SCIENCE CAMPS

Summer Science Family Activity Book

2020, Edition 3

Kids in Grades 4-6

UNIVERSITY OF SASKATCHEWAN
College of Engineering
ENGINEERING.USASK.CA

Invisible Ink

What do you do when life gives you lemons? Make lemonade? NOPE! Well... I guess you could make lemonade, but we here at Sci-Fi have an idea that we think is more fun!

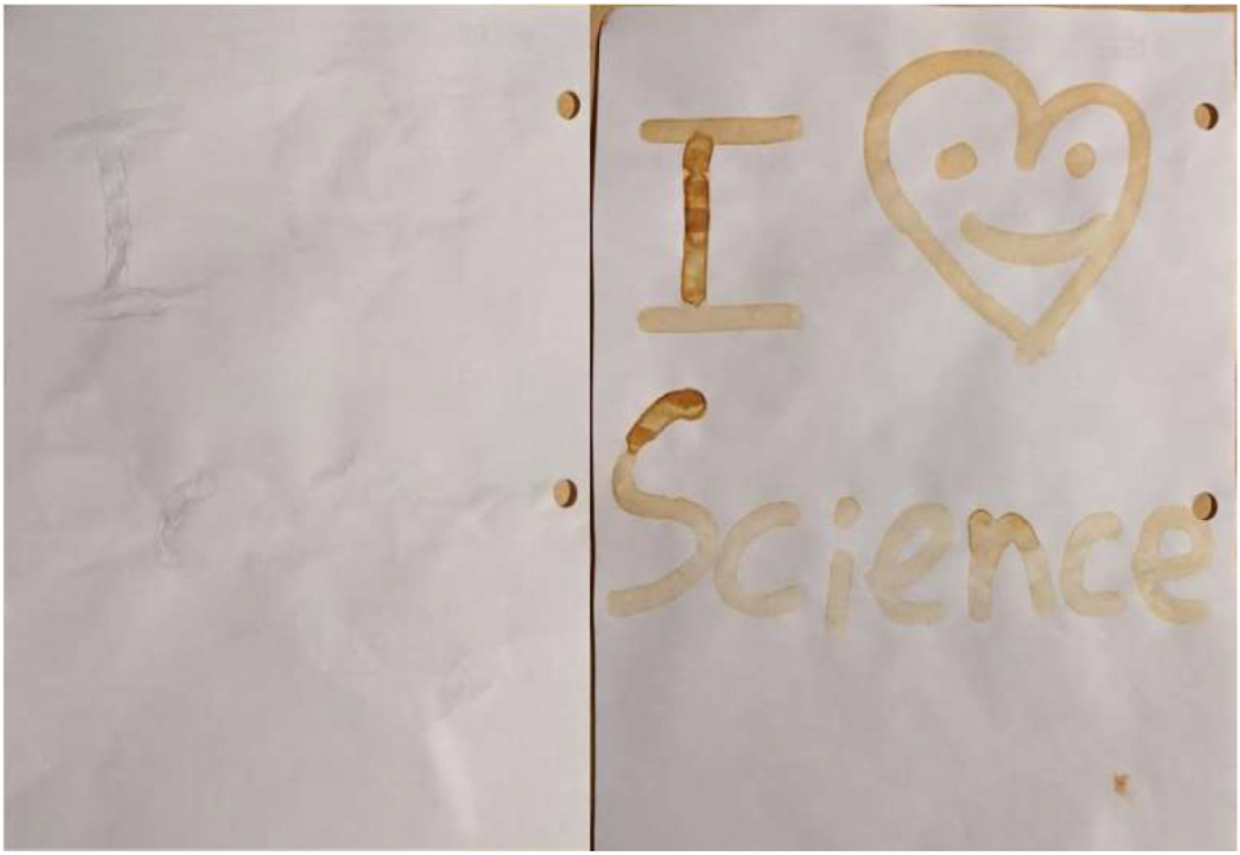
Invisible ink!!!

How do you make it you ask? It's super easy! There's only 1 ingredient you'll need for the ink, Lemon Juice!

How does lemon juice work as invisible ink? Well first write on paper with it, let the lemon juice dry, and then heat the paper and wherever you wrote with the lemon juice will turn brown!

Why does lemon juice work as invisible ink? Because the dried-up lemon juice will go through a chemical reaction (called oxidation) and turn dark before the rest of the page will!

Here's an example of one we made!



