Food for All - Student Materials

Unit 5	Biology

Student Materials Table of Contents

Unit Opening

Unit 5 Food for All	Biology
Student Name:	

Tell the Story

A Medical Mystery
Directions:

1. Silently read the texts provided.
2. Circle or highlight three details that are most important to the phenomenon being described.
3. Share with your group. Each person should identify the details that they circled or highlighted.
4. Discuss as a group and determine the overall story. What is the phenomenon?

Text 1:

Along with warm temperatures and April showers, the dreaded rash appeared each Spring among mill workers, tenant farmers, and their children. Starting around 1902 in Georgia, the disease quickly spread to 35 states. Symptoms, known as the three D's, included a rough, scaly rash on the face, hands and feet (dermatitis), diarrhea, and severe depression. In the final stages of the disease, affected patients pellagrins were often institutionalized for mental illness. In fact, in 1907, doctors treating African American psychiatric patients at Alabama's State Hospital reported 88 cases of a similar disease. Many cases ended in death.

Similar cases came to the attention of the Superintendent of the State Hospital for the Insane in South Carolina. On a trip to Europe, he confirmed his suspicion that the growing public health emergency was not a new disease but possibly the first cases of *pellagra* in the U.S. Pellagra, which means "rough skin" in Italian, had been common across Southern Europe among peasants who depended on corn as their primary food source.

Not everyone seemed to contract pellagra. Doctors and nurses working at the State Hospitals did not contract pellagra, even when their patients were. Furthermore, indigenous populations living throughout the Northern hemisphere ate a corn-based diet and there were no pellagra outbreaks described for these populations.

By 1908, outbreaks of pellagra were so widespread in the U.S. that the first of a series of conferences on pellagra was held. Several presenters pointed to corn as the cause, noting the reliance on corn and corn products among populations in which pellagra occurred.

Other researchers argued that pellagra had nothing to do with corn. One hypothesized pellagra was caused by a parasite carried by a fly; another reported he had isolated and identified a new bacteria, *Streptobacillus pellagrae*, as the cause.

In the midst of the growing epidemic, scientists raced to solve the mystery of pellagra and develop treatments. Researchers attempted to transmit pellagra from humans to monkeys. Human patients were fed diets ranging from all-vegetable to all-meat with mixed results. A detailed report revealed homes in which pellagra occurred were often clustered together and lacked window screens or connections to a sewer system.

Investigators also questioned families about the foods they ate. Based on their findings, the group ruled out corn or diet as a factor in the disease, concluding that a microbe, possibly carried by an insect, was responsible. By 1914, papers proposing an infectious agent as the cause of pellagra dominated the Conference on Pellagra.

Text 2:

Man with pellagra with typical skin lesions

Woman with pellagra

Text 3:

In the Durham and Chapel Hill area of North Carolina, Doctor Edwin Caldwell became well known for his successful treatment of pellagra. Doctor Caldwell's grandfather and father had been enslaved by the University of North Carolina - Chapel Hill, but he was born free in 1867. Unable to attend UNC-Chapel Hill due to his race, he earned a medical degree at Shaw College in Raleigh and became known for treating illnesses that stumped other physicians.

After examining a patient named Mrs. Fitzgerald and confirming an advanced case of pellagra, Dr. Caldwell recommended a diet of lean red meat, vegetables, and milk which differed from the diet of cornmeal, grits, fatback, and molasses typically eaten by families experiencing economic hardships. He also recommended that the patient's food be cooked in water from a limestone well if one was available. Mrs. Fitzgerald had a complete recovery from pellagra in the summer of 1917.

Adapted from Murray, P. (1956). *Proud Shoes: The Story of an American Family.* Beacon Press.

What is the overall story?

