W1374A

1-2 YEARS IN PROJECT

Environmental and Agricultural Science and Engineering (EASE)
Beginner Project Guide



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Welcome to the Beginner Project Area Guide for Environmental and Agricultural Science and Engineering (EASE)

In this project, you will learn basic information about biosystems engineering, environmental science and soil science in an engaging way.

Important Note:
You will need access to the internet and to the outdoors to complete most of the activities listed. If you do not have access to all the materials needed at home, that is fine. Get creative with the materials and resources available to you. If you need help obtaining materials, ask your 4-H agent for help. They can connect you to shared resources so you can complete the activities.

Activities

1. Think Like an Engineer
2. From Question to Conclusion
3. Not Dirt, Not Mud, But Soil
4. H20! The Places Raindrops Will Go
5. Sustaining Sustainability
6. Talk the Talk
7. Farm to Table and Everything in Between

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Activity 1
Think Like an Engineer

Project Outcomes

- Define “engineer”
- Identify the steps in the engineering process
- Identify a problem you have in your own yard or community

What do you think when you hear the word engineer? Do you think of people in hard yellow hats designing massive skyscrapers, people in lab coats building prosthetics in laboratories or people constructing a new animal exhibit at the zoo?

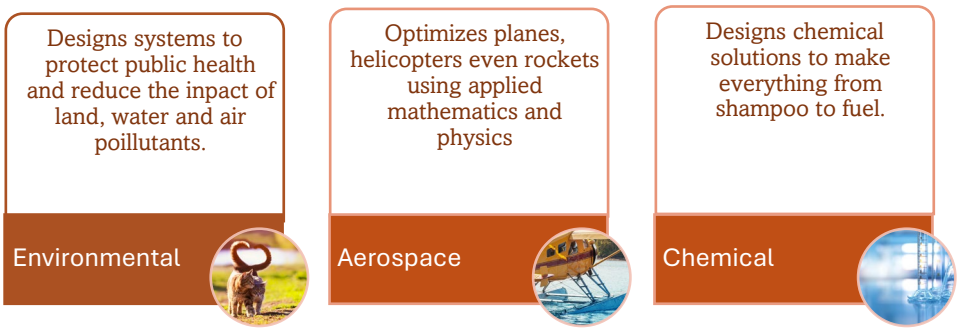
Truthfully, engineers can do all of this and so much more!



Figure 1:Freepik. (n.d.). Cartoon style building engineer with engineering equipment [Vector illustration]. Freepik. Retrieved August 19, 2025, from https://img.freepik.com/premium-vector/cartoon-style-building-engineer-with-engineering-equipment-vector

<u>Engineer:</u>
Someone who uses math and science to create things, solve problems and make the world a better place

Engineers specialize in a wide range of disciplines. Let's explore some of the unique and exciting fields in the profession!



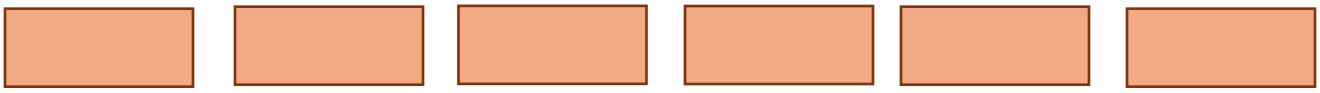
For a complete list, check out ABET for more careers to explore!
abet.org/accreditation/find-programs/

The Engineering Process

Much like the scientific method, engineers use a specific set of steps to solve real-world problems. This is called the engineering process. In this activity, we'll see how well you think like an engineer. Based on the six steps listed below, write the steps in the order you think would go in a flowchart.



Test | Plan | Improve | Ask | Create | Imagine



REMEMBER:
Engineers may improve and retest several times before the problem is solved. After solving the problem, the last and most important step is to communicate their successes.

After checking your engineering process flow chart, brainstorm a problem in your own yard. In the box on the next page, state how each step of the engineering process would help you solve it.

Example: There is constant flooding in my raised garden bed with each rainstorm.

1) Ask: "What caused the flooding to occur?"
2) Imagine: "I am imagining that installing drainage pipes will help to mitigate flooding."
3) Plan: "I will research an efficient way to install these pipes and order the necessary materials."
4) Create: "I will build the drainage pipes and a water collection bucket system in my raised beds."
5) Test: "When it rains, I will test if any flooding occurs."
6) Improve: "I might add an additional collection bucket for intense storms."
7) Communicate "I will share my success with my peers who have similar problems."

Problem: You look outside and notice a bird's nest laying on the ground. You want to make a better, more wind resistant home for your neighborhood birdies. How could the engineering process address this issue?

Ask:

Imagine:

Plan:

Create:

Test:

Improve:

Communicate:

Activity 2
From Question to Conclusion

Project Outcomes

- Define “scientist”
- List the steps of the scientific method
- Make a hypothesis about something you see in your community

Scientists are the world’s greatest answer seekers. Their careers focus on observing and discovering how nature works. By making careful observations, conducting experiments and researching, scientists help us understand new things about our world.

What is something you have discovered recently or want to learn more about? Answer in the space below.

Add your answer to the box:



Figure 2:Alamy. (n.d.). Illustration of a young scientist [Digital image]. Alamy. Retrieved August 19, 2025, from https://c8.alamy.com/comp/KTMEFW/illustration-of-a-young-scientist-KTMEFW.jpg

Scientists also specialize in a wide range of disciplines. Let's explore some of the unique and exciting fields in the profession.

Environmental Scientist

Studies the natural world to understand how human activities affect the environment and public health. They collect and analyze data on air, water, soil and ecosystems to identify problems like pollution or climate change and develop solutions to protect the environment and ensure sustainability.

Biologist

A biologist studies living organisms and their interactions with each other and their environments. They conduct research to understand how life functions, evolves and adapts, which supports advances in health, agriculture, conservation and biotechnology.

Chemist

A chemist studies the properties, composition and reactions of substances to understand how they interact and change. They use this knowledge to develop new materials, products or processes in fields like medicine, energy, agriculture and environmental protection.

Astronomer

An astronomer studies celestial objects such as stars, planets, galaxies and the universe. They use telescopes, satellites and computer models to observe and analyze cosmic phenomena and understand the origins and behavior of the universe.

Physicist

A physicist studies matter, energy and the fundamental forces of nature to understand how the universe works. They use mathematical models and experiments to explore everything from subatomic particles to galaxies, often leading to innovations in technology, engineering and medicine.

Ecologist

An ecologist studies how organisms interact with each other and with their physical environment. They investigate ecosystems, biodiversity and environmental changes to help conserve natural resources and maintain ecological balance.

Using the word bank below, can you answer the questions and spot the words of the scientific method based on the clues below?

1. This is the first step of the scientific method. It means to notice or watch problems in your environment.
2. This happens when you try to learn new information about a topic from scientific sources. This is called ___.
3. An if, the, because statement or prediction about how something will work.
4. You usually test your prediction by performing a ____. Often occurs in a lab.
5. When you look at your data, you are ____ it to help prove/disprove prediction.
6. After reviewing your data, you then should draw ____ about what the results mean.

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

Word Bank: Analyze, Conclusion, Experiment, Hypothesis, Observe, Research

Crossword Answer Key

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

A hypothesis is an explanation, or a prediction, based on prior knowledge and observations that can be tested through experiments and analysis. A hypothesis usually follows "If ____, then _____, because _____" structure.

Example: If I have a clean room, then I will study better because clean spaces have been shown to relax the body and improve focus.

Based on the example above, write three hypotheses about observations you have made in your own yard or community. Be sure to do research before you make your prediction.

Problem: You notice you are having issues focusing when you study with the television on. Fill in the blank below with your hypothesis.

Hypothesis: If_____,

then_____ because

_____.

Problem: You notice a tree next to your house is starting to become sickly looking. As you get closer you notice the tree roots are now exposed outside of the soil.

Hypothesis: If_____,

then_____ because

_____.

Activity 3

Not Dirt, Not Mud, But Soil

Project Outcomes

- Define, “What is soil?”
- Explain and identify biodiversity
- Evaluate Biodiversity in your own yard or community

Soil is so much more than just the mud on your shoes. It is a mixture of mineral and organic materials found on the Earth’s surface. Soil supports plant growth, provides a habitat for countless organisms and plays an important role in the cycling of various nutrients.