BEFORE **AFTER**

Now you can follow these directions to try it out yourself!

What are you going to need?

- 1 lemon OR a bottle of lemon juice
- 1 piece of paper
- 1 Q-tip
- Your oven

Directions

1. Cut 1 lemon in half and squeeze its juice into a small bowl OR you can use some lemon juice from a bottle you may have in the fridge (squeezed lemon juice will work better but both are ok)
2. Grab 1 piece of paper and 1 Q-tip
3. Dip the Q-tip in the bowl of lemon juice and count to 5
4. Pull the Q-tip out and lightly tap it on the edge of the bowl to get rid of big droplets
5. Use the Q-tip to write your message on the piece of paper and quickly dip the Q-tip back into the lemon juice every few letters
6. Let the lemon juice writing dry out completely. It should be almost invisible after about 1 hour
7. Make sure your parents are home and show them the "NOTE FOR PARENTS" below before moving on to steps 8 and 9
8. Preheat the oven to 350F
9. Bake the page for 10-15 minutes and voila! The secret message has been revealed!

NOTE FOR PARENTS

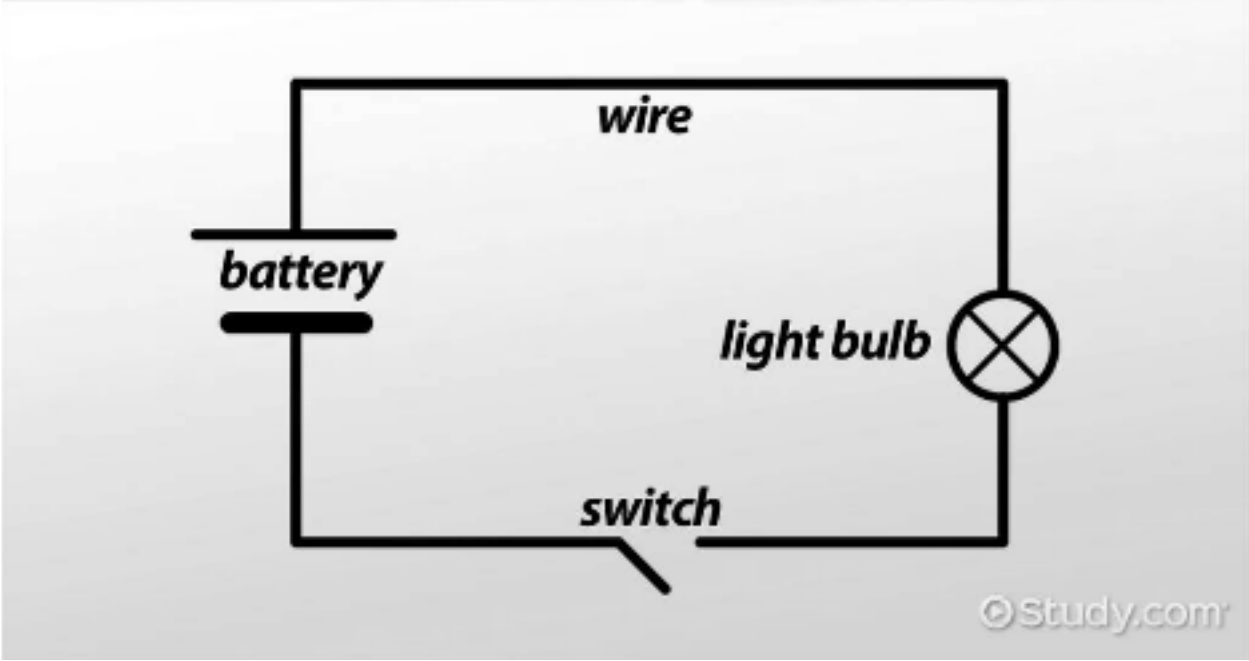
We know it may sound a little unnerving to put a piece of paper in the oven and that this may seem like a fire hazard, but we assure you it is totally safe. One of our instructors tested it out 5 times with both loose leaf and printer paper. He was even able to make the example at the same time as his chicken strips! (All the science made him hungry!)



