WISE Activity Booklets

A STEM activity booklet for fun on-the-go learning!
Made by WISE Kid-Netic Energy

DIY Activities
Puzzles
Challenges
... and more!

Grade 8
JULY 2020

Cells & Systems - Optics
Fluids - Water Systems

University of Manitoba

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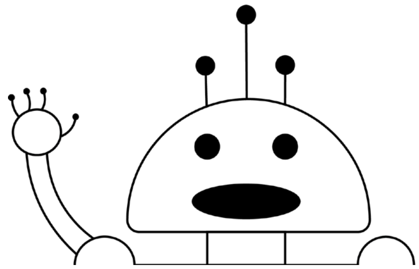


Hello there!

WISE Kid-Netic Energy is a not for profit STEM (Science, Technology, Engineering, and Math) outreach organization at the University of Manitoba. Our organization offers science and engineering workshops, clubs, camps and events to youth from Kindergarten to Grade 12 throughout the province of Manitoba. We reach on average 25 000 to 50 000 youth depending on funding levels. Our approach is simple – present STEM in messy, memorable and engaging ways so Manitoba youth feel motivated to learn more and more. We reach all Manitoba youth, and we particularly target underrepresented youth like girls, indigenous youth and youth facing socio-economic challenges.

All of us at WISE Kid-Netic Energy have been working hard to create these booklets to continue to bring our fun and educational STEM activities to Manitoba youth during these unprecedented times. We are disappointed that we cannot see you in person, and hope that these monthly booklets bring some STEM excitement to your life.

These booklets have been created by our student instructors who are all studying engineering, science, or in another STEM-related field at university. Peek the last page of this booklet to see who created the activities, experiments and recipes within.

All the activities in this booklet are based on the Manitoba Science curriculum. For any teachers viewing this booklet, all the SLO codes are listed at the bottom of each page.

If a link is listed at the bottom of the page, and you have access to the Internet, follow it to check out a video of the activity our instructors have created just for you.

We hope that you enjoy doing the experiments and activities as much as we loved creating them for you.

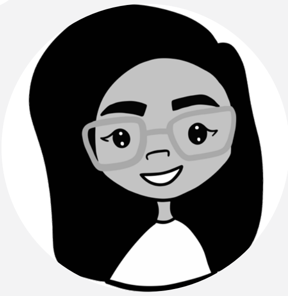
In this Grade 8 booklet, the science topics you will be exploring are: cells & systems, optics, fluids, water systems, and more!

Best of luck, and until we see you again,

the WISE Kid-Netic Energy Crew

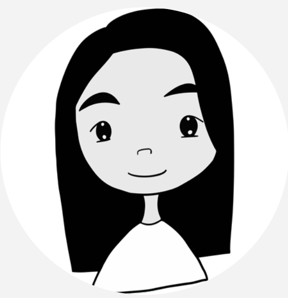
P.S. If you have any suggestions for activities or experiments you would like us to try, contact us through our website, or social media accounts that are listed on the last page of this booklet.

Meet our Amazing Authors!



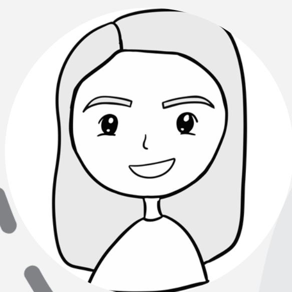
Alora

Alora just finished her fifth year in university, working towards her bachelor of Science with a major in Neuroscience and a minor in French. She is currently attending the University of Winnipeg. She is aspiring to become a high school science teacher and a guidance counsellor. In her spare time, she enjoys reading, writing, and playing the ukelele.



Amaris

Amaris just finished her first year in sciences at the University of Winnipeg and plans on majoring in biology. In her free time, Amaris likes reading, playing piano and baking.

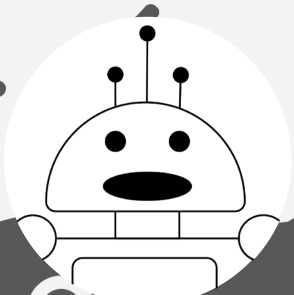


Katy

Katy has completed her second year of Biosystems Engineering at the University of Manitoba and is passionate about environmental sustainability and working with kids. In her spare time she enjoys running, painting, and spending time outside.

Zoe

Zoe just finished her first year of Engineering, and is entering the department of Civil Engineering in the fall. She loves math, and in her free time enjoys walking her dog, as well as playing volleyball and ultimate frisbee.



Esiw the Robot

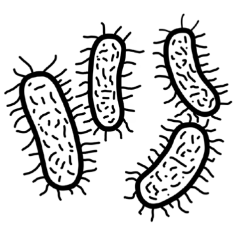
Esiw is a friendly robot that loves to help kids learn about computers & coding! Esiw loves to do math, solve problems and make people laugh!

To Be or Not to Be (Living or Not)

Many people with different worldviews or interpretations of life have different definitions of what may be living or not. Using your understanding of life and living things, write down some requirements that you think organisms must meet to be characterized as living. Make sure they are broad enough so that they can apply to more than one type of organism.

Living things must:

Now, using your criteria for living things, characterize the things below as either living or not. Describe which of your criteria it meets or fails. Even if you think it is not living, try to identify living things around it which may depend on it for their own life or which it might interact with. For example, you may say that water itself is not alive, but natural bodies of water are ecosystems full of many microorganisms which are living, plus many plants and animals need water to live.



Lactobacillus bacteria that dwell on human skin and protect against infection

Living or not?