Figure 3:English Gardens. (n.d.). January events [Image]. English Gardens. Retrieved August 19, 2025, from https://www.englishgardens.com/wp-content/uploads/January-Events.png

Soil Horizons

The soil horizon is like layers of a cake. Each layer goes deeper into the ground and has different colors, textures, and nutrients inside

Soil texture refers to the physical properties of the soil or, in other words, what soil really “feels” like in the palm of your hand.

Recall, soil is a mixture of sand, silt, clay and organic matter. Clay appears red in color and has a playdough-like texture, while sand is tan in color and has a gritty texture. Silt is a mixture between both properties.

In this activity, you will collect three soil samples: one by a pond, one under a tree and one in an open grassy area.

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Draw, color and write about these soil samples. Show how it looks, write how it feels and how it smells. Do you think these samples are made of sand, silt or clay? Why?

Around a Tree	**In a Grassy Area**	**Near a Body of Water**
Draw Here	Draw Here	Draw Here
Write Here	Write Here	Write Here

Below is a picture of the horizons, or layers, of soil.

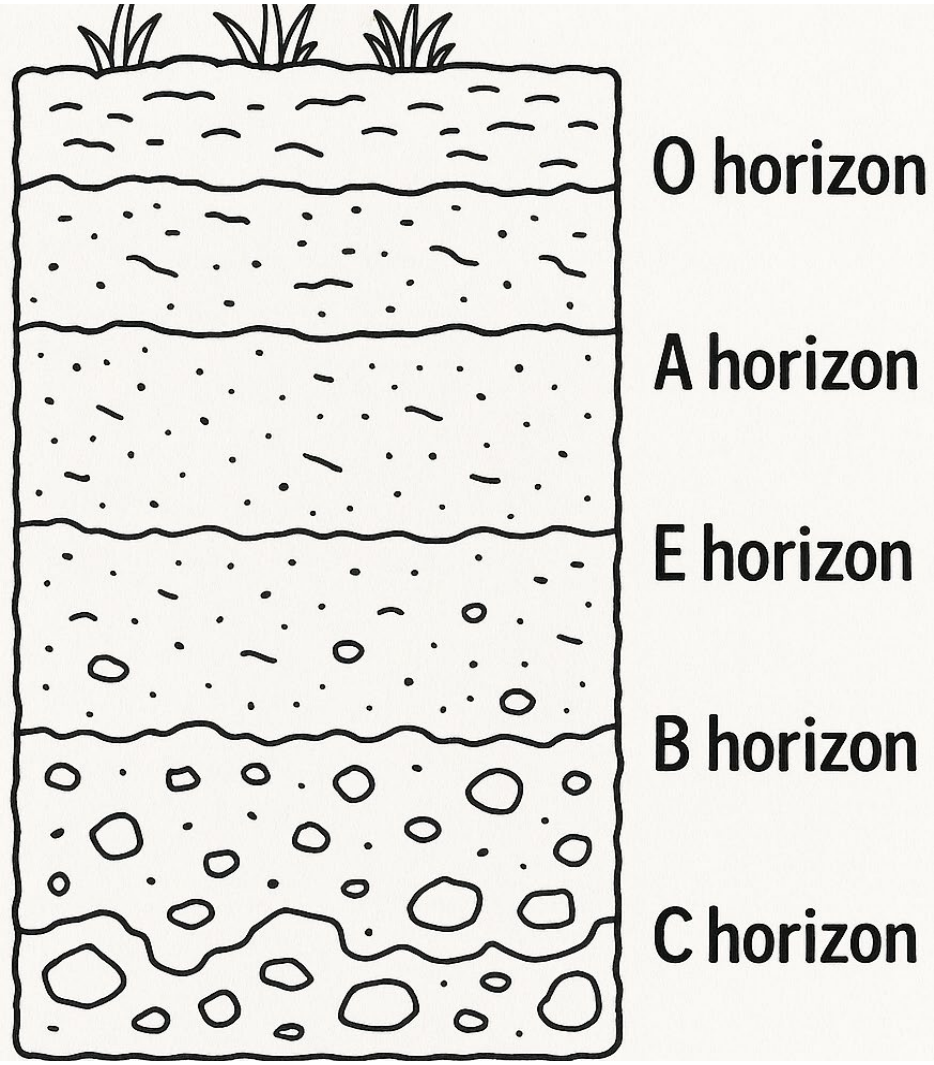


Figure 4: Image created with Copilot

Using this key, color in the layers of the soil:

O horizon - the topmost layer, made mostly from decomposing materials (color this green).
A horizon - where most plant roots grow; is made of both plant and mineral material (color this blue).
E horizon – where the majority of leaching occurs; primarily light in color (color this pink).
B horizon where nutrients leached from the previous layer accumulate (color this orange).
C horizon is referred to as the parent material; the partially weathered rock and mineral fragments that make soil over time (color this red).

Biodiversity: Different kinds of living things all in one place. Biodiversity includes many types of plants, animals, and fungi - how different they are from each other - and how they all work together to keep our planet healthy.

Look at the pictures below. Label what is biodiversity, and label what is not.



Example: Circle your answer.
Is this biodiversity? YES **NO**
Why or why not? **This is not biodiversity. There is only one type of plant in this picture.**

Now it's your turn!



1. Circle your answer.
   Is this biodiversity? YES NO
   Why or why not?



2. Circle your answer.
   Is this biodiversity? YES NO
   Why or why not?



3. Circle your answer.
   Is this biodiversity? YES NO
   Why or why not?



4. Circle your answer.

Is this biodiversity? YES NO

Why or why not?



5. Circle your answer.

Is this biodiversity? YES NO

Why or why not?

Answer Key:
1. Yes 2. Yes 3. Yes 4. No 5. No

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Biodiversity Cube Activity

Materials Needed:

- 12 straight straws
- Tape
- Scissors
- A ruler
- Outdoor area



Figure 5:Kramer, N. (2014, May 22). Flexible straw cube [Photograph]. Handmade Charlotte. Retrieved August 19, 2025, from https://www.handmadecharlotte.com/wp-content/uploads/2014/05/4_flexible-straw_cube-1.jpg

Make the Base Square

- Take 4 straws.
- Arrange them in a square shape on the ground or table.
- Tape the corners together tightly so they stay in a square.

Make the Top Square

- Take 4 more straws.
- Make another square the same way as the first.
- Tape all four corners securely.

Connect the Squares

- Take 1 straw and tape it standing straight up on one corner of the bottom square.
- Repeat for the other 3 corners so you have four vertical straws standing up from each corner.

Attach the Top Square

- Place the top square onto the four vertical straws so it lines up with the bottom square.
- Tape each corner of the top square to the vertical straws. Make sure everything is taped tightly so your cube is strong and doesn't wobble.

How to Use Your Biodiversity Cube:

- Take your cube outside and place it gently on the ground.
- Look inside the cube and count how many different types of plants you see.
- Draw or write down what you see in each square inch or each corner.
- Try it in a grassy area, a flower garden, and under a tree to see how plant biodiversity changes in different places!

Write your bio cube observations in the boxes below:

Site 1- Grassy Area

Site 2 – Flower Garden

Site 3 – Under a Tree

Activity 4
H2-Oh! The Places Raindrops Will Go

Project Outcomes

- Identify the components of the water cycle
- Visualize and diagram the water cycle in your own yard or community when it rains

The water cycle is how water moves around the Earth. First, the sun heats up water in rivers, lakes, and oceans, turning it into water vapor. This is called **evaporation**. Plants give off water through their leaves which is called **transpiration.** Next, the water vapor rises into the sky and cools down to form clouds. This part is called **condensation**. When the clouds get too heavy, the water falls back to Earth as rain, snow, or hail. This is called **precipitation**. Then the water collects in oceans, lakes, and rivers, and the cycle starts all over again.

