the candle to go out.
5. Repeat to get three measurements for this beaker.
6. Repeat the complete process for the other beakers.

Part 3 (Blow out):

1. Blow out the candle with your breath.

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Exothermic and endothermic reactions

Activity purpose:

Conduct a an exothermic and endothermic experiment to understand the differences.

stileapp.com/go/exoendo

stileapp.com/go/raexoendo

10-15 minutes | 3-4 students

Materials

Each group of students will need:

Lab equipment

- 2 thermometers
- 2x 30 ml test tubes
- 250 mL beaker
- metal forceps
- 20 mL measuring cylinder
- 1 spatula (chattaway)

Chemicals

- 20 mL of 1 M hydrochloric acid
- 2x 5 cm strip of magnesium ribbon
- 20 mL of vinegar
- 1 teaspoon of baking soda

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Collect all plastic cups containing hydrochloric acid and magnesium ribbon at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

Part 1:

1. Measure 20 mL of hydrochloric acid and pour it into a test tube.
2. Place a thermometer into the test tube and note the temperature.
3. Leaving the thermometer in the acid, use the metal forceps to add a 5 cm strip of magnesium ribbon and swirl the beaker gently.
4. Record any change in temperature. Hold the beaker to see how warm or cool it feels.

Part 2:

1. Measure 20 mL of vinegar and pour it into a test tube.
2. Place a thermometer into the test tube and note the temperature.
3. Leaving the thermometer in the vinegar, use the spatula to add about a teaspoon of baking soda to the test tube.
4. Record any change in temperature. Hold the beaker to see how warm or cool it feels.

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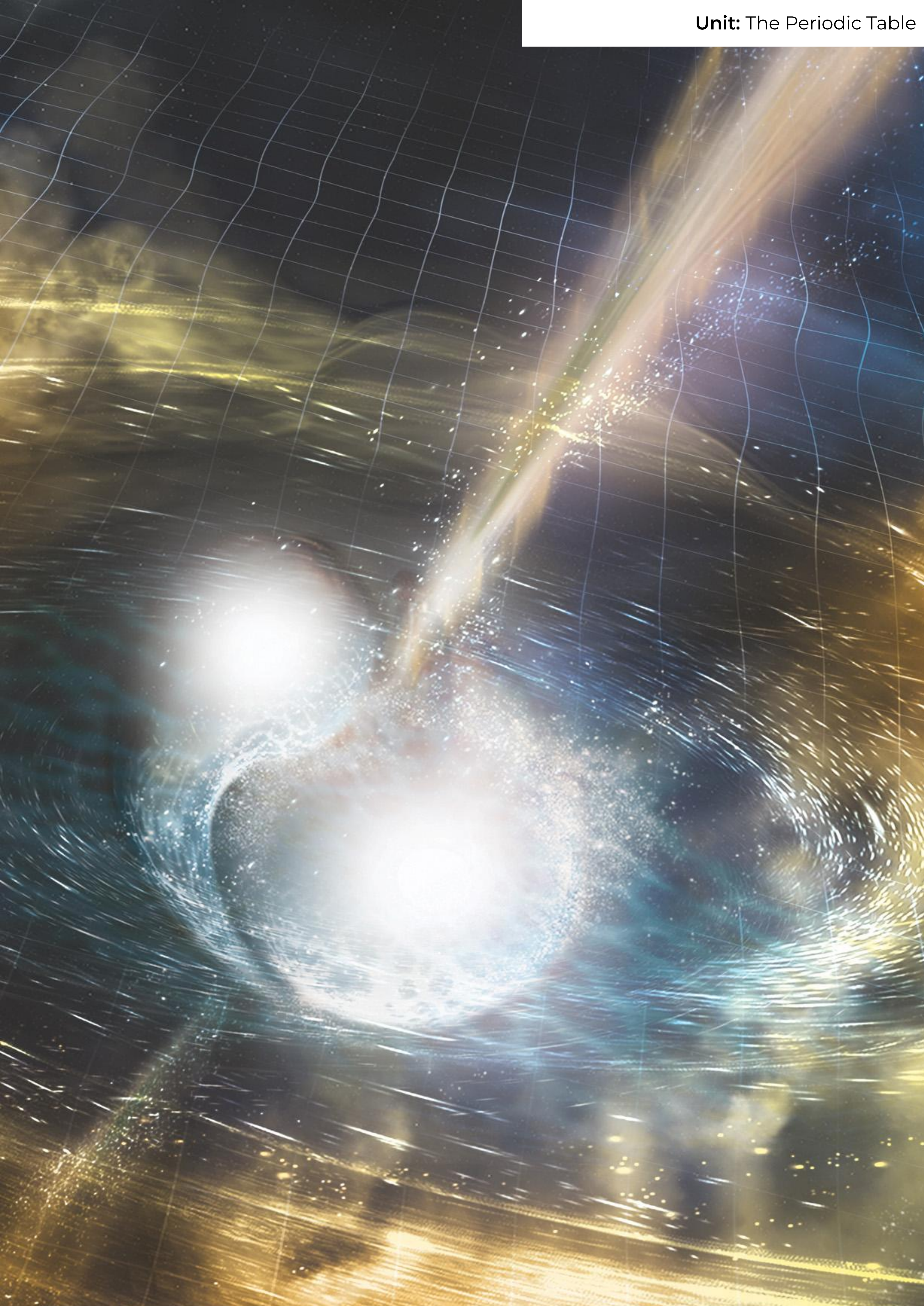

Flame colours

Activity purpose:

Conduct a flame test to identify which metal salt is present in a household chemical.

stileapp.com/go/flamecolours

stileapp.com/go/raflamecolours

45-60 minutes

2-3 students

Materials

Each testing station (2 groups) will need:

Lab equipment

- 2 test tube racks
- 2 x 30 mL test tubes labelled with the name and concentration of the metal salt they contain and hazard warnings (see chemicals)
- 2 wooden splints pre-soaked in distilled water and then placed into each solution
- 2 heatproof mats
- 2 Bunsen burners
- matches or gas lighter
- 2 metal tongs
- 250 mL beaker labelled 'used splints' containing a small amount of water to extinguish burning splints
- lab coats and safety glasses
- gloves

Chemicals

- 1.0 M potassium chloride (low hazard)
- 1.0 M lithium chloride (harmful)
- 2.0 M sodium chloride (low hazard)
- 1.0 M calcium chloride (irritant)
- 1.0 M strontium chloride (irritant)
- 1.0 M copper(II) chloride (harmful, danger to the environment)
- 1.0 M rubidium chloride (low hazard)
- 1.0 M caesium chloride (low hazard)
- 0.5% solution of Cream of Tartar (potassium hydrogen tartrate)

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Preparation

Preparation required by lab-tech:

Set up the room so that students perform each flame test at a different station.

Depending on your requirements and the number of stations you want, you may not use all of the salt solutions listed. Potassium chloride solution is required as a comparison if students will also be testing cream of tartar.

Thoroughly soak wooden splints in distilled water. Half-fill small test tubes with salt solutions and label each as appropriate. Then place a wooden splint into each half-filled test tube.

Prepare a 250 mL beaker with some distilled water for cooling the wooden splints after each flame test and label the beaker 'used splints'.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Dim the lights during the experiment if possible.

Collect all test tubes, solutions and beakers at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

1. Tie back long hair and put on safety glasses and lab coats.
2. Note how many different flame test 'stations' are set up around the classroom.
3. Prepare a qualitative data table for your results – you will be recording the name of each metal salt solution and your observations during the flame tests.
4. Perform your first flame test by placing the wooden splint (soaked in the metal salt solution) into the coolest part of the Bunsen burner flame then slowly moving it into the hottest part of the flame for 2 seconds. Be sure not to burn the wooden splint.
5. Immediately after viewing the flame colour, cool the wooden splint by placing it into the beaker labelled 'used splints'.
6. Record the name of the metal salt solution tested and your observations. Try to be as descriptive as possible with your observations – for example, a metal salt solution that produces a red flame may be more accurately described as 'brick red' or 'fire engine red'.
7. Perform the remaining flame tests around the classroom, recording your results as you go along.
8. One of the 'stations' will be set up with a solution of the common household chemical, cream of tartar; perform the flame test for this solution in exactly the same way as the others.

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Properties of metals

Activity purpose:

Classify various materials according to their properties.

stileapp.com/go/metals

stileapp.com/go/rametals

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- a multimeter and leads
- Mohs hardness kit (if available)
- hammer
- pliers
- 8 large test tubes
- 2 test tube racks
- 100 mL beaker
- Bunsen burner
- matches or gas lighter
- metal tongs
- safety glasses
- gloves
- felt-tip markers
- 2 small spatulas
- heatproof mat
- chopping mat

Chemicals

- a selection of materials: small candle, copper wire, sodium chloride (solid), magnesium ribbon, toothpick, zinc wire, sulfur, chalk, iron wire, etc.
- deionized water in a dropper bottle

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Preparation

Preparation required by lab-tech:

This activity is best set up as a round robin, where students rotate between activity stations around the classroom.
For example: 5 workstations with enough materials and equipment for 3 groups to works at each workstation = 15 groups.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Collect all labelled test tubes at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

1. Describe the appearance of each material prior to experimentation.
2. **Electrical Conductivity:** Turn the dial on the multimeter to 20,000 Ω on the resistance scale. Place the two electrodes on the sample about 1 cm apart. Record the value on the screen. If it reads 0, there's no resistance and it's an excellent conductor! Test all samples.
3. **Hardness:** Using the Moh's hardness kit, start with the softest mineral and try to scratch your sample. Move up the scale until your sample is scratched. Record the value corresponding to that mineral. Test all samples. (Note: If you don't have access to a Moh's hardness kit, scratch each material against the others using the same procedure above and organize your materials in order from softest to hardest. Apply a number to each.)
4. **Malleability:** Using the pliers, determine a ranking for which material bends most easily. Give a score out of 10 where 10 is the easiest to bend.
5. **Brittleness:** Determine which samples are the most brittle. Give a score out of 10 where 10 is the least brittle. Holding onto the sample, place it on the bench mat and hit the edge of the sample with the hammer. (Note: This should be done outside and while you and others are wearing safety glasses.)
6. **Solubility:** Using either metal tongs or a spatula, place a small piece of each sample in a labelled test tube and add 20 mL of deionized water. Using metal tongs to hold your test tube, heat gently with the Bunsen burner until the liquid starts to boil and then carefully place the test tube in the test tube rack to cool. If the sample dissolved, pour the liquid into a beaker and test for electrical conductivity using a multimeter.
7. Return all the metals to the tubs and then place all other waste into the bin. Put any unused samples back in the tub.

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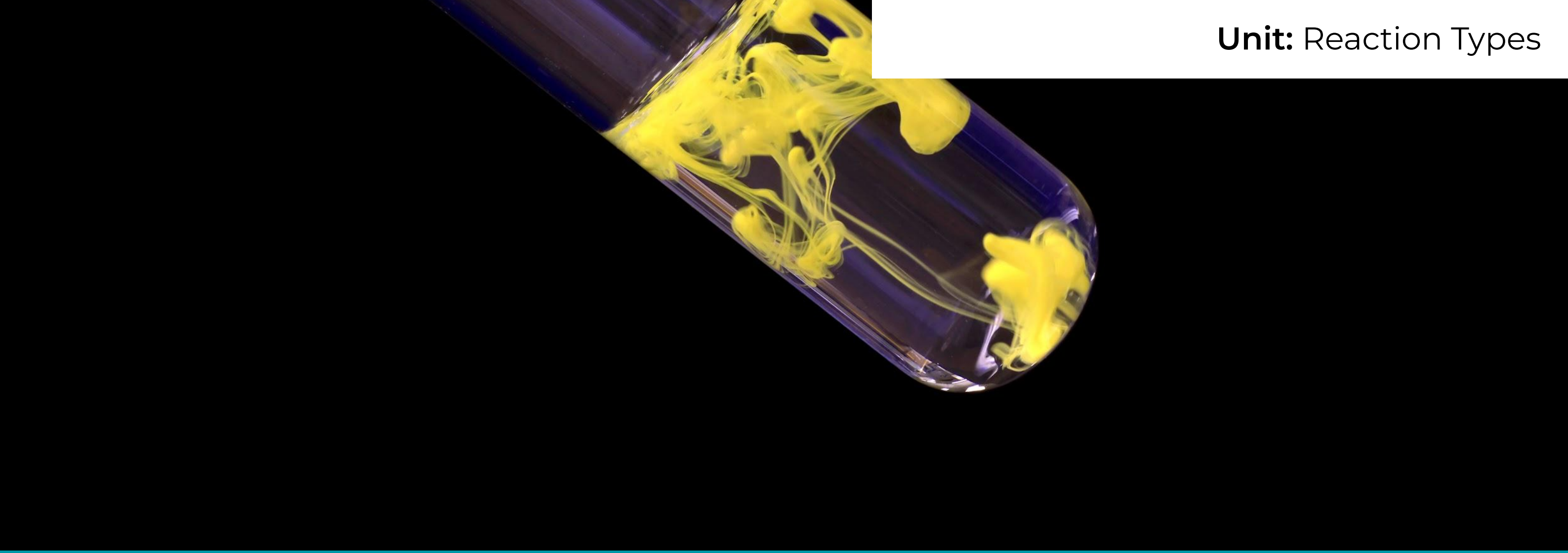

Precipitation reactions

Activity purpose:

Predict and test a range of precipitation reactions.

stileapp.com/go/precipitation

stileapp.com/go/raprecipitation

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 10 small test tubes
- 2 test tube racks
- felt-tip markers
- white tile or laminated paper
- black tile or laminated paper
- gloves
- safety glasses

Chemicals

10 mL each of 0.1 M solutions in dropper bottles of:

- magnesium nitrate
- potassium iodide
- silver nitrate
- sodium hydroxide
- iron (II) sulfate

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

The 10 combinations of solutions tested are:
magnesium nitrate + potassium iodide
magnesium nitrate + silver nitrate
magnesium nitrate + sodium hydroxide
magnesium nitrate + iron (II) sulfate
potassium iodide + silver nitrate
potassium iodide + sodium hydroxide
potassium iodide + iron (II) sulfate
silver nitrate + sodium hydroxide
silver nitrate + iron (II) sulfate
sodium hydroxide + iron (II) sulfate

This activity can also be set up a round robin with 10 stations. Each station would need two chemicals and 3 pre-labelled test tube racks.

Iron (III) sulfate can be used if the iron (II) has oxidized to orange/brown.

Notes for the teacher:

Students must wear safety glasses and gloves at all times.

Collect all labelled test tubes and their contents at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

1. Use the solubility rules to predict whether a precipitate will form for each combination of solutions. Record your predictions in the results table.
2. For the first pair of solutions, label the test tube. Add approx. 2 cm of each solution to the test tube and record your observations. Placing a white or black tile behind the test tube may help you see whether a precipitate has formed and, if so, its colour.
3. Repeat step 2 for the remaining pairs of solutions.
4. Do not place products down the sink. Check with your teacher for correct disposal.

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Physics

Effect of forces

Activity purpose:

Design a scientific investigation to explore the effect of forces on moving objects.

stileapp.com/go/effectofforces

stileapp.com/go/raeffectofforces

90-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 3 dynamic trolleys or large toy cars
- wooden ramps (approx. 1 m in length) with different surfaces attached:
    - smooth timber
    - carpet
    - linoleum
    - mulch
    - synthetic grass
- 8 m tape measure
- compass or protractor to measure angles
- stopwatch
- small weights (1 g – 100 g)

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Preparation

Preparation required by lab-tech:

It will be necessary to organise timber ramps with the materials attached in advance. They can then be stored and used in future years.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This lesson is designed to guide students through the steps of a structured inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template in the Stile lesson by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method or allowing students to generate their own questions for investigation.
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analysing data
- adding extra scaffolding to support less experienced students

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

There are lots of forces at play on any moving object. When a toy car is let go at the top of a slope it is pulled down the slope by gravity. The distance and speed the car travels depends on a number of factors. One of those factors is the amount of friction between the car's wheels and the road surface.

Conduct an investigation to find out the effect of friction on moving objects.

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The effect of gravity

Activity purpose:

Observe the effect of gravity on four balls of different mass.

stileapp.com/go/effectofgravity

stileapp.com/go/raeffectofgravity

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- balls of varying mass that are similar in size
- 0.1 g electronic mass balance
- video-recording device
- 1 m ruler

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

There are a number of slow-motion video recording apps that students could download that would assist them in viewing and analyzing their results.

Prior knowledge of balanced and unbalanced forces is assumed for this activity.

Method

Method that students will follow:

1. Weigh each ball on the electronic mass balance and record the mass (grams) in the table below.
2. Select a height to drop the balls from.
3. Set up the video-recording device so that it is focussed where the balls will hit the ground.
4. Drop all four balls at exactly the same time from exactly the same height.
5. Review the video and record your observations below.

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Parachutes

Activity purpose:

Use the engineering design process to build and test a model parachute.

stileapp.com/go/parachutes

stileapp.com/go/raparachutes

180-240 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- raw (60 g) eggs
- 6 sheets of newspaper
- masking tape
- large garbage bag
- thin cotton twine
- scissors
- 8 m measuring tape
- ziplock bag (15 cm x 16 cm)

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

It is intended that students seal their egg 'pilot' in a ziplock bag - this will contain any breakages and reduce mess.

The 60 g egg must fall from a height of at least 5 metres to the ground without breaking. This may require the use of a second storey landing or the use of a safe ladder to gain the required height. Be sure to establish a safe dropping zone to protect passersby.

Notes for the teacher:

We recommend that students work individually to initially define the problem, research, and brainstorm solutions before they join together in a group.

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

Design a parachute that will safely deliver a "pilot" from a height of 5 metres.

Your "pilot" will be a 60 g egg. The egg must not break when it hits the ground.

A template outlining the engineering design process, as well as further scaffolding is also provided to students in the Stile lesson.

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Building a catapult

Activity purpose:

Understand the key components of an effective lever.

stileapp.com/go/levers

stileapp.com/go/ralevers

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 10 craft sticks, or icy pole sticks
- 4 rubber bands
- 1 mini marshmallow
- plastic bottle cap
- protractor

Chemicals

- PVA glue

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

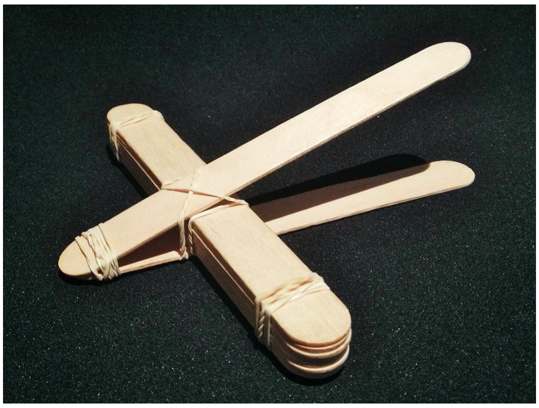
N/A

Notes for the teacher:

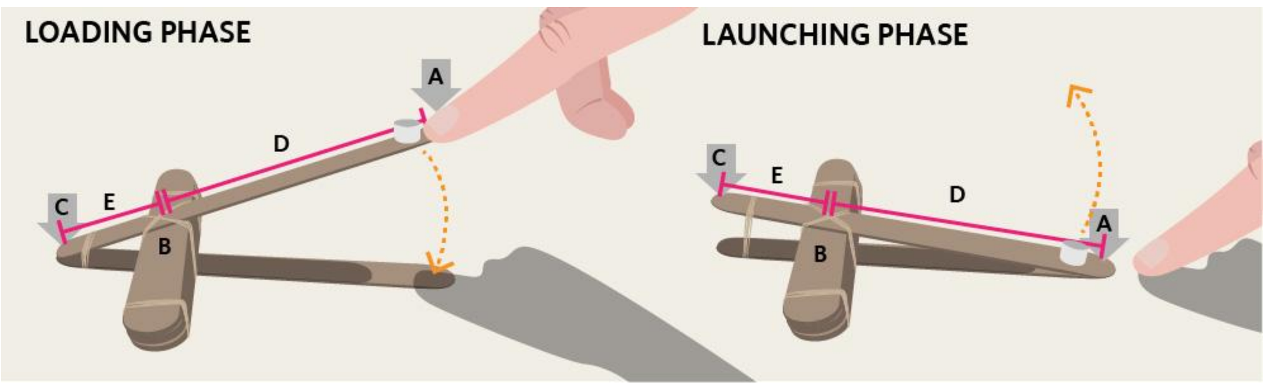
N/A

Method

Method that students will follow:



1. Form a stack of 8 craft sticks and wrap a rubber band around each end to hold them together.
2. Stack the other two craft sticks and bind them together using another rubber band, close to one of the ends.
3. Separate the two craft sticks at the other end and slide the stack of eight in between so that the upper stick makes an angle of about 30 degrees with the horizontal.
4. Wrap another rubber band around the centre of the structure to hold it all together.
5. Place a mini marshmallow on the raised end of the sloping stick and launch it by pressing down and releasing. If you have trouble keeping the marshmallow sitting on the stick, you can wrap a rubber band around the stick to provide support. Otherwise, you can glue a plastic bottle cap to the end to create a more enclosed launching pad.



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Squashed tomatoes

Activity purpose:

Design, build and test a way of moving tomatoes that won't squash them.

stileapp.com/go/squashedtomatoes

stileapp.com/go/rasquashedtomatoes

180-240 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 1 punnet of cherry tomatoes for class to share
- K'Nex, Meccano, Lego or another construction kit
- paper straws
- pulleys
- split pins
- screw eyes
- cup hooks
- paper-clips
- adhesive tape
- newspaper
- netting
- dowel
- rulers
- card
- paper cups
- boxes
- cherry tomatoes
- ramps with various surfaces
- string/thread
- cardboard tubes

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This engineering challenge was originally developed by Practical Action, an organization that uses technology to challenge poverty in developing countries. Teacher notes, student worksheets and more background information can be found at their website: https://practicalaction.org/squashed-tomato-challenge-5

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

Method

Method that students will follow:

Students will follow the engineering design process to create a new and innovative product from plastic waste.

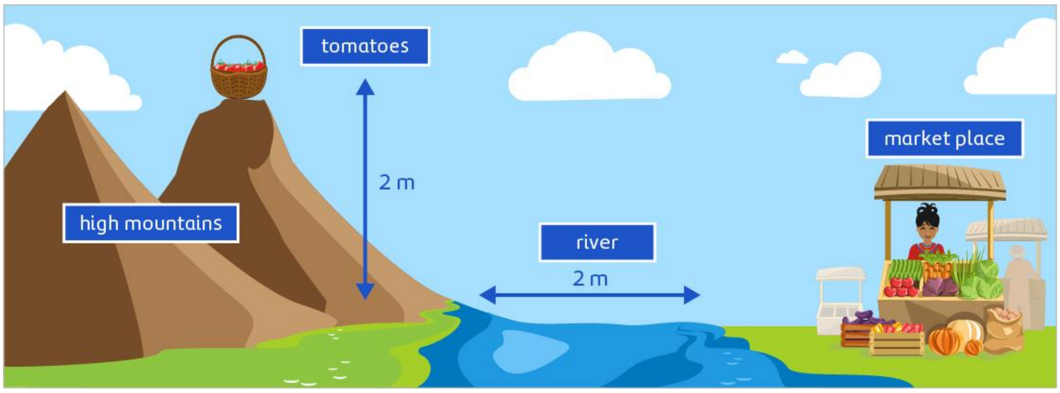
Instructions provided to students include:

We need your help to find a way to safely transport tomatoes from fields high in the valleys to a market across a river.

You will need to design, build and test a model that can transport as many cherry tomatoes as possible without squashing them. Your model must meet the following criteria:

- The tomatoes must be transported from a height of two metres and travel a minimum of two metres horizontally, not touching the ground.
- The tomatoes cannot be touched whilst they are moving, catapulted or 'flown' in any way. They must be moved in a controlled way so they don't get squashed.
- Your design must not use an external energy source.
- Your design must be constructed from the materials supplied by your teacher.

A template outlining the engineering design process and further scaffolding is provided to students in the Stile lesson.