Criteria met or failed:

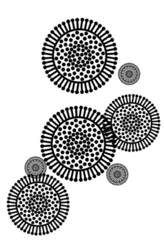
Interactions with living things:

Fire

Living or not?

Criteria met or failed:

Interactions with living things:



Viruses which can only reproduce inside of another organism's cells

Living or not?

Criteria met or failed:

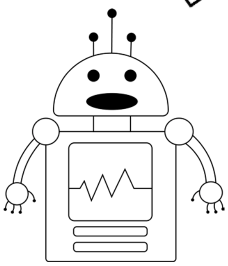
Interactions with living things:

A parasite that found its home on a zebra

Living or not?

Criteria met or failed:

Interactions with living things:

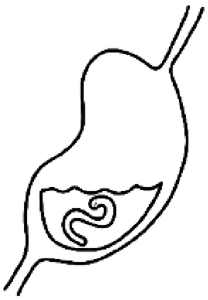


A robot who uses machine learning

Living or not?

Criteria met or failed:

Interactions with living things:



A tapeworm that gets all its food from inside an animal's stomach

Living or not?

Criteria met or failed:

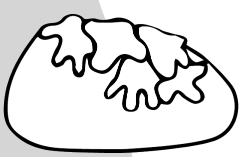
Interactions with living things:

Fungi

Living or not?

Criteria met or failed:

Interactions with living things:



A rock that supports life for a lichen growing on it.

Living or not?

Criteria met or failed:

Interactions with living things:

A lichen which is composed of algae and fungi (and is defined by both species together)

Living or not?

Criteria met or failed:

Interactions with living things:

SCIENTIST DEFINITIONS

Most scientists characterize living things by 6 requirements. Living things must:

1. Be made of one or more cells
2. Reproduce, grow and repair themselves
3. Respond to their environment
4. Produce waste
5. Require energy
6. Have a lifespan

Natural Light Phenomena Journal

Natural light phenomena are all around us and can be seen across the world. They are unusual displays of light from the sun being reflected, refracted, and dispersed to create interesting visual phenomena. Examples of natural light phenomena are discussed below!

Over the course of the next few weeks (or months), see how many of these natural light phenomena you can observe for yourself! Use this journal as a guide to find and observe natural light phenomena and draw pictures of what you see in the spaces provided. If you see one of the following phenomena multiple times, be sure to record the information on a new sheet of paper!

SUN DOGS

Sun Dogs are two bright spots of light that can appear on either side of the sun. They are visible when the sun shines light through ice crystals in the atmosphere, and the light rays are refracted, or bent, as they travel through the ice crystals. Because light travels differently through ice than through the atmosphere, the direction of its motion changes slightly, producing the appearance of multiple sources of light, or smaller bright spots next to the sun.

Location:

Date and Time:

Observations:

RAINBOW

A rainbow is a reflection, refraction, and scattering of light as it passes through water droplets in the atmosphere. Rainbows are most commonly seen after rain, and can even be created (on a small scale) when sunlight is filtered through the spray of a garden hose, or water in the air. You have probably seen one before! The multicoloured arc of a rainbow is every colour of the visible colour spectrum, from red on the outer arc to violet on the inner arc.

Location:

Date and Time:

Observations:

CLEAR BLUE SKY

The sky is blue because of the way sunlight is scattered as it enters the atmosphere and interacts with all the gases and air particles there. Blue light has a shorter wavelength and is more frequently scattered than other wavelengths (and colours) of light. Purple light has even shorter wavelengths and is the most frequently scattered colour, but the sky is not usually this colour because some of the purple colour is absorbed within the atmosphere.

Location:

Date and Time:

Observations:

SUNRISE

We learned about why the sky is blue, so why do you think the sky changes colour from dark to red, pink, orange, yellow, and sometimes purple as the sun rises? Record your reasoning in the observation section, and see if you can wake up early enough to watch a sunrise! Take note of the colours you see, and what that means about the wavelengths of light.

Location:

Date and Time:

Observations:

SUNSET

When the sun is shining from a far distance, or at the horizon, sunlight has to travel a greater distance through the atmosphere to reach you! At sunrise and sunset, the light is scattered differently by atmospheric particles (there simply is more atmosphere to travel through) and less blue is visible, with more of the other wavelengths and colours being scattered instead.

Location:

Date and Time:

Observations:

LIGHTNING & THUNDER

Lightning is the result of electrical discharge in storm clouds. An electrical charge builds up in the clouds, and lightning connects it to the ground, in a powerful bolt of electricity. It is usually accompanied by thunder, the sound produced from lightning. Although the light and sounds are produced at the same time, thunder is usually heard a little later, because light travels faster than sound.

Location:

Date and Time:

Observations:

HEAT LIGHTNING

Heat lightning, also known as silent lightning, is faint lightning visible in the sky without the accompanying thunder or rain. Not only can light travel faster than sound, it can also be seen from a greater distance. Heat lightning is simply lightning from a thunderstorm far away being reflected off the clouds. It is most likely to occur in the summer months on warm, humid nights.

Location:

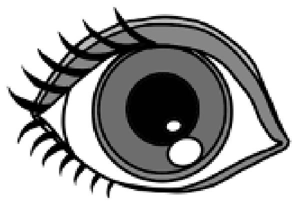
Date and Time:

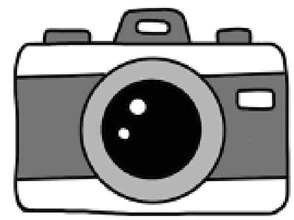
Observations:

Eye / Camera

Have you ever wondered how seeing works? Or how a camera works? Did you know that they're two very similar processes? In both cases there are multiple different processes that need to work to produce an image that is clear and can be understood.