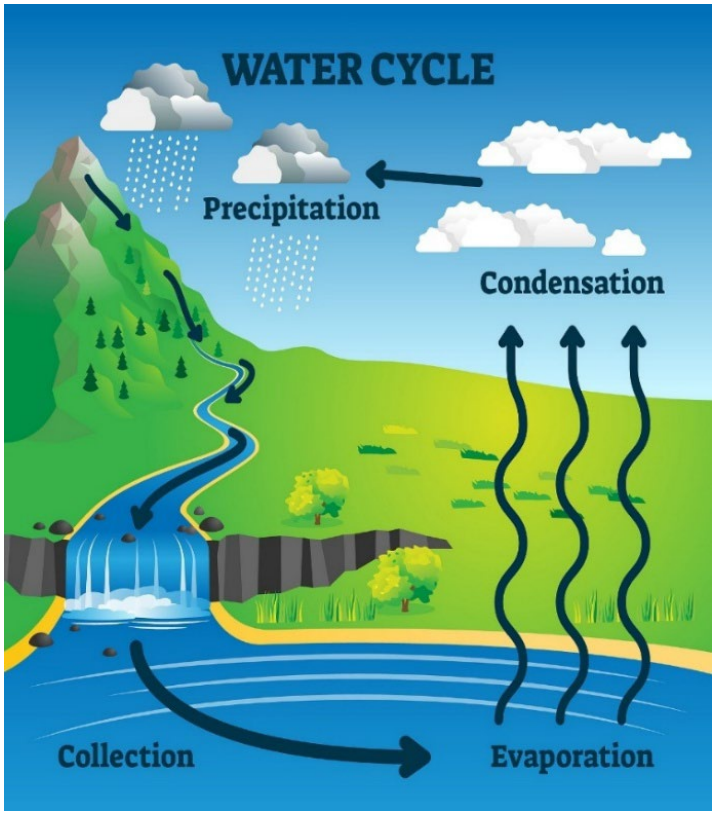


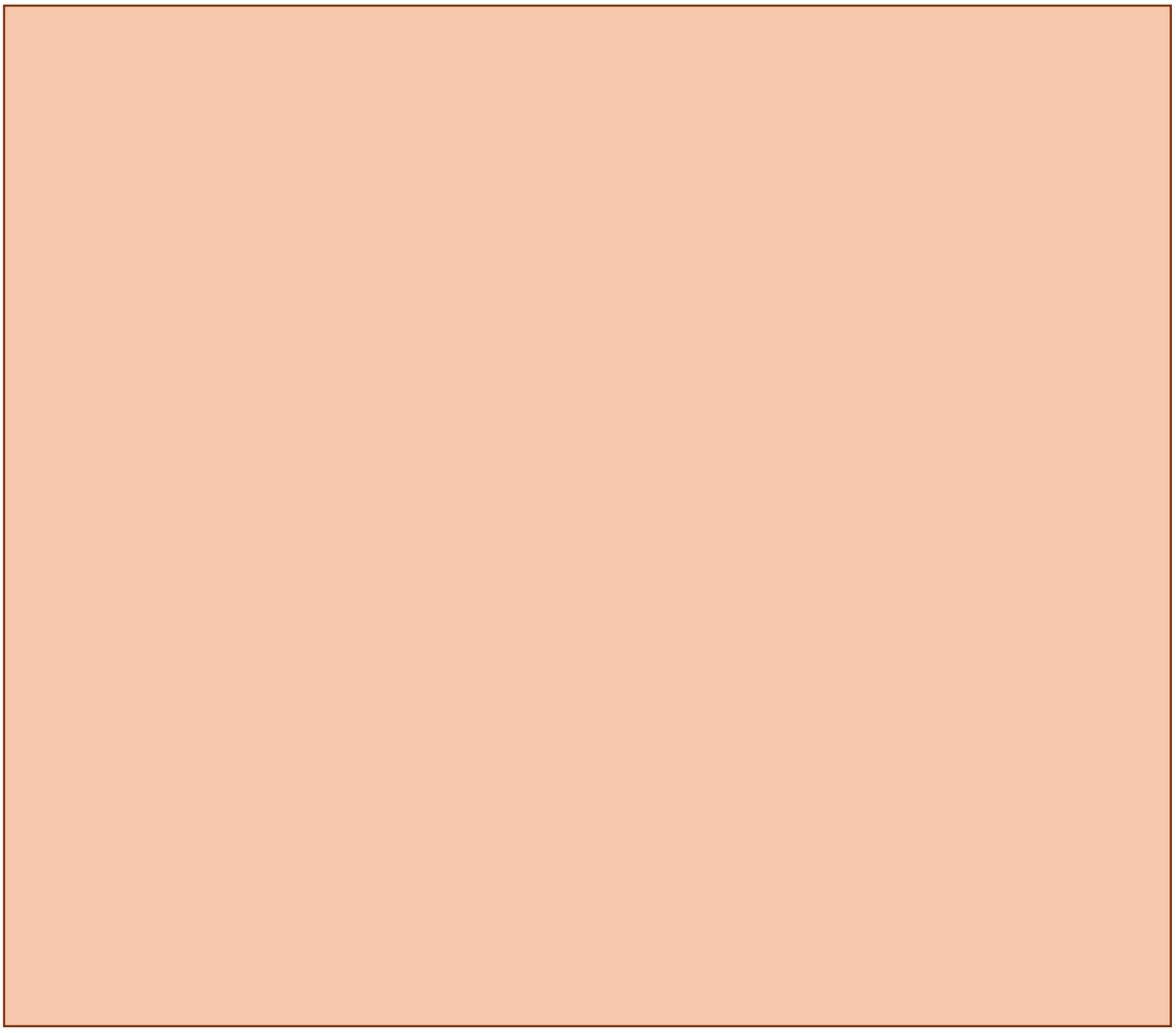
Figure 7: Unknown author. (n.d.). Water cycle diagram [Image]. Blogger. Retrieved August 19, 2025, from https://1.bp.blogspot.com/gO9HcqdN3YQ/YCh_JZZbkZI/AAAAAAAAKtU/Bf9OapouwB8ahifPyPdnNntq3aPfXe9wACLcBGAsYHQ/s1600/water+cycle+new.jpg

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Water Cycle Scavenger

The water cycle is happening all around you. In this activity, let's see just how many elements of the water cycle you can spot. Go outside, maybe to a nearby park, and try to find evidence of condensation, evaporation, precipitation and transpiration.

Draw and list the examples in the box below:



Cloud Jar Activity

Did you know you can make water cycle magic at home? In this activity we will be making cloud jars. Follow the steps below to make your very own cloud.

1. Gather materials: Clear glass, hot water, ice, metal or plastic lid, hairspray
2. Pour hot water into the glass jar until it's about 1/3 full.
3. Heat the water in a microwave until it's very warm – about 50 seconds (adult help may be needed). ***The glass jar will be very hot.**
4. Swirl the water gently to warm the sides of the jar.
5. Spray a quick squirt of hairspray into the jar (this gives the water vapor something to stick to).
6. Immediately cover the jar with the lid or plate.
7. Place a few ice cubes on top of the lid or plate.
8. Wait and watch as a cloud begins to form inside the jar

Which Steps of the Water Cycles are Reflected in this Activity?