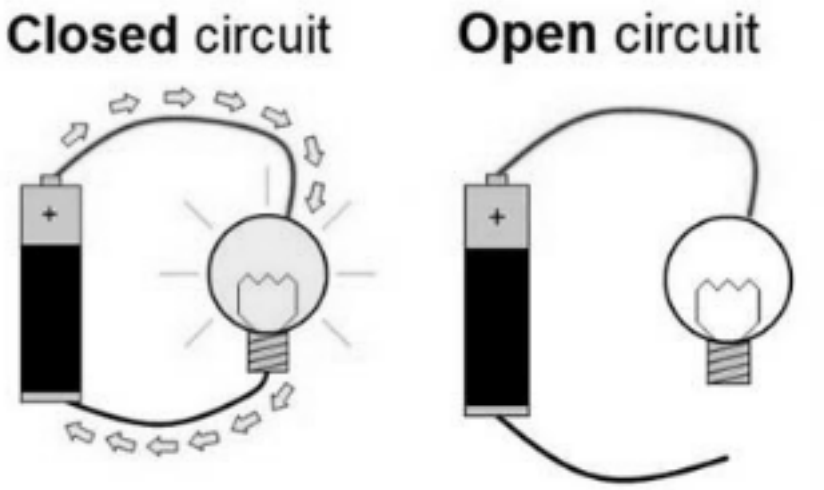
Super Switches

Have you ever wondered how a light switch actually works? How does it instantly turn on after you flip the switch? This can all be explained with science!

A switch works by **closing a circuit** which allows current (electricity) to flow through the wires and turn on your light. You can imagine it like a pipe full of water, if there is a break in the pipe water won't flow to the end.



As you can see when the switch closes it completes the circuit and electricity can flow to the light bulb.



Now you may ask: what is electricity? Well, electricity is actually the flow of **electrons** through metals. Electrons are tiny particles inside of atoms! We control the flow of electrons to do work for us, like turning on our lights or heating up our stoves!

Remember: Using electricity when it isn't needed is bad for our planet, it is a good idea to always turn off lights if they aren't being used!

Activity time! Circle which word you think completes the sentence.

1. When I leave the room I should - turn off / leave on - the lights.
2. Electricity flows when you - open / close - the switch.
3. When current flows through the wires it is like - water flowing through a pipe / a big river.
4. Electricity is actually - magic / the flow of electrons.

Words can be diagonal and backwards!

E Q E T N E R R U C Z

U L L L I G H T I S N

P R E Z L K O R V K J

F L C C M E C T N I G

X Q T U T U Z F L C A

V C R Z I R V Q X Q Y

P G O T G A I C W I P

D R N K T F F C X J T

H C T I W S N B I L D

G H W Z Y V N N L T F

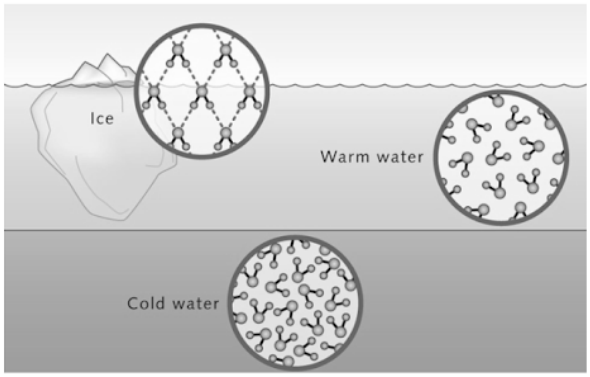
C H V J D D J B D N Y

SWITCH CIRCUIT CURRENT ELECTRICITY ELECTRON LIGHT

The Science of Freezing using Ice Cream!

In this activity, we will be making our own ice cream! Usually, to make ice cream, you need to churn it (stir it really hard for a long time) and then freeze it for several hours. Thankfully, we can use science to make this process a lot quicker!

What happens when water freezes?
Freezing is when water gets so cold that the *molecules* inside slow down enough and connect themselves in a pattern, becoming a solid! In the image below, you can see the particles are organized as solid ice, but not when it is liquid water.



What is a *molecule*?
A molecule is a group of atoms that are bonded together. In this image, we see two hydrogen atoms bonded to one oxygen atom to make groups of three. Each of these is called a molecule. A cup of water has about 800,000,000,000,000,000,000,000,000 molecules of water!

We can force water to get very cold without it freezing using science!
Pure water has a freezing point of 0º Celsius. At that point, it tries to form into its solid pattern. If you add table salt to the water, the salt will dissolve and spread through the water. These atoms will get in between the water, which makes it much harder to form into a solid structure!