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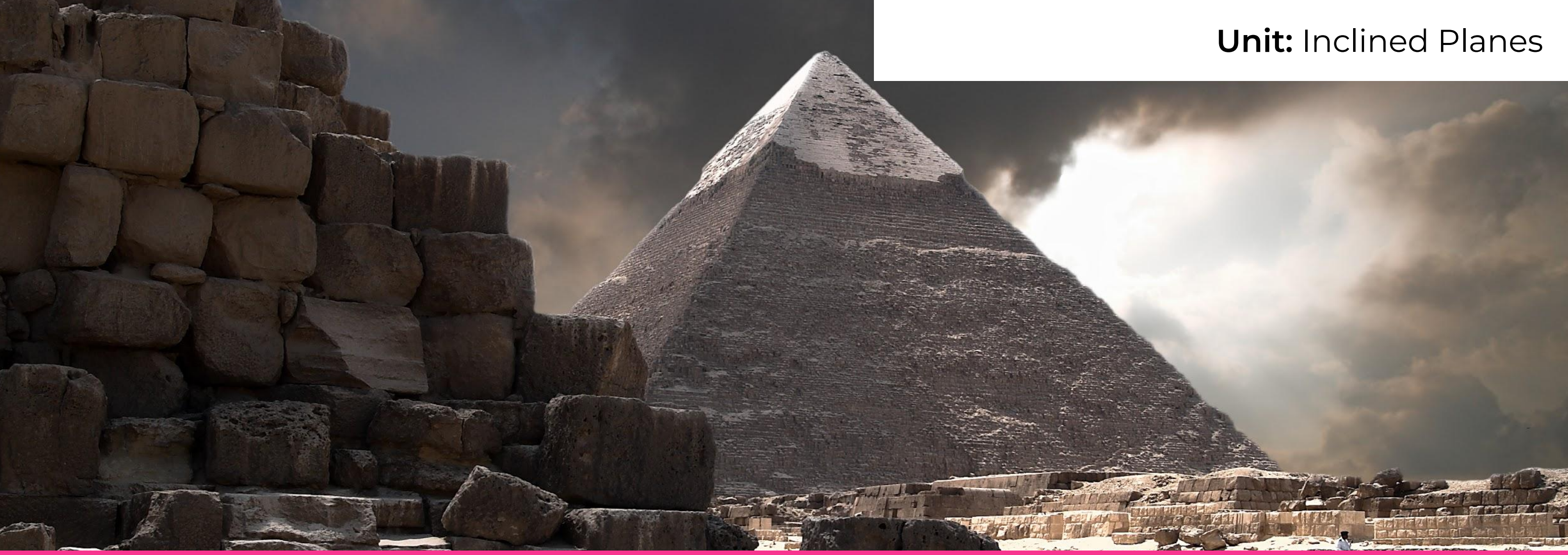

The mechanical advantage of ramps

Activity purpose:

Investigate the effect of friction on the mechanical advantage of ramps.

stileapp.com/go/inclinedplanes

stileapp.com/go/rainclinedplanes

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- smooth plank of wood
- stack of books
- 1 kg spring balance
- small ziplock bag of rice tied with string or rubber band
- 30 cm ruler
- protractor

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

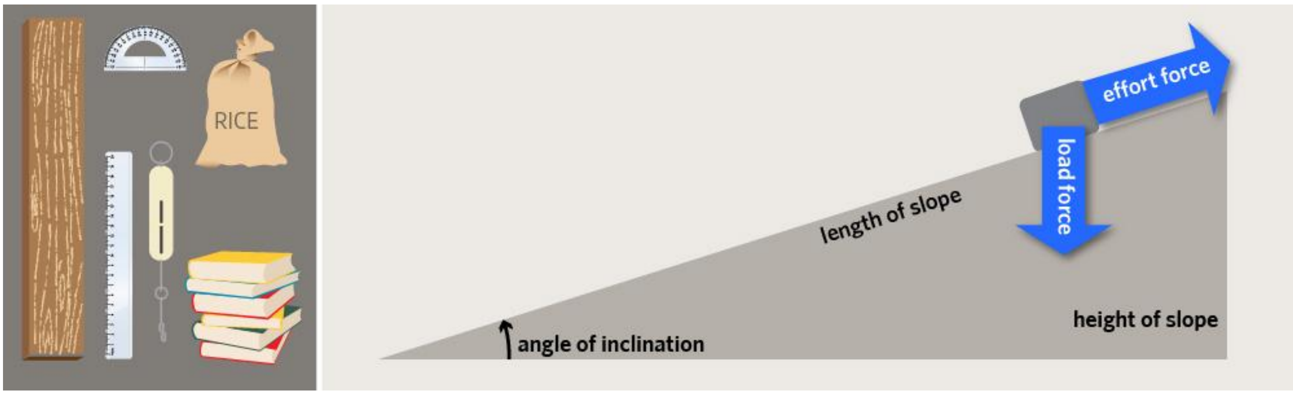
Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

investigate the effect of friction on the mechanical advantage of ramps.



Working in groups, your task is to design and carry out an experiment using only the materials provided in the above list. The experiment should let you compare the ideal and actual mechanical advantages of ramps with different angles of inclination, shown in the above diagram. Remember the two formulas for mechanical advantage:

Your teacher will show you how to measure a force in newtons (N) using the spring balance. The rest is up to you!

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Energy mystery box

Activity purpose:

Explore everyday items that exemplify different forms of energy.

stileapp.com/go/energy-mystery-box

stileapp.com/go/raenergymysterybox

30-40 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

One mystery box that contains:

- apple
- leaf
- sparkler and lighter
- torch and batteries (the required number of batteries for the torch to run)
- rubber band
- 2 ping pong balls
- squeaky toy (rubber duck)
- piece of Velcro

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

The items in the mystery box can be swapped out depending on what is available at your school. It would be good to have at least one item for each of the main forms of energy (sound, light, heat, electrical, gravitational, elastic, kinetic, chemical). You could also include a magnet if you wish to introduce magnetic potential energy. Velcro is included as an example of biomimicry and is the subject of a class poll later in the activity.

Alternative setups include having just one mystery box for the whole class or stations set up around the class with a few of each item.

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Use your senses to examine each item as you interact with it in different ways. *Caution: Do not use the senses of taste or smell.*
2. Record your observations.
3. Propose a form of energy that may be associated with each item.

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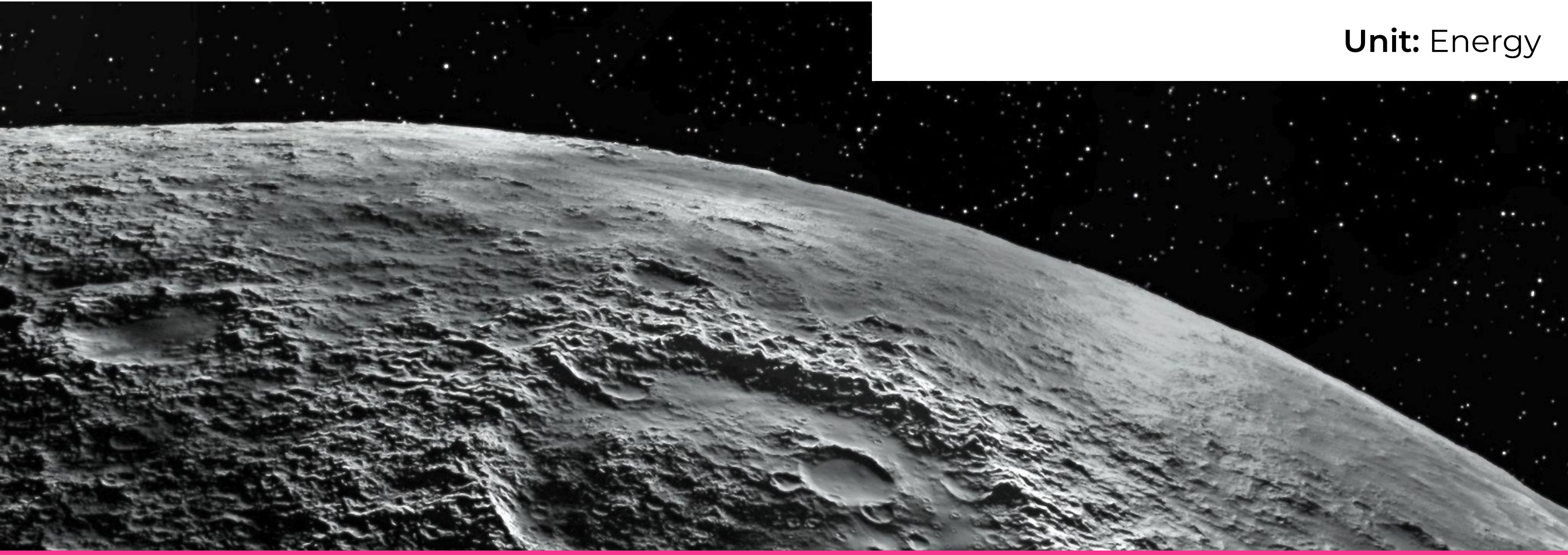

Asteroid marble drop

Activity purpose:

Explore how kinetic energy depends on the mass and speed on an object.

stileapp.com/go/asteroid-marble-drop

stileapp.com/go/ramarbledrop

30-45 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- 1 small marble or pebble
- 1 large marble or pebble
- shallow tray or box, such as a baking tray
- 1 kg packet of flour
- cocoa powder or hot chocolate powder
- spoon
- 30 cm ruler
- sieve
- electronic balance or kitchen scale

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

To save time, you may like to ask half of the groups in the class to investigate the effect of mass and the other half to investigate the effect of speed. After plotting their results, you could bring them back for a class discussion where they present and compare their results.

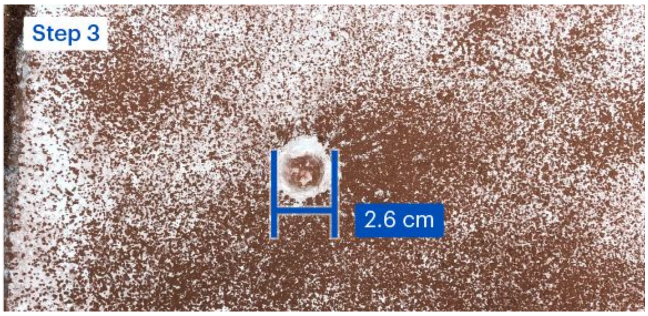
Method

Method that students will follow:

Part 1: The effect of speed

Low speed

1. Pour flour into the tray to make a layer about 1 cm thick. Use the back of the spoon to gently even out the surface of the flour. Dust the top of the flour with cocoa powder using the sieve.
2. Measure 30 cm above the surface of the flour. Take a small marble and drop it into the box from that height.
3. Measure the width of the crater across the widest part, from the outer edges. Record the measurement in the results table in centimetres (cm).
4. Repeat the same test two more times. Then calculate the average of the three tests.



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Method that students will follow (cont'd):

High speed

1. Smooth the surface of the flour again and dust with cocoa powder.
2. Repeat the method above but this time throw the marble downwards instead of dropping it.

Part 2: The effect of mass

1. Reset the flour in the tray from Part 1. Dust again with cocoa powder if necessary.
2. Use the electronic balance to measure the mass of the small marble and the large marble individually. Record both measurements in the results table.

Small mass

1. Measure 30 cm above the surface of the flour. Take the small marble and drop it into the box from that height.
2. Measure the crater width and record it in the results table.
3. Repeat the same test two more times. Then calculate the average of the three tests.

Large mass

1. Smooth the surface of the flour again and dust with cocoa powder.
2. Repeat the method above, but dropping a large marble instead of a small one.

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Rubber band racers

Activity purpose:

Explore elastic potential energy by building toy cars powered by rubber bands.

stileapp.com/go/rubber-band-racers

stileapp.com/go/rarubberbandracers

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- rubber band
- 2 skewers
- 4 plastic lids of the same size (e.g. milk bottle lids)
- measuring tape
- cardboard tube (e.g. toilet paper roll)
- toothpick
- scissors
- 20–30 g plasticine or other small weight
- *optional*: ruler

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

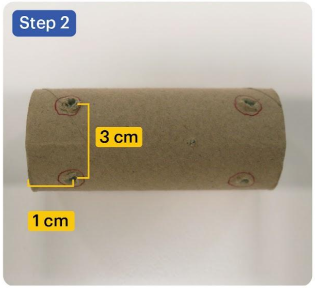
Optional activity: When students have collected and interpreted their results, you might organize a race to see whose rubber band racer is the fastest. This might help students consider how they could improve their designs.

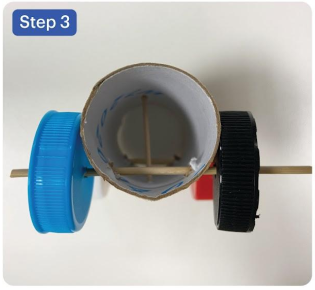
Method

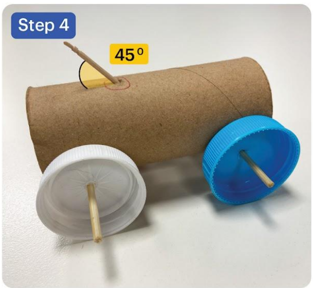
Method that students will follow:

Part 1: Making the rubber band racer

1. Using scissors, carefully make small holes in the centre of each plastic lid. Make sure the holes are just big enough for the skewers to push through, but not move around.
2. Using scissors, carefully make four small holes in the cardboard tube, as shown in the diagram. Make sure they are 1 cm from each end of the tube and 3 cm apart. This will ensure the racer moves in a straight line.
3. Push the skewers through the holes in the cardboard tube and make sure they can rotate easily.
4. Place the lids on either end of the skewers to make the wheels. Use the scissors to shorten the skewers for a more compact car. Check that the wheels move freely by rolling the car on the ground.
5. Make a hole in the top of the cardboard tube and push the toothpick in at a 45° angle. The toothpick should reach the bottom of the tube, to hold it in place.
6. Place the plasticine or other small weight inside the tube. This will help the racer travel in a straight line.







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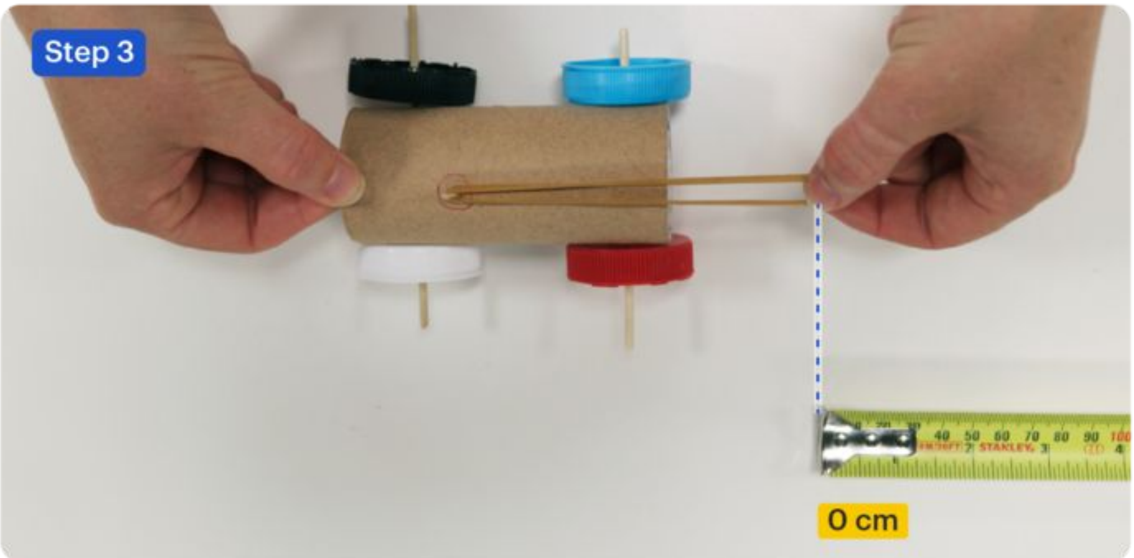
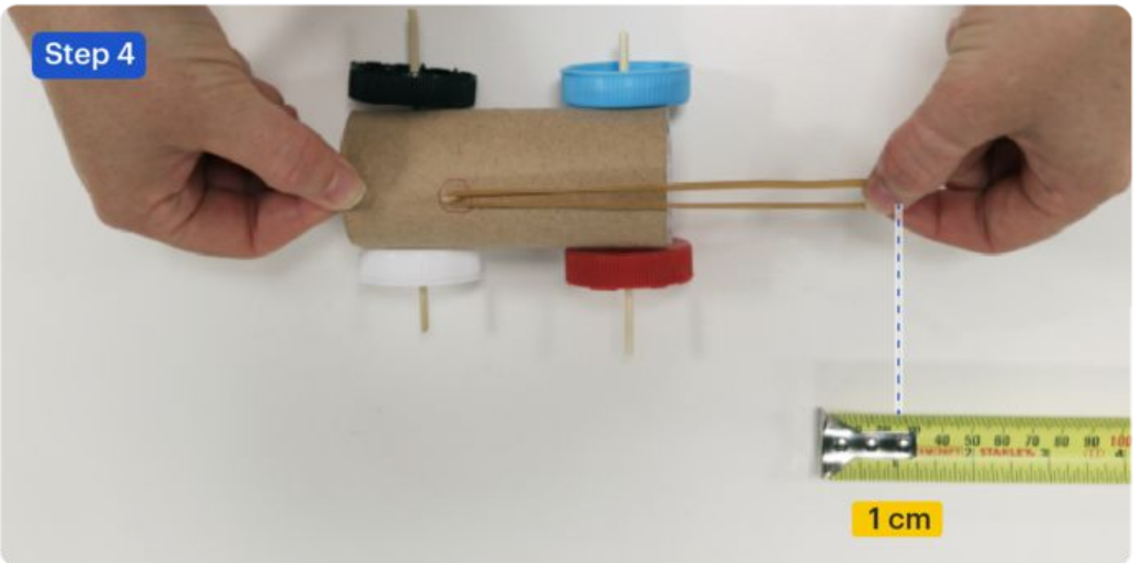
Method that students will follow (cont'd):

Part 2: Testing the racer

1. Find a clear area with a hard, smooth floor. Lay out the tape measure to a length of 200–300 cm. You will use this to measure the distance travelled by the racer.
2. Hook the rubber band over the toothpick and extend it out in front of the car, so it is straight but not stretched.
3. Line up the end of the rubber band with the 0 cm mark on the tape measure, as shown in the diagram.
4. Hold the back of the racer with your other hand. Stretch the rubber band to 1 cm. This is the stretch distance. Release the car and measure how far it travels, to the nearest centimetre. This is the travel distance. Record this data in the results table.
5. Run two more trials with the same stretch distance. Then calculate the average of the three trials.
6. Repeat Steps 4 and 5 with stretch distances of 2 cm, 3 cm, 4 cm and 5 cm.





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Water wheels

Activity purpose:

Students make a simple model of a water wheel to collect evidence about energy transfer.

stileapp.com/go/water-wheels

stileapp.com/go/rawaterwheels

40-50 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- 2 pieces of thick cardboard or thin plastic
- approx. 9 paper or plastic cups
- bamboo skewer
- scissors
- stapler
- pen
- 1 m ruler or tape measure
- water jug or another pouring vessel
- large container or bucket
- 2 chairs

Chemicals

- water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This activity prepares students for completing the engineering challenge about biomimicry design, which involves designing a water wheel or turbine using biomimicry. We recommend saving the student's water wheels so students can look at them during the design phase of the engineering challenge. If you want students to have the choice to reuse and modify their water wheels, we suggest providing water-resistant materials such as wood, plastic or laminated cardboard.

Method

Method that students will follow:

Part 1: Making the water wheel

1. Follow the video to construct a simple water wheel. *Refer to Stile lesson for video.*
2. Hold the water jug above the water wheel. Use the ruler to record its height.
3. Pour the water in a steady stream to test the water wheel.

Part 2: Making observations

4. Pour the water in a steady stream to make the water wheel spin again. This time, make observations of the water wheel at the following points:
   a) before pouring the water over it
   b) while water is being poured over it
   c) after the water stops being poured
5. Record detailed observations in the results table. Things you should pay attention to include:
   - the motion of the water wheel
   - the motion of the water
   - any other observations, such as sounds that are made

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Bouncing balls

Activity purpose:

Compare the energy efficiency of the bouncing of various balls.

stileapp.com/go/bouncingballs

stileapp.com/go/rabouncingballs

30-40 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 3 spherical balls of different kinds (e.g. tennis ball, baseball, cricket ball, golf ball, table tennis ball, squash ball, super ball)
- metre ruler or tape measure
- 160 cm x 30 cm sheet of paper
- sticky tape
- marking pen

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Find an area of flat, hard floor next to a wall. Attach the sheet of paper to the wall with sticky tape, with one of the narrow ends touching the floor. Measure exactly 150 cm from the floor and draw a line on the paper, labelled "150 cm".
2. Hold the first ball so that the top is exactly 150 cm above the ground. Release the ball without applying any force. Record how high it bounces by drawing a line on the paper where the top of the ball reaches. Label this line (e.g. "tennis 1" if it's the first trial with a tennis ball) and measure its height in centimetres.
3. Repeat Step 2 two more times *with the same ball.*
4. Repeat Steps 2 and 3 for the other two balls.

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Create a light bulb

Activity purpose:

Build a filament light bulb and explain why it isn't energy efficient.

stileapp.com/go/create-lightbulb

stileapp.com/go/ralightbulb

30-40 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- power pack that supplies up to 12 V
- 2 alligator clips and wires
- 10 cm long piece of nichrome wire
- 2 large metal nails (approx. 3–4 cm long)
- piece of plasticine or play dough (approx 3 cm x 3 cm)
- glass jar with a wide opening

Chemicals

N/A

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Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

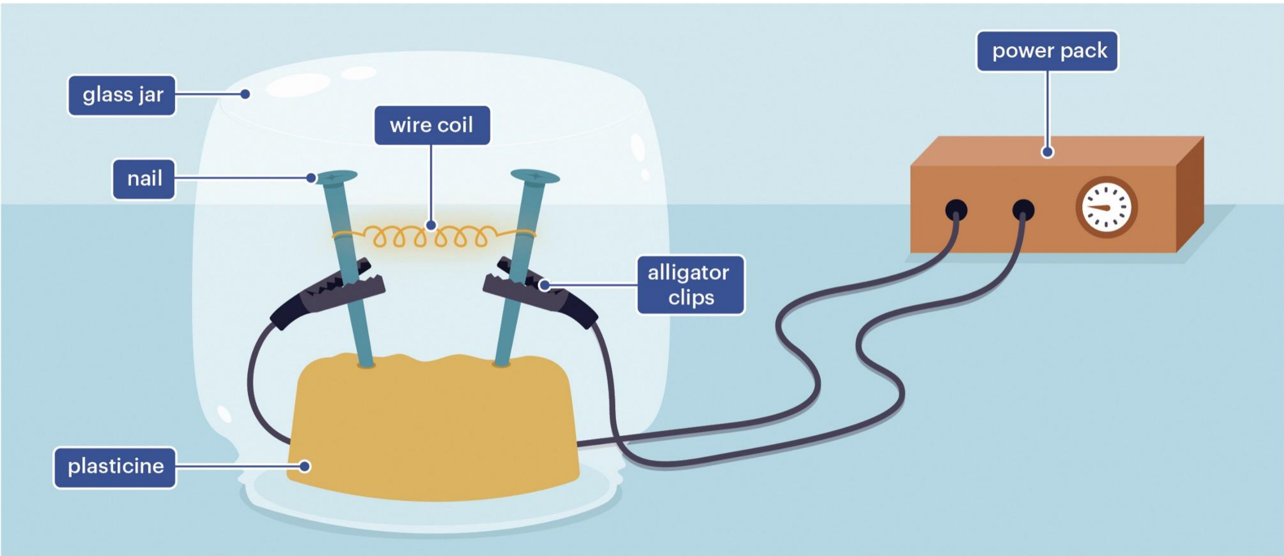
Safety:

- Students to wear safety glasses at all times.
- The filament will heat up quickly. Make sure students know not to touch it. If the voltage or current is too high, the nichrome wire will get too hot and may break down. This will break the circuit.
- Ensure the experimental setup is not taken apart until the nichrome wire has been allowed to cool for at least a few minutes.

Method

Method that students will follow:

1. Tightly wrap the nichrome wire around a nail or pencil to form a coil, leaving the ends straight. Remove the wire from the nail. The wire coil should be only 1-2 cm long. This will be the *filament*.
2. Roll the plasticine into a spherical shape. Then firmly press it onto a lab bench. Stick the two nails vertically out of the plasticine, about 2–3 cm apart.
3. Wrap the ends of the wire coil around the top of each nail. The nails act as the *connecting wires*.
4. Connect an alligator clip to each of the nails below the wire coil.
5. Plug in the power pack. Ensure that it is turned down to 0 volts (V).
6. Attach the other end of each alligator clip to the power pack. This will complete the circuit between the power pack, wires, nails and wire coil.
7. Turn on the power pack. This is the *electrical source*.
8. Slowly increase the voltage until the nichrome wire starts to glow. *Note: The glowing filament is easier to observe if the classroom is dark.*
9. Carefully place the glass jar over the entire plasticine and nail setup. This is the *glass bulb*.



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Biomimicry design

Activity purpose:

Challenge students to design and test a water wheel or turbine that takes inspiration from an animal or plant.

stileapp.com/go/biomimicry-design

stileapp.com/go/rabiomimicrydesign

240-330 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

The materials for this activity may vary. We suggest providing the following:

- *optional:* water wheels that students created in the water wheel practical activity
- selection of used plastic bags and plastic containers
- selection of cardboard or thin plastic sheets
- paper or plastic cups
- water jugs, buckets or other vessels
- thin-spouted watering cans
- paddles, such as ping pong paddles or spatulas
- pipe or hose offcuts
- small weighted objects, such as washers or paper clips
- bamboo skewers
- cotton thread
- rope or string
- scissors
- masking tape
- staplers
- stopwatches or video recording devices
- tally counters
- rulers

Chemicals

- water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

We recommend giving students advance notice about this engineering challenge so that they can begin developing their ideas. You may like to introduce the challenge at the start of the unit as the major project that students will be working towards.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

We suggest running this challenge in four phases:

1. The planning phase (45–90 minutes): Introduce the *Background* and the *Design brief,* have students *Form a team, Define* the problem and *Brainstorm* possible solutions. This phase can be completed at the start of the unit. Students can *Research* the topic outside of class time.
1. The design phase (90–120 minutes): Teams gather together to *Design* their devices and *Create* prototypes.
2. The testing phase (45–60 minutes): Teams *Test and evaluate* their prototypes and attempt to *Improve* their designs, time permitting.
3. The sharing and reflection phase (45–60 minutes): Teams *Share* the inspiration for their designs, how well their prototypes performed and how they could be improved. Finally, they *Reflect* on their learning by relating it back to the essential question and self-assess using a rubric.

Method

Method that students will follow:

Students will follow the engineering design process to create a new and innovative product.

Instructions provided to students include:

Your task is to redesign a water wheel or turbine by taking inspiration from nature. The new design should be more efficient, affordable, reliable or sustainable.

You will need to design, build and test a small-scale model that meets the following criteria:

- takes up a maximum space of 30 cm height x 30 cm length x 30 cm width
- is able to turn on an axle using the kinetic energy of flowing water
- takes inspiration from how an animal or plant functions
- is constructed with materials supplied by your teacher or that you can easily get from home

Further scaffolding to plan and conduct this engineering challenge is provided in the lesson.