Figure 6:No Time For Flash Cards. (2015, March). How to make a cloud in a jar [Image]. No Time For Flash Cards. Retrieved August 19, 2025, from https://www.notimeforflashcards.com/wp-content/uploads/2015/03/how-to-make-a-cloud-in-a-jar-preschool-science-.png

Activity 5
Sustaining Sustainability

Project Outcomes

- Define sustainability
- Differentiate between renewable and non-renewable resources
- Understand the difference between weather and climate
- Evaluate the carbon footprint of daily activities
- Visualize and diagram the water cycle in your own yard or community when it rains

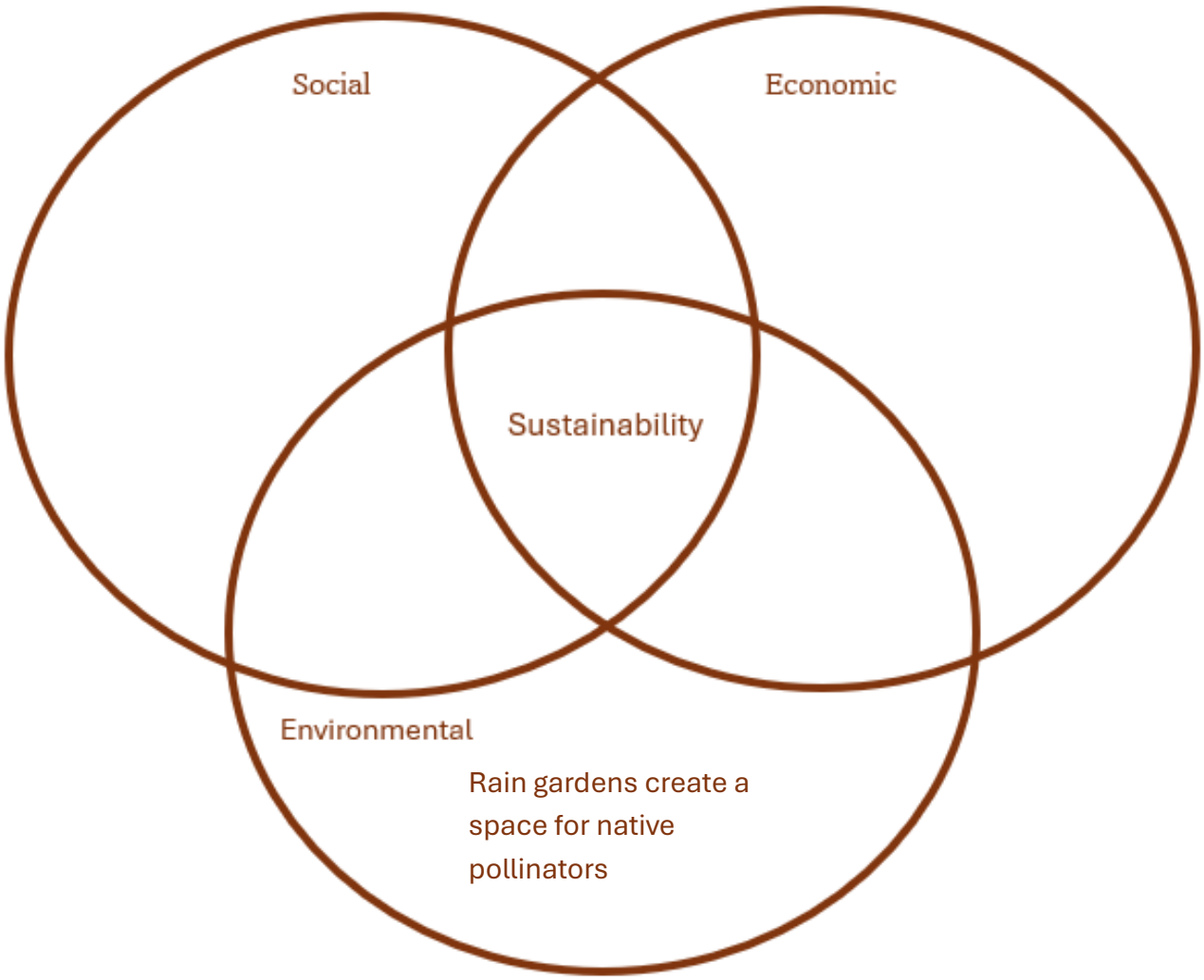
Sustainability means taking care of the Earth so that people today and people in the future can all have clean air, fresh water, healthy food and a safe place to live. It's about using what we need without hurting the planet.



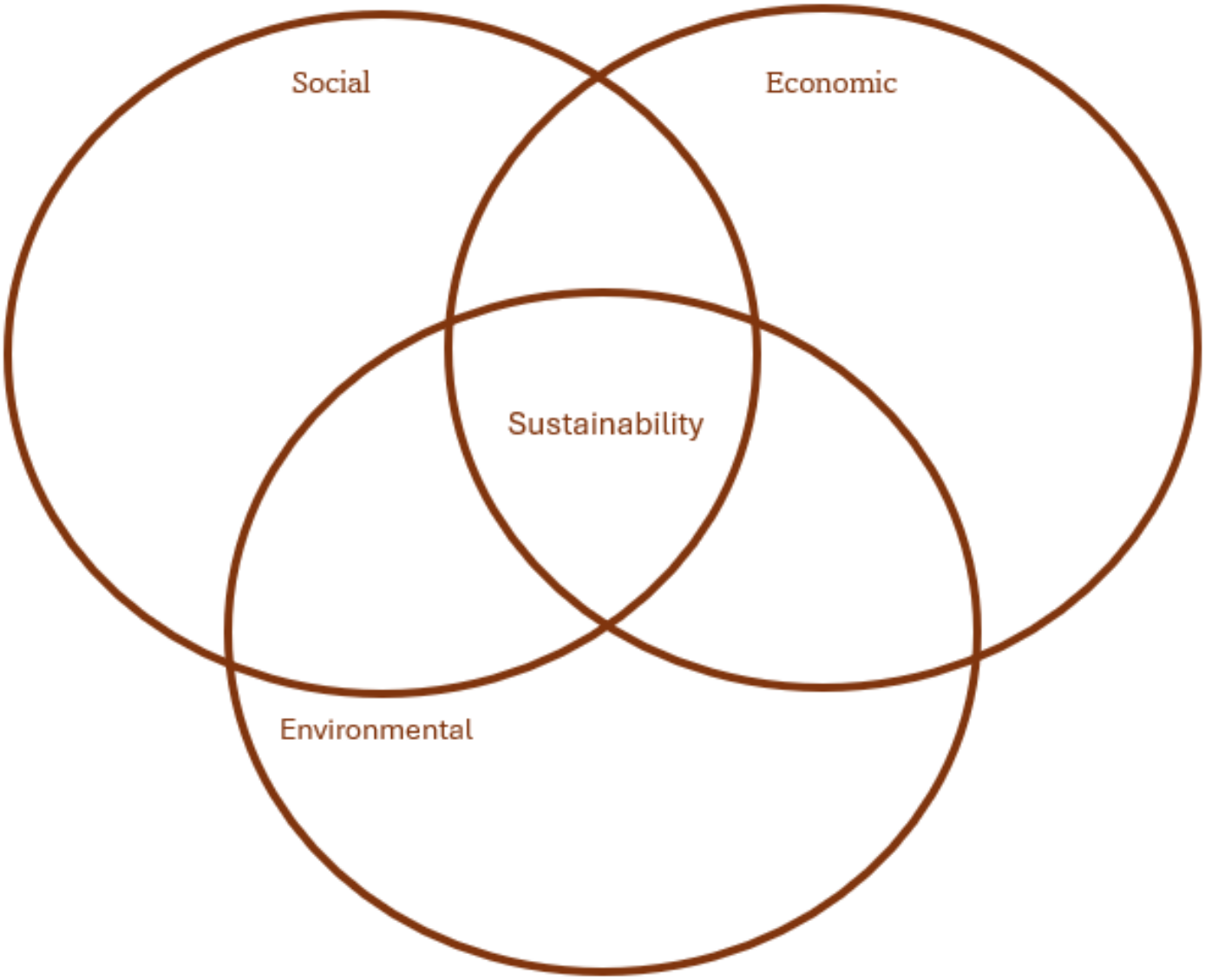
Figure 7:Chartered Accountants Ireland. (n.d.). Sustainability icons over a green scene [Image]. Chartered Accountants Ireland. Retrieved August 19, 2025, from https://www.charteredaccountants.ie/sf_images/default-source/sustainability-centre-images/bubble-susta

Sustainability has three important parts: environmental, social and economic. Environmental sustainability means protecting nature, like keeping the air and water clean, saving animals and plants and not using up all the Earth's resources. Social sustainability means helping people live safe, healthy and fair lives, like having clean homes, good schools and being kind to one another. Economic sustainability means making sure people have jobs and money to live on, but without harming the planet. Can you define examples of social, environmental, and economic sustainability in the diagrams below?