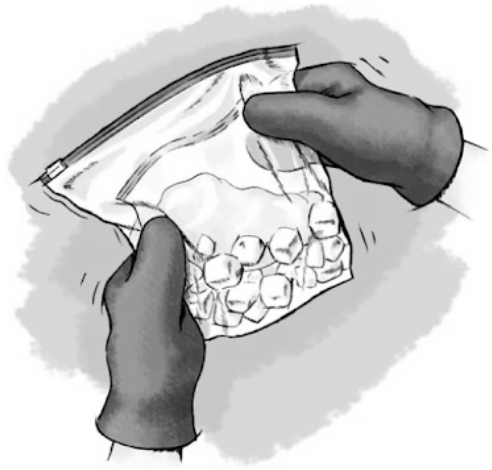
But how does this help us make ice cream?
Ice has a very thin layer of water on its edges, which is why it can be so slippery! When you add salt to ice, it will lower the freezing temperature of the water that is already on the ice and cause some (or all) of the ice to melt. Now you will have water that is very cold – below freezing temperature! We can use this cold water to rapidly cool down our cream, making it into ice cream!

Ice Cream in a Bag

You will need:

- 2 tbsp Sugar
- 1 cup half and half (or milk, or heavy whipping cream. Results are best when it is thicker.)
- 1/2 tsp Vanilla extract
- ½ cup of Salt
- Sandwich-sized Ziploc bag
- Large-sized Ziploc bags
- 4 cups of ice (or about 2 trays full)

Please be careful!
Do not directly touch the ice after it has been salted. It can become cold enough to harm your skin!



In the large bag:
Add the ice cubes, then add the salt to the same bag. **Please be careful!**

In the small bag:
Add sugar, half and half (or milk, or heavy whipping cream), and vanilla. **Seal the bag very well!** You can keep the bag in the fridge if you are not quite ready to move onto the next step.

Make the ice cream:

Make sure that the small bag is fully sealed before moving on!

1. Put the small bag into the large ice bag. **Make sure both bags are sealed!**
2. Shake the bag for 5 minutes!
   - It may be easier to shake the bag if you are wearing **oven mitts or wrap it in a cloth**, as it will feel quite cold.
   - Check the clock before you start! If after 5 minutes the small bag is still liquid, shake for 5 more.
   - As you shake, you can try to feel the small bag. Is it changing?
3. You should now have ice cream! Carefully remove the ice cream bag from the large bag and dispose of the ice.
   - If it doesn't quite look right, you can shake for a few more minutes!
   - You can eat it now or save it for later by leaving it in the freezer!

Optional additional activity:
If you're curious just how important the salt is to this experiment, you can try to make another bag of ice cream, but this time leave out the salt. Compare the temperature of the large bags – how much colder is the salted bag? Does the small bag get cold enough to become ice cream?

Hot and Cool Media

What is media?
Media is sharing information! It has many forms like print, songs, movies, and advertising. Examples of everyday media include the news, books, videos, the radio, and any posters.

Hot Media
This type of media only engages one of our senses. This is usually sight or sound. Examples are a picture in a book, bolded text, or a song playing on the radio. It doesn't need your full attention to understand the message, but it might bring your attention to certain parts of it. For example, this text is cool, **but this text is hot**. The bold text grabs your attention, making it hotter than the words around it.

Cool Media
Cool media engages more than one sense! The name of cool media comes from the *idea* of cool, not the temperature. It means something is neat or exciting. Examples are television, games, or audiobooks. These examples engage your sense of sight and your sense of sound. Cool media needs more attention than hot media does, as parts of the message do not stand out as much.

Information Overload
In the 1800s, there were too many newspapers. Many newspapers had their own news stories. All of these stories meant that a lot of information was shared at once, and many people could not remember it all. Receiving too much information at once, making it hard to remember, is information overload. We currently live in the *information age*, as our technology changes quickly. This changes how we receive information as well. We receive large amounts of information every day, which makes us more likely to feel information overload.