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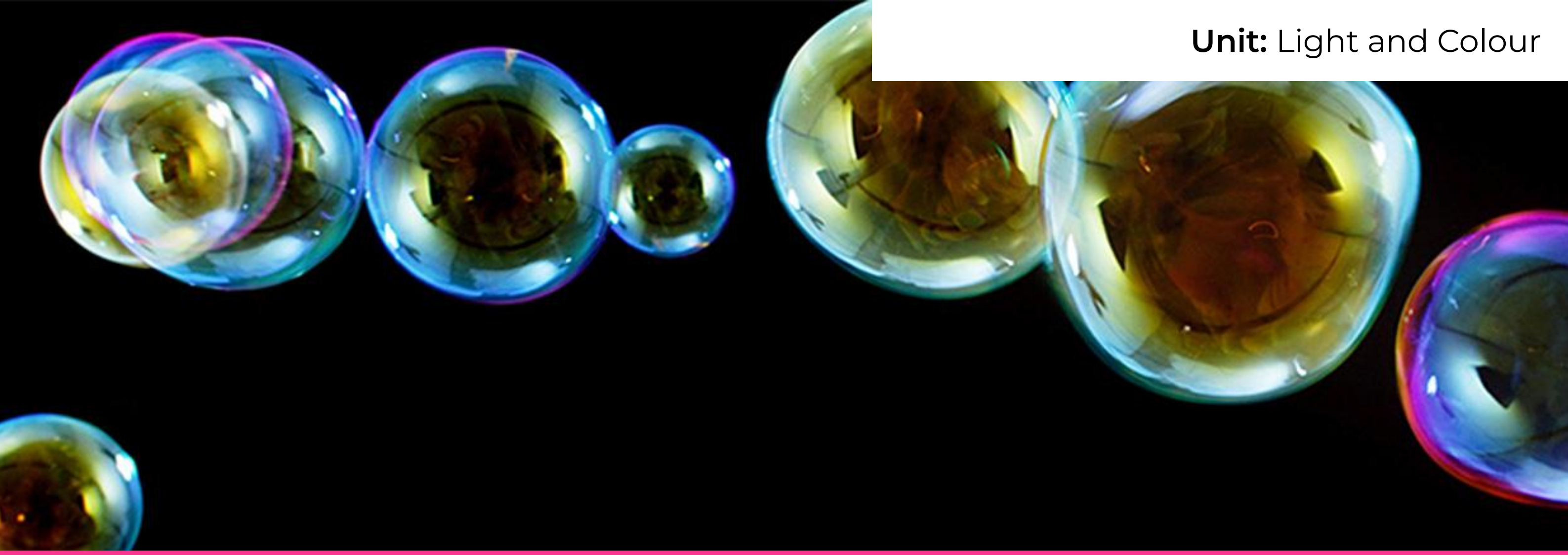

Properties of bubbles

Activity purpose:

Examine the properties of bubbles.

stileapp.com/go/bubbles

stileapp.com/go/rabubbles

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 1250 mL soft drink bottle
- 2 straws
- 1.5 m piece of string
- plastic tray or container
- device for taking photos (optional)
- 200 mL measuring cylinder
- 50 mL measuring cylinder

Chemicals

- 200 mL concentrated pure soap liquid
- 50 mL glycerine
- 1 L water

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Preparation

Preparation required by lab-tech:

The bubble mixture can be made ahead of time to reduce the class time of this activity (see Part 1 below).

Preparation required by teacher:

Allow advance notice for your lab-tech to purchase supplies as these quantities are not normally kept on hand. Also state whether or not you would like the lab-tech to make the bubble solutions for you the day before class, or not. The glycerine and detergent will probably be supplied in bulk bottles, with measuring
jugs to dispense.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Part 1: Making your bubble mixture

1. To make your bubble mixture simply mix the water, soap liquid and glycerine in the soft drink bottle. Shake the mixture well and let it sit until it settles (for the best mixture let the mixture sit for 24 hours).

Part 2: Making your bubble wand

1. You will need to make a bubble wand. Cut a piece of string to about 1.5 meters in length. Thread the string through both straws and tie it off.

Part 3: Make your bubbles

1. Go outside and find an open space with little to no wind. Pour your bubble mixture into your plastic tray or container. Dip your bubble wand into your bubble mixture, hold it up so that the breeze is at your back and watch the bubble form before your eyes.
   * Try to make a bubble as big as possible.
   * Try to make a bubble last as long as possible.

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Which material is the best insulator?

Activity purpose:

Investigate the best material for insulating a hot pizza.

stileapp.com/go/bestInsulator

stileapp.com/go/rabestinsulator

120-180 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

The materials needed will depend on the experimental design that each group of students comes up with. It is likely that you will need to provide the following materials:

- 3 aluminium cans (minimum)
- 3 thermometers (1 per aluminium can)
- scissors
- sticky tape or glue
- different materials: cotton, nylon, wool, polyester, cardboard
- kettle plastic measuring jug (to dispense hot water)
- stopwatch

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

N/A

Preparation required by teacher:

N/A

Notes

Notes for the lab-tech:

We recommend that you use something to act as a model for a hot pizza. For example, you might use an aluminium can filled with hot water.

Notes for the teacher:

This lesson is designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template in the Stile lesson by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method or allowing students to generate their own questions for investigation.
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analysing data
- adding extra scaffolding to support less experienced students

This investigation could also be turned into an engineering challenge. Rather than asking students to investigate which material would make the best insulator, you could ask students to create the ideal pizza delivery box using the engineering challenge template in the Stile lesson library.

Method

Students will design their own method, to be approved by their teacher.

Instructions provided to students include:

Conduct an investigation to find out which type of material will keep an object hot for the longest time.

The design of the investigation is up to you, but here are some points to help guide you:

- We recommend that you use something to act as a model for a hot pizza. For example, you might use an aluminium can filled with hot water.
- Consider what types of materials you want to compare, and how you will arrange them around your model.
- How often will you measure temperature, and for how long?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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Modelling convection currents

Activity purpose:

Observe and explain the movement of convection currents.

stileapp.com/go/convection

stileapp.com/go/raconvection

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 500 mL beaker
- straw
- tweezers
- beaker
- Bunsen burner
- heatproof mat
- gauze mat
- tripod
- lighter or matches
- gloves
- safety glasses
- large stoppered flasks for waste

Chemicals

- 2 or 3 small pieces of potassium permanganate (small enough to fit through a straw)
- 400 mL cold water

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

If you do not have potassium permanganate, you may like to use some other material instead. Alternatives include tea leaves, beans, sultanas, rice and food dye.
If using tea leaves, dampen the tea leaves in tea bags prior to cutting them open, as dry tea leaves tend to float on top of the water.

Sultanas need to be organic, without the coating of oil on them.

Notes for the teacher:

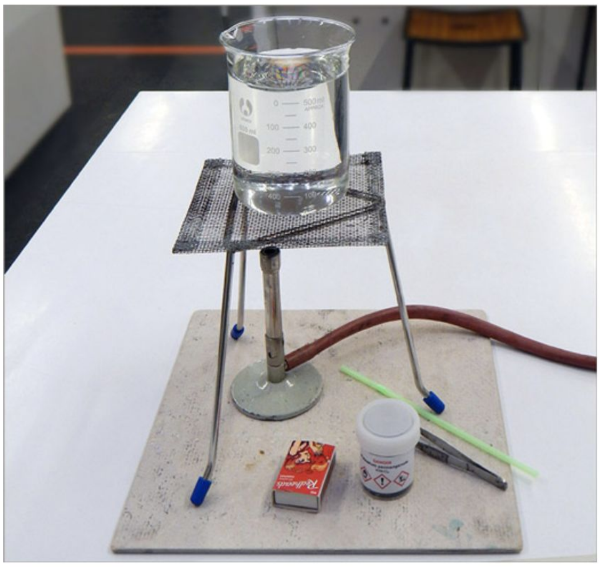
Ensure potassium permanganate is added to the cold water before the bunsen burner is lit as it is an oxidiser (may intensify fire).

Collect all stoppered flasks and materials at the conclusion of the lesson for correct disposal.

Method

Method that students will follow:

1. Set up the Bunsen burner, heatproof mat, tripod and gauze mat.
2. Add 400 mL of cold water to the beaker and place it on the tripod. Allow the beaker to rest until the water is still.
3. Place the straw into the beaker so that it is touching the side. Using tweezers, carefully slide the pieces of potassium permanganate down the straw to the bottom of the beaker.
4. Carefully remove the straw to prevent it from disturbing the water.
5. Observe the movement of the dissolved potassium permanganate in the still cold water.
6. Light the Bunsen burner and change it to the blue flame. Position the Bunsen burner so that the flame is directly beneath the potassium permanganate crystals.
7. Observe what happens to the dissolved potassium permanganate as the water is heated.
8. Pour all waste into large stoppered flasks and return to your teacher for correct disposal.



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Which colour absorbs the most radiation?

Activity purpose:

Investigate heat absorption of different coloured surfaces.

stileapp.com/go/whichcolour

stileapp.com/go/rawhichcolour

120-180 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

The materials needed will depend on the experimental design that each group of students comes up with. It is likely that you will need a collection of the following materials per group:

- 3 aluminium cans (minimum)
- 1 thermometer per aluminium can
- access to room temperature water
- 500 mL measuring jug
- paint, paper or foil to cover the cans
- paintbrushes (if using paint)
- sticky tape (if using paper or foil)
- torch or lamp
- stopwatch

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This lesson is designed to guide students through the steps of an open inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing. You can easily modify the template in the Stile lesson by:

- varying the level of inquiry, e.g. defining a particular aim, set of materials or method or allowing students to generate their own questions for investigation.
- focusing on a particular aspect of inquiry, e.g. devising a hypothesis, identifying variables or analysing data
- adding extra scaffolding to support less experienced students

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to the student include:

Conduct an investigation to find out which colour is the best at absorbing radiation.

The design of the investigation is up to you, but here are some points to help guide you.

Consider what you will be heating. For example, you might heat cans filled with water. You could paint the cans different colours or place different coloured paper around them.
Decide what the source of radiation will be. Will you use a lamp, sunlight or something else?
How often will you measure temperature, and for how long?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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Build a solar oven

Activity purpose:

Follow the engineering design process to design, build and test a solar oven.

stileapp.com/go/solaroven

stileapp.com/go/rasolaroven

180-240 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 1 fun-sized chocolate bar (alternatives include marshmallows or cheese)
- cardboard box, such as a shoe or cereal box
- aluminium foil (1 roll for class to share)
- cling wrap (1 roll for class to share)
- coloured paper
- a selection of other materials, such as newspaper, styrofoam, black paper or bubble wrap
- scissors
- tape
- ruler

To test the oven:

- paper plate
- thermometer

Chemicals

- PVA glue

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Sunlight is the intended heat source; this activity should be conducted on a sunny day.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

Design a solar oven that can melt a fun-sized chocolate bar. Your solar oven must:

- only use materials supplied by your teacher
- only use sunlight as a heat source
- melt the chocolate bar within an hour

To test your solar oven you will:

1. Place the solar oven outside. Position the oven so that it receives the maximum amount of sunlight.
2. Place the chocolate bar on the paper plate inside the oven.
3. Place a thermometer inside the oven and record the initial temperature.
4. One hour later, record the temperature of your oven. Examine the chocolate bar.

A template outlining the engineering design process and further scaffolding is provided to students in the Stile lesson.

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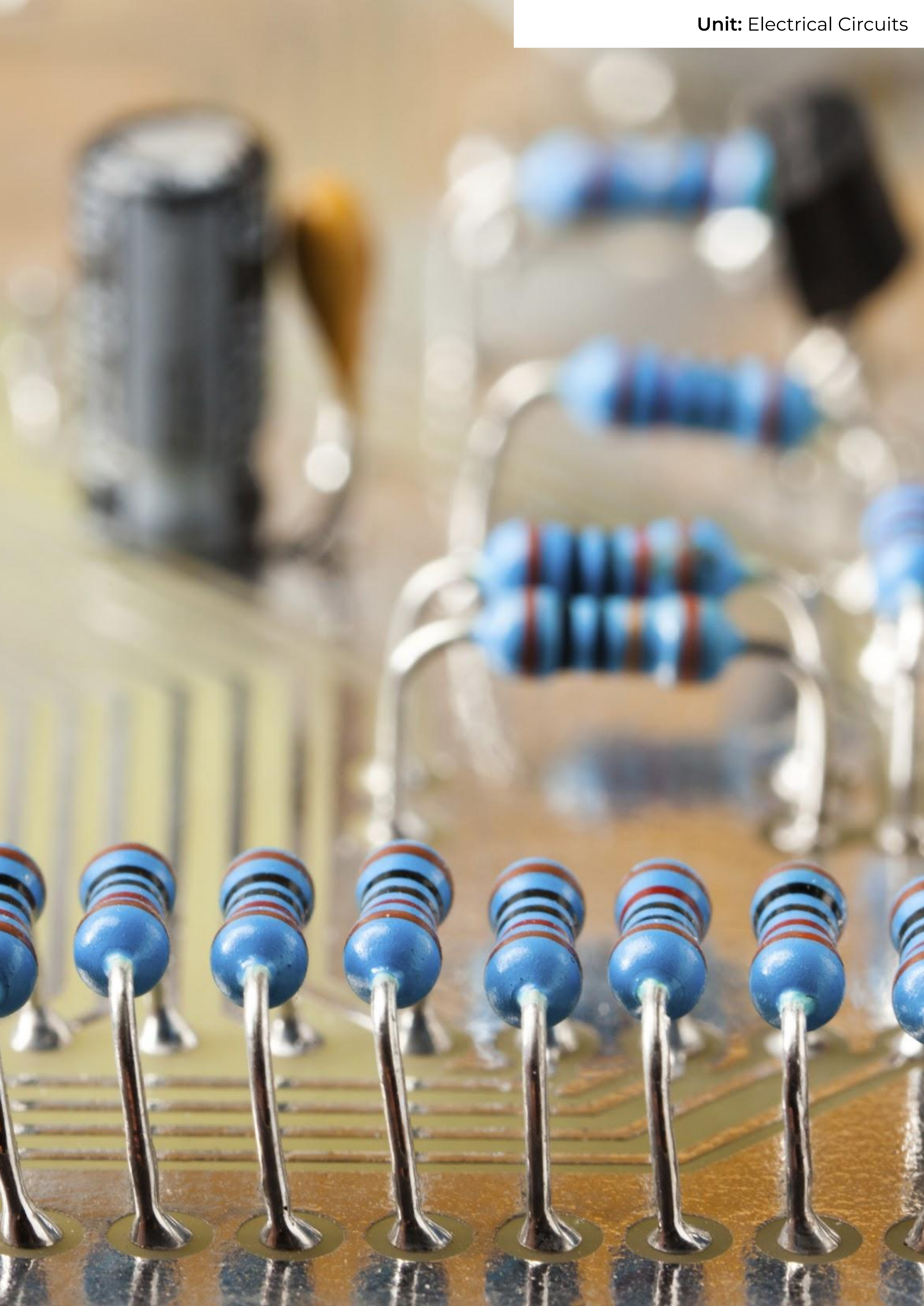

Current and voltage in an electrical circuit

Activity purpose:

Investigate whether current and voltage vary around a simple electrical circuit.

stileapp.com/go/currentvoltage

stileapp.com/go/racurrentvoltage

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 3 V battery, or 2 x 1.5 V batteries
- low voltage (3 V) light bulb or lamp
- 2 resistors, preferably of of 47 Ω and 56 Ω
- 2 black leads and clips
- 2 red leads and clips
- an ammeter to 100mA and a voltmeter to 3V (or a multimeter)

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Prior to class check that you know where to place the leads into the multimeter and how to set the multimeter to read for required the voltage and amps.

Notes

Notes for the lab-tech:

We recommend using two resistors of 47 Ω and 56 Ω. If possible, the values should be concealed from students so that they can measure or calculate them for themselves.

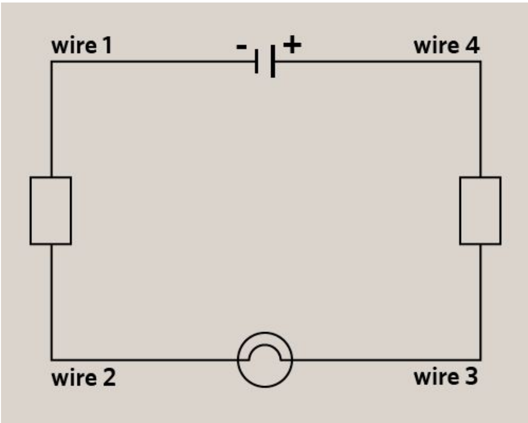
Notes for the teacher:

N/A

Method

Method that students will follow:

1. Construct the simple circuit depicted in the image.
2. Replace wire 1 with the ammeter by disconnecting both ends of the wire and then connecting the ammeter's black lead to the negative terminal of the battery and the red lead to the first resistor.
3. Adjust the setting of the ammeter (or multimeter) until you can read the current in milliamps (mA). Record this value in the canvas below.
4. Disconnect the ammeter and replace the original wire.
5. Repeat steps 2-4 for each of the remaining three wires in turn. Record your results in the canvas as you go.
6. Measure the voltage provided by the battery by connecting the black lead of the voltmeter to the black or negative terminal of the battery and the red lead to the red or positive terminal. You don't need to disconnect anything in the original circuit. Record this measurement in the canvas.
7. Measure the voltage across the first resistor by connecting the two leads of the voltmeter to either side. To get positive readings, connect the black lead closer to the negative terminal of the battery – but if you do get negative readings then just ignore the negative sign. Record this measurement in the appropriate place in the canvas.
8. Repeat step 7 for the light globe and the second resistor.



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100%

Magnets

Activity purpose:

Distinguish between magnetic and non-magnetic materials, and test the behaviour of magnets in terms of poles and magnetic fields.

stileapp.com/go/magnets

stileapp.com/go/ramagnets

10-15 minutes

1-2 students

Materials

Each group of students will need:

Lab equipment

- 2 bar magnets
- lead pencil
- plastic straw
- rubber eraser
- paper clip
- stainless steel spoon
- leaf
- copper coin
- silver coin (copper and nickel)
- aluminium foil
- paper
- iron nail

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

None

Notes for the teacher:

None

Method

Method that students will follow:

Part 1: Magnetic or non-magnetic?

Hold some everyday materials close to a magnet to determine if they are magnetic or non-magnetic.

You might test:

- a lead pencil, plastic straw, rubber eraser, paper clip, stainless steel spoon, leaf, copper coin, silver coin (copper and nickel), your finger, aluminium foil, paper, iron nail, etc.

Part 2: Attraction or repulsion?

Take two bar magnets. Try to put the two north poles together. Then try to put the two south poles together. Finally try to put a north pole and a south pole together.

In each case, do the magnets *attract* or *repel*?

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Mapping magnetic fields

Activity purpose:

Map magnetic fields and explain the interaction of magnets using the magnetic field model.

stileapp.com/go/magneticfields

stileapp.com/go/ramagneticfields

45-60 minutes | 1-2 students

Materials

Each group of students will need:

Lab equipment

Part 1:

- 1 alnico bar magnet
- 1 other magnet, such as a horseshoe magnet, ring magnet or button magnet
- A4 paper or transparent plastic
- iron filings
- compass
- pencil or marker

Part 2:

- 2 bar magnets
- A4 paper or transparent plastic
- iron filings

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

It is possible to purchase iron filings in suspension in flat perspex boxes. These are ideal for this activity. Otherwise, keeping the magnets in clear snap-lock plastic bags or plastic film makes it easier to clean off the iron filings.

Notes for the teacher:

Keep the magnets in clear snap-lock plastic bags or plastic film. This makes it easier to clean off the iron filings.

Method

Method that students will follow:

Part 1A: Field lines

1. Place the bar magnet on a sheet of paper on a bench.
2. Hold the transparent plastic sheet (or a second sheet of paper) above the bar magnet.
3. Sprinkle the iron filings onto the sheet, around the location of the magnet.
4. Lightly tap the side of the sheet to allow the iron filings to spread.
5. Observe the pattern that is created. Take a photo of your result.
6. Gently gather up the iron filings into their container.

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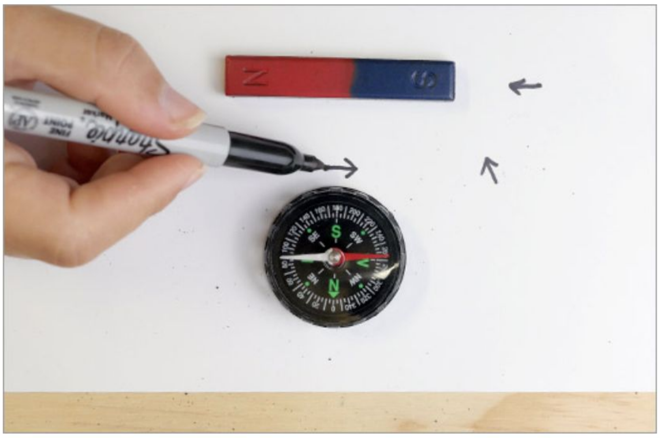
Method (cont.)

Part 1B: Field direction

1. Place a compass at different positions around the magnet.
2. At each position, draw a small arrow to show the direction of the compass's "north" arrow.
3. Take a photo of your result.
4. Repeat Part 1 and Part 2 of the method with the other magnet shape.

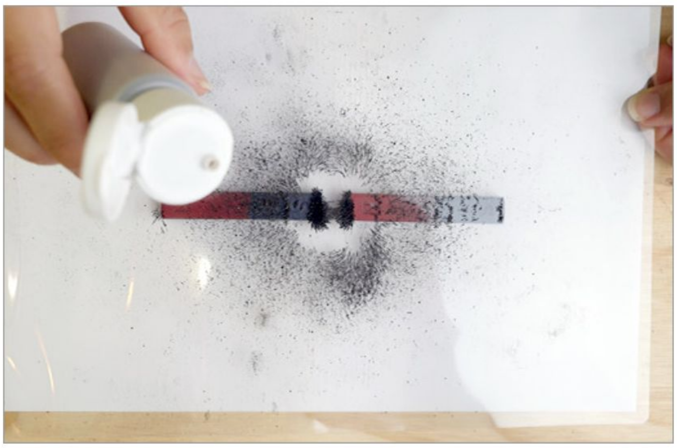


Part 2A: Attraction

1. Place the two bar magnets about 2 cm apart with a north and a south pole facing each other.
2. Hold the sheet of plastic or paper over the bar magnets.
3. Sprinkle the iron filings onto the sheet, around the space in between the magnets.
4. Lightly tap the side of the sheet to allow the iron filings to spread.
5. Take a photo of your result.

Part 2B: Repulsion

1. Without creasing it, gently bend the sheet to gather up the iron filings in the centre. Slide them carefully back into their container.
2. Repeat Part 2A but with two north poles facing each other.



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Electromagnets

Activity purpose:

Plan and conduct a scientific investigation to explore the strength of electromagnets.

stileapp.com/go/electromagnets

stileapp.com/go/raelectromagnets

60-90 minutes

1-2 students

Materials

Each group of students will need:

Lab equipment

Part 1:

- 1 m length of insulated copper wire with 1 cm of insulation removed at each end
- 1.5 V C or D-sized battery (or power supply set to 2 V)
- iron nail
- staples or paper clips
- electrical or masking tape (optional)

Part 2:
The materials needed will depend on the investigation that your students design. These may include:

- iron nails of different sizes
- other metal pieces, such as steel, nickel and aluminium
- extra insulated copper wire
- extra batteries, possibly with different voltages

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This activity assumes that students have already had a basic introduction to electromagnets.

Part 2 of this lesson is a template designed to step students through a guided inquiry. It is important to consider if this type of inquiry is appropriate for your students and the type of investigation they are pursuing.

This activity works best in a dark classroom.

Method

Method that students will follow:

Part 1:

1. Wrap the wire tightly around the iron nail 40 times to make 40 coils. Leave the wire ends free.
2. Attach the wire ends to the battery. Ensure that sections without insulation make contact with the battery terminals. Secure the ends with tape.
3. Test the electromagnet by trying to pick up staples or paper clips.

Part 2:

Students will conduct an investigation to find *one way to make an electromagnet stronger*.

Instructions provided to students include:

The design of the investigation is up to you, but here are some points to help guide you.

- Which part of the electromagnet will you change? This is your independent variable.
- You should aim to have *at least* three different conditions for your independent variable. For example, if you were changing the number of coils, your conditions might be 20 coils, 40 coils and 60 coils.
- Which other variables will you keep constant so that it is a fair test?

Further scaffolding to plan, conduct and communicate a science investigation is provided for students in the Stile lesson.