Example: Sustainability attributes for a rain garden

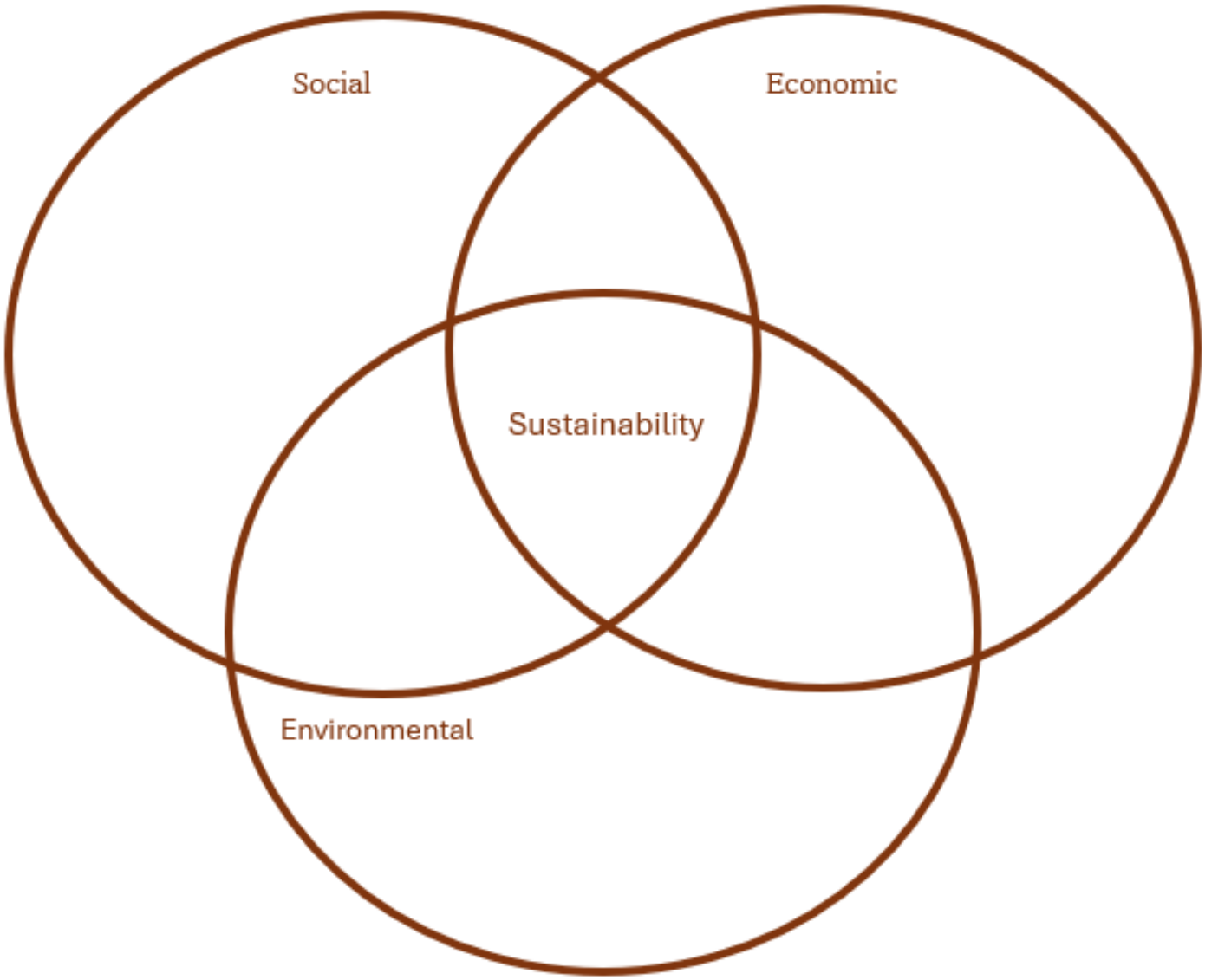


Define Sustainability Attributes for a State Park



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Define Sustainability Attributes for a Compost Center



Carbon Footprint Activity

A carbon footprint is the amount of carbon dioxide (CO_2) and other greenhouse gases released into the air by the things we do every day, like riding in cars, using electricity or throwing away trash. These gases can make the Earth warmer and hurt animals, plants and even people.



Figure 8:Adobe Stock. (n.d.). Carbon footprint infographic [Illustration]. Adobe Stock. Retrieved August 19, 2025, from https://as2.ftcdn.net/v2/jpg/04/22/34/17/1000_F_422341753_pER5lO7WERP5ZYDq6Gfuq9d1GaqpBg5q.jpg

You make a smaller carbon footprint when you:

- Turn off lights when not using them
- Recycle and reuse things
- Walk, ride a bike or carpool
- Eat more local food

Calculate your footprint:
epa.gov/ghgemissions/carbon-footprint-calculator
Reflect on whether your footprint is larger or smaller than expected in the box below:

Renewable energy is energy that comes from natural sources that are constantly replenished, like sunlight, wind, water, plants and the Earth's heat. These sources don't run out, and they create less pollution than fossil fuels like coal or gasoline.



Figure 9:PixelTote. (n.d.). Solar panels in a field under a blue sky [Photograph]. PixelTote. Retrieved August 19, 2025, from https://cdn.pixeltote.com/marketing/assets/previews/f/4/f45c56ed-d955-464a-ac1d-c060312cd33a/pv-lg-solar-panels-in-a-field-with-the-blue



Figure 10:Coal Education. (n.d.). Truck transporting coal [Photograph]. Coal Education. Retrieved August 19, 2025, from http://www.coaleducation.org/technology/Transportation_Coal_Prep/images/Truck2.jpg

Nonrenewable energy comes from sources that are limited and cannot be replaced quickly once they are used up. These include fossil fuels like coal, oil and natural gas.

Potato Battery Activity

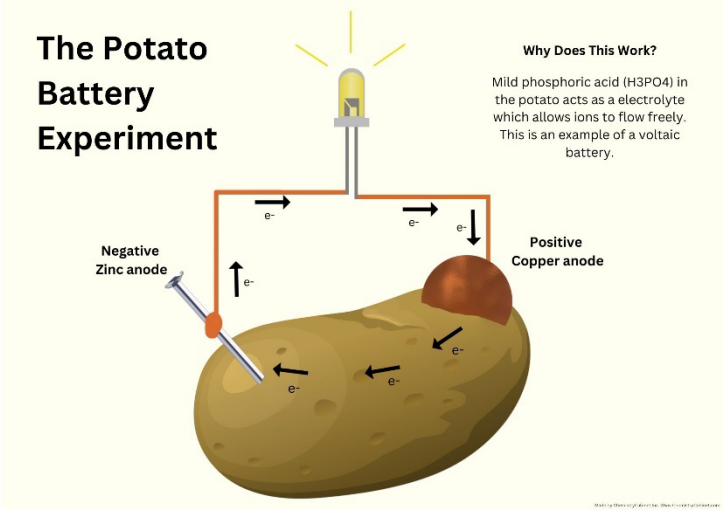


Figure 113: Unknown author. (n.d.). The potato battery experiment diagram [Graphic illustration]. Retrieved August 19, 2025, from https://th.bing.com/th/id/OIP.XwZHdeKdAWYHrk6teUJZbgHaFP?w=225&h=180&c=7&r=0&o=7&pid=1.7&rm=3

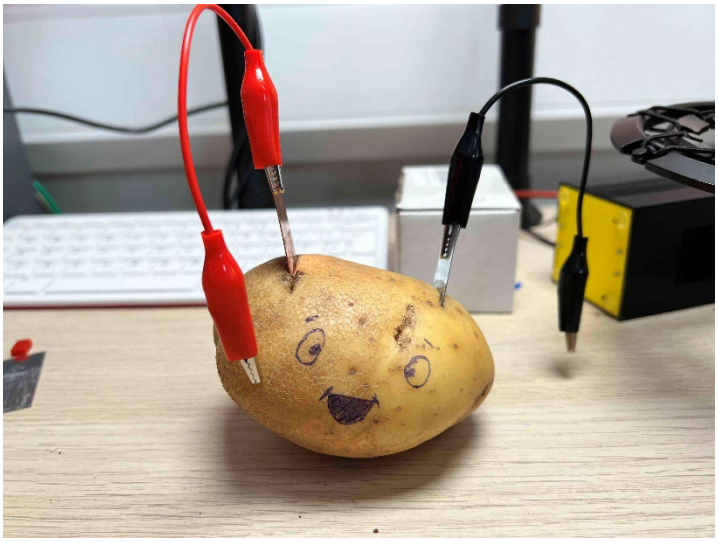


Figure 124: Unknown author. (n.d.). Potato with electrodes and happy face [Photograph]. Retrieved August 19, 2025, from https://tse3.mm.bing.net/th/id/OIP._hXt3oec15DkdRJ-Bk8f4wHaFj?r=0&rs=1&pid=ImgDetMain&o=7&rm=3

Pokey Potato

Materials Needed for the Activity:

- 1 potato (raw)
- 2 metal items: 1 penny (or copper strip) and 1 nail (zinc-coated or galvanized)
- 2 wires with clips (or ask for help stripping wires)
- A small LED light

Instructions:
Stick the penny halfway into one side of the potato.
Stick the nail halfway into the other side (not touching the penny – see Figure 13 above).