MEDIA

G S C J Q F G A L T C I G G T
R V C I N F O R M A T I O N E
S A P I W F X E T C H Y Q G C
T E D L M V V E R F L S V M H
B E V I I O X S R E T S O P N
O F L D O T C Q H T S E S M O
O C E E B T H G I S V M E G L
K O T O V S S S D M R A I W O
S I O K U I W M Z N G G V J G
S K D L E H S L B A U N O R Y
F F O R C P O I X Z P O M E H
O O A Q V G H T O Y U C S Y R
C H T U N I U S O N G C L J N
S J N P R I N T V K F R L M Q
S M D K F T L P W R I H Z V J

BOOKS
COMICS
COOL
GAMES
HOT
INFORMATION
MOVIES
POSTERS
PRINT
RADIO
SHARE
SIGHT
SONG
SOUND
TECHNOLOGY
TELEVISION
TEXTBOOK
VIDEO

Answers:

Soil Texture

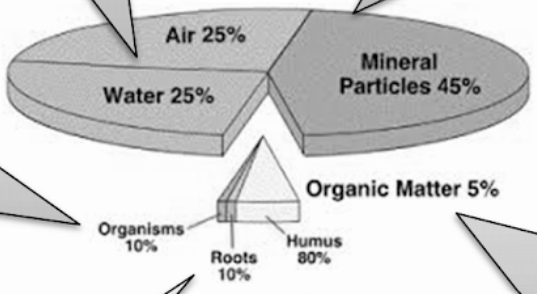
Soil is the most important part of Earth. The quality of the soil present largely determines the capacity of land to support plants, animals, and society. Plants rely on the upper most layer of land surface which is the soil as their sources of water, physical supports, and nutrients.

Composition of Soil

Gases [air] and water are important for plant growth since it provides nutrition to plants. Most common gases in the soil are carbon, nitrogen, and oxygen.

Soil minerals store the most nutrients. Soil Minerals can be divided into 3 main categories - sand, silt, and clay based on the particle size. Sand is the largest particle and clay is the smallest.

Organisms present in soil form soil structure, maintain its fertility, and providing oxygen to the soil through mixing.

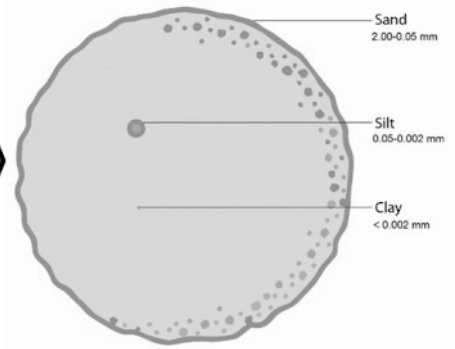


Soil organic matter is the decomposed plant and animals present in soil. It is the source of food and water and helps keep soil particles loose and soft.

Roots are the parts of plants buried in soil. It stores food and water from the soil and helps the plants stand upright and grow.

Humus is dark, organic material that forms in soil when plant and animal matter die, and their remains are absorbed in soil.

