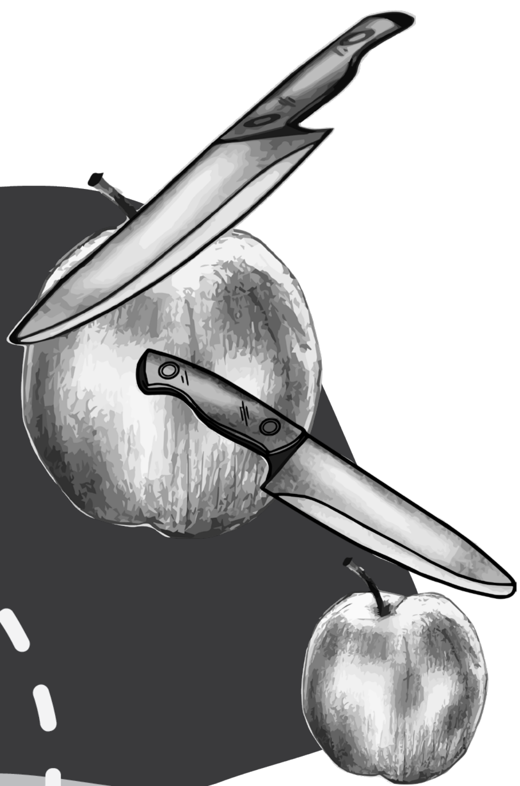
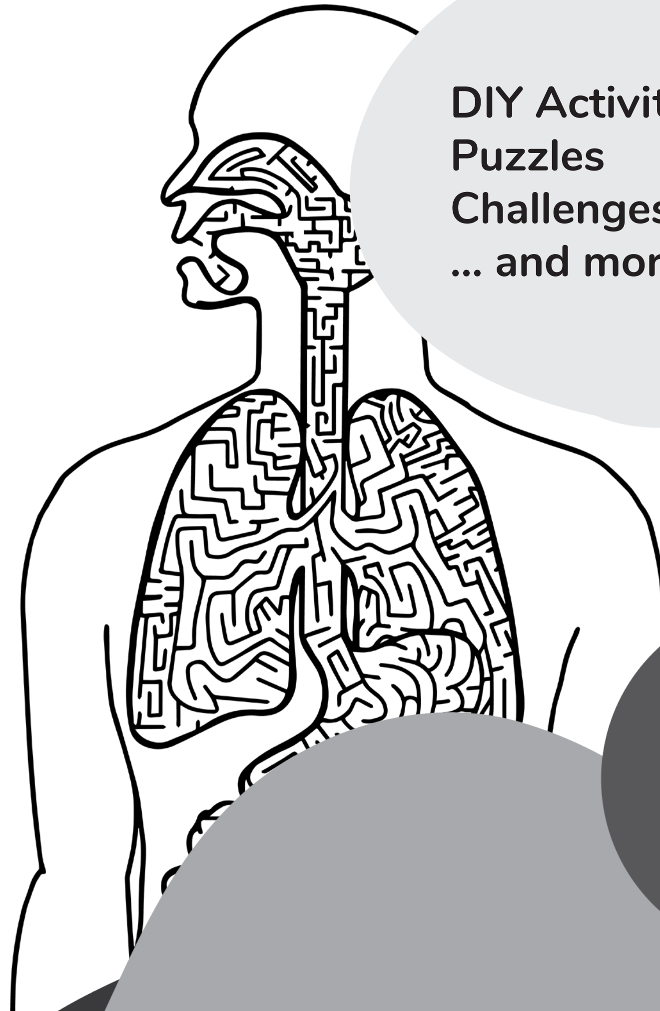
WISE Activity Booklets

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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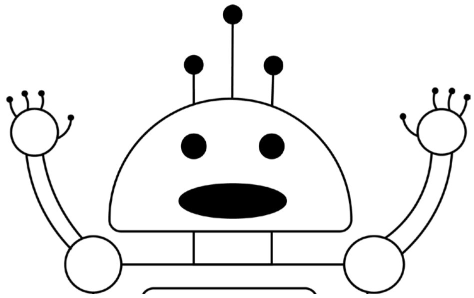


Hello there!

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 next 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.

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

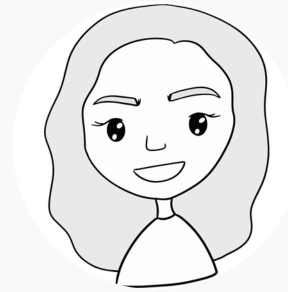
In this Grade 8 booklet, the science topics you will be exploring are: cells & systems, optics, fluids, water systems, and more!

Best of luck, and until we see you again,

the WISE Kid-Netic Energy Crew

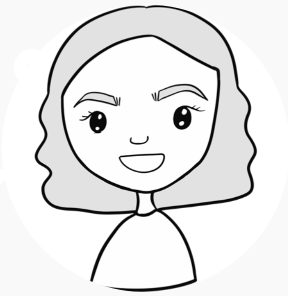
P.S. If you have any suggestions for activities or experiments you would like us to try, contact us through our website, or social media accounts that are listed on the last page of this booklet.

Meet our Amazing Authors!



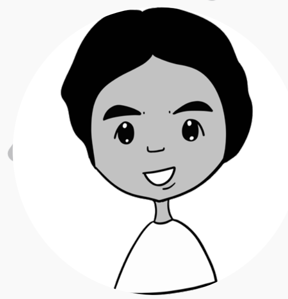
Amelia

Amelia just completed her first year of the after-degree program in early years education. When she isn't reading, she loves writing lists, running, having quality conversations with friends, knitting and singing show-tunes.