Connect Wires:
Clip or wrap one wire from the penny to the positive (+) side of the light.
Clip or wrap another wire from the nail to the negative (–) side.

Watch the magic. The light should come on.

Weather Vs. Climate Activity

Weather is what is happening outside right now, like if it's sunny, rainy, snowing or windy. It changes every day and even from morning to night. Climate is the usual weather that a town or city has over a long time, like 10 years. It helps to know what kind of weather to expect in different places. Florida is very different from Alaska! In the diagram below, sort which statement is an example of weather or climate:

A. It's 56 degrees outside.
B. In Chicago, it is windy during the winter.
C. Did you see the tornado that just hit Tennessee?
D. Florida has the best summers.
E. It's hurricane season again
F. It's going to snow tomorrow.
G. Arizona is very hot and dry every year I visit.
H. There is a heat advisory this week.

Weather	Climate
1.	1.
2.	2.
3.	3.
4.	4.

Key

Weather: A, C,F, H

Climate: B, D,E, G

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Activity 6

Talk the Talk

Project Outcomes

- Differentiating between fact and opinion
- Identifying resources for fact-based versus opinion-based information

Knowing the difference between **fact** and **opinion** helps scientists avoid mixing personal feelings with real data, so they can make informed decisions!

A fact is something that is true. For example: "Water freezes at 32 F (0 C)."

An opinion is what someone thinks or feels, but it cannot be proven true or false. Example: "Snow is the best kind of weather."

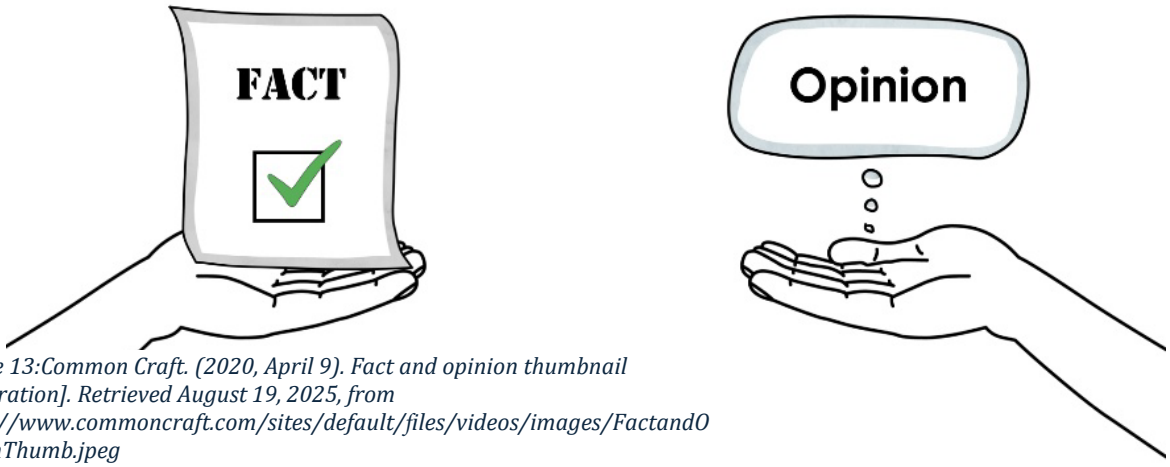


Figure 13:Common Craft. (2020, April 9). Fact and opinion thumbnail [Illustration]. Retrieved August 19, 2025, from https://www.commoncraft.com/sites/default/files/videos/images/FactandOpinionThumb.jpeg

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3 Truths and a Lie

In this activity, read each box below and see if you can identify which of the scientific facts is an opinion in disguise. Circle the opinions (or lies) and discuss why you picked them in the box below:

Box 1

1. Pluto is not a planet.
2. Butterflies have the most fascinating wings.
3. Sunflowers undergo photosynthesis.
4. Penguins cannot fly.

Box 2

1. Dogs are descendants of wolves.
2. Microbes live in the soil.
3. Strawberries are sweeter than apples.
4. Gravity causes items to fall to the ground.

Box 3

1. Octopuses have three hearts.
2. Giraffes are the tallest mammals on Earth.
3. Dolphins are the most playful animals.
4. Bats use echolocation to find food.

Box 4

1. The Earth has four main layers.
2. Volcanoes are the most destructive.
3. Earthquakes can happen under the ocean.
4. Soil is made from rocks, plants and living things.

Justification Box:

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Pluto is not a planet.

Butterflies have **the most fascinating** wings.

Sunflowers undergo photosynthesis.

Penguins cannot fly.

Dogs are descendants of wolves.

Microbes live in the soil.

Strawberries are **sweeter** than apples.

Gravity causes items to fall to the ground.

Octopuses have three hearts.

Giraffes are the tallest mammals on Earth.

Dolphins are the **most playful** animals.

Bats use echolocation to find food.

The Earth has four main layers.

Volcanoes are the **most destructive**.

Earthquakes can happen under the ocean.

Soil is made from rocks, plants, and living things.

Finding scientific sources can feel scary! What are some ways to find sources? Look for ones ending in .org, .gov and .edu. Be careful of some .com sites. They may lead you where you do not need to go.

To help you get started, check out these resources:

NASA Climate Kids: climatekids.nasa.gov

National Geographic Kids: kids.nationalgeographic.com

Mystery Science: mysteryscience.com/

NOAA SciJinks: scijinks.gov/

Activity 7
Farm to Table and Everything in Between

Project Outcomes

- Define a food system and supply chain
- Differentiate between different food systems and labor resources needed

A food system is everything that helps get food from farms to your dinner plate. The food system includes growing food, harvesting, transporting, selling at stores and even throwing away leftovers. Everyone, like farmers, truck drivers, store workers and even you, are part of the food system.

A food supply chain is the path food takes to travel from where it's made to where it's eaten. For example, an apple might start on a tree at a farm, go to a packing center, then to a grocery store and finally to your lunchbox. Each stop is a link in the supply chain.



Figure 14:Rogue Valley Food System Network. (n.d.). Summit system graphic [Graphic]. Rogue Valley Food System Network. Retrieved August 19, 2025, from https://rvfoodsystem.org/wp-content/uploads/2023/02/Summit-system-graphic-web.png

Art of Food Systems Activity

In this activity, we will explore how food systems differ between different items. For example, a food system for apples differs from a food system for Pop-Tarts. There are less ingredients, no processing and fewer transportation stops with the apple vs. the Pop-Tart. Based on the example below, we draw food systems for these three items: McDonald's Cheeseburger, rice and blueberry muffin.