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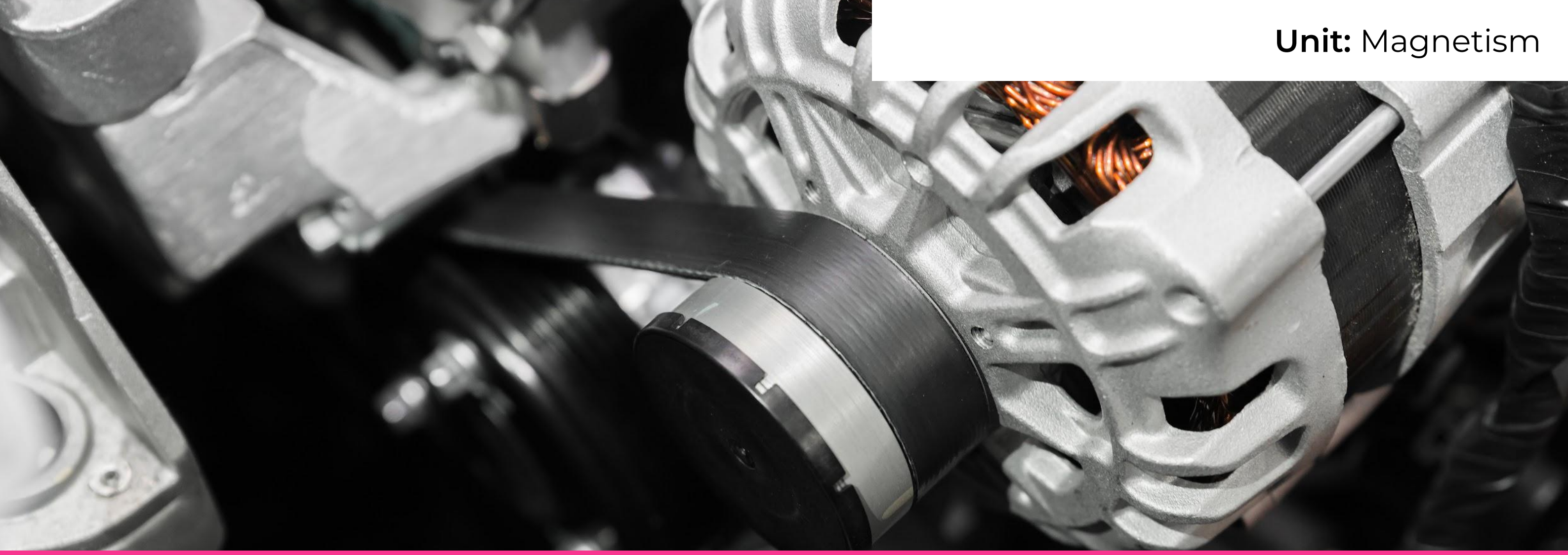

Make a simple electric motor

Activity purpose:

Examine the role of magnets in the operation of a simple motor.

stileapp.com/go/electricmotor

stileapp.com/go/raelectricmotor

60-90 minutes

1-2 students

Materials

Each group of students will need:

Lab equipment

Part 1:
- D-sized battery
- button neodymium magnet
- 1 m insulated copper wire
- 2 paper clips
- piece of sandpaper
- play dough or clay
- electrical tape

Part 2:
- simple motor from Part 1
- scissors
- assorted construction materials, such as paper, cardboard, wire and aluminium (from drink cans)
- connective materials such as masking tape, Blu-Tack and rubber bands

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Ends of copper wire can be pre-stripped by lab-techs prior to class if needed.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Part 1:

1. Wrap the insulated copper wire around the battery until there are about 10 coils. Remove the coil from around the battery.
2. Wrap the ends of the wire around the coil until they hold it securely in place. Make sure the ends of the wire are directly opposite each other on the coil.
3. Stand the coil vertically and use the sandpaper to scratch the top half of the insulation off both ends of the wire.
4. Bend the paper clips into long hooks with loops at the end. Use electrical tape to attach them to each end of the battery, with the loops sticking up to the same height.
5. Put a lump of play dough onto a table and press the battery into the centre. The paper clip loops should face upwards.
6. Place the neodymium magnet on top of the battery.
7. Insert each end of the coil into the paper clip loops. You might need to give the coil a small push to start the motor.

Part 2:

1. Create a simple moving machine by designing parts and attaching them to your motor. You can use ideas from your class discussion about electric motors in the home for inspiration about what you want your machine to do.

Your machine must:
- only use materials supplied by your teacher
- only use the simple motor as a source of movement

It may have only one moving part, or a series of interconnected moving parts.

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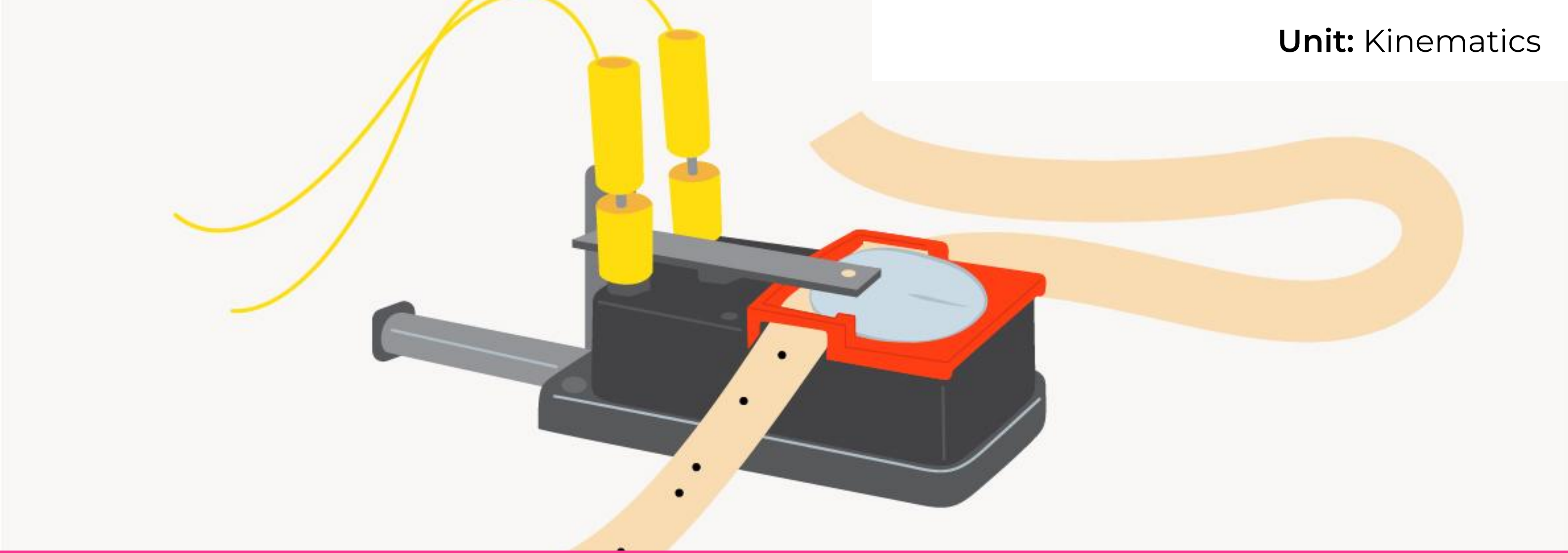

Measuring motion using a ticker timer

Activity purpose:

Use a ticker timer to understand how to record the motion of a moving object.

stileapp.com/go/tickertimer

stileapp.com/go/ratickertimer

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- ticker timer
- 1 m ticker timer tape
- AC power supply
- 2 power supply leads
- ticker tape
- ruler
- scissors
- graph paper
- glue

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

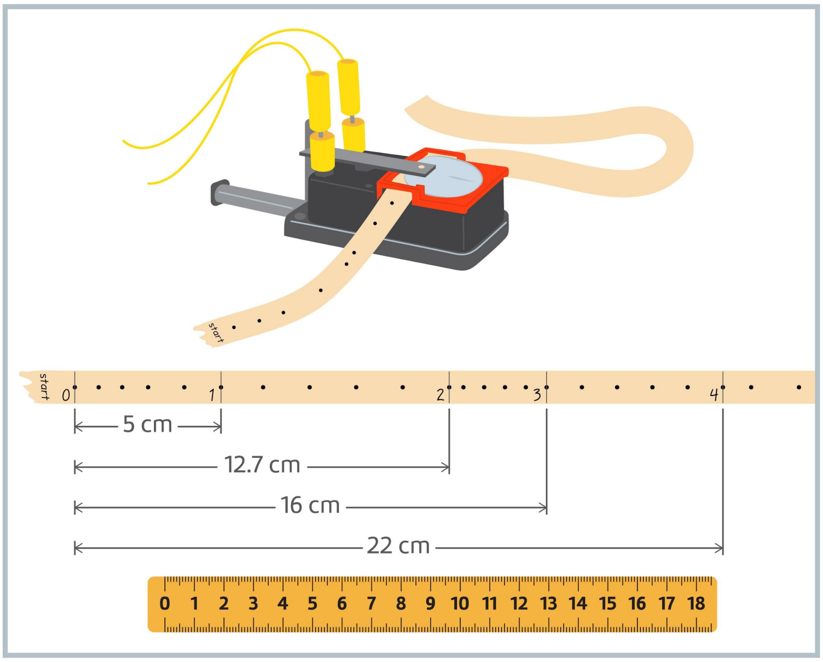
N/A

Method

Method that students will follow:

Part 1: Distance-time graph

1. Cut a 1-metre section of tape and thread the start of the tape through the slots in the ticker timer.
2. Write "start" on the short end of the tape – the end that you will pull.
3. Turn on the power and pull the tape through the machine at different speeds (slow, medium and fast) in any order. Avoid stopping altogether.
4. Mark the first clear dot at the start end of the tape with a zero. Count along five dots and draw a line through the middle of the fifth dot. Repeat until the entire tape is divided into five-gap sections and then number the sections in order from the start.
5. Measure how far each line is from the zero dot. Record the measurements in the results table.



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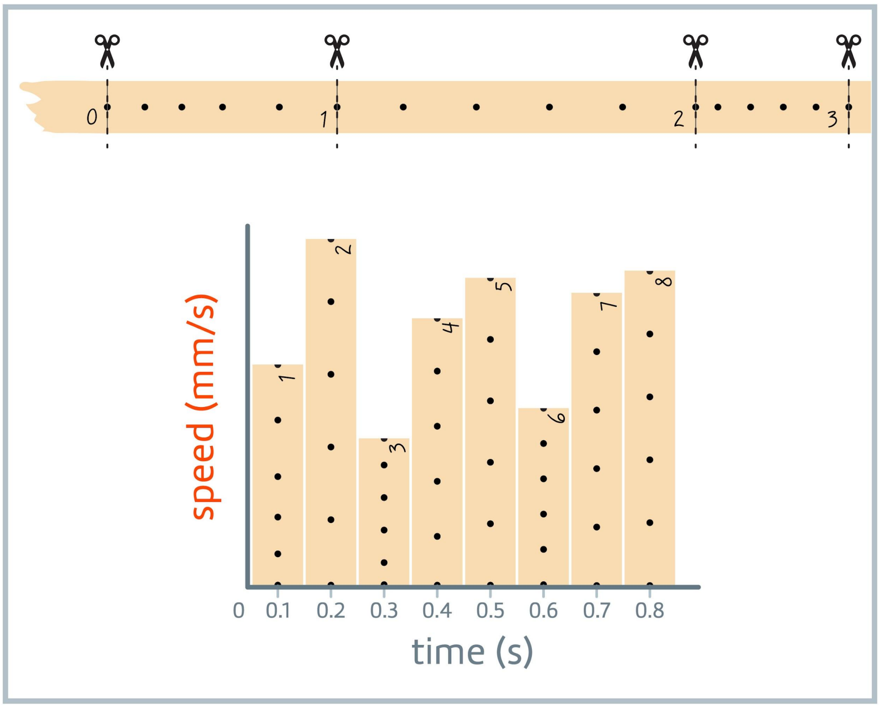
Method (cont.)

Part 2: Speed-time graph

1. Cut your piece of tape at each of the lines you drew.
2. Paste the sections of tape onto the graph paper in order (from left to right) to produce a column graph.
3. Draw axes on the graph and label the x-axis "time" and the y-axis "speed".



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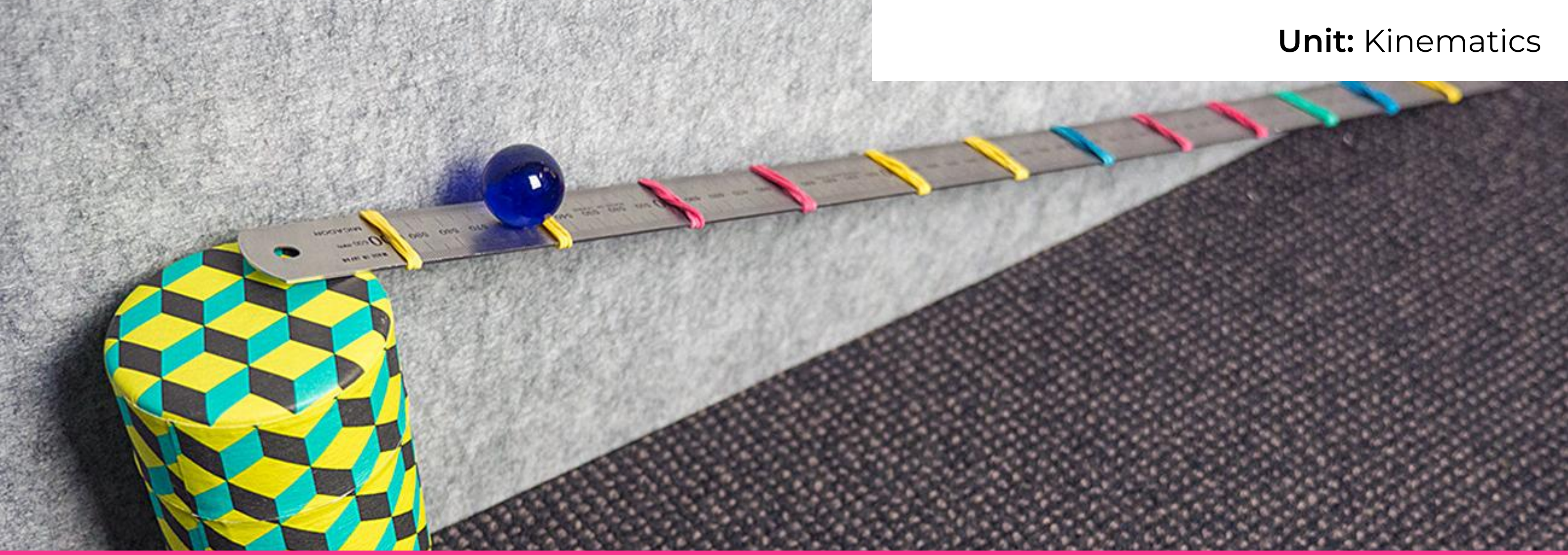

Measuring motion using a rolling ball

Activity purpose:

Investigate how sound can be used as an indicator of speed.

stileapp.com/go/rollerball

stileapp.com/go/rarollerball

45-60 minutes	3-4 students

Materials

Each group of students will need:

Lab equipment

- a ruler or similar narrow, flat piece of wood, plastic or metal, 600 mm to 1 m long
- 20 rubber bands to fit ruler width
- small hard ball, eg. of glass (marbles), metal, or hard plastic
- books or similar to prop up the ruler
- optional: cardboard or other suitable material, scissors and tape to make walls to keep the ball on the ruler
- optional: device to record video

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

If cardboard is required to keep the marbles on the ruler, cut pieces 100 cm x 10 cm (depending on width of ruler). Place under ruler so that side pieces come up and around the ruler.
The tape can be placed over the top of the open "tunnel" so that the marble can still be seen as it travels.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Put rubber bands around the ruler at regular intervals 50 mm apart.
2. Prop the ruler up with one or two books.
3. Experiment running balls down the length of the ruler:
    a. If necessary make walls to keep the balls from falling off the sides. Possibly put the ruler against a wall and tilt it slightly towards the wall
    b. Add or remove books to adjust the angle of the ramp. You don't want the balls to roll too fast, but if the ruler is too flat the balls will stop
4. When your setup is working well, release a ball from just above the top band so the ball runs down the length of the ruler. Listen to the rate of the "clunks" as the ball goes over the bands.

Optional: Film the ball going down the ruler. Use the slow motion option if your camera has it.

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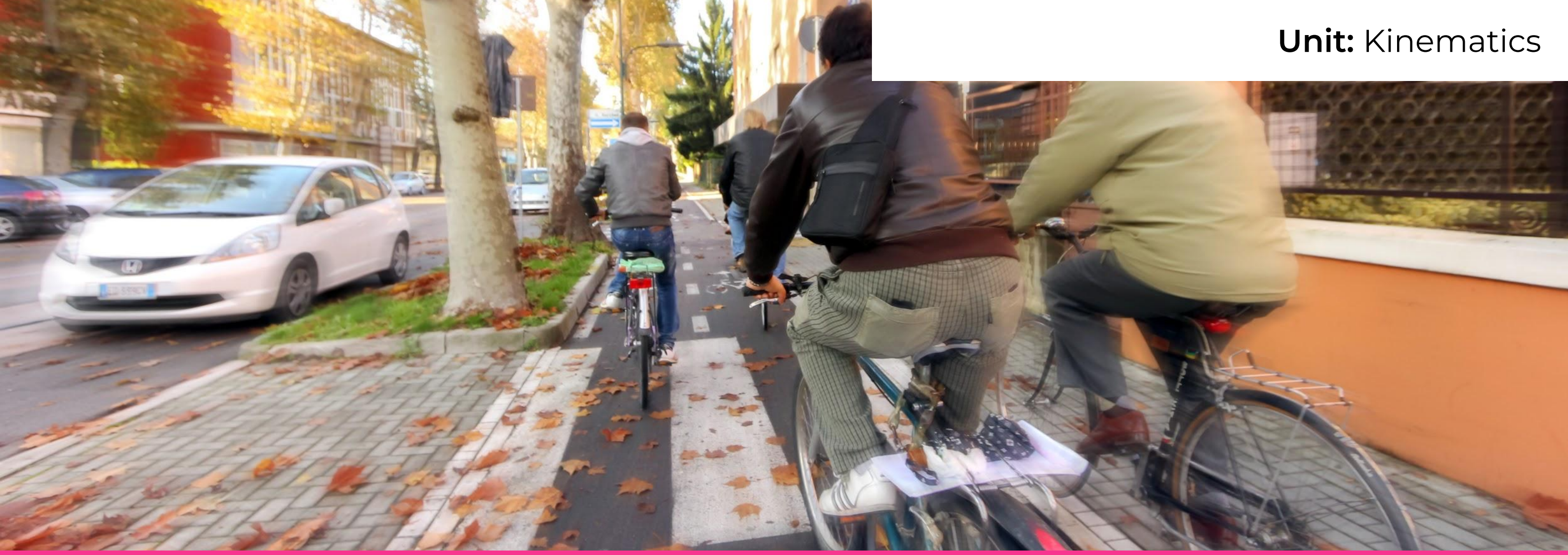

Measuring motion using video

Activity purpose:

Use video footage of a moving object to create a distance time graph and measure speed.

stileapp.com/go/speedvideo

stileapp.com/go/raspeedvideo

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- device for taking photos
- 1 m ruler
- pen
- long strip of cardboard or masking tape
- a moving object such as a small trolley or block of wood pulled by string

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

For this option students use their phones or cameras to film an object moving over a short distance, then use the footage to extract data to create distance-time and speed-time graphs. They then analyze the graphs. For the final question they take screenshots of their graphs and copy them into a Stile canvas where they can compare them against one another.

Students need reasonably advanced computer skills for this option.

Method

Method that students will follow:

1. Set up a "track" where you will be able to move your chosen object in a straight line and video its entire journey without moving the camera.
2. Measure off the long strip of cardboard or masking tape so that you will be able to see how far your object has moved at any point of time.
3. Video your object as you move it along the track at variable speeds.

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Measuring motion using a data logger

Activity purpose:

Generate distance-time and speed-time graphs for some motion that they create, and then analyze the graphs.

stileapp.com/go/motiondetector

stileapp.com/go/ramotiondetector

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- data logger
- motion detector
- computer
- a moving object such as a small trolley, block of wood pulled by string, or person walking

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Set up the motion detector with a suitable space in front of it to move the object. Check the range of the detector to ensure the movements you make are within this range.
2. Start with the object as close as possible to the detector and then move it away From the detector. Go at a range of speeds (slow, medium, fast) and you can stop for periods too.
3. Use the data logger software to generate distance-time and speed-time graphs for the motion.

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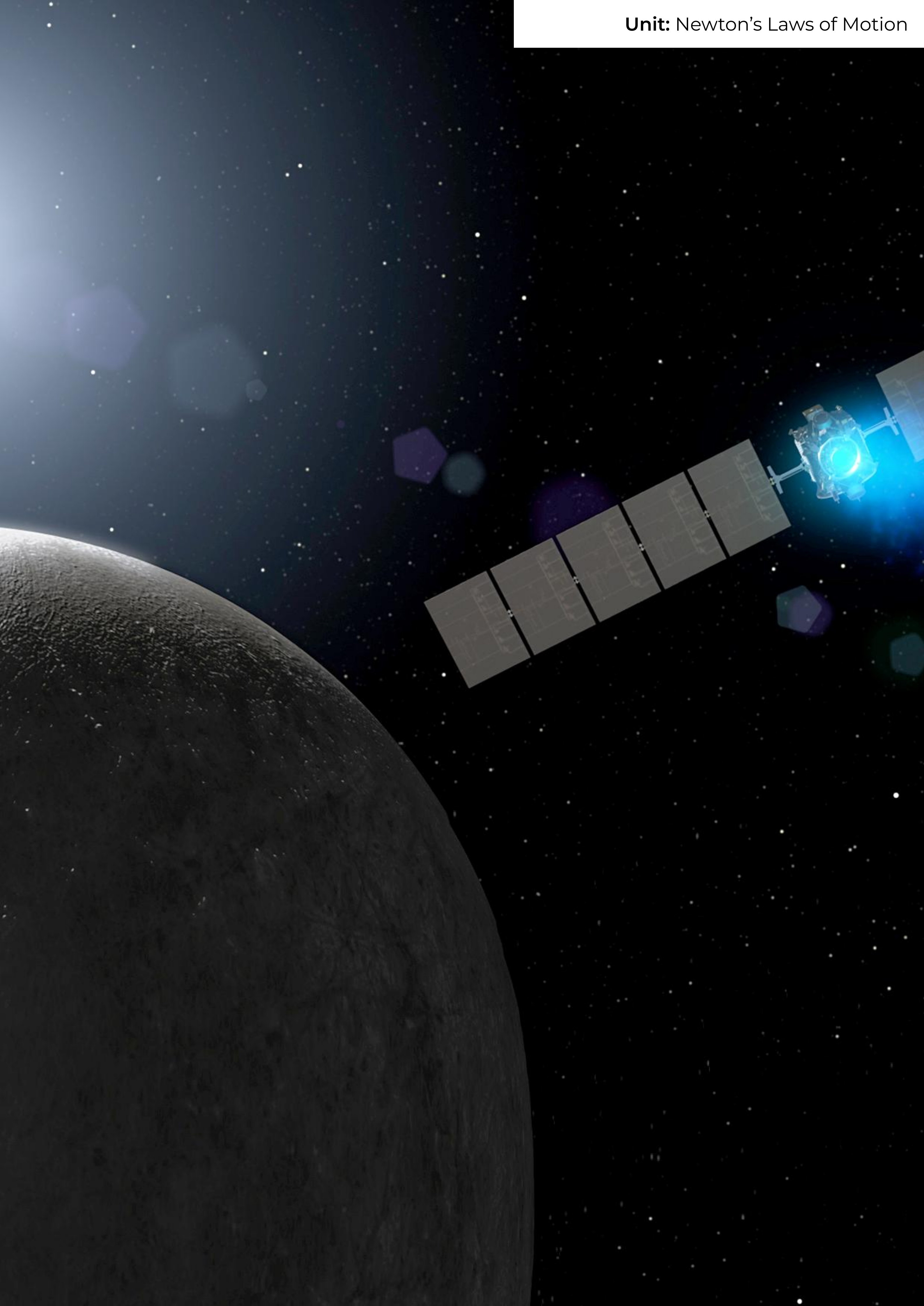

Demonstrating Newton's first law

Activity purpose:

Complete simple demonstrations to model Newton's first law of motion.

stileapp.com/go/Newtonsfirst

stileapp.com/go/raNewtonsfirst

45-60 minutes

2 students

Materials

Each group of students will need:

Lab equipment

For teacher demonstration:

- apple
- sharp knife
- cutting mat

Per group:

- A4 piece of paper
- 1 coin
- paper
- 2 x 30 cm rulers
- sticky tape

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

To keep the first ruler in place and level, a thin strip of Blu-Tack along the sides or tape across the top half way along to secure.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Students are provided with two demonstrations of inertia:

Teacher demonstration: A knife cutting an unsupported apple.
The demo is designed to generate cognitive conflict, stimulating interest in inertia. A video version of this demonstration is included in the Stile lesson.

Student activities: Students demonstrate inertia for themselves with stationary and moving coins or toy cars. These activities give students hands-on experience with inertia.

Method

Method that teacher will follow:

1. Place the apple on the cutting mat. Push the knife into the apple, approximately half way through, so that the apple holds in place.
2. Raise the knife and the apple above the cutting mat. Hit the top of the knife with the wooden spoon.

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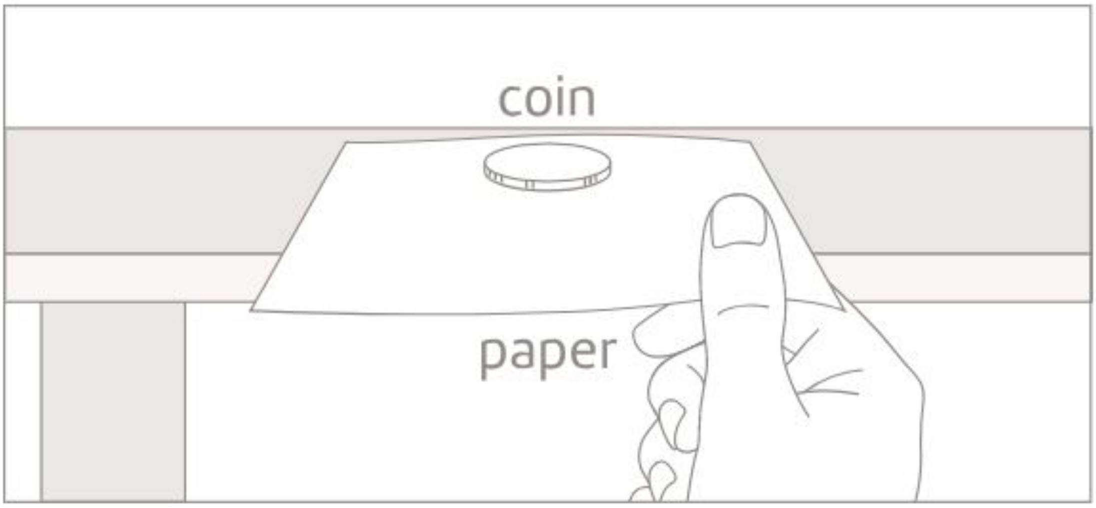
Method (cont.)