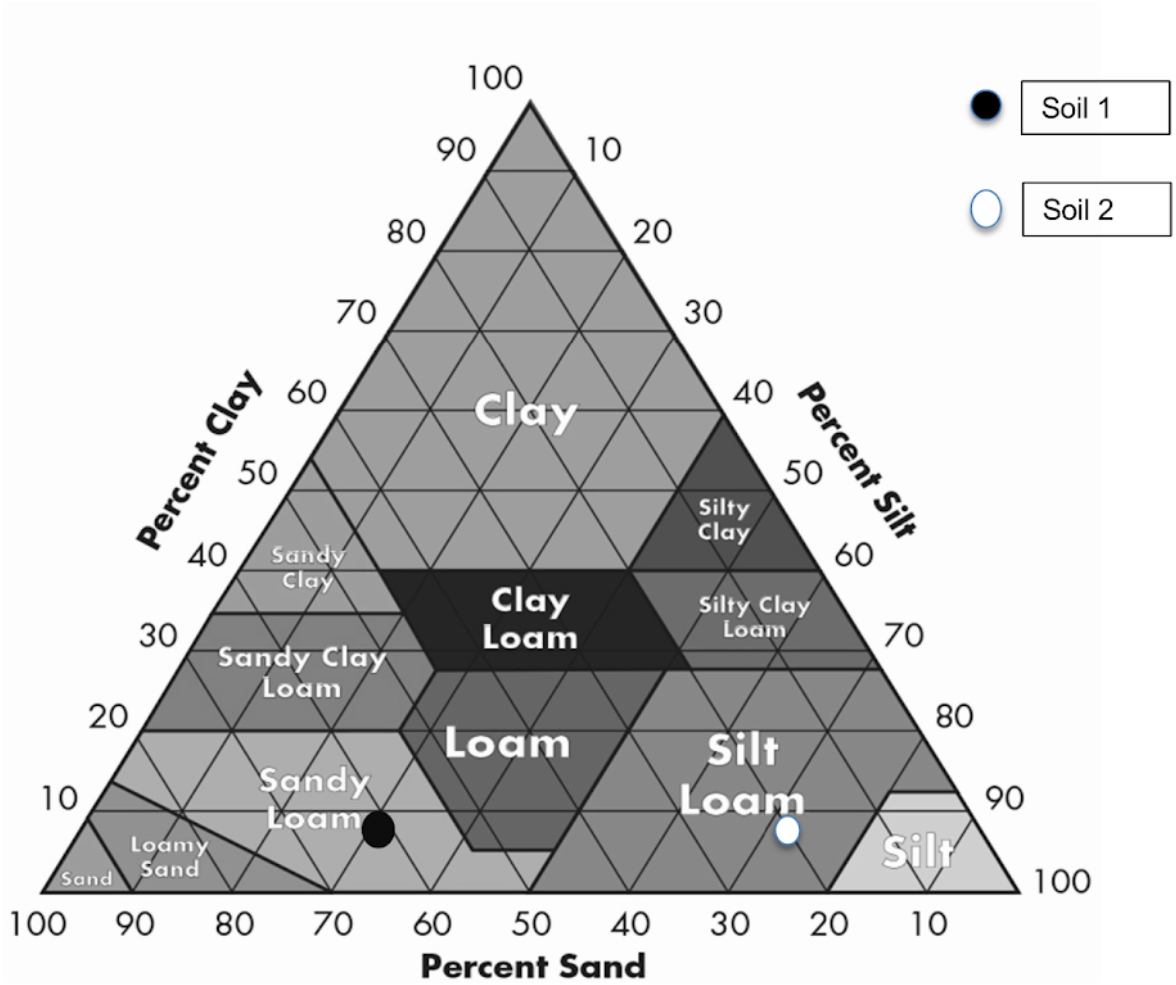
- The soil texture then results from the varying amounts of all three particles.
- You can identify a soil texture by using a texture triangle.
- Clay since it is smaller in particle size does not let much water pass through it.
- Whereas sand because of its larger particle size will have more pore spaces and will let more water be absorbed and transported in the soil.



Activity Time!

Remember the texture triangle and how it helps identify the type of soil? The scientists are in the field and have forgotten their triangle home. They need your help to figure out the type of soil. To make things easier they will help you solve one as well.

Follow the lines on the triangle from all three sides to find the type of soil. Remember the percentages all equal to 100%. Soil 1 and Soil 2 are done for you.



Hint: Use a ruler if it helps or trace the percentages until you find an intersection of them all. Notice the lines go straight left to right and diagonal as well.

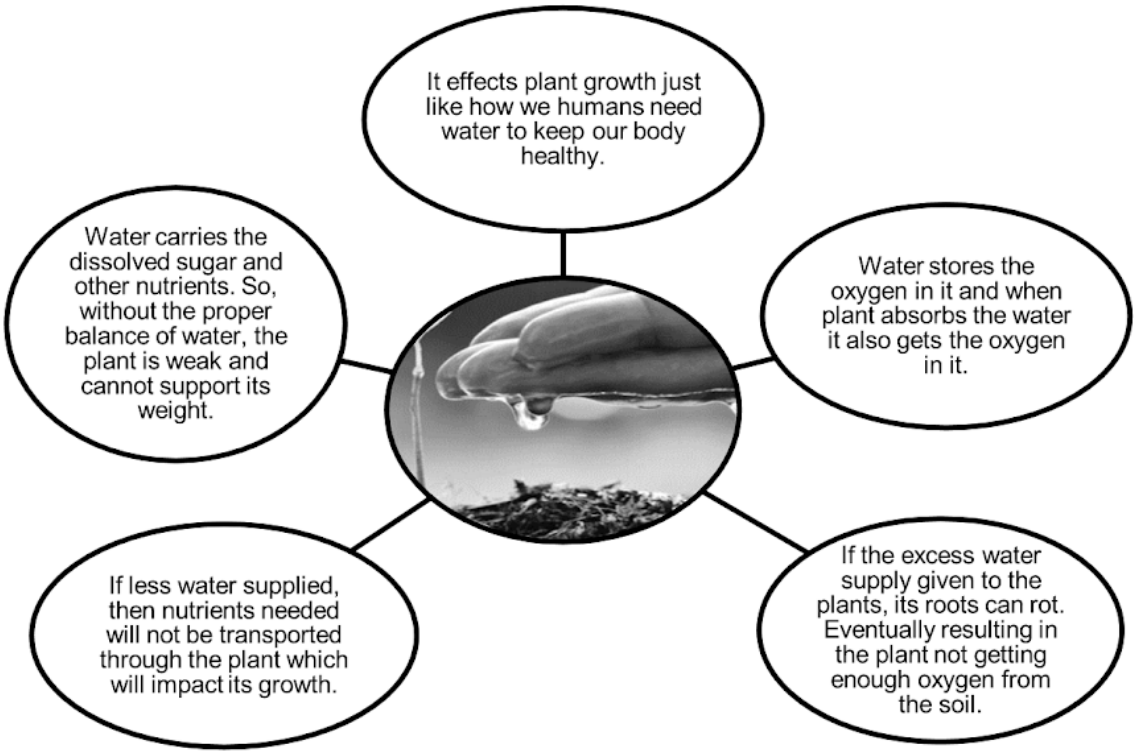
No.	Composition	What soil type am I?
1.	Sand: 60% Silt: 30% Clay: 10%	
2.	Sand: 20% Silt: 70% Clay: 10%	
3.	Sand: 10% Silt: 60% Clay: 30%	
4.	Sand: 40% Silt: 40% Clay: 20%	
5.	Sand: 50% Silt: 10% Clay: 40%	
6.	Sand: 0% Silt: 0% Clay: 100%	