Example: Pop-Tart

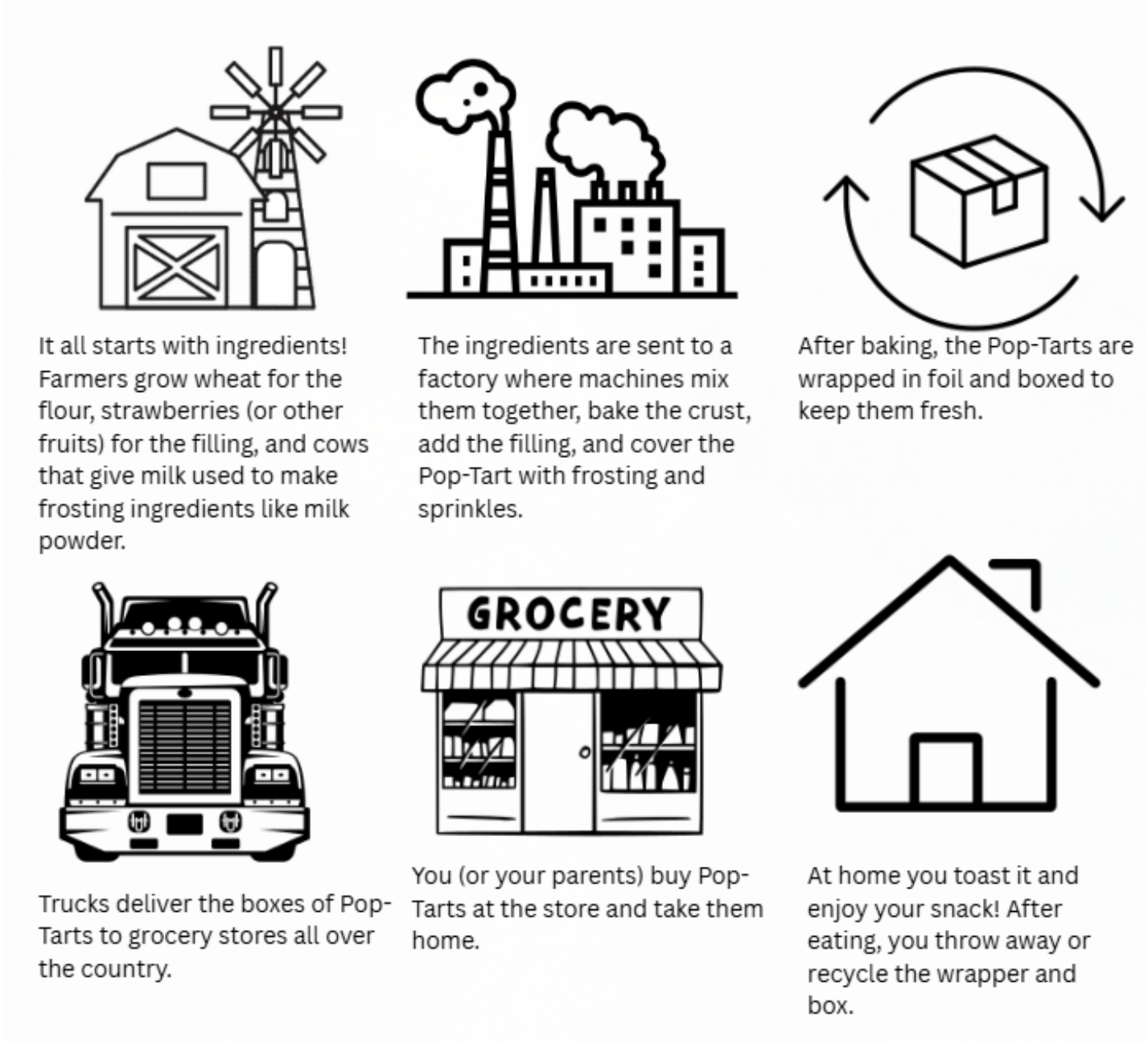
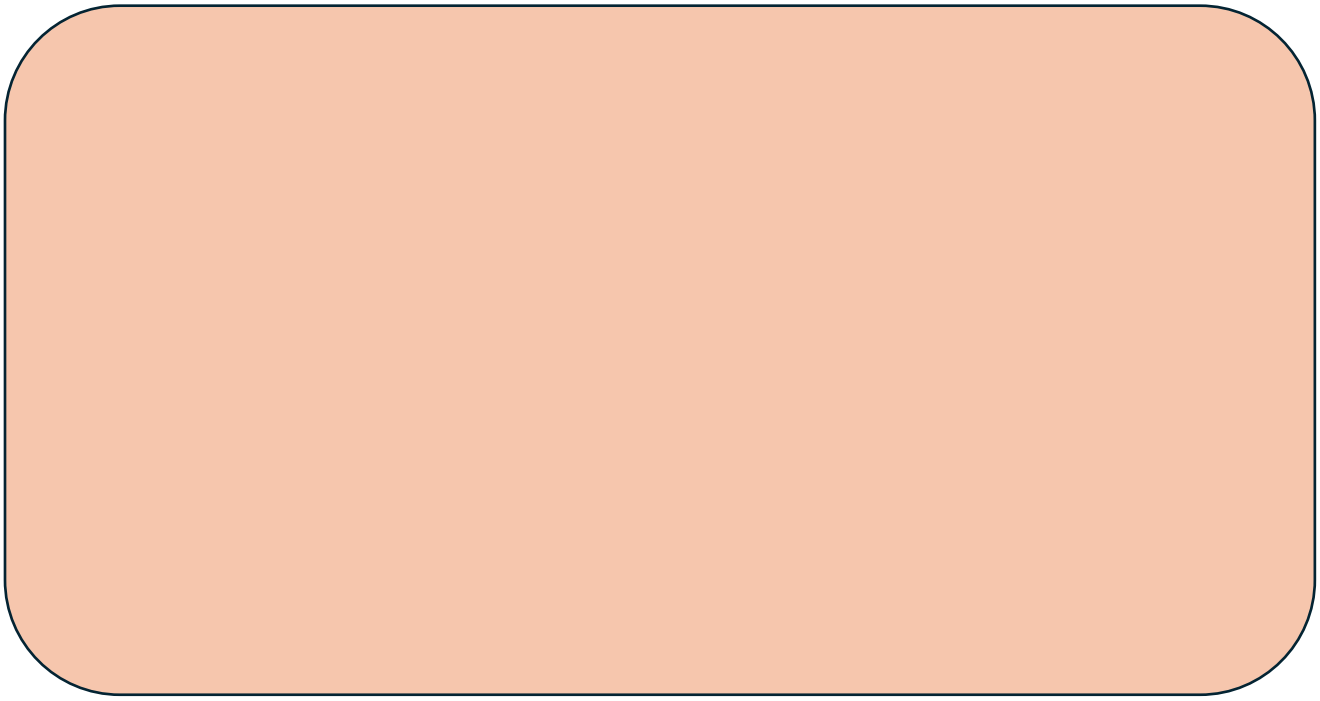
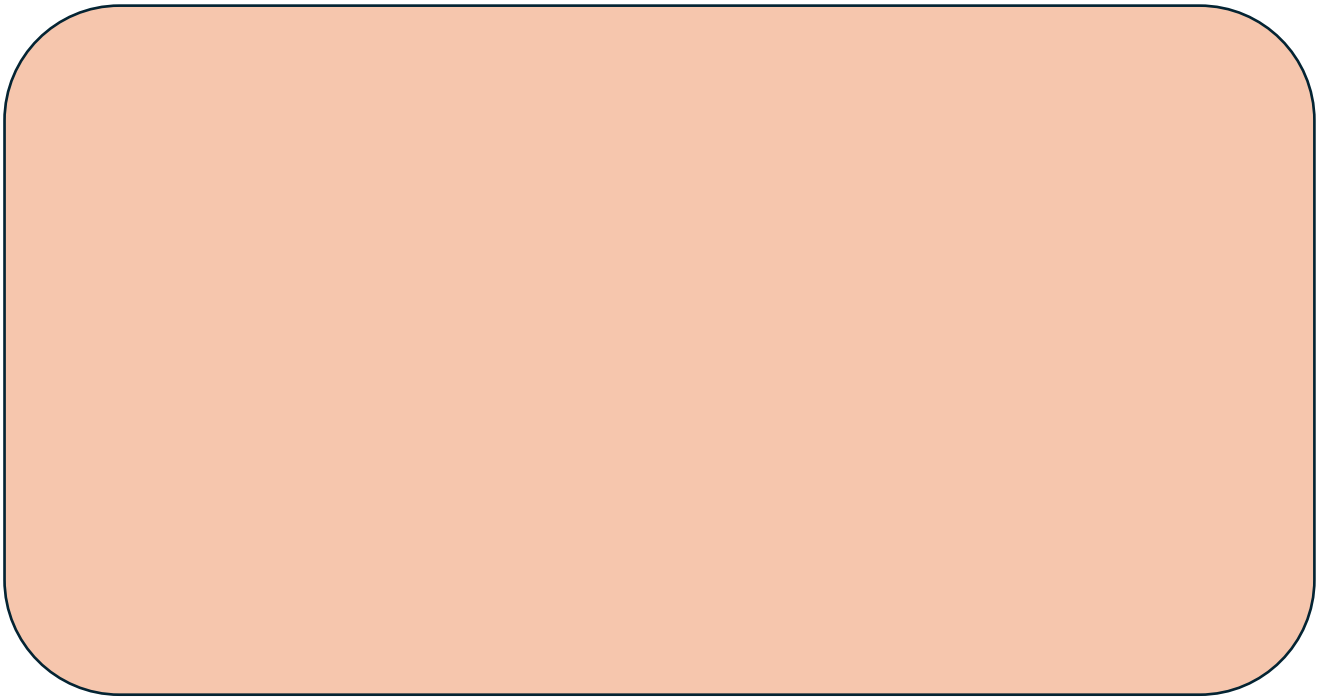