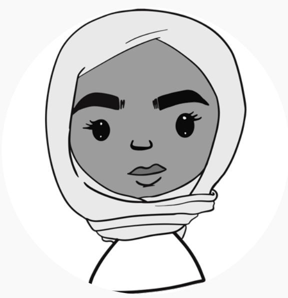
Brenna

Brenna has finished her second year of mechanical engineering and loves science, especially physics! In her free time she likes to paint or draw, see friends, and play with her dog.



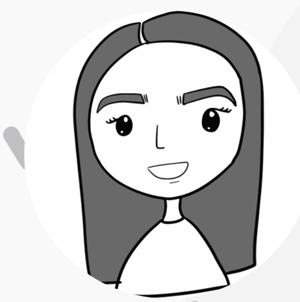
Olivia

Olivia is going into her third year of biosystems engineering. She hopes to work in renewable energy or water treatment in the future. In her free time, she plays and refs touch football and enjoys playing the piano.



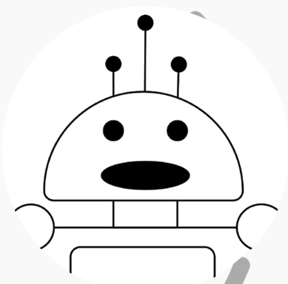
Reem

Reem has finished her first year of science at the U of M and her favourite classes are psychology and microbiology. In her free time, she loves to watch movies and bake desserts.



Shannon

Shannon has finished her first year of Engineering. In her spare time she enjoys drawing, exercising, being outdoors, and trying new things. She is super pumped to be a part of WISE for the summer!



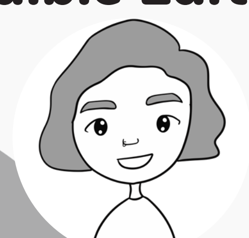
Esiw the Robot

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!

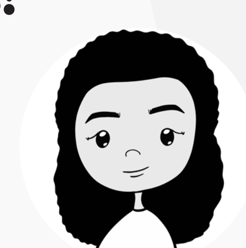
... and our Incredible Editors!

Alex

Bea



Mahalia

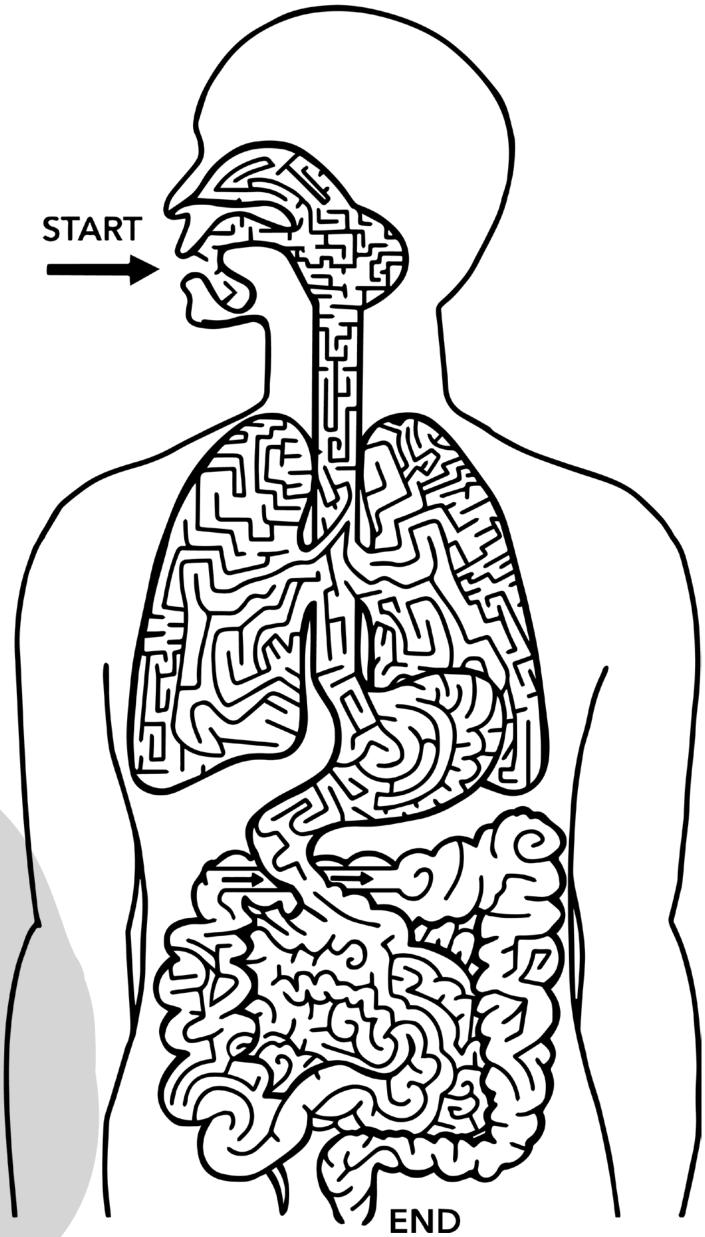


Michelle

This activity was created by Shannon

Systems Maze

Follow the maze to navigate through the body systems (from the entry point of food or air, through the body, and out!)