Match the function of an eye structure to the corresponding part of the camera!





EYE STRUCTURE	FUNCTION	CAMERA STRUCTURE
Retina	Controls how much light enters the eye / camera	Aperture
Brain	Helps focus light	Camera Lens
Optic Lens	Light-sensitive surface, which captures the image of what we're looking at and receive an inverted vision of the image	*Digital version:* imaging sensor chip / *Non-digital version:* film
Iris	Flips the image received so it's right-side up	*Digital version:* programming to flip the image / *Non-digital version:* prism or mirror

Can you think of any **differences** between the functions and structures of the eye and the camera?

SLO: 8-2-14

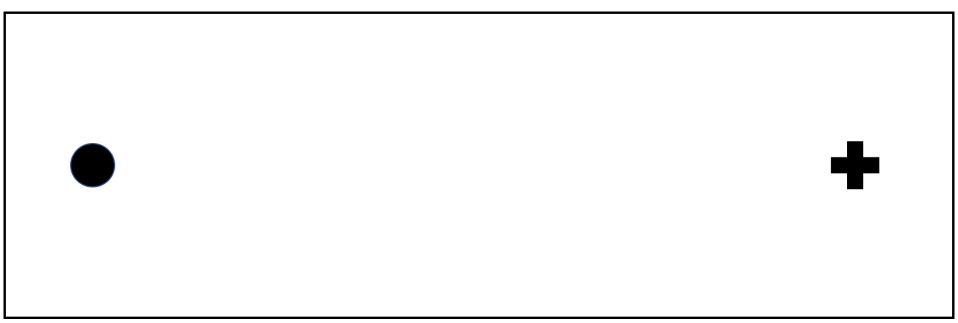
A FEW DIFFERENCES

Lens diversity: When staying focused on a moving object, the thickness of the optic lens can change to accommodate the image being viewed at different distances. Camera lenses have cannot change shape. Instead, mechanical parts in the camera can adjust the positioning of the lens to stay focused on a moving object but only to a certain extent. Photographers need to change lenses depending on what they're shooting.

Photoreceptors: The retina of the eye contains two types of photoreceptors (specialized cells that receive light inputs) called rods and cones. Rods help us see in low-light and can't help us perceive colour. Cones are specialized in colour and there are 3 kinds: red cones detect long wavelength, green cones detect medium wavelengths, and blue cones detect short wavelengths. Different combinations of the cones receiving signals allow us to see the world in colour! Cameras only have one type of photoreceptors, which respond to the different wavelengths of light by using filters that are placed on top of the photoreceptors. The camera has an even distribution of photoreceptors, whereas the human eye has the cones concentrated at the centre of the retina, and rods toward the periphery.

Capturing the full image: Cameras always capture the full image, however, in our eyes we have a persisting blind spot! This is where the optic nerve connects to the eye to receive signals from the retina. These areas don't have any photoreceptors at all. You don't typically notice your blind spot because your brain uses signals from your other eye to fill the gap.

FIND YOUR BLIND SPOT

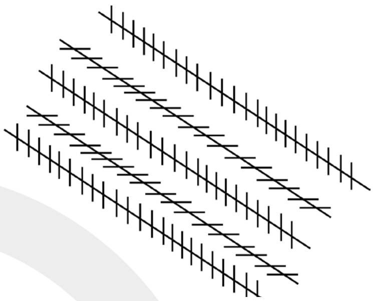


1. Look at the picture above. Place the paper about 50cm away from your face.
2. Close your right eye.
3. Look at the plus symbol with your left eye.
4. Move the picture forward until the circle disappears.
5. Congratulations! You've found your blind spot. Try the same process by closing your left eye and focus on the dot with your right eye. Move the paper until the plus sign disappears!

This activity was made by Alora

Optical Illusions and Eye Tricks

What a lot of people don't know is that a lot of "seeing" is done by the brain! The optic nerve, which is responsible for sending the light signals from the retina to the brain, connects to the occipital lobe. This is known as the visual cortex found at the back of the head. Our brain can do a lot of amazing things with the visual information it receives and that's how we produce optical illusions!

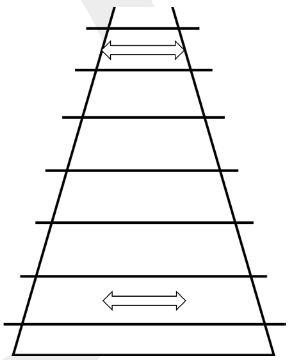


ZOLLNER ILLUSION

Take a look at the picture to the left. Do you think the lines will eventually converge / cross over as they continue out of the frame?

◯ YES ◯ NO

After you make your prediction, take a look at the next page!

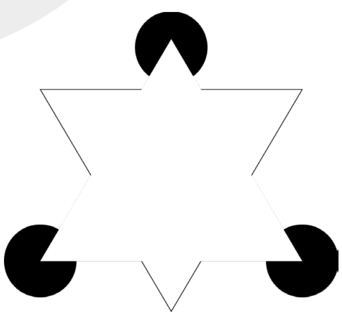


PONZO ILLUSION

Take a look at the picture to the left. Which arrow looks bigger?

◯ TOP ◯ BOTTOM ◯ NEITHER

After you make your prediction, check the next page to see what's happening!