Figure 15: By Author

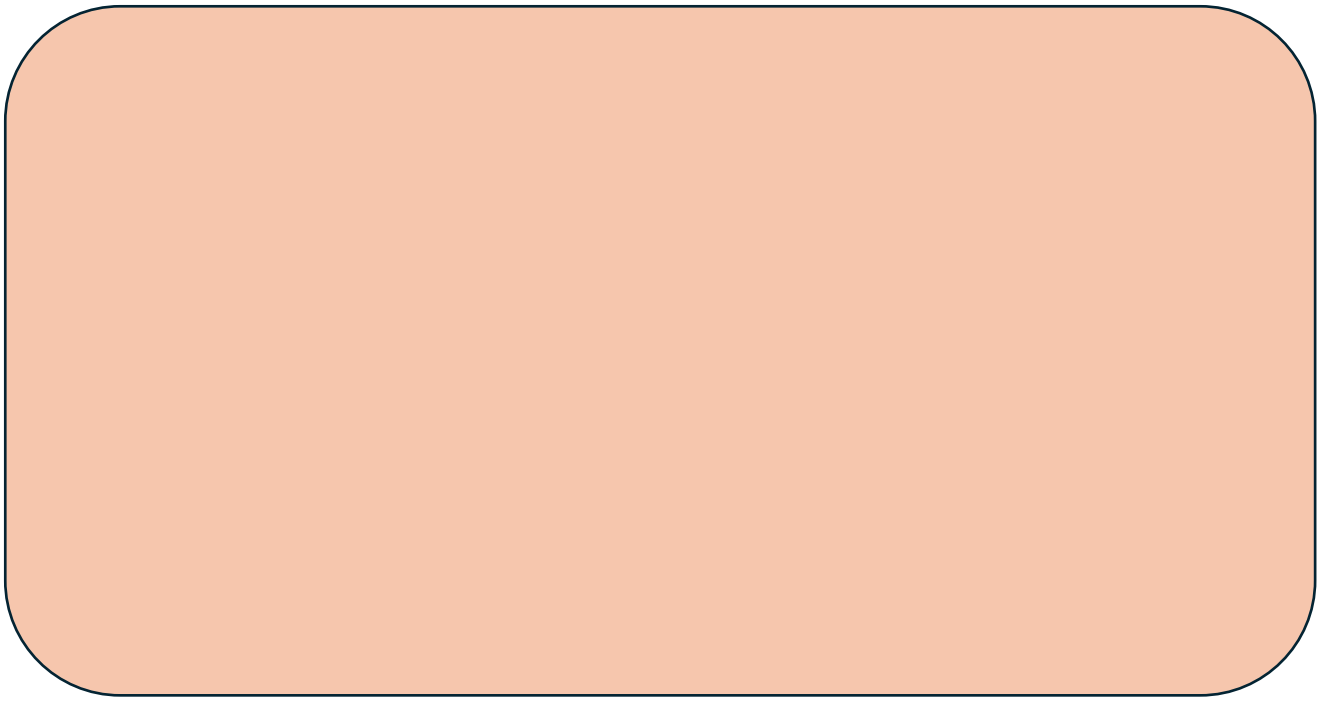
McDonald's Cheeseburger:



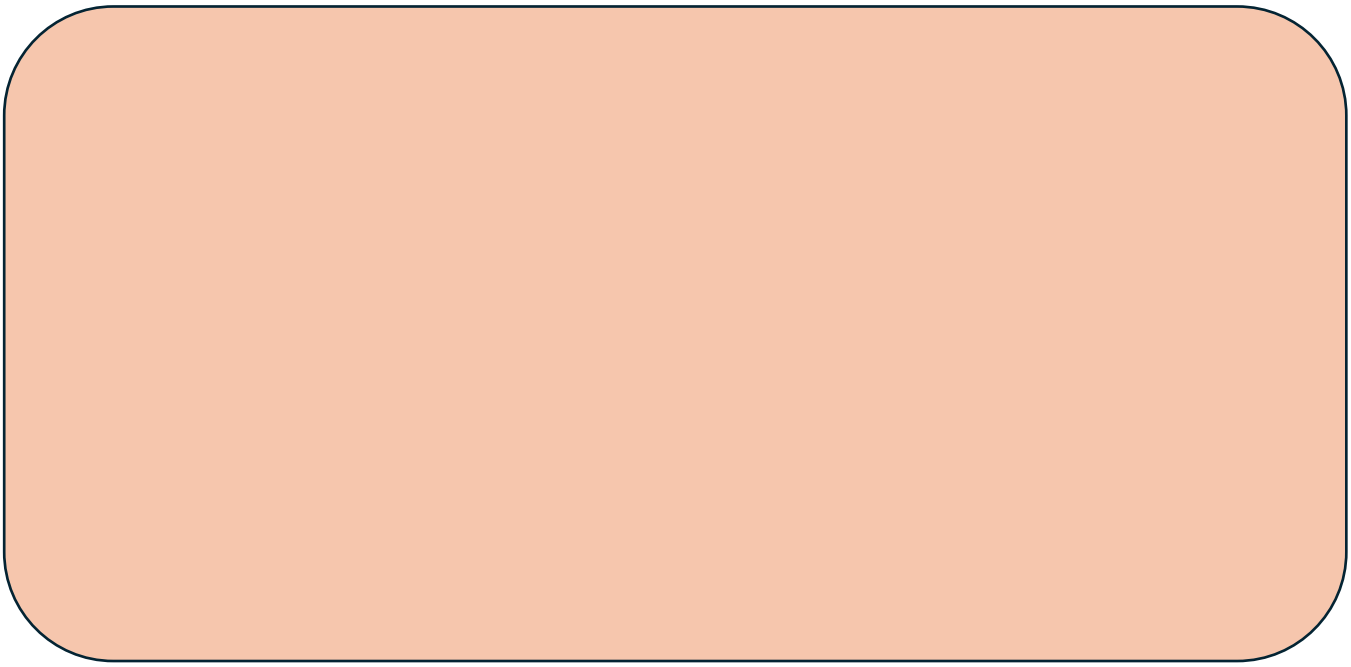
Rice:



Blueberry Muffin:



How are these food systems similar and different from each other?
Are there food systems that you think generate less food waste than others? Are there food systems that use less resources than others?
Reflect in the box below:



Congratulations!

You have now completed the Beginner Environmental and Agricultural Science and Engineering (EASE). By completing this part of the project, you have learned more in-depth information about biosystems and ag engineering.

Continue to seek opportunities to apply what you have learned in your project and learn new things along the way.

More information can be found on the Tennessee 4-H EASE project webpage, including the project outcomes and curriculum for beginner and advanced levels.

References:

Tolipova, A. (2024, September 16). Conducting plant research in modern greenhouse [Photograph]. Freepik. https://img.freepik.com/premium-photo/conducting-plant-research-modern-greenhouse_249974-25478.jpg

1-2 YEARS IN PROJECT



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