Method that students will follow:

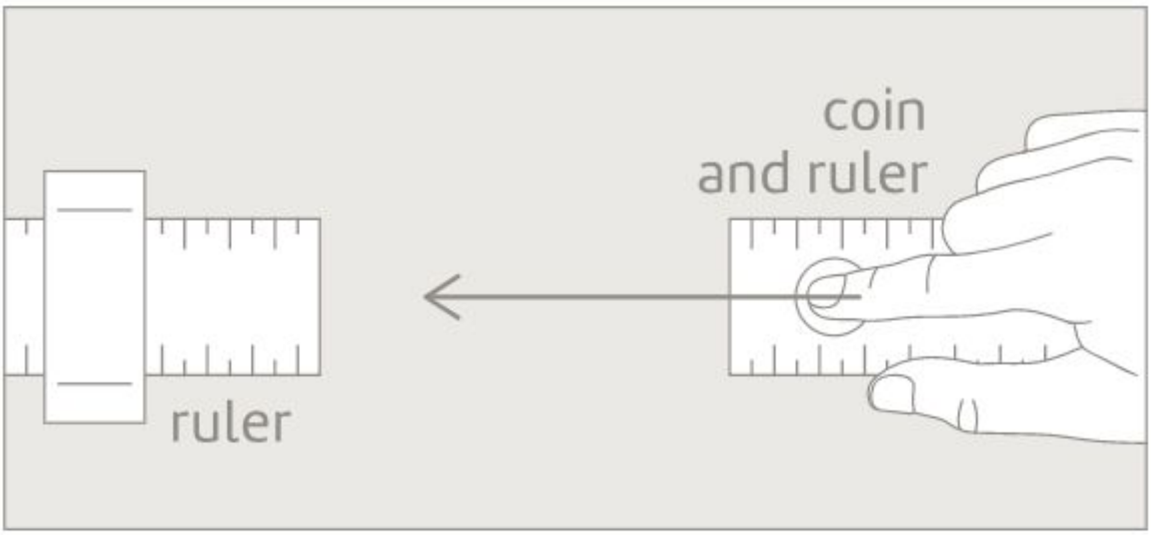
Activity 1:

1. Place a coin or something a bit heavier on a sheet of paper near the edge of a table, so the paper sticks out from the edge.
2. Pull the paper out as quickly as you can. How does the coin move?



Activity 2:

1. On a smooth flat tabletop fix a ruler so it won't move. Place your coin on another ruler about a metre away.
2. Holding the coin in place on the second ruler, push them together and then let go so they slide together towards the fixed ruler. How does the coin move when the rulers collide?



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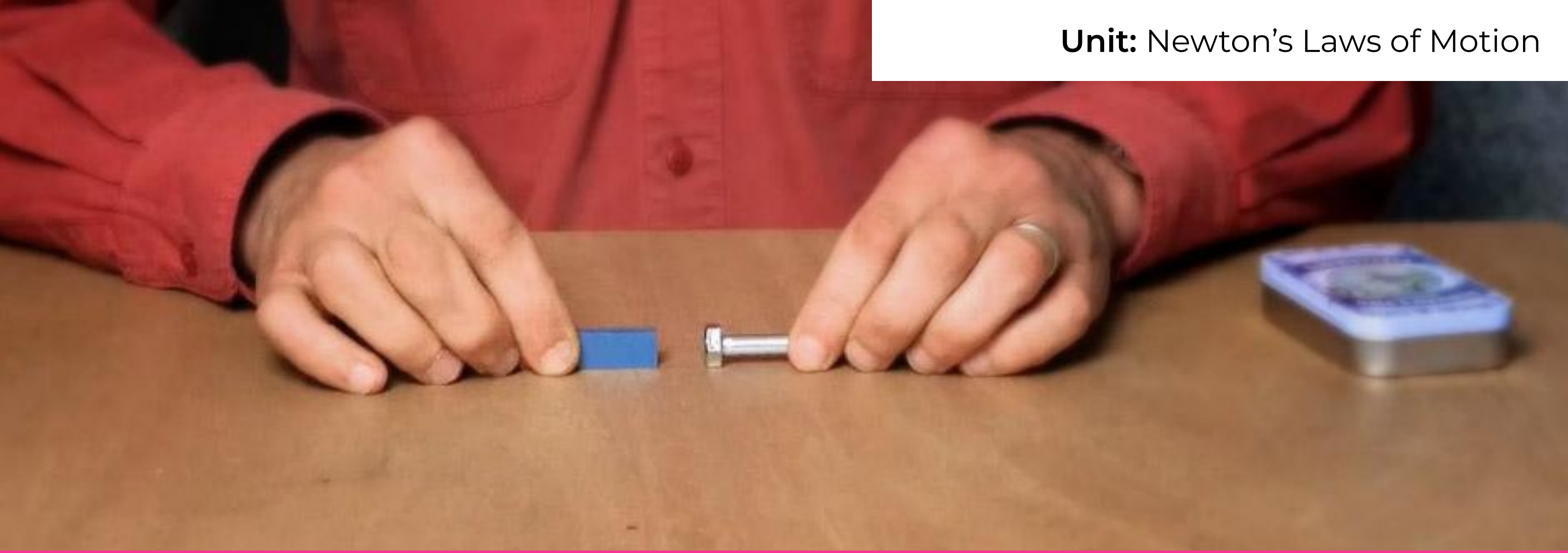

Demonstrating Newton's third law

Activity purpose:

Complete simple demonstrations to model Newton's third law of motion.

stileapp.com/go/Newtonsthird

stileapp.com/go/raNewtonsthird

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- wheeled desk chairs
- open space of smooth floor for wheeling
- bar magnet
- bolt (approx. equal mass to bar magnet)
- 2–5 kg spring balances
- old CD
- balloon
- valve type drink bottle lid
- hot glue gun

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Students complete a series of activities to demonstrate Newton's third law. The first three require little setup and can all be done in a single period, while the fourth is a small project. Make a selection, or do them all.

You could also set up the demonstrations as a round-robin depending on the independence and behaviour of your students.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

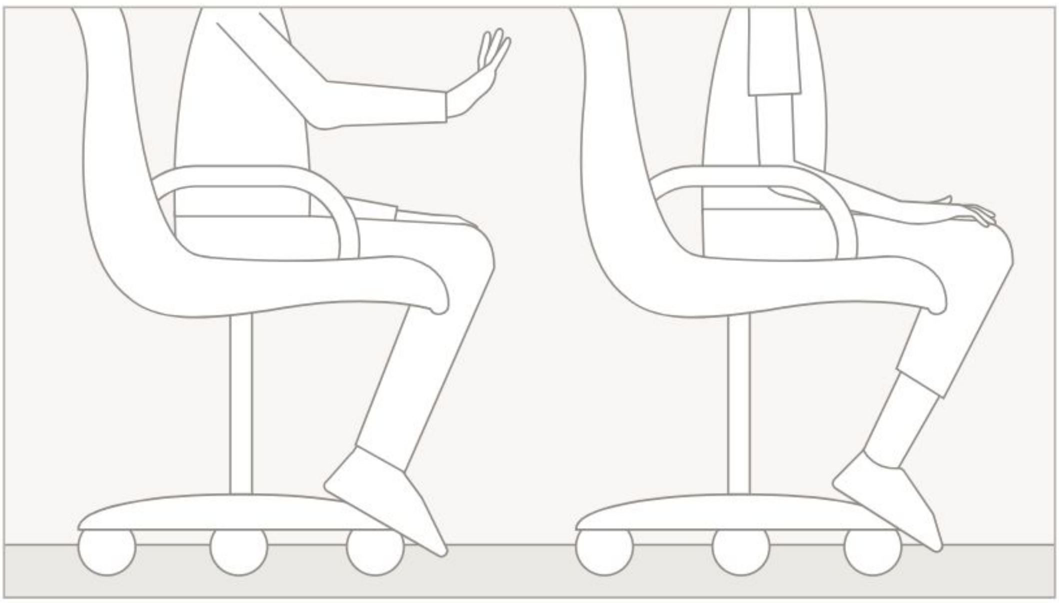
N/A

Method

Method that students will follow:

Activity 1:

A student sits in each chair with the chairs next to each other. Feet must be off the floor. to begin with, at least, choose students of about the same mass. One student pushes the other's chair. Observe what happens.



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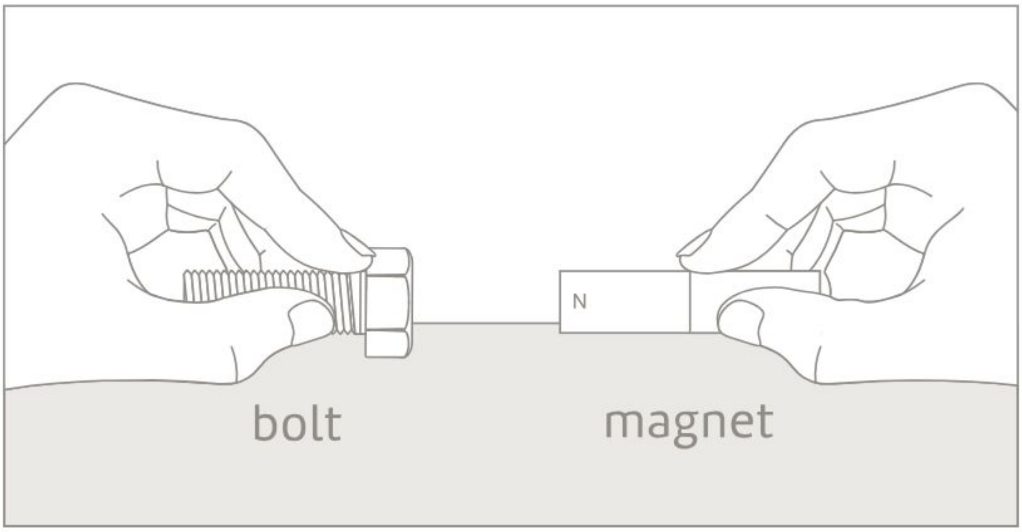
Method (cont.)

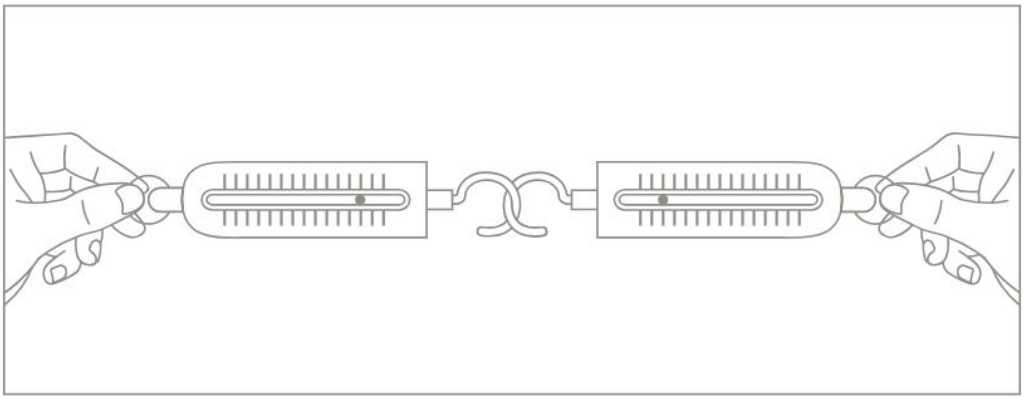
Activity 2:

1. First, make sure that the bolt is not magnetic by testing it against another piece of iron or steel, such as a paper clip.
2. Hold the magnet and the bolt down on a table, close enough that you can feel them pulling towards each other.
3. Remove your hand from the bolt. What happens?
4. Hold both objects down again the same distance apart as in step 2.
5. Remove your hand from the magnet. What happens?



Activity 3:

1. Hook two spring balances together with one student pulling or holding each end.



Activity 4:

1. Students make a CD hovercraft by watching an instructional video.

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Water rockets

Activity purpose:

Build and test rockets powered by jets of water. Students are challenged to find the best mix of water and air in order to maximize launch distance.

stileapp.com/go/waterrockets

stileapp.com/go/rawaterrockets

90-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 600 mL plastic drink bottle
- cork (to fit 600 mL bottle)
- bicycle pump with a needle attachment
- potato chip can (needs to be 20 cm long and wide enough to fit 600 mL bottle)
- heavy wire (eg. coat hanger)
- scissors
- water
- 30 m tape measure
- safety glasses

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

This activity will need to be conducted in a large outdoor space.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

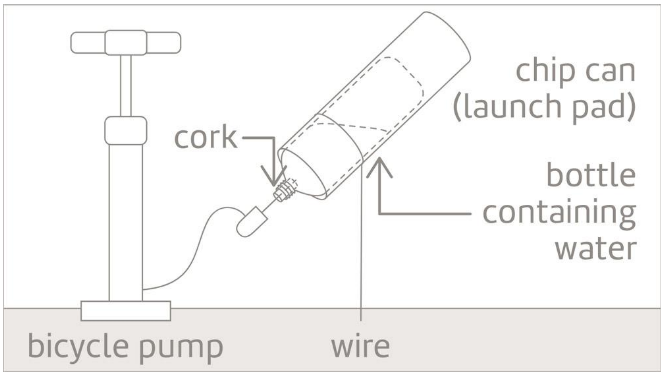
N/A

Method

Method that students will follow:

Building your rocket

1. Make a launch pad by cutting the lower section off the potato chip can to leave a
2. 20 cm long open tube. Check that the bottle slides in easily.
3. Wrap the upper third of the wire securely around the chip can and extend the remaining straight section of wire past the base of the can.
4. Insert the needle attachment of the pump into the cork so that it sticks out slightly. Make sure the cork fits securely into the plastic bottle.



Launching your rocket

Note: The rockets must only be launched in a large outdoor area with at least 20 m of open space in front of the launch area. Wear safety glasses and make sure nobody is in the line of fire.

1. Set up the launch pad by pushing the wire into the ground so that the chip can sits at an angle of about 45°.
2. Begin by launching an empty bottle: insert the cork into the bottle, slide it into the launch pad and then insert the needle attachment into the pre-made hole in the cork.
3. While one team member holds the launch pad steady, another rapidly pumps the bike pump and the other team members estimate and record the launch distance. A launch occurs whenever the cork comes out of the bottle, even if the bottle doesn't leave the launch pad.
4. Repeat steps 2 and 3 with the bottle full of water and record the launch distance (the launchers might get a little wet).
5. Repeat steps 2 and 3 with 200 mL of water in the bottle and record the launch distance.

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Balloon cars

Activity purpose:

Design balloon-powered cars and then vary their masses as an intuitive exploration of Newton's second law.

stileapp.com/go/ballooncars

stileapp.com/go/raballooncars

90-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

To be determined by students. We suggest:

- car body: cardboard, craft sticks, boxes, styrofoam blocks
- axles: wooden skewers, drinking straws
- wheels: bottle caps, CDs
- binding materials: sticky tape, rubber bands, paper clips, Blu-Tack
- other: 3 balloons, flexible drinking straws, 4 x 100 g masses (e.g. chocolate bars), mass balance, 10 m measuring tape, scissors

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Supply a roll of masking tape to mark where the 10 m line is.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

Method

Method that students will follow:

Students will follow the engineering design process to design their own balloon powered car.

Instructions provided to students include:

Design a scale model of a balloon-powered car. Your scale model must:

- be built only from the materials provided
- be powered by 1-3 balloons inflated by human breath
- be able to transport up to 4 masses of 100 g each a distance of 10 m

A template outlining the engineering design process and further scaffolding is provided to students in the Stile lesson.

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Jet-propelled can

Activity purpose:

Investigate how Newton's laws apply to jet propulsion using water streaming from a can.

stileapp.com/go/jetcan

stileapp.com/go/rajetcan

45-60 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- one or more empty drink cans with the ring-pull openers still attached
- a nail
- 1 m fishing line
- fishing swivel (optional)
- bucket or tub of water to immerse can to be filled
- enough water for each group to refill can 4-5 times

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Ensure a few weeks notice is given so that enough soft drink cans with pull openers still attached can be saved to do this activity.

Notes

Notes for the lab-tech:

Ensure that the nail is a good size, and if it can be inserted into the can by hand or if a hammer may be needed.

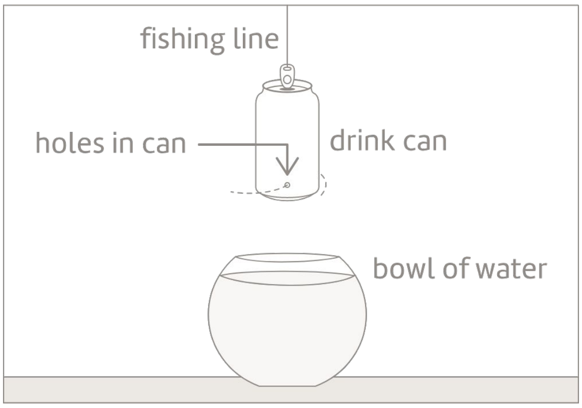
Notes for the teacher:

N/A

Method

Method that students will follow:

1. Lie a can on its side. Use a nail to carefully punch two holes on either side, just above the bottom rim. Before removing the nail from each hole, angle it to the left to slant the holes parallel to the base of the can.
2. Bend the pull tab straight up and tie a length of fishing line to it. If available, add a fishing swivel to allow the can to rotate freely.
3. Submerge the can in the bucket of water to fill it up.
4. Holding the fishing line, raise the can out of the water. As water streams out of the holes it should start to spin. Try to count the number of spins. Repeat two more times. Find the average number of spins over the three trials.
5. Add an extra slanted hole and repeat steps 3 and 4.
6. Add a fourth slanted hole and repeat again.



If there is time, you can experiment with more holes.

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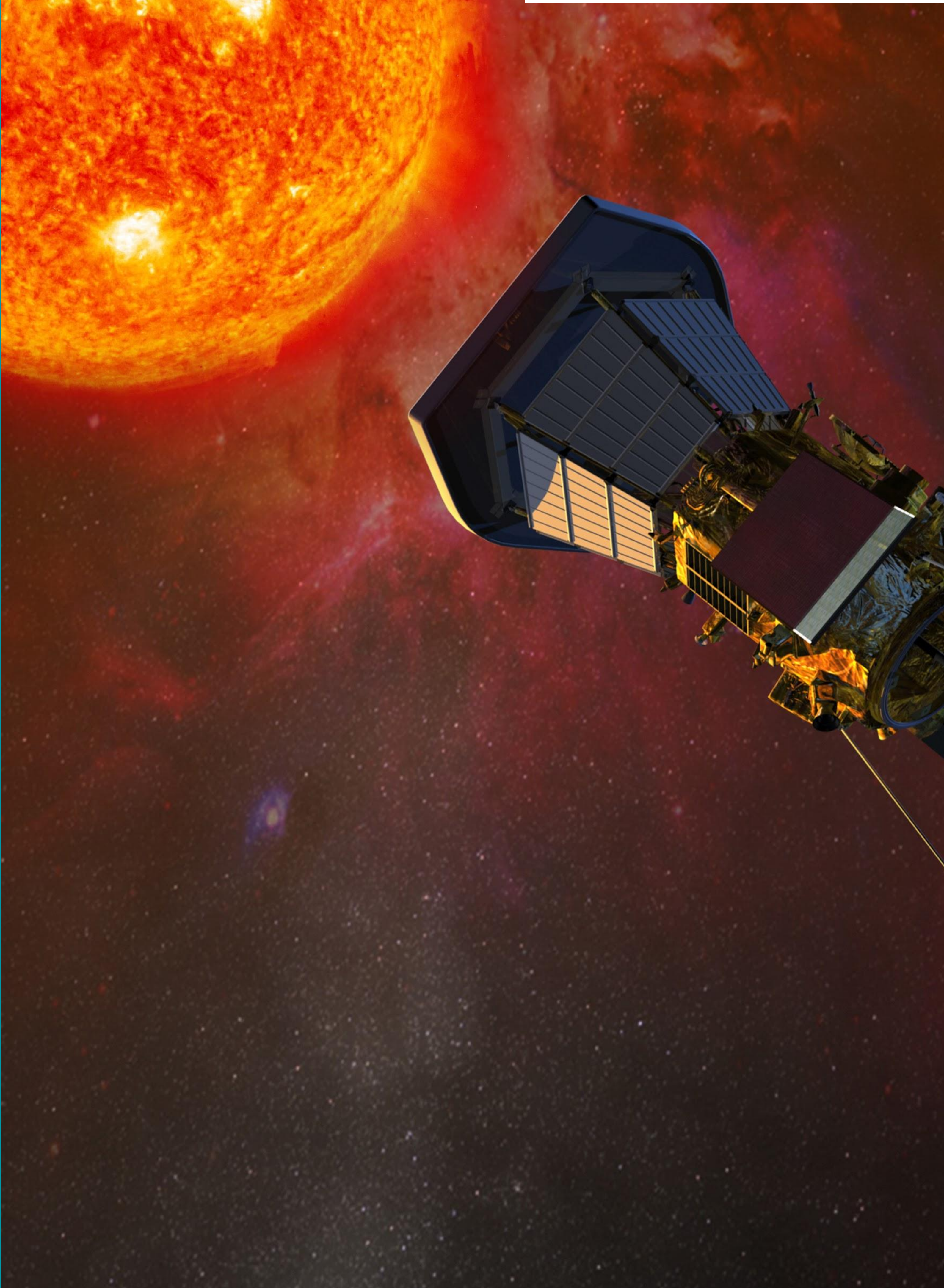
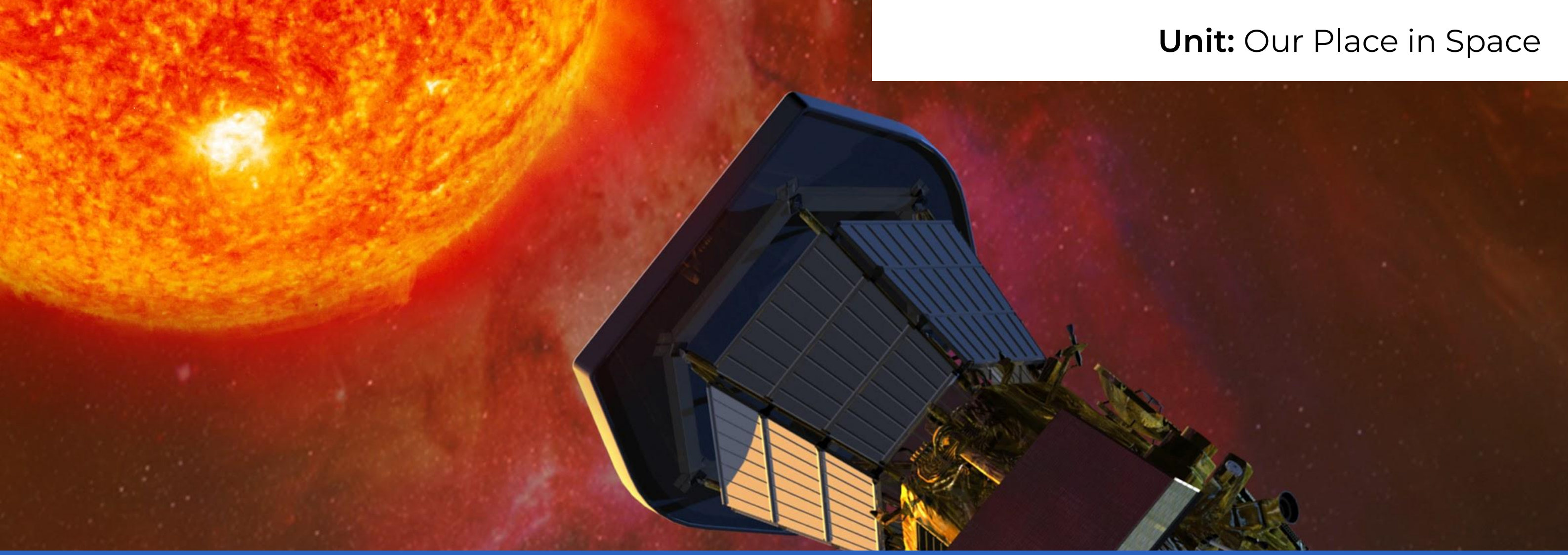
Earth & Space





Heat shields

Activity purpose:

Design, build and test a model heat shield.

stileapp.com/go/heatshields

stileapp.com/go/raheatshields

180-240 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- scissors
- tape
- PVA glue
- rulers
- 2 mini or fun-size chocolate bars without nuts
- wire mesh (e.g. stainless steel gauze mat)
- a selection of materials, such as newspaper, cardboard, cotton wool, bubble wrap, electrical tape, woollen cloth, styrofoam, steel wool

To test the heat shield:

- hair dryer
- 2 tongs
- oven mitts or heat proof gloves
- thermometer
- stopwatch

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

You will need to set up at least one testing station for the class, though more are recommended if you have access to more hair dryers. Remember that the testing area may become warm with the hair dryers running so should be located in a ventilated area. If using multiple hair dryers, check beforehand that they can run at the same time without overloading a circuit. It is also helpful to mark out where the heat shield and hair dryer should be placed (10 cm apart) for consistency.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

The wire mesh or cloth can provide structure and stability to the heat shield. You can use any type, but something that will not conduct the heat is ideal. If your activity budget allows, you could offer a variety for students to test and select from.

Notes for the teacher:

We recommend that students work individually to define the problem, research, and brainstorm solutions before they join together in a group.

Method

Method that students will follow:

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

Design a heat shield that will keep a "space probe" safe from the Sun's heat.