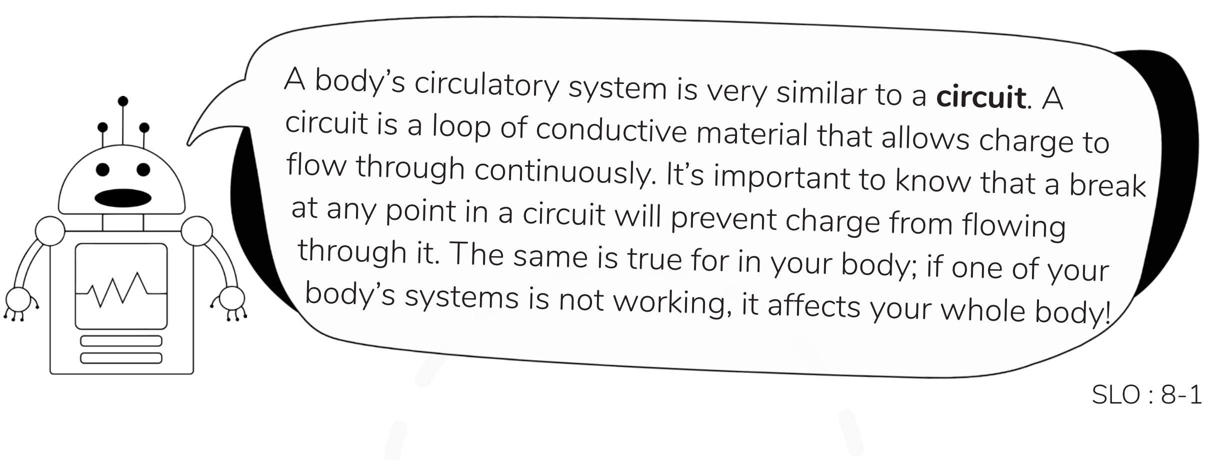


It's important to recognize that the individual systems in your body function interdependently, meaning that they rely on each other in order to function. Let's take a look at two of your body's systems and how they work together:

Your **DIGESTIVE SYSTEM** is all about getting food into your body, breaking down the food, absorbing the nutrients you need, and elimination of the materials you don't need.

Your **RESPIRATORY SYSTEM** works to bring oxygen from the air into your lungs and pass it through our bloodstream, where it's carried off to all the tissues and organs of your body.

The respiratory and digestive systems work together to power the body. A properly functioning respiratory system delivers adequate oxygen to the blood. Because the digestive system uses muscular contractions to break up food and move it along the tract, it needs oxygen to function properly. In turn, the respiratory system depends on a properly functioning digestive system in order to receive the fuel it needs to work effectively.



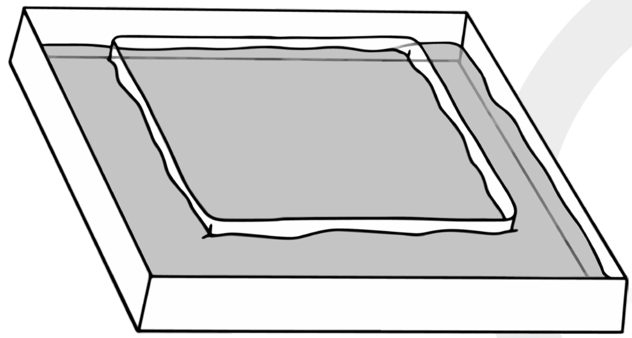
Disappearing Glass

Let's do an at home experiment and make a dish become invisible!

MATERIALS

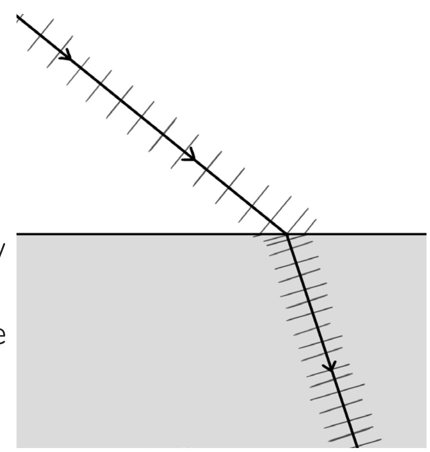
- A Pyrex glass dish, or a similar clear and oven safe glass dish
- A larger container that the glass dish will fit inside
- Vegetable / canola oil (Some brands will work better than others! 100% canola oil works well)

1. Fill the large container with vegetable oil until it is about 1 inch deep
2. Set the glass dish in the oil. Take notice of what the glass dish in the oil looks like
3. Pour vegetable oil into the dish to fill it up and watch it disappear!



EXPLANATION

REFRACTION is when light changes direction as it moves from one medium to another. This happens because light waves change speed as they enter a new medium, and the light will bend if it enters the new medium at an angle.



An **INDEX OF REFRACTION** is a numerical value of how a particular medium affects light. Each unique medium has an index of refraction. The higher the value, the more the substance will slow down light. As light moves from one substance to another, a larger change in the indexes of refraction will make the light bend more.

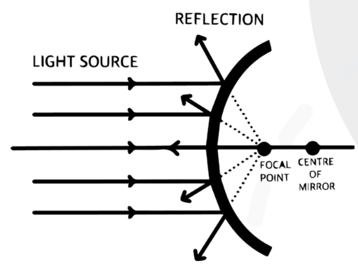
The reason we can normally see clear and colourless objects like glass or water is because of how they refract and interact with the light that hits them; we don't see any colour, but we can see that the light is distorted where the object is. But the reason this experiment works is because glass and vegetable oil happen to have very similar indexes of refraction. When the glass is surrounded with oil, it acts the same as its surroundings and the light does not bend as it enters and exits the glass. Because the light is passing straight through the clear glass dish, we can't see it!

Esiw Funhouse

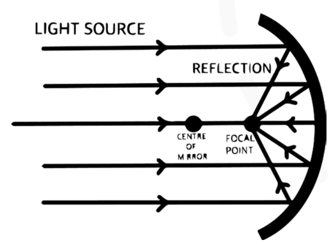
How we see objects depends on how the surrounding light rays interact with them. Light can be reflected, refracted or absorbed. The law of reflection says that when a ray of light hits a surface, it bounces a certain way. Knowing this, let's analyze mirrors to explain the properties of reflected light.