KANIZSA TRIANGLE ILLUSION

Describe and count the shapes you see in this picture:

____

TROXLER'S EFFECT

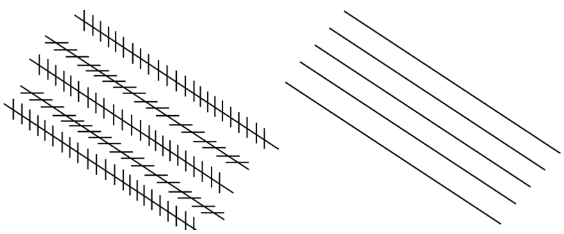
In order for this effect to take place, stare at the centre cross on the image on the next page. What happens when you do this for a few moments?

____

SLO: 8-2-14

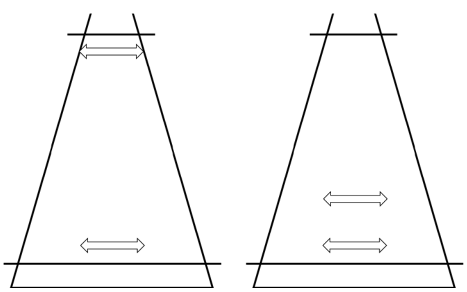
WHAT'S HAPPENING HERE?

ZOLLNER ILLUSION



Our perception of the long lines is heavily influenced by the direction of those short lines. The picture on the right is the same image as the one on the left, but without the short lines added on. Because the short lines are perfectly vertical or horizontal, it gives us the illusion that the long parallel lines will eventually collide as well.

PONZO ILLUSION



Typically people guess that the top arrow is larger. Our brain likes to make assumptions based on context. In this case, the space at the top is narrower, which makes the arrow appear larger at the top. In the second picture, we can actually see that the arrows are the same size!

KANIZSA TRIANGLE ILLUSION

Many people will describe seeing a white triangle located in the middle of the image when in reality, there's simply an empty space. This illusion is an example of the Law of Closure. This law explains that people tend to group things together in order to create a cohesive picture, even when gaps in the image are present.

TROXLER'S EFFECT

When you stare at the centre cross without blinking for long enough, the blurry figure around it should begin to disappear! This experiment is a great example of how our brain adapts to **sensory stimuli**. Sensory stimuli are basically just what we see or what's happening around us. Our brain actually stops responding to unchanging stimuli if it's categorized as unimportant. This causes the image to disappear from our consciousness!

This activity was made by Zoe

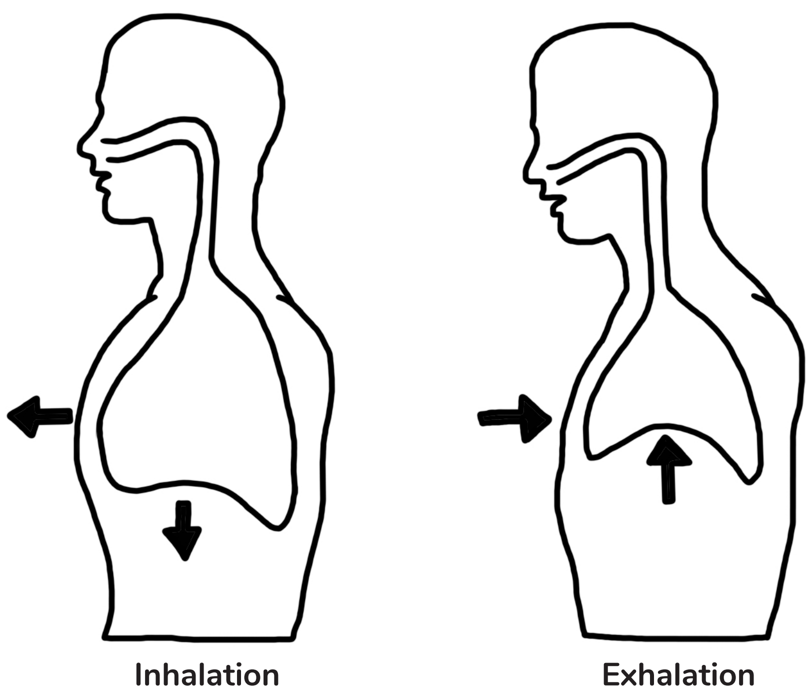
Hydraulics and Pneumatics in the Body

Hydraulic and pneumatic systems convert fluid pressure to mechanical motion, and are used in many everyday machines and objects. Did you know that the human body makes use of these systems too? Between the lungs and heart, can you figure out which one is which type of system?

DEFINITIONS

HYDRAULIC SYSTEMS use liquid substances to transmit power. Liquid substances can include water-based fluids, petroleum-based or mineral-based fluids, as well as synthetic fluids. Some examples of hydraulic systems are various kinds of lifts (for example, jacks and lifts for cars, wheelchair lifts, amusement park rides, moving theatre stages, elevators, etc.), hydraulic brakes (for example, in cars or mountain bikes), construction gear (cranes, dump trucks), dishwashers, and dentist and barber chairs.

PNEUMATIC SYSTEMS use easily compressible gas such as air or pure gas to transmit power. Some examples of pneumatic systems are air brakes used by buses, tampers used to pack down dirt/gravel, nail guns, dentist's chairs, and precision drills used by dentists.



Is this a pneumatic or a hydraulic system?

○ PNEUMATIC ○ HYDRAULIC

LUNGS

The way you breathe has everything to do with differences in pressure between the inside of your lung and the outside air.
To **inhale**, your chest muscles contract to pull the chest cavity more open, which increases the volume inside the lung. This expansion decreases the pressure of air inside the lungs, causing fresh air to rush in.
To **exhale**, your chest muscles relax and your lungs spring back, decreasing the volume of your lungs. This increases the pressure of air, causing air to rush back out.