Your "space probe" will be a small chocolate bar and the Sun will be simulated by a hair dryer.

Your heat shield model must:

- only use materials supplied by your teacher
- have a maximum surface area of 20 cm x 20 cm
- be 10 cm from the hair dryer
- be 5 cm from the space probe
- protect the chocolate from melting for 5 minutes

A template outlining the engineering design process, as well as further scaffolding is also provided to students in the Stile lesson.

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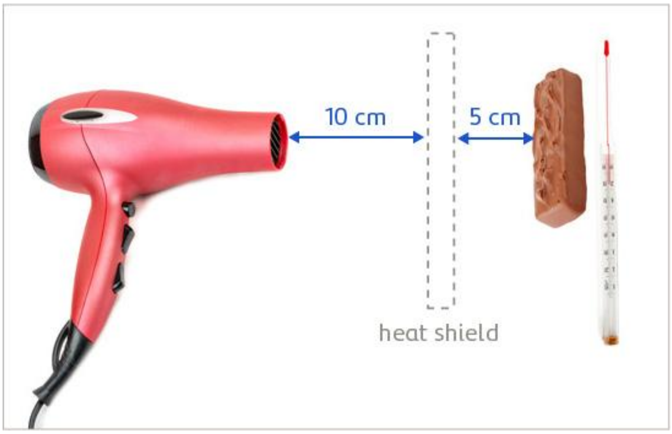
Method (cont.)

To test the heat shield, students will use the following method:

1. Use tongs to hold the heat shield 10 cm from the hair dryer.
2. Use another pair of tongs to hold the chocolate bar 5 cm behind the heat shield. Place the thermometer on the surface of the chocolate.
3. Turn on the hair dryer. Record the temperature every minute for 5 minutes and record any changes you observe.



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Modelling the Solar System

Activity purpose:

Examine why most models of the Solar System are inaccurate and create a size model and a distance model of the Solar System.

stileapp.com/go/solarsystemmodel

stileapp.com/go/rasolarsystemmodel

90-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Part 1: Size model

- 1 fit ball, approximately 700 mm diameter
- balls and objects of various sizes, such as beads, sand, marbles, tennis balls, basketballs, seeds, etc.
- ruler or measuring tape
- pens or markers
- 3 sheets of paper

Part 2: Distance model

- 9 flags on sticks
- open space, e.g. a playing field, 100m long
- 30m measuring tape

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

This activity will need to be conducted in a large outdoor space.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

Part 1: Size model

Calculate the scaled size of each planet in the model by following the instructions below:

1. Measure the diameter of each ball or object. Identify which object is the right size to represent each planet.
2. Create a label for each planet.
3. Take a photo to show the size comparison between the planets and the Sun.

To calculate the scaled size for each planet:
1. Divide its diameter by 2000
2. Round to the nearest millimetre

Worked example

The diameter of Mercury is 4880 km.

Scaled diameter of Mercury = 4880 ÷ 2000 = 2.44 mm

2.44 is less than 2.5, so we round down to 2 mm.

So in the model, Mercury will have a diameter of 2 mm.

Part 2: Distance model

Calculate the scaled distance of each planet from the Sun by following the instructions below.

1. On the playing field, place the flag for the Sun at one end of the 100 m long line.
2. Measure out the scaled distances to each of the planets and mark their position switch flags.
3. Take a photo of your distance scale model.

To calculate the scaled distance for each planet:
1. Divide its real distance by 45,000,000
2. Round to one decimal place

Worked example

The distance of Mercury from the Sun is 57,000,000 km.

Scaled distance of Mercury =
57,000,000 ÷ 45,000,000 = 1.266 m

1.266 is more than 1.25, so we round up to 1.3 m (one decimal place).

So in the model, Mercury will be 1.3 m from the Sun.

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Modelling day and night

Activity purpose:

Investigate how the rotation of the Earth results in day and night.

stileapp.com/go/daynightmodel

stileapp.com/go/radaynightmodel

20-30 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- polystyrene ball, about 10 cm in diameter
- bamboo skewer
- torch
- 2 pins (coloured head pins and drawing pins work well)
- felt-tip marker

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This activity works best in a dark classroom.

We assume that students have already learnt the cause of day and night.

Method

Method that students will follow:

1. Gently push the skewer through the centre of the polystyrene ball. The ball represents the Earth and the skewer represents the Earth's axis.
2. On the polystyrene ball draw:
   a. the directions north, south, east and west
   b. the country where you live
3. Place a pin in the country where you live.
4. Turn on the torch and point it directly at the polystyrene ball.
5. Slowly rotate the polystyrene ball from west to east, using the bamboo skewer.
6. Take a photo or video, or draw a diagram of the model.

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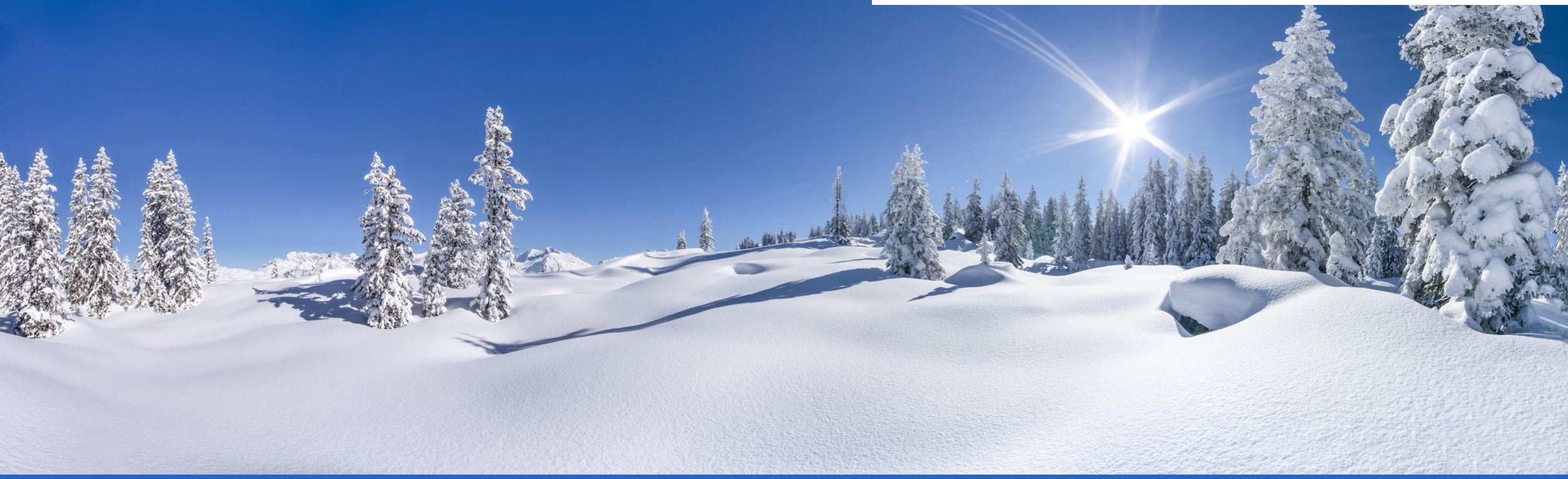

Modelling sunlight intensity

Activity purpose:

Model direct and indirect sunlight and explain how this relates to seasonal temperature changes.

stileapp.com/go/sunIntensity

stileapp.com/go/rasunintensity

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- torch
- cardboard tube
- sticky tape
- 2 large sheets of 1 cm^2 graph paper
- pen or marker
- protractor
- 30 cm ruler

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

A variation of this activity is to measure the heat intensity from a heat lamp using thermometers or strips of thermochromic paper.

Notes for the teacher:

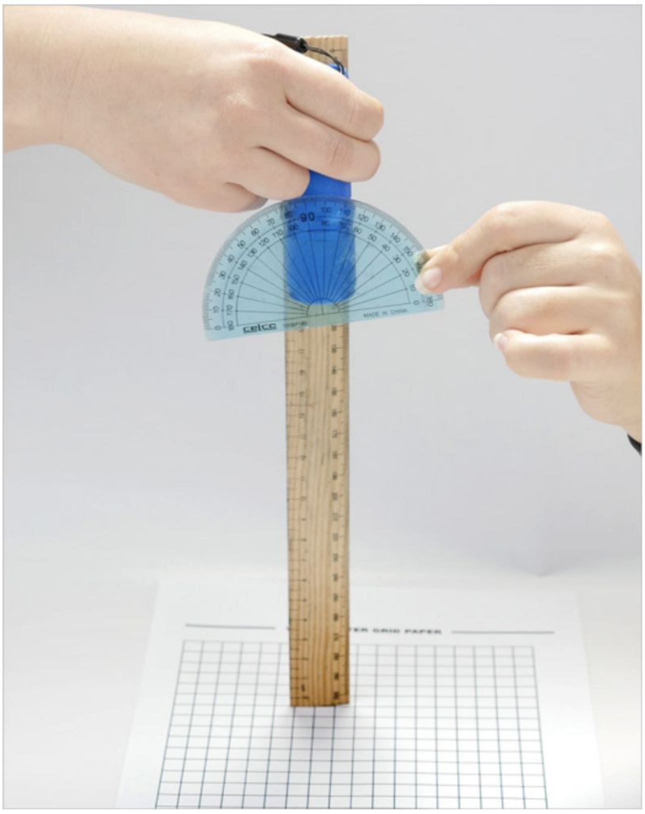
As a variation to this activity, students could measure light intensity by using the free Science Journal app. The app is available for download from the Apple Store (iOS) Or Google Play (Android).

Students could graph this data and examine how light intensity changed according to the angle of light from the torch.

Method

Method that students will follow:

1. Tape the cardboard roll around the torch so it makes a narrow beam of light.
2. Hold the torch above the piece of graph paper. Use the ruler to make sure the torch bulb is 20 cm above the paper. Use the protractor to make sure the torch is at a 90° angle to the paper.
3. Observe how bright the light appears to be on the paper. This is the light intensity.
4. While one person holds the torch steady, another person traces the outline of the beam on the paper. Clearly label this first trace as "90°".
5. Using the ruler and protractor, tilt the torch so that the torch bulb is still 20 cm above the paper but now angled at 75°. Again, observe how bright the light is on the paper.
6. Trace the outline of the beam and label it as "75°".
7. Repeat steps 5 and 6 for the angles 60°, 45° and 30°.



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Modelling the phases of the Moon

Activity purpose:

Create a model that shows how the phases of the Moon are formed.

stileapp.com/go/moonphases

stileapp.com/go/ramoonphases

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- cardboard tube
- pair of scissors
- sticky tape
- large (60 cm x 20 cm) strip of cardboard
- styrofoam ball the size of a large orange
- ping pong ball
- aluminium foil
- sturdy but bendable piece of wire, about 40 cm long
- ruler
- torch or other strong light source
- stack of books

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

The setup in this activity can also be used to model eclipses.

An alternative way to do this activity would be to provide students with a torch, a basketball and a tennis ball. Students could then use these items to act out the phases of the Moon.

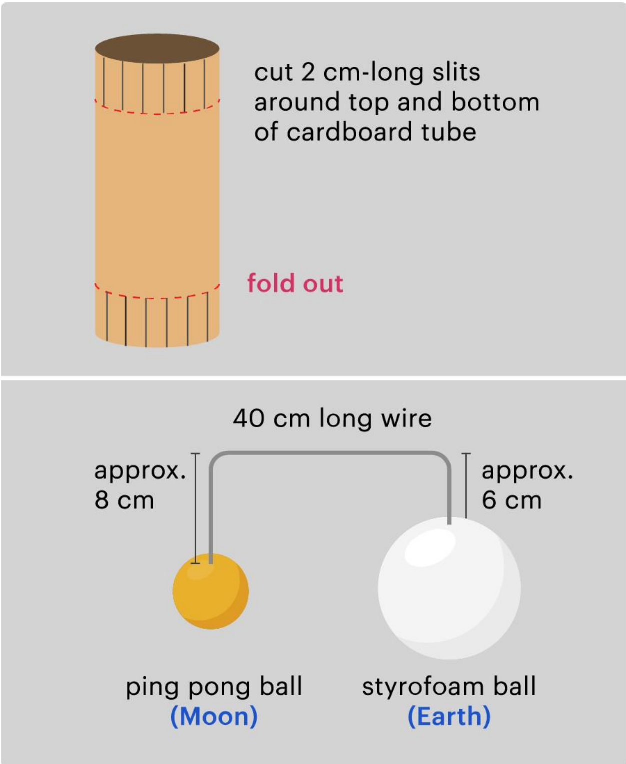
This activity works best in a dark room.

Method

Method that students will follow:

To create the model:

1. Cut at least 8 vertical slits around each end of the cardboard tube. Each slit should be about 2 cm long.
2. Stand the tube vertically so that the strips at the bottom lie flat on the table. Fold out the strips at the top so they fan out like a flower.
3. Using sticky tape, attach the cardboard tube to the table.
4. Attach the styrofoam ball to the open "flower" at the top of the tube using sticky tape. This ball represents the Earth.
5. Wrap the ping pong ball with a sheet of aluminium foil, shiny side out. This ball represents the Moon.
6. Insert one end of the wire into the top of the Earth so that the wire is vertical.
7. Measure 6 cm along the wire and bend the wire at a right angle to create a horizontal arm.
8. Insert the other end of the wire into the Moon.
9. Measure 8 cm along the wire from the Moon and make another right-angled bend so that the Moon hangs vertically. The centre of the Moon should be at the same height as the centre of the Earth.



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Method (cont.)

Using the model:

1. Balance the torch on a stack of books at the other end of the table. The torch represents the Sun. Adjust the height of the stack of books so that the torch beam is at the same height as the centres of the Earth and Moon.
2. Slowly rotate the wire so that the Moon orbits around the Earth. By viewing the Moon from the opposite side of the Earth, you can observe the phases of the Moon.
3. To capture the full moon phase without the Earth's shadow, you will need to temporarily raise the Moon.
4. Take photos or a video of the phases.

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Modelling eclipses

Activity purpose:

Model how lunar and solar eclipses occur.

stileapp.com/go/eclipsemodel

stileapp.com/go/raeclipsemodel

30-45 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- cardboard tube
- pair of scissors
- sticky tape
- styrofoam ball the size of a large orange
- ping pong ball
- 15 cm square aluminium foil
- sturdy but bendable piece of wire, about 40 cm long
- ruler
- torch or other strong light source
- stack of books

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

The setup in this activity can also be used to model the phases of the Moon.

An alternative way to do this activity would be to provide students with a torch, a basketball and a tennis ball. Students could then use these items to act out the phases of the Moon.

This activity works best in a dark room.

Method

Method that students will follow:

To create the model:

1. Cut at least 8 vertical slits around each end of the cardboard tube. Each slit should be about 2 cm long.
2. Stand the tube vertically so that the strips at the bottom lie flat on the table. Fold out the strips at the top so they fan out like a flower.
3. Using sticky tape, attach the cardboard tube to the table.
4. Attach the styrofoam ball to the open "flower" at the top of the tube using sticky tape. This ball represents the Earth.
5. Wrap the ping pong ball with a sheet of aluminium foil, shiny side out. This ball represents the Moon.
6. Insert one end of the wire into the top of the Earth so that the wire is vertical.
7. Measure 6 cm along the wire and bend the wire at a right angle to create a horizontal arm.
8. Insert the other end of the wire into the Moon.
9. Measure 8 cm along the wire from the Moon and make another right-angled bend so that the Moon hangs vertically. The centre of the Moon should be at the same height as the centre of the Earth.

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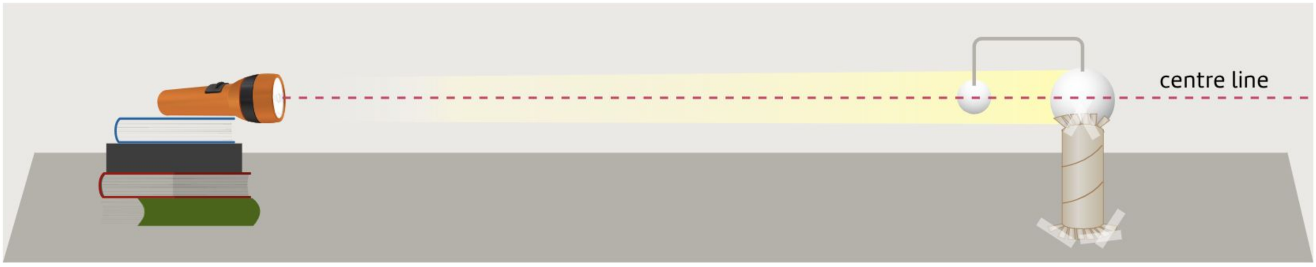
Method (cont.)

Using the model:

1. Balance the torch on a stack of books at the other end of the table. The torch represents the Sun. Adjust the height of the stack of books so that the torch beam is at the same height as the centres of the Earth and Moon.
2. Slowly rotate the wire so that the Moon orbits around the Earth. By viewing the Moon from the opposite side of the Earth, you can observe a lunar eclipse and a solar eclipse.
3. Take photos or create a video showing both types of eclipse.



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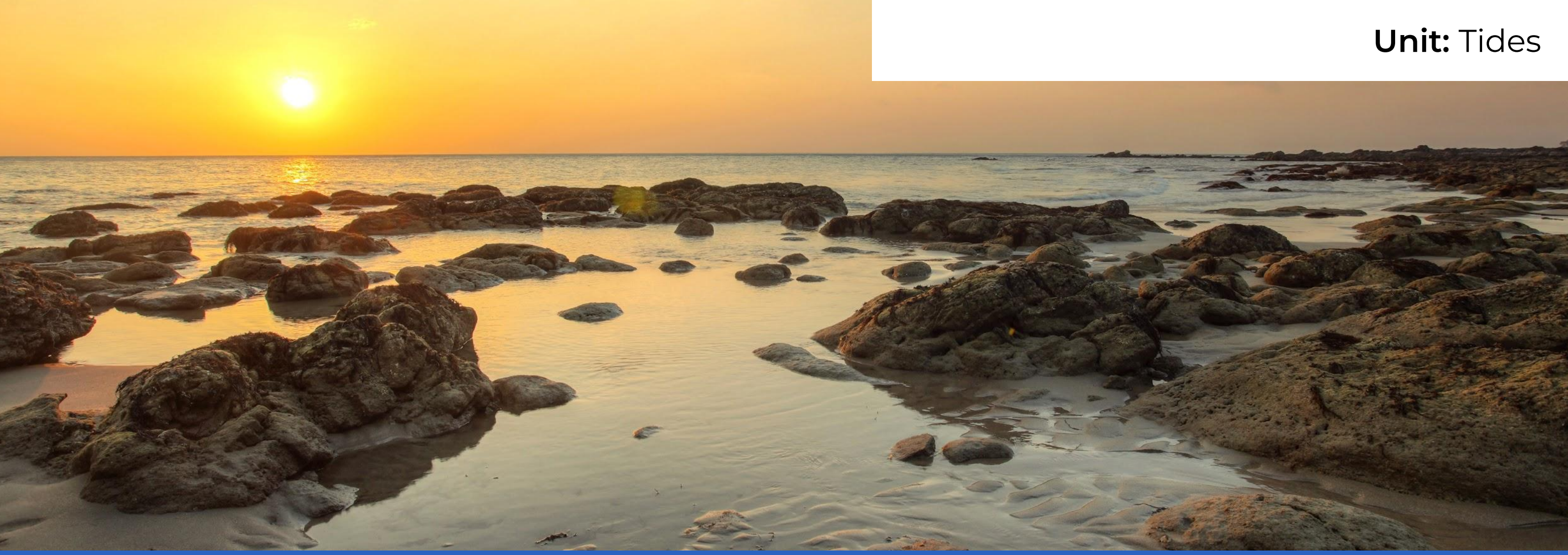

Modelling tides

Activity purpose:

Model how tides occur.

stileapp.com/go/tides

stileapp.com/go/ratides

20-30 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- copy of templates (included on following pages)
- scissors
- split pin

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Print the templates (included on the following pages) in advance.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Use the scissors to carefully cut around the shape of the Earth on Sheet 1.
2. Carefully push the split pin through the centre point on Sheet 2.
3. Lay the cut-out Earth on top of Sheet 2, face up, and carefully push the split pin through the Earth's centre point.
4. Spin the Earth anticlockwise to see the tides rise and fall.

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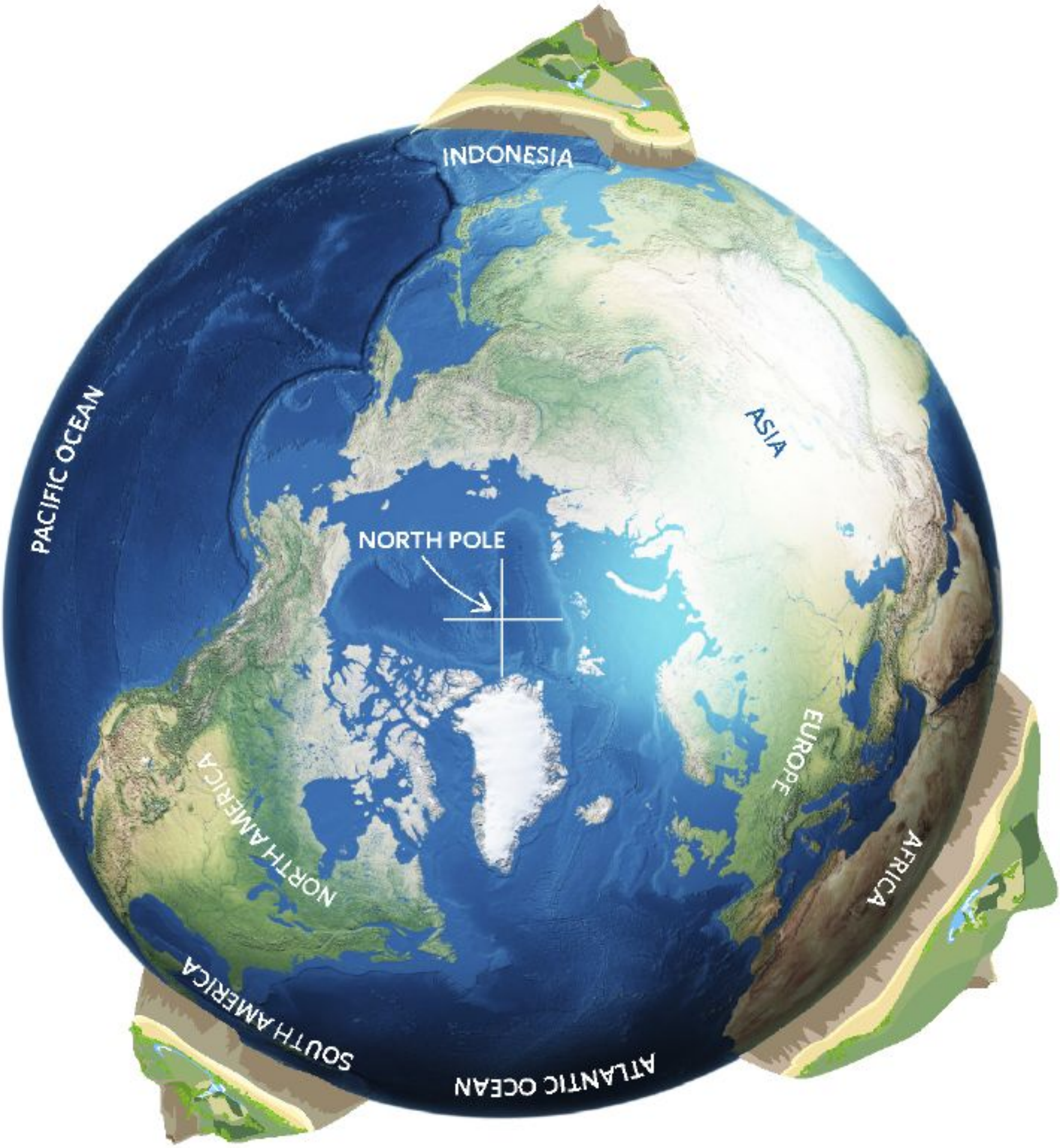
MODEL OF THE TIDES



SHEET 1

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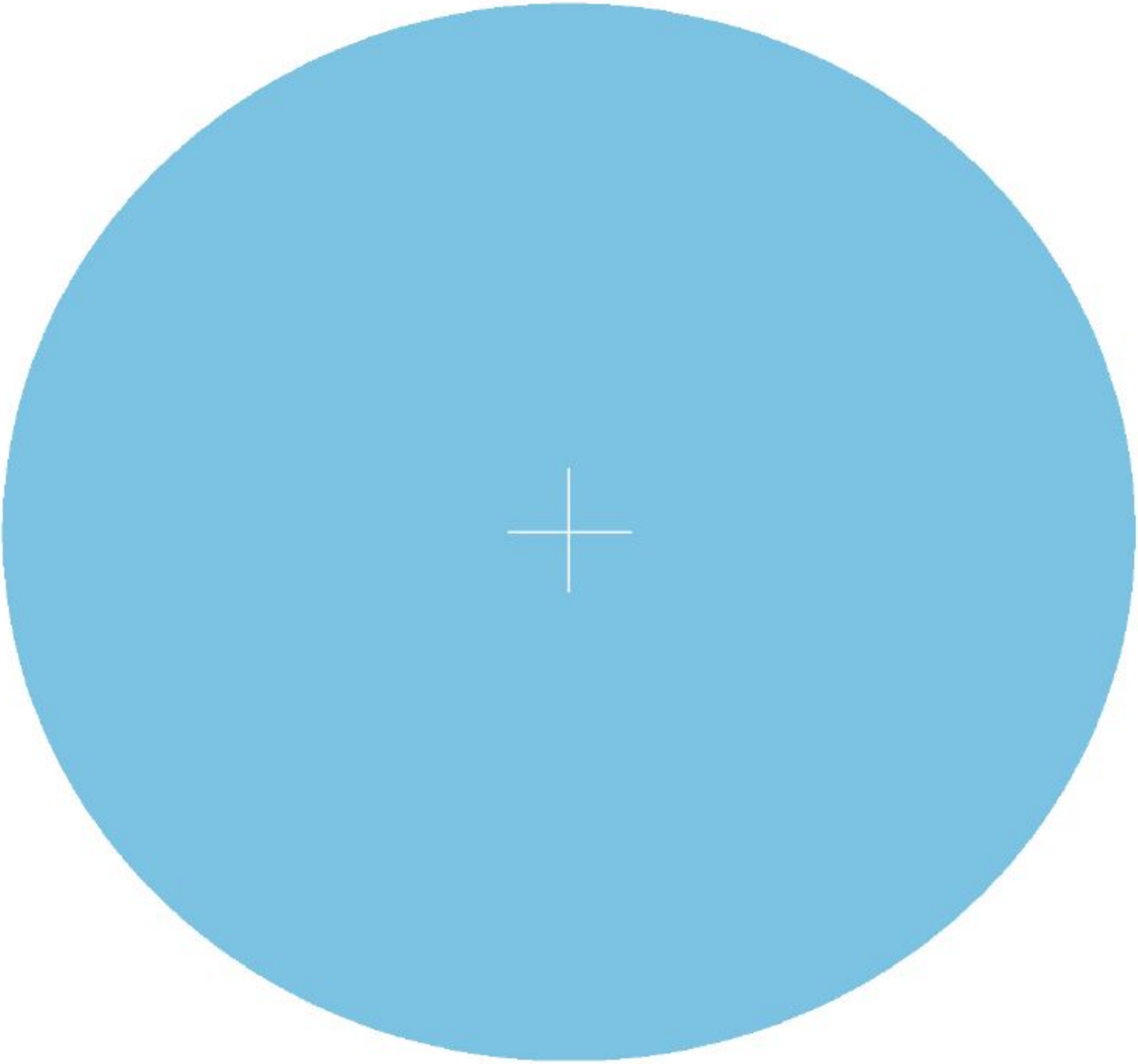
MODEL OF THE TIDES



SHEET 2

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Power-station models

Activity purpose:

Build a variety of energy station models and understand how they interact.

stileapp.com/go/powerstation

stileapp.com/go/rapowerstation

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Students will require a variety of materials.