DEFINITIONS

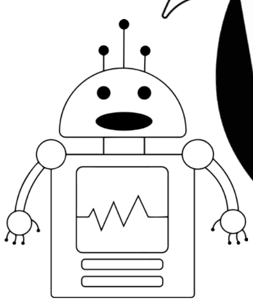
A **MIRROR** is a reflective surface that bounces off light, thus producing an image visible to us. Surely you're familiar with plane mirrors, which are the simple flat mirrors that can be found almost anywhere. But what about double-sided table mirrors? Or the rounded ones you see hanging from the ceiling in stores for security? There are two types of these curved mirrors: convex and concave.



A **CONVEX MIRROR** is curved where the reflective surface bulges out towards the light source. This bulging surface produces images that make objects appear smaller but gives a wider, rounder angle of view. Your rear-view mirrors in your car, and the security mirrors found in stores are examples of these.



A **CONCAVE MIRROR** is curved where the reflective surface caves in from the light source. They can reflect in two different ways: If the object is close, the mirror will magnify it a great deal. If the object is farther away, however, the mirror will make it appear smaller and inverted. You find these mirrors on vanities that people use for shaving.



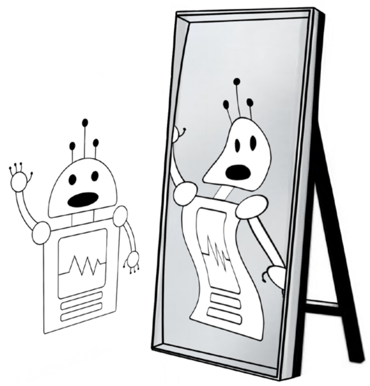
Did you know computers have the ability to reflect too? There is a process where computers can metaprogram, meaning the computer itself can write its own programs! It takes variables, such as its own conditions, and relevant information into account to define properties. For example, think of you walking in a park. If in your travels you see an obstacle in your path, you acknowledge it and adapt by either stepping around or over the object. Just like you, a **reflective program** has the ability to think about what is happening and can alter itself to the circumstances.

This activity continues on the next page!

SLO : 8-2-01, 8-2-12

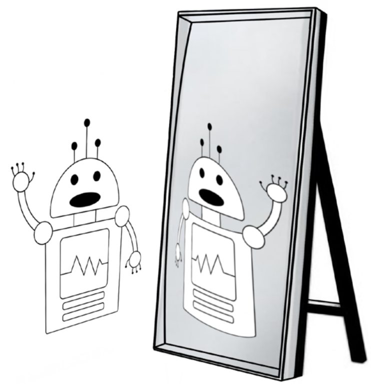
Funhouse mirrors, a main attraction to carnivals, use concave and convex mirrors to alter your appearance. Can you state which mirror is used in each scenario? Your options are: Concave, Convex, or Combination of Both