- Draw arrows to represent how fluid air flows in and out of our lungs as we breathe in and out.

- Draw dots inside of the lungs to represent air molecules (and air pressure) inside the lungs during inhalation and exhalation. (Hint: Gases fill their container. When air molecules are closer together, pressure is higher. When air molecules are further apart, pressure is lower.)

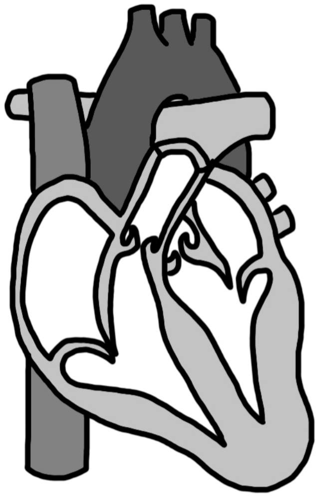
SLO: 8-1-11, 8-3-12

HEART

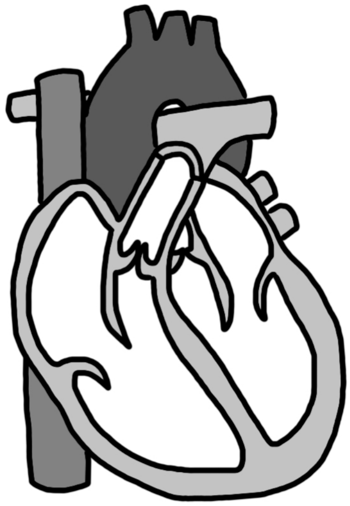
Your heart is a very strong muscle, and its contractions force blood to move due to pressure.
In **systole**, your heart contracts to pump blood out. The contraction causes a higher pressure in the heart chambers, forcing blood out into your blood vessels.
In **diastole**, your heart relaxes between beats to refill with blood. A relaxed heart has lower pressure inside its chambers.

- Draw arrows to represent how fluid flood flows through the heart during systole and diastole.

- Draw dots inside the heart chambers to represent the blood molecules (and pressure) in the heart during systole and diastole. (Hint: more blood in one area results in higher pressure).



Systole



Diastole

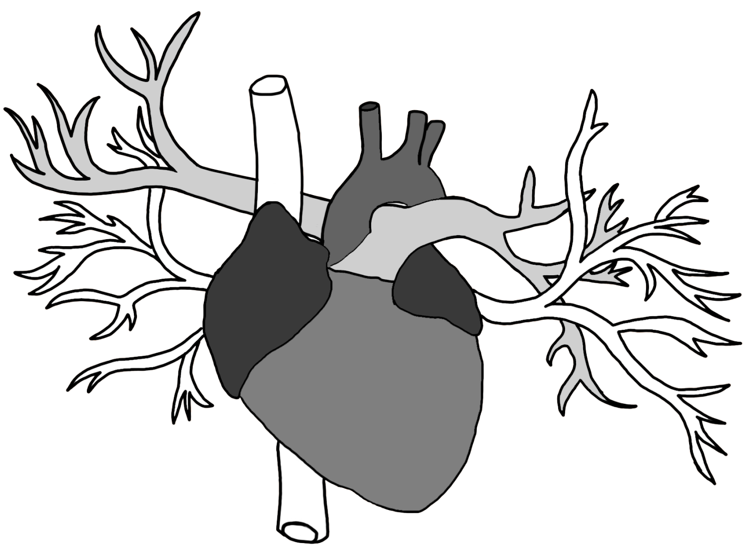
Is this a pneumatic or a hydraulic system?

○ PNEUMATIC ○ HYDRAULIC

BLOOD VESSELS

The pumping of your heart affects the pressure of blood inside your vessels. Vessels are built differently to withstand pressure.
Arteries receive blood from the heart after it contracts during systole. They carry the blood from the heart to the rest of your body. They withstand a lot of pressure, and are thicker and made up of smoother muscle fibers and elastic tissue.
Veins carry blood back to your heart to fill it during diastole. They don't have as much force acting on them as arteries do, so they don't need to be as thick.

- Draw dots to represent the pressure in the veins and arteries. (Hint: draw more dots to represent high pressure, and fewer dots to represent low pressure).



Note: veins are coloured white, and arteries are grey (light grey or medium grey)

Density Towers Experiment

Here's an activity that will let you play with density, viscosity, and buoyancy. Let's make a tower of liquids!

DEFINITIONS

DENSITY is the mass of a liquid per unit volume. It is kind of like the "heaviness" of a substance. If we have the same volume of two liquids, the one that has a higher density will be heavier. In your density tower, you'll be able to see distinct layers because of differences in liquid densities.

VISCOSITY is the rate at which a liquid flows while it's moving, like when it's being poured from one container to another. For example: honey flows slowly compared to water, and has a high viscosity.

BUOYANCY is the ability to float on top of a liquid. The buoyancy of an object depends on the density and shape of that solid object. A solid object can only float on top of a liquid that is denser than the solid itself.

Using the signs < and > estimate which liquid has a higher density or viscosity!