Suggested materials:

- card
- papier mâché
- old containers (butter or yoghurt containers)
- string
- wire
- pens
- paint
- paint brushes (2 per colour)
- paddle pop sticks
- coloured paper

To make papier mâché:

- newspaper
- PVA glue
- flour
- water
- mixing bowl or plastic container
- spoon

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

Split students into groups to make models of the following:

- a solar photovoltaic plant
- a wind farm
- a hydroelectric dam
- an open-pit coal mine and power station
- a nuclear power station

Set your models in a diorama with the surrounding land in order to show:

- the types of location where plants of this kind are built, and
- roads or other infrastructure required by the plant. Remember, the plant has to be built, may need deliveries of material while operating, and will need maintenance.

Method

Method that students will follow:

Students will design and construct models of their assigned energy plant.

Instructions provided to students include:

In groups, make models of different types of electricity-generating plants. Use card, papier mâché, old containers, string, wire, pen, paint and other *resources* suitable for the job.

1. Make models of the following:
    - a solar photovoltaic plant
    - a wind farm
    - a hydroelectric dam
    - an open-pit coal mine and power station
    - a nuclear power station
2. Set your models in a diorama with the surrounding land in order to show:
    - the types of location where plants of this kind are built, and
    - roads or other infrastructure required by the plant. Remember, the plant has to be built, may need deliveries of material while operating, and will need maintenance.
3. Try to plan so different groups can put their models together to create a landscape with different types of electricity plant.
4. Research online to see what the plants look like and what transport infrastructure they require.

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Steam turbine model

Activity purpose:

Show how steam can be used to power a turbine.

stileapp.com/go/steamturbine

stileapp.com/go/rasteamturbine

45-60 minutes

2 students

Materials

Each group of students will need:

Lab equipment

Part 1:

- 15 cm x 15 cm paper or light card
- scissors
- tape or glue stick
- pencil
- 30 cm ruler
- pin
- pencil with eraser on end, or chopstick

Part 2:

- 250 mL beaker
- 250 mL measuring jug
- kettle for hot water
- matches or gas lighter
- heatproof mat
- gauze mat
- tripod
- Bunsen burner
- 20 cm x 20 cm square of aluminium foil
- 30 cm string

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

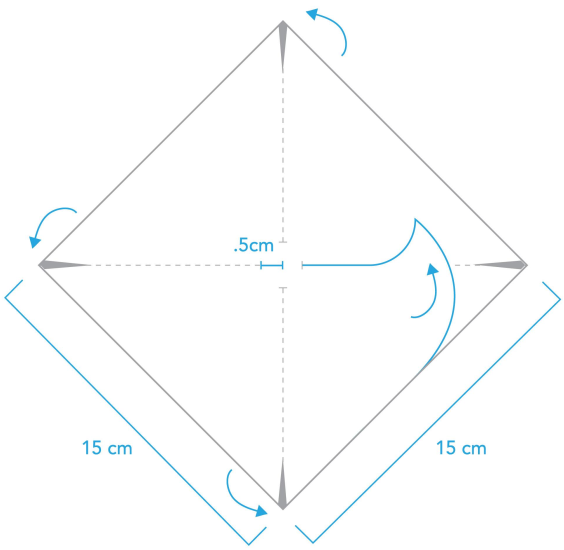
N/A

Method

Method that students will follow:

Part 1: Make a pinwheel turbine

1. Cut out a 15 cm x 15 cm paper square.
2. Use the ruler to draw diagonals between opposite corners.
3. Mark each line 0.5 cm from the centre.
4. Cut each line from the outside in to the mark.
5. Curl every second corner into the centre and tape or glue down.
6. Push a pin through the middle of the pinwheel into the eraser on the end of the pencil.
7. Move the pinwheel around to enlarge the hole, so the pinwheel moves freely.



Part 2: Make a boiler

1. Boil water in a kettle and use a measuring jug to pour it into the beaker, about a quarter full.
2. Wrap the foil tightly over the top of the beaker and tie string around to hold it firm.
3. Punch a small hole in the foil using the tip of a pencil.
4. Put the beaker on the tripod with the Bunsen burner underneath and bring back to the boil.
5. Hold the pinwheel over the escaping steam so it spins.

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Beat the flood

Activity purpose:

Design, build and test a model flood-proof home.

stileapp.com/go/flood

stileapp.com/go/raflood

180-240 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- resource cards (included on following pages)

Absorbency testing

- retort stand
- boss head
- clamp
- stopwatch
- 100 mL beaker
- 100 mL measuring cylinder
- food colouring
- 30 cm ruler
- materials to test – ice cream sticks, aluminium foil, plasticine, cling film, plastic bottles, foil food trays, paper straws, tree bark, plastic binder sheets

Tensile strength testing

- 2 retort stands
- 2 boss heads
- 2 clamps
- slotted weights on a holder
- large counterweights
- scissors
- materials to test – ice cream sticks, aluminium foil, plasticine, cling film, plastic bottles, foil food trays, paper straws, tree bark, plastic binder sheets

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Materials (cont.)

Model construction

- Lego
- ice-cream sticks
- aluminium foil
- plasticine
- grass or leaves
- cling film
- plastic bottles
- foil food trays
- paper straws
- tree bark
- mud or clay
- plastic binder sheets
- string
- glue
- small nails
- split pins
- a sink or plastic tub for model testing

Preparation

Preparation required by lab-tech:

Photocopy and laminate the resource cards (included on following pages) in advance.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This engineering challenge was originally developed by Practical Action, an organization that uses technology to challenge poverty in developing countries.

Teacher notes, student worksheets and more background information can be found at their website:
https://practicalaction.org/beattheflood

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

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Method

Method that students will follow:

Students will follow the engineering design process to design, build a test a model flood proof home.

Instructions provided to students include:

We need your help to design a house that will survive flooding and keep the families and their possessions dry. You will need to design, build and test a small scale model that meets the following criteria:

- is no larger than 50 cm^2
- constructed from the materials supplied by your teacher
- costs less than $2500

Your model will be tested by being placed in a sink or plastic tub filled with water to a level of 5 cm.

A template outlining the engineering design process and further scaffolding is provided to students in the Stile lesson.

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Hardwood

For modelling you could use ice-cream sticks.


Properties:
Absorbent, strong, durable, resists termites, biodegradable, recyclable.

Availability:
This needs to be transported onto the island and then down the river. There is no readily available hardwood on the island.

Cost:
$10 per stick

Corrugated iron

For modelling you could use aluminium foil.


Properties:
Water-resistant, prone to rust, strong, recyclable, difficult to cut into sections, non-biodegradable.

Availability:
Imported onto the island by boat. Weight of material leads to high transport costs compared to locally available material.

Cost:
$40 per sheet (20cm x 20 cm)

Bricks

For modelling you could use plasticine or lego bricks.


Properties:
Strong, weather-resistant, durable, recyclable, non-biodegradable.

Availability:
Can be made on the island or imported via boat.

Cost:
$1 per brick

Reeds

For modelling you could use grass or leaves.


Properties:
Needs attaching to another structure, malleable, weather-resistant.

Availability:
Available throughout the island.

Cost:
free

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Polythene roll

For modelling you could use cling film.


Properties:
Water-resistant, does not provide structural strength, tears easily, malleable, non-recyclable, non-biodegradable.

Availability:
Imported onto the island by boat. Low transport costs due to its low weight.

Cost:
$5 per piece (20 cm x 20 cm)

Concrete

For modelling you could use plasticine.


Properties:
Water-resistant, very strong, difficult to demolish, durable, malleable, non-recyclable, non-biodegradable.

Availability:
Imported onto the island by boat. Weight of material leads to high transport costs.

Cost:
$20 per stick

Polyurethane Sheet

For modelling you could use plastic bottles.


Properties:
Water-resistant, strong, recyclable, difficult to cut, liable to cracking, non-biodegradable.

Availability:
Imported onto the island by boat-low transportation costs due to weight.

Cost:
$5 per bottle

Steel

For modelling you could use foil food trays or card wrapped in foil.


Properties:
Water-resistant, prone to rust, strong, recyclable, difficult to cut into sections, non-biodegradable.

Availability:
Imported onto the island by boat. Weight of material leads to increased transport costs.

Cost:
$50 per sheet (20 cm x 20 cm)

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Bamboo

For modelling you could use paper straws.


Properties:
Water-resistant, reasonable strength but will need binding together, biodegradable, recyclable.

Availability:
Easily available on the island.

Cost:
$1 per straw

Softwood

For modelling you could use tree bark.


Properties:
Very absorbent, reasonable strength, susceptible to termites, biodegradable, recyclable.

Availability:
Readily available on the island in all forest areas.

Cost:
$2 per 10 cm length

Dung/Soil/Ash

For modelling you could use mud or clay.


Properties:
Malleable, recyclable, biodegradable, repels termites, fibrous which stops cracking.

Availability:
Readily available in many areas of the island.

Cost:
free

Glass

For modelling you could use plastic binder sheets.


Properties:
Recyclable, non-biodegradable, water-resistant, highly fragile.

Availability:
Imported onto the island by boat. Weight of material leads to high transport costs compared to locally available material.

Cost:
$40 per sheet (20 cm x 10 cm)

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Wind power

Activity purpose:

Design, build and test a model wind turbine.

stileapp.com/go/windpower

stileapp.com/go/rawindpower

180-240 minutes

3-4

Materials

Each group of students will need:

Lab equipment

- materials to make blades – plastic (from drink containers), cardboard (from packaging) or metal (from soft drink cans)
- 6 dowel or metal rods to make drive shafts
- DC motor, either 1.5 V or 2.0 V
- plastic gears to fit on the ends of the drive shafts
- split pins
- scissors or retractable craft knife
- masking or electrical tape
- leads with alligator clips
- 12 red LEDs (the red ones use the least current)
- cardboard to create housings and blade hub
- Blu-Tack

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This engineering challenge was originally developed by Practical Action, an organization that uses technology to challenge poverty in developing countries. Teacher notes, student worksheets and more background information can be found at their website: https://practicalaction.org/wind-power-challenge-stem

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

Method

Method that students will follow:

Students will follow the engineering design process to design, build and test a model wind turbine.

Instructions provided to students include:

We need your help to design and build a wind turbine to deliver electricity to all the members of the local village. You will need to build and test a small scale model that meets the following criteria:

- produces enough energy to light 12 LEDs
- should fit within a 30 cm x 30 cm base and be no taller than 50 cm
- constructed from the materials supplied by your teacher

A template outlining the engineering design process and further scaffolding is provided to students in the Stile lesson.

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Modelling the water cycle

Activity purpose:

Build a solar still and simulate aspects of the water cycle as you purify fresh water from salty water.

stileapp.com/go/watercycle

stileapp.com/go/rawatercycle

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- large metal or plastic flat-bottomed bowl
- 500 mL measuring jug
- small shallow glass or cup
- measuring jug or measuring cylinder
- cling film (wider than the bowl)
- adhesive tape
- small stone, pebble or marble
- teaspoon

Chemicals

- hot water
- food dye
- 1 teaspoon salt

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow:

1. Add a measured volume of hot water (equivalent to about 1 cm depth) to the bowl.
2. Add some food colouring and about a teaspoonful of salt to the hot water in the bowl, stir to dissolve.
3. After considering the factors that influence where you should put your solar still, take all the equipment outside to a sunny, level place.
4. Place the glass or cup in the middle of the bowl making sure no water splashes into it.
5. Cover the bowl loosely with cling film, then tightly seal the film around the rim of the bowl using the adhesive tape.
6. Place the stone in the middle of the cling film above the cup. It should cause the film to angle down into the cup, but must not touch the cup.
7. Record the "initial time" in your results table. Also note the colour of the salty water.
8. Leave the solar still for at least an hour (the longer the better) and then check that there is some water in the cup. Record the "final time" in your results table.
9. Take the solar still back indoors, carefully remove the cling film and take out the cup.
10. Measure the amount of purified water in the cup and note the colour of this water. Record these details in the results table.

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Making mineral paints

Activity purpose:

Investigate the use of mineral powders to make paints.

stileapp.com/go/mineralpaints

stileapp.com/go/ra/mineralpaints

60-90 minutes

3-4 students

Materials

Lab equipment

Per group:

- gloves, safety glasses and lab coats
- dust mask, mortar and pestle (if students are grinding minerals)
- 250 mL beaker
- 3 x 100 mL beakers
- 10 mL measuring cylinder
- 1/2 teaspoon measure
- pasteur pipette
- spatula
- 3 lidded specimen jars, each containing 30 g finely ground mineral
- 3 paint brushes
- 2 sheets of white paper
- sheet of coloured paper

For class to share:

- electronic mass balances

Chemicals

Per group:

- minerals: haematite (iron(III) oxide), malachite (copper(II) carbonate) and calcite (calcium carbonate)
- 1 egg
- water

For class to share:

- ethanol
- samples of raw minerals to look at

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Preparation

Preparation required by lab-tech:

Egg yolk mixture may be prepared for the whole class in advance if desired. We suggest preparing approximately 250 mL.

Preparation required by teacher:

Egg yolk mixture may be prepared for the whole class in advance if desired.

Notes

Notes for the lab-tech:

Part 3 of this activity invites students to experiment with ratios of pigment to binder in their paint. This is why students are provided with more mineral powder than they need for their initial paint samples.

Notes for the teacher:

N/A

Method

Method that students will follow:

Part 1:

1. Select a mineral to make paint with.
2. If the mineral is in lumps rather than a fine powder, carefully measure out 30–35 g into the mortar. If you have a pre-prepared mineral powder, you can skip the following steps and move on to the questions below.
3. Cover the mortar with a sheet of paper or put it inside a plastic bag. Put on the dust mask.
4. Use the pestle to gently grind the mineral until you have a fine powder.
5. Uncover the mortar. Use the spatula to scrape the mineral powder into a small pile in the mortar.
6. Observe the powder and answer the questions below.

Part 2:

1. Break the egg and carefully separate the yolk from the white. Drop the yolk into the 250 mL beaker.
2. Use a measuring cylinder to add 5 mL of water to the egg yolk and mix thoroughly to form a paste.
3. Use a spatula and electronic mass balance to measure out about 10 g of the mineral powder into one 100 mL beaker.
4. Collect half a teaspoon of yolk mixture. Add it to the mineral powder in the 100 mL beaker.
5. Mix the mineral powder and yolk mixture gently but thoroughly with the spatula until it forms a thick, smooth paste. This is your tempera paint sample. Note: If the mineral does not wet and mix in easily, add a drop of ethanol to help moisten it.
6. Use the pipette to add 5–10 drops of water to the paint and mix gently with the spatula.
7. Use a paintbrush to paint shapes on to a piece of white paper (or coloured paper if using calcite). Label this as "Paint Sample 1".

Part 3:

Students make two more paint samples of their own design.

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Effect of cooling rate on crystal growth

Activity purpose:

Investigate how cooling rate affects the growth of epsomite crystals.

stileapp.com/go/crystals

stileapp.com/go/racrystals

45-60 minutes

3-4 students

Materials

Lab equipment

Each group of students will need:
- 2 glass microscope slides, labelled using a felt-tip marker
- 2 cover slips
- microscope
- stopwatch

For the whole class:
- 100 mL beaker containing 50 mL of saturated Epsom salts solution
- glass rod
- container labelled 'used slides'

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Lab tech to prepare a 50 mL solution of saturated Epsom salts.

An hour beforehand, place one microscope slide – labelled "cold" – and one cover slip (per group) in the fridge and leave until needed. Label the other slide with "room temperature".

It can work well to store the slides and cover slips in take-away containers, and to rest the “cold” container on a bed of ice in an ice-cream container so that they remain as cold as possible prior to use in the classroom.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

Nil

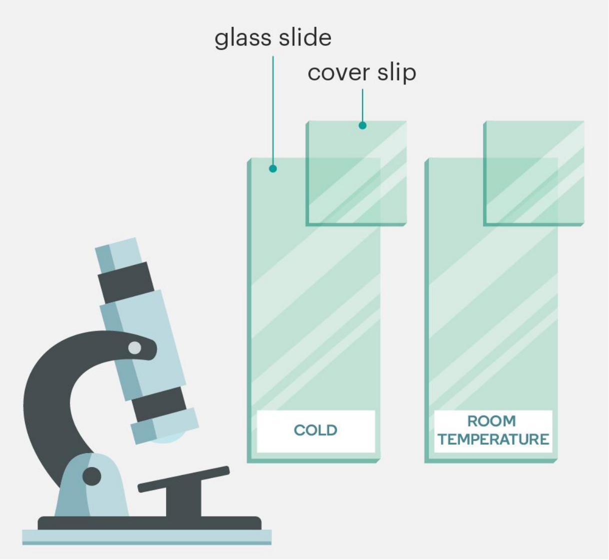
Notes for the teacher:

Nil

Method

Method that students will follow:

1. Set up the microscope so that it's ready to use with 40x magnification.
2. Use the glass rod to add a droplet of salt solution to the slide marked "room temperature" and immediately place a cover slip on top.
3. Observe the slide under the microscope and record what you see in the Results section.
4. Repeat steps 2 and 3 for the cold slide and cover slip, taking them directly from the fridge and working as quickly as possible.



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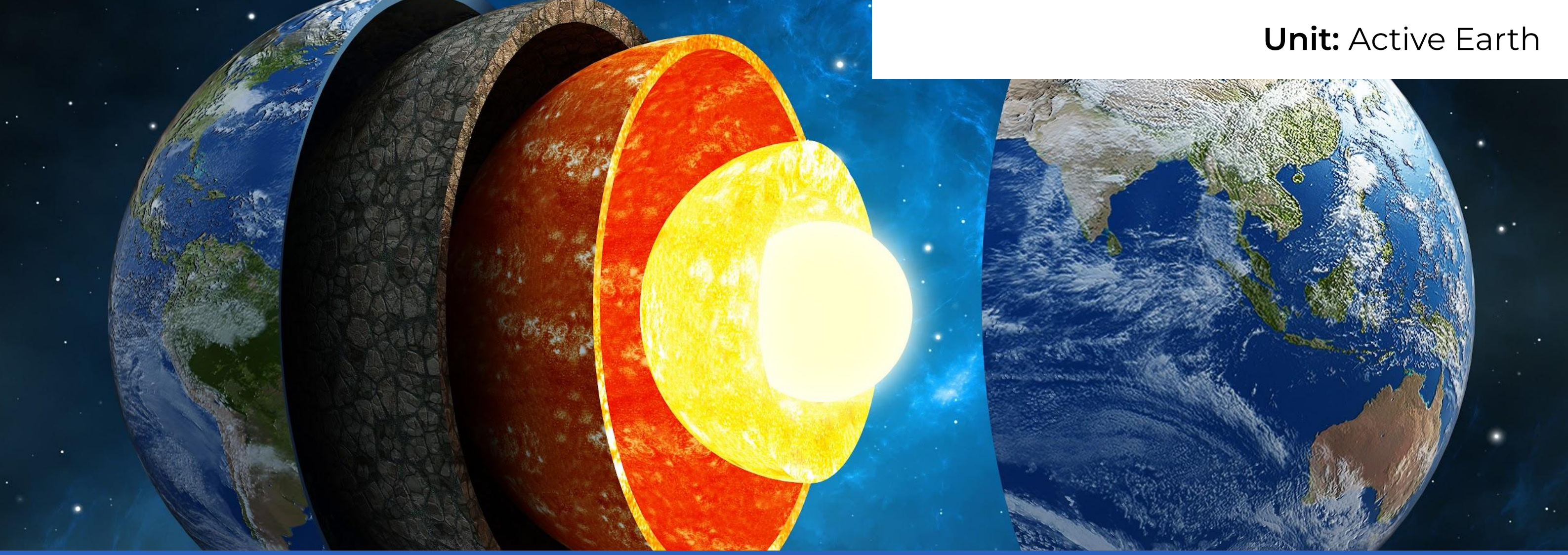

Model of the Earth

Activity purpose:

Represent the layers of the Earth by building a simple 3D model.

stileapp.com/go/earthmodel

stileapp.com/go/raearthmodel

45-60 minutes

2-4 students

Materials

Each group of students will need:

Lab equipment

- 30 cm ruler
- 4 different coloured lumps of play dough, each colour weighing approximately 400 g
- 4 toothpicks
- 4 small sticky notes
- scissors

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Preparation

Preparation required by lab-tech:

Play dough will need to be prepared in advance.

Preparation required by teacher:
Nil

Notes

Notes for the lab-tech:

We recommend that students work in pairs or small groups to encourage teamwork. This will also reduce the amount of materials required – each model needs about 1 kg of play dough.

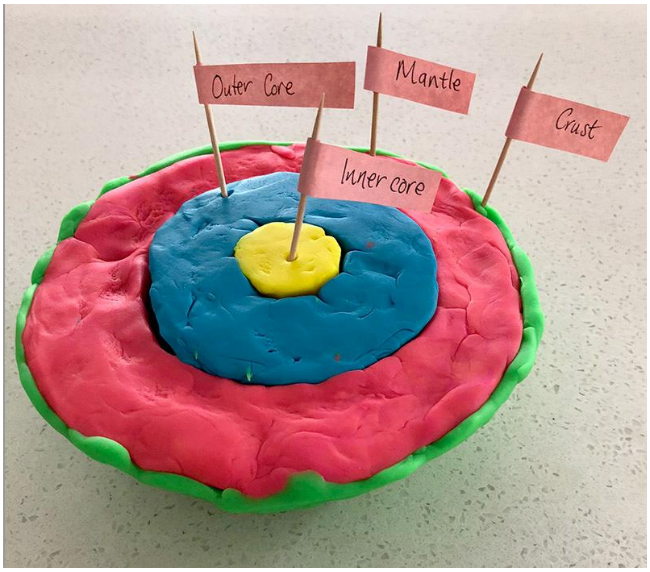
Notes for the teacher:

N/A

Method

Method that students will follow:

1. Make a ball of play dough to represent the Earth's inner core. It will need to measure 2.4 cm across. Cut the ball in half and measure this distance using the ruler.
2. Roll out three layers of play dough using the other three colours. Measure the thickness of each layer to make sure they match the values you calculated above. Note: The crust layer will be extremely thin!
3. Wrap the "outer core" layer around the "inner core" half-ball to make a hemisphere. You may need to mould the play dough to make a neat, flat surface. Take care not to change the thicknesses of the layers.
4. Wrap the "mantle" around the "outer core".
5. Wrap the "crust" around the "mantle".
6. Make labels for each of the layers by writing on the sticky notes, and then wrapping the sticky end around the toothpick. Stick the toothpicks into each layer to complete your model.