1



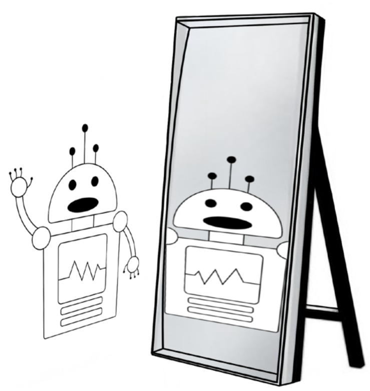
mirror type

2



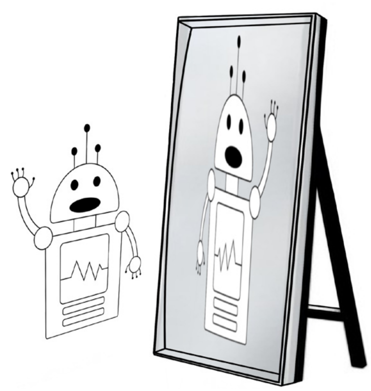
mirror type

3



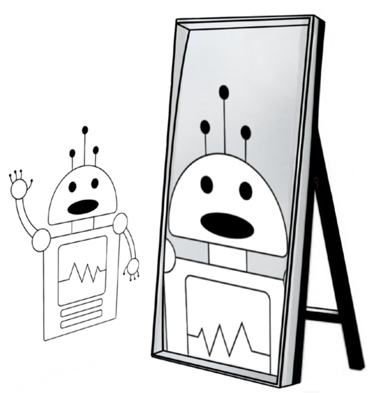
mirror type

4



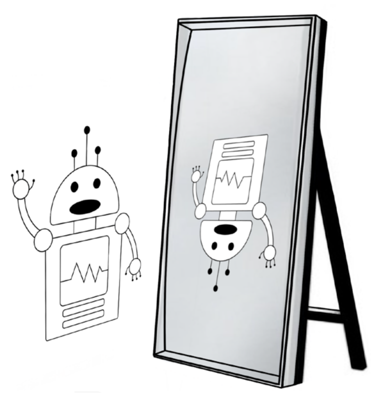
mirror type

5



mirror type

6

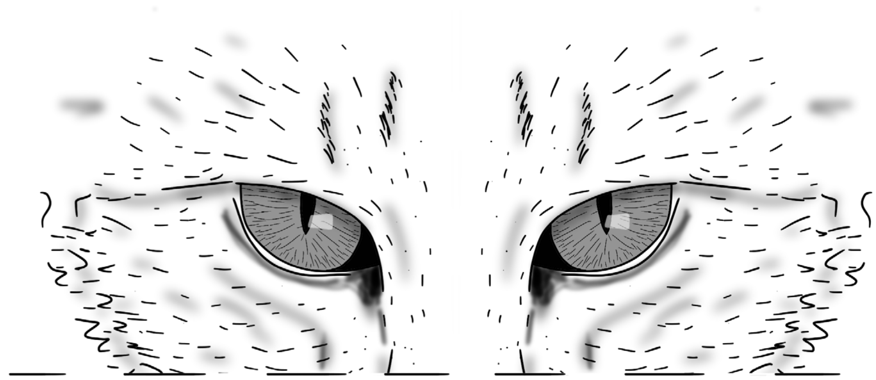


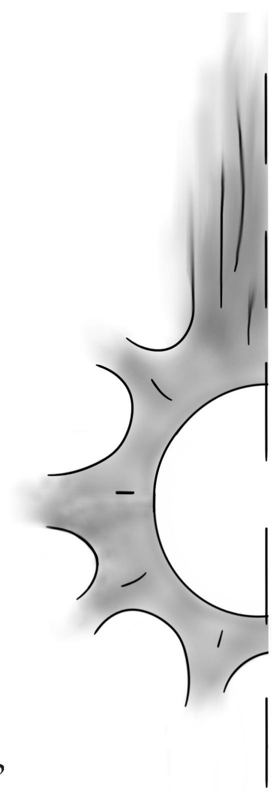
mirror type

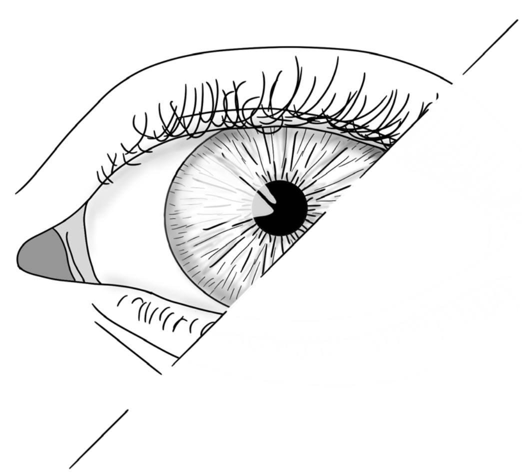
Fill in the Reflection

A reflection is caused when light bounces off of a surface. A reflection creates a mirror image. The law of reflection states that the angle of incidence (of light hitting a surface) will always be the same as the angle of reflection.

For each image below, imagine that the dotted line is a surface. Draw the mirror image of each picture to show how the angle of incidence is the same as the angle of reflection. (The sun pillar, in the bottom left corner, is a real world example of reflection!)







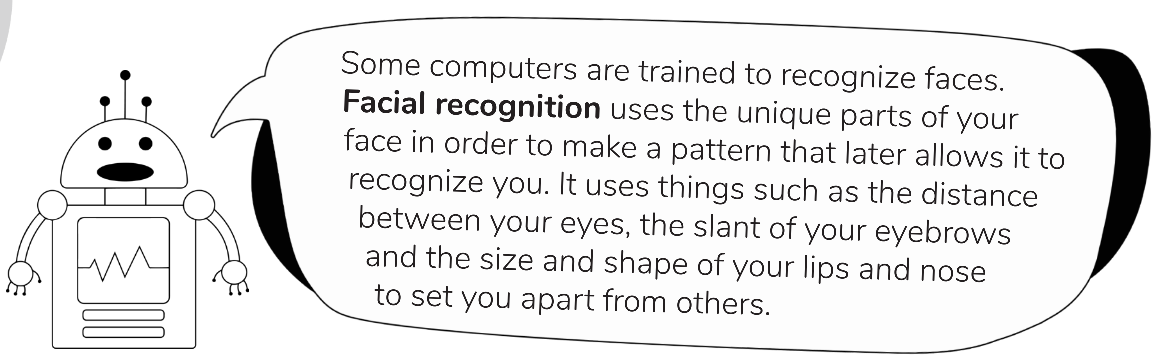
SLO : 8-2-01, 8-2-09

The Science of Selfies

You might notice that some apps make your face look different than what you're used to. On Snapchat and Instagram, you look more normal than on your phone's camera app. Why does that happen? Why does your mind say "wow I don't look like myself" when you see a selfie from the camera app?

During your life, you see yourself a certain way when you look in the mirror. Basically, you see your face as the opposite of what it actually looks like! Since your face is not symmetrical, when you see your face in a picture that does not use the mirror effect, your brain isn't used to seeing yourself that way, so you tend to notice everything that isn't "perfect" about you. Keep in mind, no one is perfect! It's your brain's reaction to something that is familiar but slightly different than you're used to seeing.

1. Get one of your friends to draw a picture of you.
2. Next, draw a picture of yourself in the mirror.
3. When both drawings are done, look at them and compare them. Are there any differences between them? Do you part your hair on one side, or have any characteristics that appear on opposite sides of your two drawings?
4. Recognize that in the end, both versions are based on a perception (and one is not better than the other). Going forward, when you look at a picture of yourself, remember that it is the same you, just a little different than how you are used to seeing yourself.

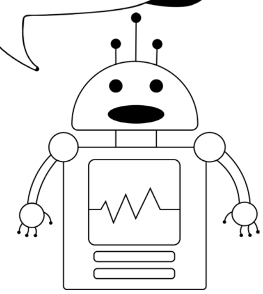


This activity was created by Amelia

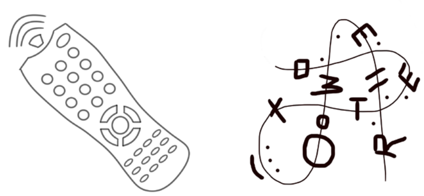
Electromagnetic Radiation Signal Processing

Figure out the name for each piece of technology that uses electromagnetic radiation by following the line and filtering out the noise.

Computers receive information from data (or "inputs", or "signals"). **Signal processing** is the process of filtering out unimportant information and keeping only the important information from a message or signal. The information that is not important is called noise.