DENSITY

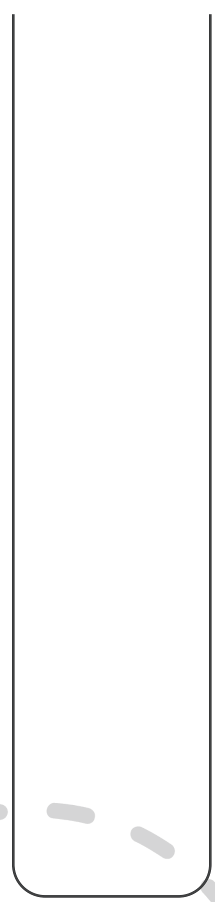
Honey	Canola Oil
Water	Maple Syrup
Rubbing Alcohol	Corn Syrup

VISCOSITY

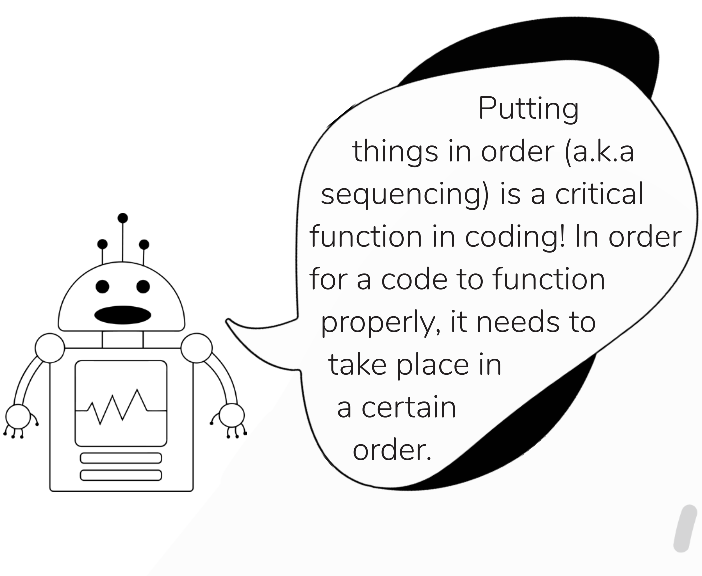
Water	Honey
Coffee	Ketchup
White glue	Canola Oil

Use this diagram to record all the data from your density tower experiment!

Liquid density (draw and label the different liquid layers in order)



Solid buoyancy (draw the different objects and where they settled)



SLO: 8-3-01, 8-3-06, 8-3-08

MATERIALS
- Tall, clear container or vase
- Food colouring (optional)
- Small cups (one per liquid)
- Paper towel
- Masking tape
- Permanent marker

LIQUIDS
- Honey
- Corn syrup
- Pancake syrup
- Milk / Cream
- Dish soap
- Water
- Vegetable oil
- Baby oil
- Rubbing alcohol

TEST OBJECTS
- Bolt
- Plastic bead
- Popcorn kernel
- Macaroni noodle (uncooked)
- Rice

If you don't have some of these liquids or test objects, you may just omit them from the experiment. This just means your tower won't have quite as many layers which is totally okay!

1. Line up the small cups, and label each one with the name of one of the liquids you'll be using in the density tower. In order to have things run smoother, put them in order from most dense to least dense. **Hint:** They are in order in the material list, from densest (honey) to least dense (rubbing alcohol)
2. Mark the same place on each cup up to which you will fill it with your liquid. Make sure they're as close to the same level as possible on each individual cup.
3. Test the size of your density tower container:
   a. Take one of the cups and fill it up to the line with water. Put this cup of water into the large container that will hold your density tower.
   b. Repeat this until you have done it as many times as you have liquids (eg. if you are using all 9 liquids, do this step 9 times in total). This will ensure the large container can hold all of the liquid you have planned. If it doesn't hold all of the "cups" of water, you need a larger container or need to use a smaller volume of each liquid.
   c. Once you have verified your container is a good volume, empty it and return to the experiment!
4. Fill each cup with its respective liquid up to the mark you determined was a good volume. **Optional:** Colour the water cup with food colouring to make it a more distinctive layer.
5. Start adding liquids from the densest to the least dense into the density tower container. Be sure to add layers slowly to prevent disrupting the layers!
   a. When adding the liquids with high viscosity (honey, syrups, milk, and soap), try your best not to touch the sides of the density tower container while you pour them. They will stick and make for messier layers.
   b. When adding the liquids with low viscosity (i.e. water, oils, and rubbing alcohol), try to pour them down the sides to prevent disturbing the layer underneath.
6. Allow some time for the layers to settle! A couple of minutes should do.
7. Observe the distinct layers of your density tower and draw it out on the previous page!
8. Test the density / buoyancy of the solid materials! Allow some time between objects for the layers to form again before dropping in the next object.
   a. Order them from heaviest to lightest and simply drop them into your density tower.
   b. Document on the next page where the object stopped in your density tower.
   c. Try dropping in other small items that weren't listed above.

Tin Foil Canoe Challenge

Have you ever paddled a canoe? Canoes made from birch bark used to be the main source of water transportation for Indigenous peoples. Birch bark canoes were made across the continent and are still made today!

For this challenge we will combine engineering and coding to design a small-scale canoe. Instead of using birch bark, we will use tin foil as our only building material. The challenge is to use the following supplies to design, build, and test a tin foil canoe that can float under the pressure of 1500 Newtons of force. You will get this force from one of the three options below:

MATERIALS

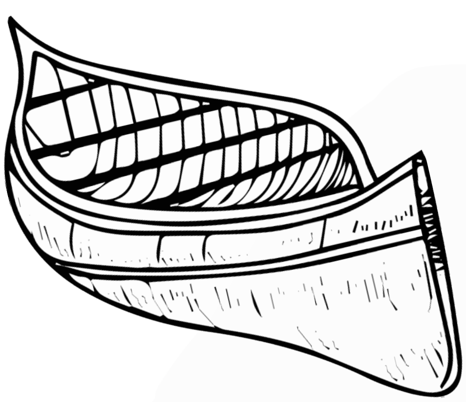
- 15x15 cm square of tin foil (one piece per canoe)
- 1 container of water