1. Sandy Loam 2. Clay Loam 3. Silty Clay Loam 4. Loam 5. Sandy Clay 6. Clay

Soil Moisture

Soil Moisture is the water stored in the soil inside its particle spaces.

Importance of Soil Moisture



Farmers and Gardeners must regularly track the moisture content of the soil to ensure the right amount of water is being supplied to the plants.
Scientists made our lives easier by introducing the Moisture sensor. These sensors read the moisture content in the soil.
They can also attach water motors to supply water every time the moisture goes below a certain number and stop the supply if soil moisture is in excess.

Do you remember what an ***algorithm*** is? An *algorithm* is a set of instructions for a computer to perform a task.

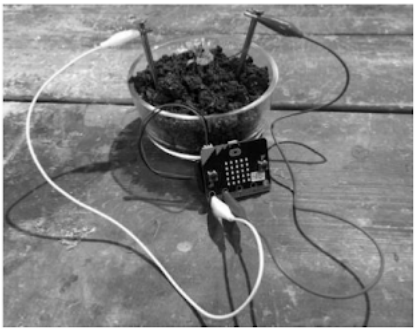
A ***variable*** is a name we assign to a value/number. In this activity, do you know the variable? What value are we finding? Yes, you guessed it right! The moisture value so our variable will be the Moisture.

The **Loops** are a way you can repeat a few actions repeatedly for a time. Your function is written inside a loop to make sure the actions repeat for however long we desire.

In coding, you can name this algorithm to reduce the time of writing the code again and again. Such named algorithms are implemented as ***functions***. Functions allow us to give a name to a block of code.

The Conditionals are ***if-statements***. They put a limit your command. If this condition occurs, you do this else you do that. These are often accompanied by ***Boolean or logical operators*** in which the expression either is true or false.

The Micro: bit is a tiny computer that makes coding tangible and promotes digital creativity. If coded and connected to hardware, it can help sense light and temperature. You can also code it to read soil moisture. So, it can be a helpful tool in weather sensing and agriculture.

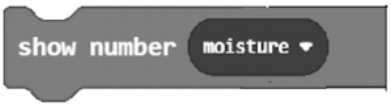


Micro: bit connects to two alligator clips and nails. These nails are inserted in soil for which we are measuring the moisture.

Activity Time

The Engineer assigned to build the code for the Micro: bit to detect moisture has called in sick. The farmers need the sensors to maintain the health of their crops. However, due to the unfinished code, they cannot use the sensors. Luckily, the Engineer left pieces of the blocks of code to be used on their desk. If you notice, they look like jigsaw puzzles. Cut these pieces out and fix the puzzle pieces. Finish the blocks of code to save the day for the farmers!

Hint: While giving coding instructions sequence matters the most. You will first be setting the variable to a pin value. Then set it to be shown on the Micro: bit. Lastly, use a conditional statement to show the moisture value if a button is pressed!



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