1



Uses infrared waves to control a piece of technology from a distance

____

name

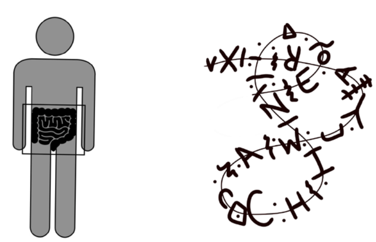
2

Uses radio waves and microwaves to transmit and broadcast signals

____

name

3



Uses X-Rays to view internal parts of the body

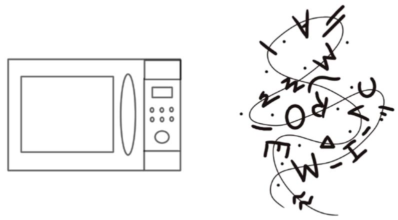
____

name

This activity continues on the next page!

SLO : 8-2-01, 8-2-07, 8-2-08

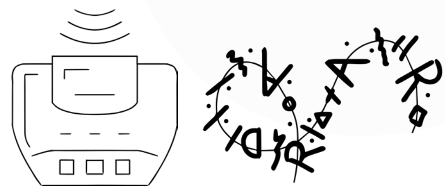
4



Uses microwaves to heat food

name

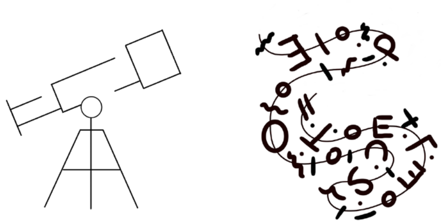
5



Uses microwaves to monitor vehicle speed

name

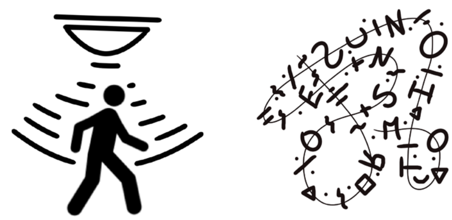
6



Uses a variety of electromagnetic radiation to make objects that are far away appear closer

name

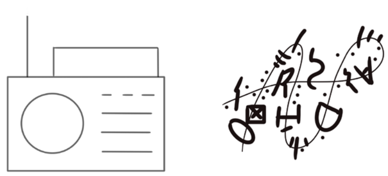
7



Uses microwaves or radio waves to detect motion

name

8



Uses radio waves to transmit audio messages

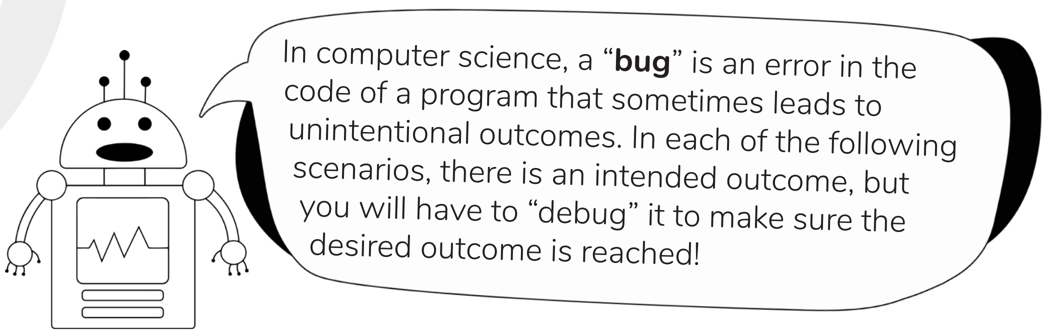
name

Debugging Force, Pressure and Area

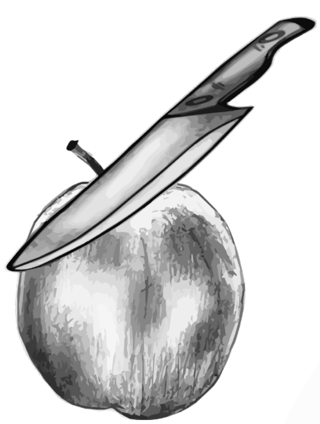
Pressure is the relationship between force and area. Pressure and force are directly related, meaning that if force increases, pressure increases as well. However, pressure and area have an inverse relation, meaning as the area increases, pressure will decrease.

Let's compare getting poked in the arm by a finger to getting poked by a needle. When you're poked with a finger, it doesn't cause a great deal of pain. The force has little lasting effect since the surface of your finger is relatively large. However, if you were to apply the same force but use a needle instead, you will experience more pain since the area of the needle is significantly smaller. Since there's a decrease in area, the amount of pressure going into your arm increases.

Using your knowledge on the relation between force, pressure, and area, can you debug each scenario by determining what's wrong, and stating how to correct them? Make sure to discuss force, pressure, and/or area in your answers!



1. You want to cut an apple. You grab a knife and hold it so that the wide side of the knife is facing the fruit.



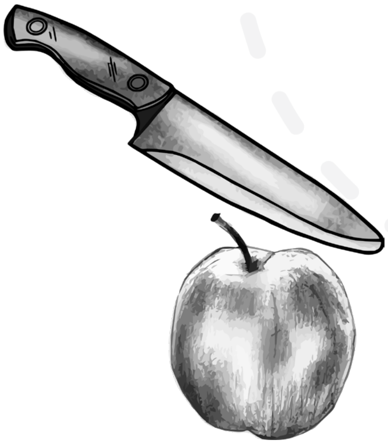
Will you be able to cut the fruit? Why or why not?

On the image, draw arrows to indicate the magnitude of the applied force (ie. Draw a big arrow for a large force, and little arrows for a little amount of force)

How would you correct this scenario?

SLO : 8-3-01, 8-3-09

2 Okay, you figured out how to hold the knife, but realized the knife is very dull.



Will you be able to cut the fruit? Why or why not?