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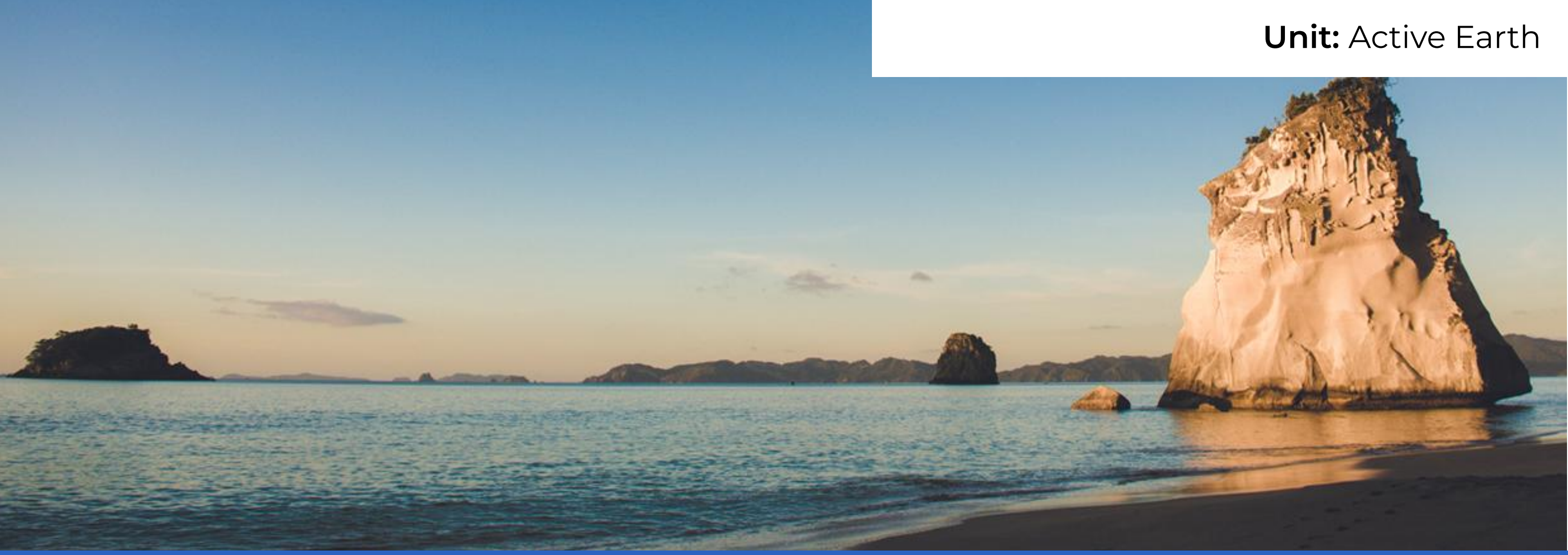

Modelling the rock cycle

Activity purpose:

Model the processes involved in the rock cycle.

stileapp.com/go/rockcycle

stileapp.com/go/rarockcycle

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

- aluminium foil (1 roll for the class)
- ziplock plastic bag approx 16 cm x 17 cm
- 2 x 500 mL beakers
- 500 mL measuring jug
- kettle
- scissors

Chemicals

- 4 lollies (we recommend Starburst Chews because they stick together when pressed and easily melt in hot water; chocolate or crayons could also be used)
- 200 mL ice
- 250 mL hot water

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Preparation

Preparation required by lab-tech:

Depending on the number groups more than one kettle will be required as each group will need 250mL of hot water.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This practical activity assumes that students are already familiar with the rock cycle.

A photo of each "rock" formed in this activity (using Starburst Chews) can be found in the model answers on Stile.

Method

Method that students will follow:

Part 1:

1. Cut the "rock" material into small pieces, squeeze the air out of the bag and seal the pieces in the ziplock bag.
2. Fold aluminium foil around the bag to form a flat parcel.
3. Press down with your hand to flatten the parcel. You could also place a heavy book on the parcel or even stand on it.
4. Remove the aluminium foil and observe the "rock" formed. Keep the ziplock bag sealed and take a photo.

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Method (cont.)

Part 2:

1. With the "rock" material still sealed in the ziplock bag, squeeze and knead the bag with your fingers. Your hands will also warm up the bag and its contents.
2. Stop kneading when the pieces start to merge together. Keep the ziplock bag sealed and take a photo.

Part 3:

1. Use the kettle to boil water and half fill one of the 500 mL beakers.
2. Place ice cubes into the other 500 mL beaker and half fill with cold water.
3. With the "rock" material still sealed in the ziplock bag, place the bag into the hot water.
4. Leave for about 2 minutes or until the material has melted.
5. Remove the bag and place it into the ice water for about 2 minutes or until the material has hardened.
6. Remove the "rock" material from the ziplock bag and take a photo.

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Relative dating

Activity purpose:

Model the formation of sedimentary rock layers and compare the ages of "fossils" using relative dating.

stileapp.com/go/relativedating

stileapp.com/go/rarelativedating

45-60 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

-

Chemicals

- 1 slice of each type of bread:
    - wholemeal
    - multigrain
    - white
    - light rye
- 1 teaspoon of sprinkles
- 3 gummy bears
- 1 tablespoon of strawberry jam

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Preparation

Preparation required by lab-tech:

Provide 1–2 jars of strawberry jam for the class to share. Students could take a tablespoon of jam per group and use the tablespoon to spread the jam.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

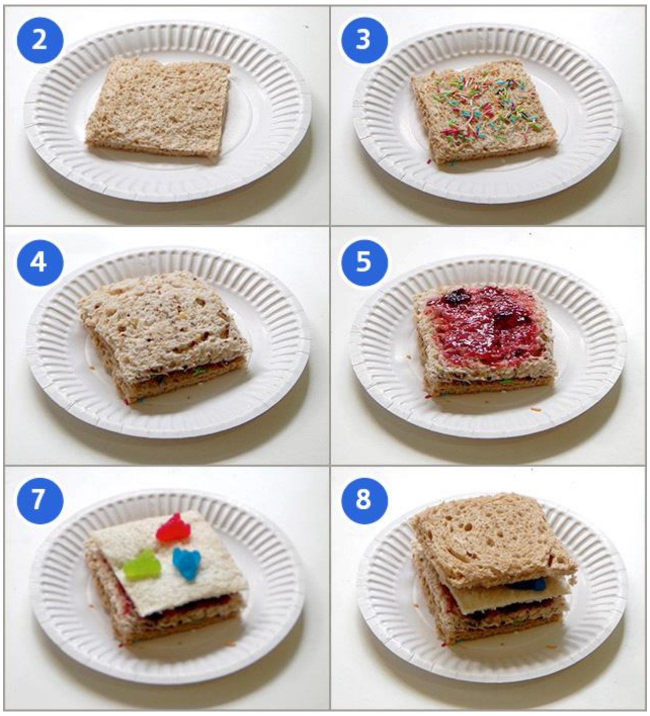
This activity assumes that students are already familiar with the three types of rock, the four types of fossil and how sedimentary layers form.

Method

Method that students will follow:

Part 1:

1. Carefully cut the crusts off each slice of bread.
2. Place a slice of wholemeal bread onto the paper plate. This represents a layer of mudstone.
3. Scatter a thin layer of sprinkles on the wholemeal bread. These represent fossilized shells.
4. Place the multigrain bread on top of the sprinkles. This represents a layer of conglomerate, a type of sedimentary rock containing pebbles.
5. Spread a layer of strawberry jam on the multigrain bread. This represents a thin layer of pink limestone.
6. Place the white bread on top of the jam. This represents a layer of white sandstone.
7. Place the gummy bears on the sandstone layer. These represent the bodies of an extinct type of animal.
8. Finally, place the rye bread on top of the stack. This represents a layer of brown sandstone.
9. Carefully press all of the layers firmly together.
10. Take a side-on photo of your "rock" sequence.



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Method (cont.)

Part 2:

1. Carefully bend the model you made in Part 1 by placing your hands on either side and pulling downwards. This represents a fold.
2. Take a side-on photo of the folded "rock" sequence.
3. Place the model back on the plate and carefully cut it in half.
4. Lift up one half so that it sits higher than the other. This represents a fault.
5. Take a side-on photo of the fault in the "rock" sequence.


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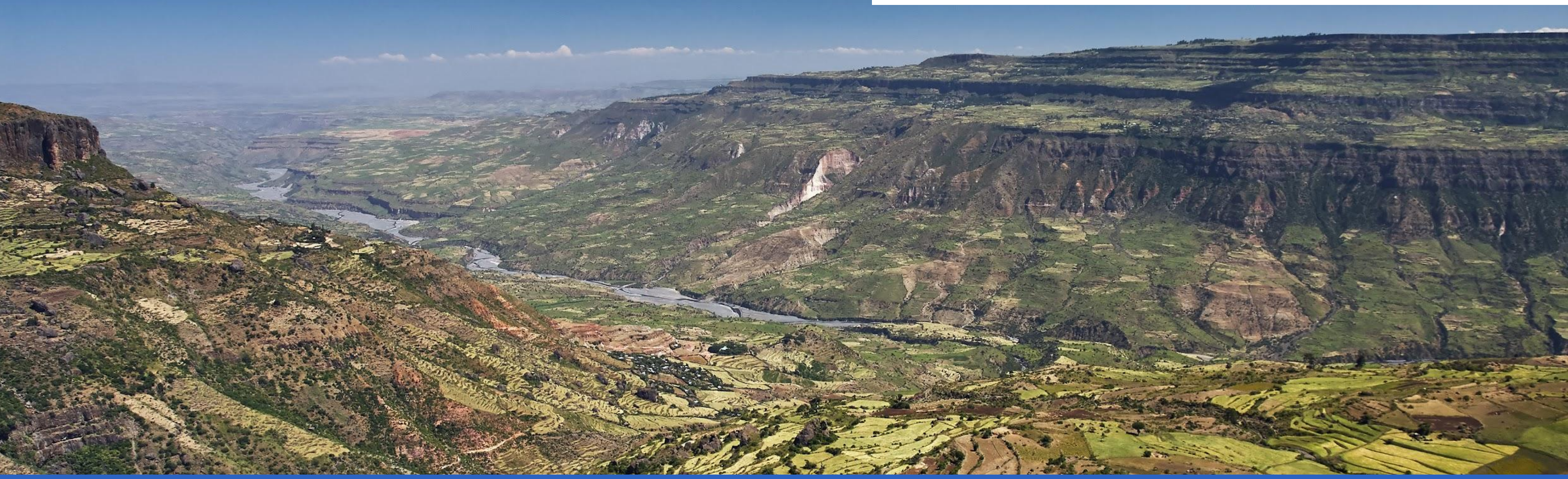

Modelling tectonic plates

Activity purpose:

Build a model of tectonic plates to investigate the three types of plate boundaries.

stileapp.com/go/plateboundary

stileapp.com/go/raplateboundary

60-90 minutes

2-3 students

Materials

Each group of students will need:

Lab equipment

Materials will vary depending on the design of the individual models. Examples of materials include:

Various choices for the semi-liquid material (e.g. shaving cream, tomato sauce, melted chocolate, golden syrup, mud, etc.)

Various choices for the solid tectonic plates (e.g. cardboard, crackers, wafers, thin plastic sheets, flat shells, etc.)
a flat, shallow bowl or tub.

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

The more viscous the semi-liquid layer, the easier it is to move the tectonic plates around. Heavy solid materials can sink into semi-liquid material.

The transform boundary test works best when the "tectonic plates" have uneven edges, such as rough pieces of cardboard or crackers with uneven borders. As the tectonic plates slide against each other, they can get caught and demonstrate stress building up to form an earthquake.

Method

Method that students will follow:

Students will design and construct their own model and select their own materials.

Instructions provided to students include:

Build a model to show the different ways tectonic plates move and change the Earth's surface.

The materials you use are up to you, but make sure you select:

- a solid material that represents the tectonic plates
- a semi-liquid material that the tectonic plates move on

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Earthquake-resistant buildings

Activity purpose:

Follow the engineering process to design, build and test an earthquake-resistant building.

stileapp.com/go/quakeresistance

stileapp.com/go/raearthquakeresistance

180-240 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- Blu-Tack or plasticine (1 stick/25 grams)
- uncooked spaghetti (30 pieces)
- scissors
- 30cm ruler

Shake table (optional, one per class)

- 2 x 1 m lengths of dowel
- 2 x 75 cm lengths of PVC
- 2 x 60 cm lengths of PVC
- 4 PVC elbows
- wooden board, 60 cm x 60 cm
- 8 nuts
- 4 eye bolts
- 4 bolts
- 8 elastic bands
- electric drill with drill bit

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Preparation

Preparation required by lab-tech:

If you have the time and resources, you can construct your own shake table for simulating earthquakes.

Alternatively, four students can stand at each corner of a standard classroom table and simulate an earthquake by shaking the table.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

Method

Method that students will follow:

Students will follow the engineering design process to design and construct a model earthquake-resistant building. They will then take turns testing it on the shake table.

Instructions provided to students include:

You are to design a building that would withstand a major earthquake. You will need to design, build and test a small scale model that meets the following criteria:

- is quick and easy to assemble
- has a minimum height of 60 cm
- has a maximum base of 30 cm x 30 cm
- remains standing after an earthquake, as simulated by shaking a table for 10 seconds
- is constructed from the materials supplied by your teacher
- costs less than $60 to build, given the material costs listed below

Your model cannot be attached to the table in any way.

You can only use the following materials to build your model:

- spaghetti ($1 per 10 cm)
- Blu-Tack or plasticine ($1 per gram)
- scissors or retractable craft knife
- ruler

Calculate the cost of your model based on how much of each material you use.

A template outlining the engineering design process, as well as further scaffolding is also provided to students in the Stile lesson.

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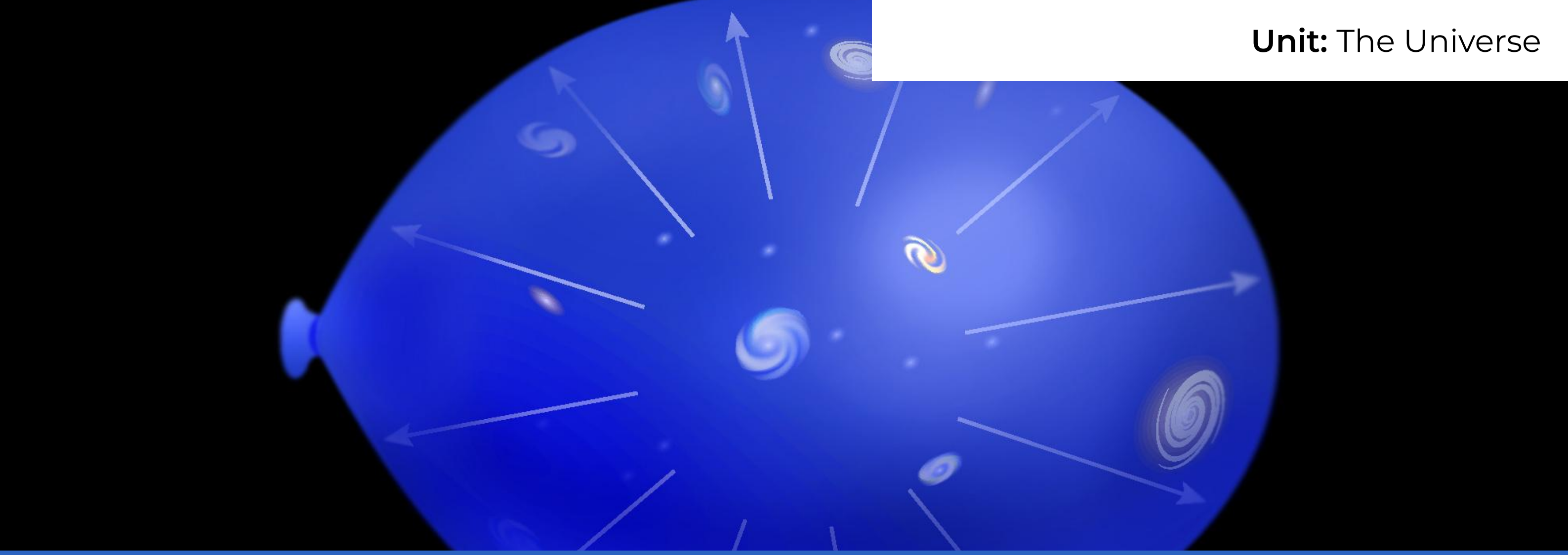

Model of universe expansion

Activity purpose:

Reinforce the basic concept of the expanding universe through a concrete model.

stileapp.com/go/universeexpansion

stileapp.com/go/rauniverseexpansion

25-30 minutes

2 students

Materials

Each group of students will need:

Lab equipment

- balloon
- felt-tip marker
- 30 cm ruler
- clip to seal the balloon

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

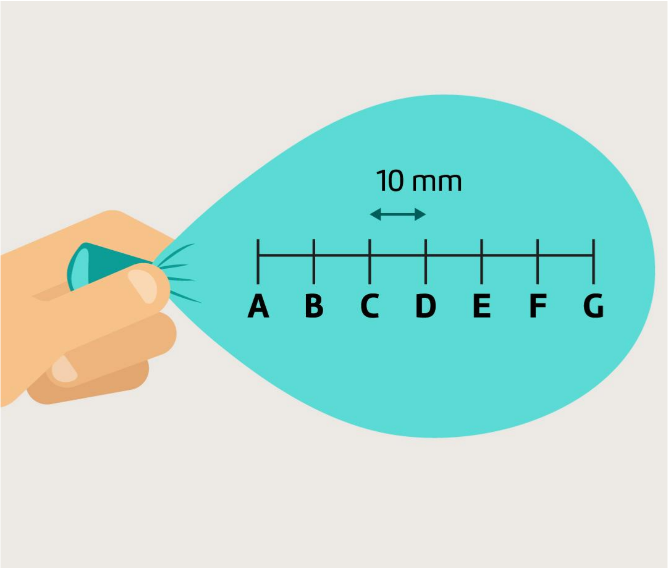
Notes for the teacher:

N/A

Method

Method that students will follow:

1. Semi-inflate a balloon until it is firm. Secure the end with a clip.
2. Draw a line on the surface of the balloon, as shown in the diagram. Mark 7 points along the line at 10 mm intervals. Label the marks A to G. These represent galaxies. Assume that A represents the Milky Way.
3. Inflate the balloon with one large breath and secure with the clip. Measure the distances between A and the other galaxies. Fill in the row of the table below for Time 1.
4. Repeat Step 3 two more times, for Time 2 and Time 3.



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Albedo and colour

Activity purpose:

Investigate how colour influences albedo, measured by recording temperature.

stileapp.com/go/albedocolour-G (guided)
stileapp.com/go/albedocolour-O (open)

stileapp.com/go/raalbedocolour
stileapp.com/go/raalbedocolour-open

30-45 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

- 3 thermometers or an infrared temperature probe
- 1 piece of black paper
- 1 piece of white paper
- 1 piece of paper of a third colour
- a tray (optional)
- high intensity lamp or sunlight
- stopwatch

Note: Make sure that the pieces of paper are all of the same type, size and thickness. Paper napkins are a good option.

Chemicals

N/A

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Preparation

Preparation required by lab-tech:

Nil

Preparation required by teacher:

Two options are provided for this activity in Stile – a guided or open investigation.
Consider which is the most appropriate for your students.

Notes

Notes for the lab-tech:

N/A

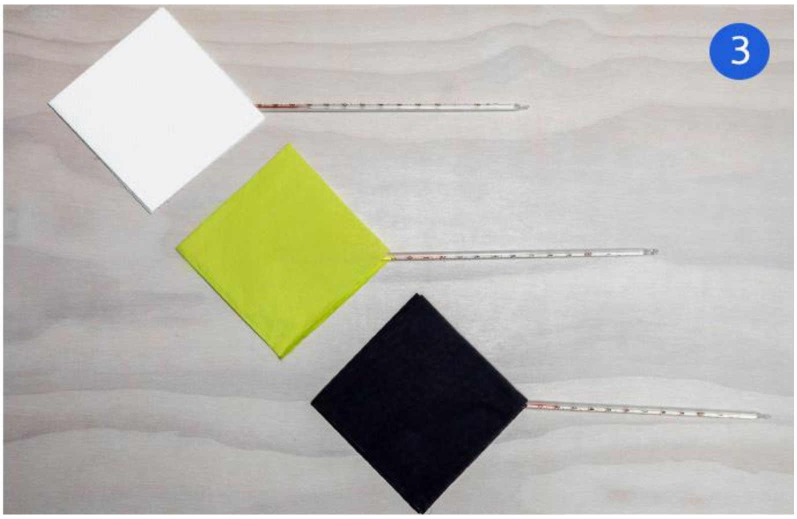
Notes for the teacher:

N/A

Method

Method that students will follow:

1. Fold each piece of paper the same way to make pockets as shown.
2. Place a thermometer with the bulb in the centre of each pocket, under 1 layer of paper.
3. Lay the the paper pieces and thermometers together on the tray or a surface where they are not under the light source. Make sure that each pocket has the single paper layer facing up.
4. Read the temperatures and record in the table below.
5. Move the paper and thermometers under the lamp or in the sun.
6. Record the temperatures every 2 minutes for 10 minutes.



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Floating gardens

Activity purpose:

Follow the engineering design process to design and construct a model floating garden.

stileapp.com/go/floatinggardens

stileapp.com/go/rafloatinggardens

90-120 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Each group of 3-4 students will need a range of materials that give them a range of options for each element of their design:

- to help the model float, e.g. 2 x 250 mL plastic drink bottles, 2 x small plastic food trays, 15 x straws, 10 x corks, bubble wrap (23cm wide x 30cm long), 2 x balloons
- to bind the model together, e.g. 2m of string, 1 stick of Blu-Tac, 1 x glue stick, 1 roll of adhesive tape, elastic bands
- to provide padding or support, e.g. cardboard, craft sticks, 1 x egg carton, cotton wool, straw, paper towel
- extra challenge: potting mix and seeds (eg. lettuce or alfalfa) to actually grow some vegetables
- scissors

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Preparation

Preparation required by lab-tech:

To test the models you will need a large tub or sink half-filled with water, card cut to 23 cm x 30 cm and 5 one-kilogram weights.

Preparation required by teacher:

Nil

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

This engineering challenge was originally developed by Practical Action, an organization that uses technology to challenge poverty in developing countries.
Teacher notes, student worksheets and more background information can be found at their website:
https://practicalaction.org/floatinggardenchallenge

We recommend that students work individually to initially define the problem, research and brainstorm solutions before they join together in groups.

Method

Method that students will follow:

Students will follow the engineering design process to create a floating garden.

Instructions provided to students include:

We need your help to design a floating garden for communities in Bangladesh. You will need to build and test a small-scale model that meets the following criteria:

- floats on water while supporting a weight of 5 kg
- has a fairly flat top for soil to support crops
- is less than 23 cm wide and 30 cm long
- is built out of any materials provided to you by your teacher

A template outlining the engineering design process and further scaffolding is provided to students in the Stile lesson.

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Modelling sea level rise

Activity purpose:

Experimentally model the effects on sea level of melting sea and land ice, and thermal expansion.

stileapp.com/go/sealevel-G (guided)
stileapp.com/lsSealevel-O (open)

stileapp.com/go/rasealevel
stileapp.com/go/rasealevel-open

60-90 minutes

3-4 students

Materials

Each group of students will need:

Lab equipment

Part 1:

- 2 x 600 mL beakers
- 1 x 250mL beaker
- permanent marker

Part 2:

- 250 mL conical flask
- retort stand and clamp
- long thermometer
- Bunsen burner
- tripod
- heatproof mat
- gauze mat
- tongs
- permanent marker
- plasticine
- 30 cm ruler
- masking tape

Chemicals

Part 1:

- approx. 600 mL water
- 2 ice cubes, the same size

Part 2:

- approx. 10 drops food colouring
- approx. 300 mL water

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Preparation

Preparation required by lab-tech:

Prepare ice cubes ahead of time.

Preparation required by teacher:

Two options are provided for this activity in Stile – a guided or open investigation. Consider which is the most appropriate for your students.

Notes

Notes for the lab-tech:

N/A

Notes for the teacher:

N/A

Method

Method that students will follow (for guided investigation):

Part 1:

1. Place the smaller beaker upside down in one of the beakers. This represents a land mass.
2. Half fill each large beaker with water.
3. Place one ice cube into the water of the first beaker to represent sea ice and the other ice cube on top of the small beaker in the second beaker to represent land ice, as shown in the photo below.
4. Mark the water level on each beaker.
5. Place the beakers in the sun or somewhere warm and wait for them to melt.
6. After all of the ice has melted, observe the water level in each beaker.

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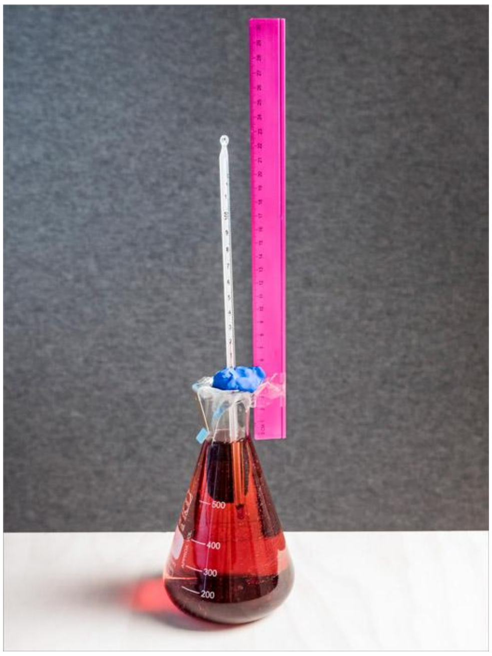
Method (cont.)

Part 2:



1. Fill the flask with very cold water up to the bottom of the neck, as shown at right.
2. Add food colouring to improve visibility.
3. Place the thermometer in the flask and secure it in place using the retort stand and clamp. Ensure that the bulb doesn't sit on the bottom of the flask.
4. Use sticky tape to attach a ruler to the side of the flask. Ensure that the ruler is vertical and positioned so that zero aligns with the current water level.
5. Note down the starting temperature of the water and the water level on the ruler (0 mm).
6. Slowly heat the water.
7. Complete the table, recording the temperature and water level for every 5°C increase in temperature.

Method that students will follow (for open investigation):

Students will design their own method, which will require teacher approval before commencement.

Instructions provided to students include:

Design a scientific experiment to test the relative importance of the three factors above for rising sea levels. You will need to design a small-scale model that represents the important features of the real-world situation while controlling certain variables.

Your experimental design should include the following sections:

- Aim: state the purpose of the experiment
- Hypothesis: frame a scientific hypothesis that outlines what you predict will happen and why
- Variables: identify the independent, dependent and controlled variables
- Materials: make a list of the materials you'll need, including a drawing of the experimental setup
- Procedure: write a numbered list of the steps of the experiment that is clear enough for anyone to follow

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