FORCE OPTIONS

- 1 hockey puck = 1500 Newtons of force
- 3 golf balls = 1500 Newtons of force
- 30 marbles = 1500 Newtons of force

1. Design and construct your tin foil canoe using only a 15x15 square of tin foil. You can design your canoe on a separate sheet of paper before starting construction.
2. Build the canoe you have designed!
3. Measure your canoe, and fill in the values for the canoe variables on the next page.
4. Float your canoe in a container of water, and test it with a force of 1500 Newtons: add the hockey puck, golf balls, or marbles, and time the test to see whether your canoe can handle the force for at least 10 seconds without sinking.
5. Record your results for your first design by circling either 'Yes' or 'No' on the next page. If you answered 'Yes' for all the questions, then your design was successful! If you answered 'No' to any of the questions, repeat these steps until you create a successful design.

   Note: When recording your variables, please use the largest measurement for each canoe dimension. For example, if your design is wider in the middle, measure the largest width and record that number as your variable. Record all variables in centimeters (cm).



SLO: 8-3-09

CANOE #1

RESULTS:

Did the canoe float on the water?

Yes No

Could the canoe support the 1500 Newton force?

Yes No

Was the canoe still afloat after 10 seconds?

Yes No

VARIABLES:

Length =

Width =

Height =

SurfaceArea (Length*Width) =

Force = 1500 Newtons

CANOE #2

RESULTS:

Did the canoe float on the water?

Yes No

Could the canoe support the 1500 Newton force?

Yes No

Was the canoe still afloat after 10 seconds?

Yes No

VARIABLES:

Length =

Width =

Height =

SurfaceArea (Length*Width) =

Force = 1500 Newtons

CANOE #3

RESULTS:

Did the canoe float on the water?

Yes No

Could the canoe support the 1500 Newton force?

Yes No

Was the canoe still afloat after 10 seconds?

Yes No

VARIABLES:

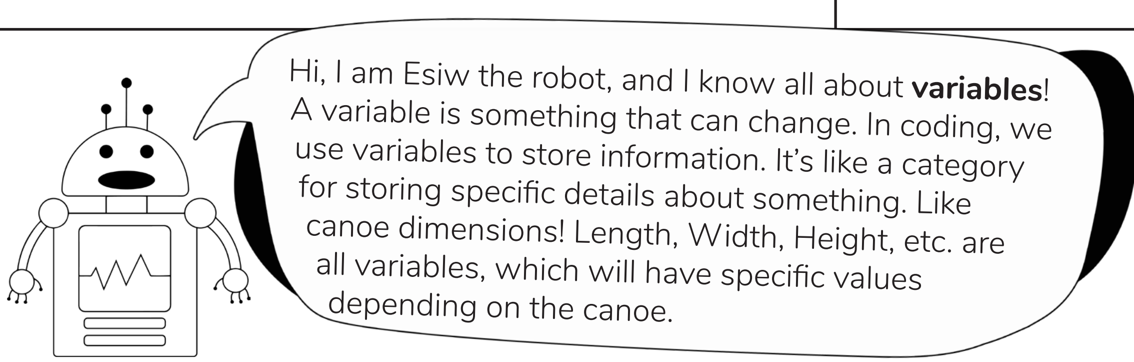
Length =

Width =

Height =

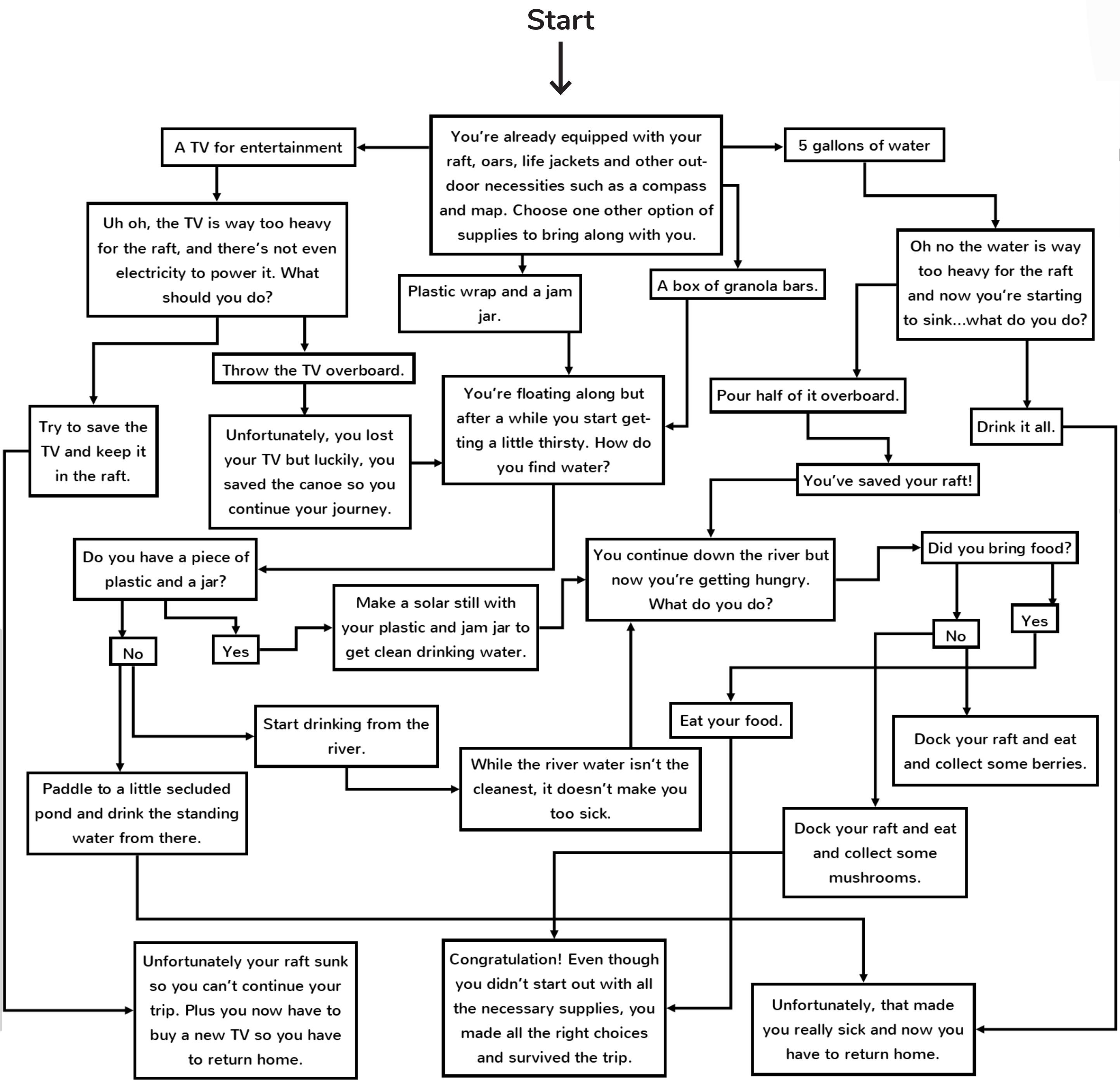
SurfaceArea (Length*Width) =

Force = 1500 Newtons



Choose Your Own Adventure

You're planning for an outdoor adventure! How will you make the most of the resources you have available to you in your teeny tiny raft? Please note that nothing in this scenario is advisable in the real world.



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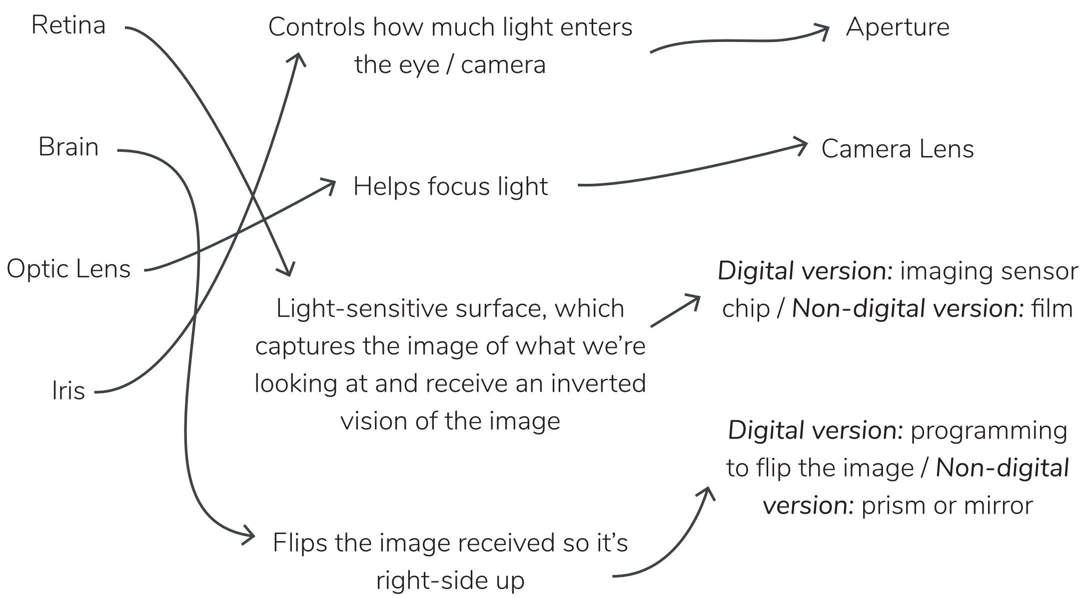
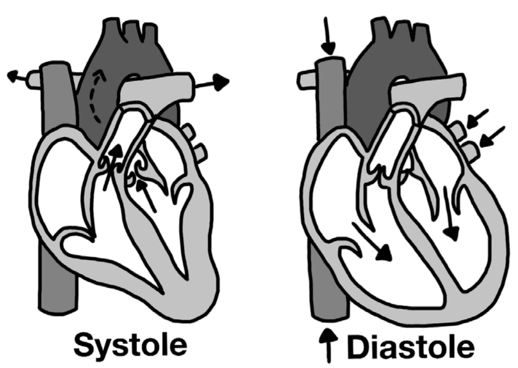
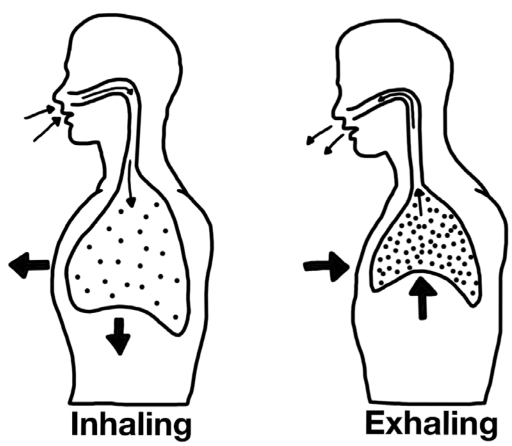
Answer Keys

8 - Eye / Camera



12 - Hydraulics & Pneumatics in the Body





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