On the image, draw arrows to indicate the magnitude of the applied force.

How would you correct this scenario?

3 Oh no! Your friend decides to go ice skating but didn't realize how thin the ice was and ended up falling through! You race to help but do so standing up.

Why would walking on the thin ice be dangerous?

On the image, draw arrows to indicate the magnitude of the applied force.

How should you approach your friend?

4 You see a friend walking home wearing high heels through the snow. They appear to be struggling.

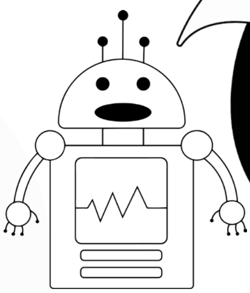
What problems will this cause your friend when walking home?

On the image, draw arrows to indicate the magnitude of the applied force.

What would be a better option for your friend?

This activity was created by Brenna

Graphing in Code



Can you read code like a computer? Follow the instructions below and see what you end up with! People write code to give computers instructions on what to do. Coding involves lots of phrases like “while”, “for”, and “else”, as well as statements that can be true or false like “if”, “less than”, or “equal to”. To help make code clearer to follow, the instructions that depend on a certain initial statement are indented. Code can also include comments, which are italicized and start with “#”. The computer won’t read these, but the comments can help explain the code to the people looking at it.

```
if have a pencil and ruler == true:
     begin activity
else:
     go get a pencil and ruler

for each dot on the page:
     set pencil on the dot
     while length < 5 cm:
          draw vertical line down from the dot

     if length == 5 cm:
          stop drawing vertical line
          begin drawing horizontal line to the right
          if length == 5 cm:
               stop drawing horizontal line
          #go back to the top of this “for” loop and repeat!

for graph on the left:
     print “pressure” on the vertical axis
     print “volume” on the horizontal axis
     set pencil at the top of the vertical axis
     while pencil is within the graph boundaries:
          draw a curved line down and to the right
          #this line should be curved so that it looks like the left side
          of a ‘u’ shape

for graph on the right:
     print “temperature” on the vertical axis
     print “volume” on the horizontal axis
     set pencil at the bottom left corner of the graph
     while pencil is within the graph boundaries:
          draw a straight diagonal line to the top right corner

if both graphs complete == true:
     #congratulations, you just read and followed code!
     #continue activity and see explanation on the next page
```

RESULTS

Awesome, you just drew two graphs! But what do they mean?
First, check your results on page 18 to make sure you drew your graphs correctly.

These are pressure-volume and temperature-volume graphs for gases. They show the relationship of how a change in pressure or temperature will affect the volume.

Let's start with the pressure graph on the left! As pressure decreases, volume increases, assuming that the temperature stays the same. This is because lower pressure allows the gas particles to spread apart and expand, so they take up more space. A higher pressure will do the opposite and squish the gas, so it is compressed and takes up less space. With high enough pressure, you can even compress a gas to make it become a liquid!

For the graph on the right, assuming that the pressure is constant, you can see that as temperature increases, so does volume! This is because a hotter temperature gives the gas particles more energy, so they move around more and take up more space. With a cooler temperature, the particles have less energy, so they move around less and are closer together. If the temperature is low enough, the particles will condense and change from a gas to a liquid.

Water Heat Capacity Experiment

Heat capacity describes how much heat energy is needed to raise the temperature of a substance, or how much heat energy must be lost to lower the temperature of that substance. Water has a very high heat capacity. A high heat capacity means that it takes a while for water to change temperature, even when the air and ground around it are heating up or cooling off. In fact, water needs over 4 times as much heat energy as air does for the same temperature change!

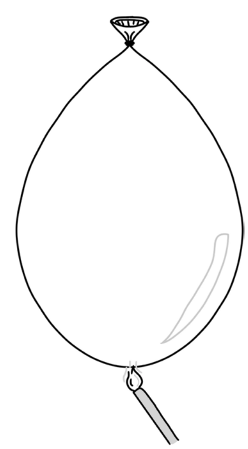
Around the world, this explains why places near the coast like Vancouver or Boston have much milder climates than places inland, like Winnipeg or Kansas City. The nearby ocean water keeps these places cooler in the summer and warmer in the winter, because it doesn't change temperature easily. Water takes a long time to heat up, but it also holds on to that heat really well.

To learn more about the heat capacity of water, let's do an at home experiment!

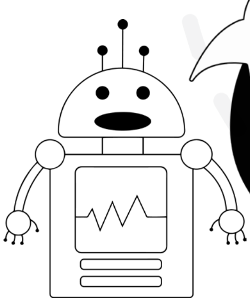
MATERIALS

- 2 Balloons
- Water
- Lighter or matches
- A phone or stopwatch

1. Start by filling one balloon with air, and the other with water. Tie a secure knot in each so the air or water cannot escape.
2. Hold up the balloon filled with air and bring the lighter or match underneath, so the fire is close to the surface of the balloon. Time how long it takes until the balloon pops.
3. Now, hold up the balloon filled with water. Repeat the process and hold the flame up to the bottom of this balloon. Time how long it takes this balloon to pop.



NOTE: Please be careful with fire! Check with a parent or guardian before trying this out and be sure to avoid getting the fire too close to yourself or any flammable objects. We also recommend doing this outside or somewhere you don't mind getting wet with water.



Esiw here! Science experiments and computer code both use **variables**, which are data values that can be changed and will influence the end result. For this experiment, the length of time that the balloon lasted before it popped was dependent on the variable of what the balloon was filled with. Use your data from the experiment to fill out the code below!

```
for each trial of the experiment:
    if balloon is filled with ________________ :
        time until popped = ________________
    else if balloon is filled with ________________ :
        time until popped = ________________
```

Consider the place you live, or places you have lived before. Are there big fluctuations in the temperature? Does it change temperature a lot (and get really hot at certain times of year, but really cold at other times?)

Would you rather live in a place with a consistent temperature, or a place that experiences these big changes in temperature?

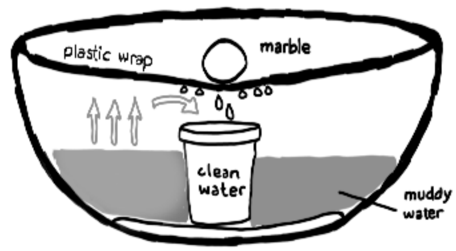
RESULTS

You probably noticed that the balloon filled with air popped almost immediately, but the balloon filled with water took a while longer before it was affected by the fire. For the balloon of air, the rubber quickly heated up and melted. But for the second balloon, the water inside absorbed a lot of the thermal energy from the fire. This protected the rubber from the hot flame, and it could last much longer before it eventually popped.

Build a Solar Still

A solar still is a contraption that allows you to collect fresh water when you may not have access to a clean source. Whether you're camping or you get stranded on your own, this is a good emergency technique to get clean drinking water. It even works with salt water!

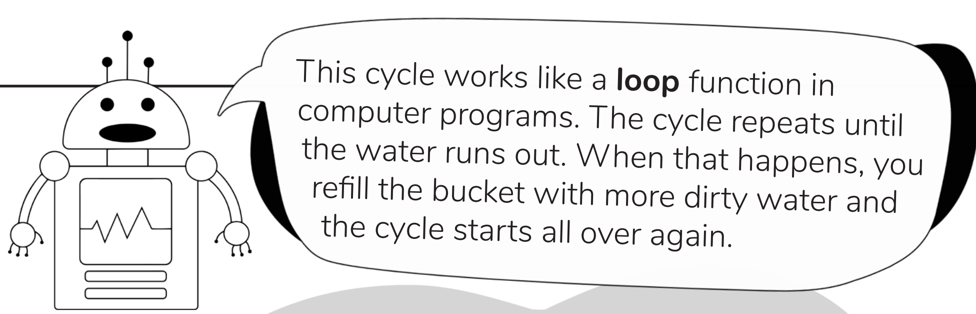
MATERIALS



- Clean glass jar
- Wide plastic bucket or bowl
- Plastic wrap
- Small rock or marble
- Rubber band or tape
- Water (from whatever source you have access to)

1. Find a sunny spot to place your solar still. It's best if it's a spot that gets sun all day.
2. Pour a couple inches of water into the bucket. To show how the solar still works, you can either use water from a pond or stream or add a bit of dirt to clean water.
3. Place the clean jar in the centre of the bucket. Make sure none of the dirty water touches the inside of the jar.
4. Cover the bucket with plastic wrap. If the wrap you used doesn't seal properly around the bucket, you can seal it with a rubber band or tape!
5. Place the small rock on top of the plastic wrap, directly over the jar.
6. Finally, leave the solar still undisturbed for several hours. When you check on it, there should be some water in the jar that is clean to drink!

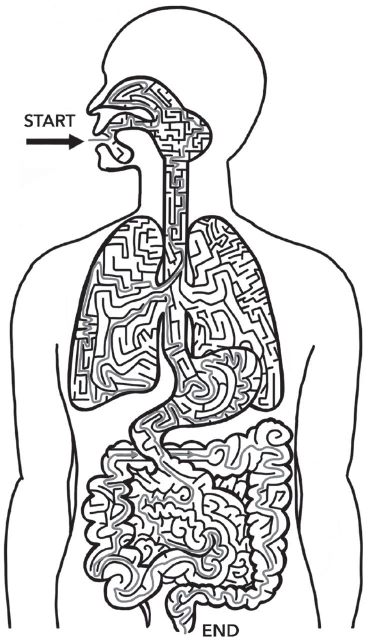
What causes the water to become pure? What steps does the water take on its way to the cup?



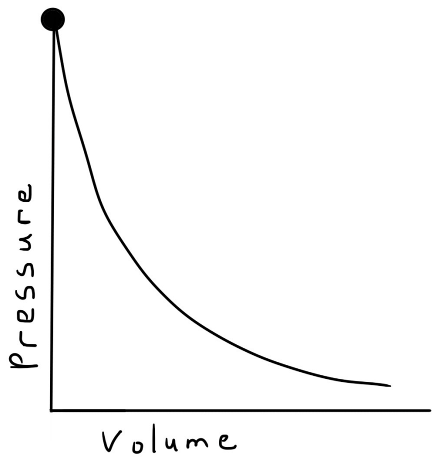
SLO : 8-4-01, 8-4-14

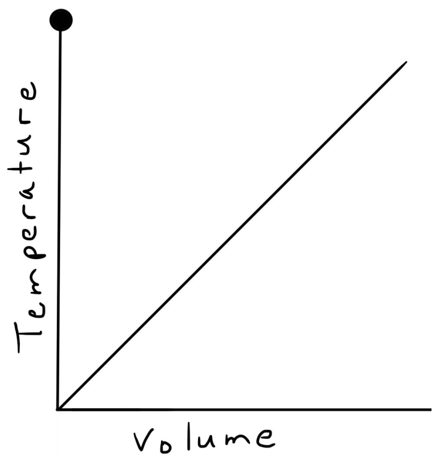
Answer Keys

4 - Systems Maze



14 - Graphing in Code





6 - Esiw Funhouse

1. Both (concave and convex)
2. Convex
3. Convex
4. Concave
5. Concave
6. Concave

13 - EMR Signal Processing

1. Remote
2. Satellite dish
3. X-ray machine
4. Microwave
5. Radar
6. Telescope
7. Motion sensor
8. Radio

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