Important details our group surfaced (provide at least 5):

1. _____
2. _____
3. _____
4. _____
5. _____

Overall Story (based on group discussion):

In the past…
Then…
Finally…

Performance Task Organizer

Unit 5 Food for All	Biology
Student Name:	

Initial Explanation

Look back at your notes from *Tell the Story*. What do you think caused the pellagra outbreak? Why do you think some people fell ill from pellagra, while others did not?

Construct your initial explanation, based on your prior knowledge from previous units, and from the texts you have read so far. You will be asked to revise this explanation multiple times across this unit.

Begin by listing relevant evidence from the text and prior knowledge you already have.

Evidence from the text	Prior knowledge

Initial claim: Based on what I listed above, I think pellagra was caused by

Evidence and Reasoning: I think this because

Scientific Explanation

Many researchers felt that corn was the cause behind the pellagra epidemic and that efforts to understand pellagra should focus on why some people that had a high-corn diet became ill.

Use evidence and scientific reasoning to explain why so many people throughout the course of history, and all over the world, have relied on corn and other cereal crops. Be sure you use science related to **how matter and energy flows between and within systems**.

Review your initial explanation written in the unit launch, *Initial Explanation*. How have your ideas changed? What new evidence and scientific reasoning have you incorporated?

Reflect on the durability of scientific reasoning and concepts that you used in your explanation. Do you think that the scientific concepts, theories, and laws that governed the natural world for our hunter-gatherer ancestors (pre-Neolithic Revolution) and in the early 1900s during the pellagra epidemic apply to us in modern times in the same way? Why or why not?

Pellagra is most likely not currently a concern for people living in your community.

However, that does not mean it is irrelevant now. Reflect on what you know about the pellagra story (and what you have discussed in this learning cycle) and how it connects to you or your community. Record your ideas below.

Revised Explanation

Look back at your initial explanations for pellagra from the Unit Opening and review your explanation about the importance of corn as a cereal crop in *Scientific Explanation*.

Using evidence and scientific reasoning, revise your explanation for why some populations that relied on corn suffered from pellagra, while others did not. Be sure you use science related to **how matter and energy flows between and within systems**.

Reflect on the durability of scientific reasoning and concepts that you used in your explanation. Do you think that the scientific concepts, theories, and laws that governed the natural world for our hunter-gatherer ancestors (pre-Neolithic Revolution), indigenous people in the early years of agriculture, and in the early 1900's during the pellagra epidemic apply to us in the same way? Why or why not?

Making Connections: Access to a fresh, diverse diet was shown to treat and prevent pellagra. You previously considered whether your community offers cheap, easily accessible, and palatable food options that are based on whole foods (not ultra-processed). We know that Americans on average eat ultra-processed food for approximately 60% of their diet.

Why is this a concern? Although pellagra is no longer a problem because of the fortification of foods, in Unit 3, we discussed how ultra-processed food and other environmental factors contribute to obesity and other mismatch and health problems. Discuss your ideas below.

Final Pellagra Explanation

Look back at your revised explanation from the previous 5E and consider all of the new information you have learned.

Using this additional evidence and scientific reasoning, revise your explanation again for why many populations relied on corn as a source of energy, but only some populations that relied on corn suffered from pellagra (while others did not). Be sure you use science related to **how matter and energy flows between and within systems**.

Reflect on the durability of scientific reasoning and concepts that you used in your explanation.

Making Connections: Discuss how the pellagra epidemic was, in part, caused by inequities in the system in which people lived. How are there similar inequities found in our communities today?

Final Task

In this task, you will have an opportunity to reflect upon how what you learned in this unit relates to challenges with inequity in access to diverse and nutritious foods in your community or communities around you. Then you will learn about an innovation that is being proposed as a way to address these challenges. After exploring the innovation, you will work with your group to construct an explanation for how that innovation sustainably considers how matter and energy flow in ecosystems and if it would be a promising fit for your community.

Part 1 - Making Connections Between the Past and Present:

- What were some of the historical problems related to inequity in access to diverse and nutritious foods you noted in previous sections of your performance task organizer?

- What was the incomplete or inaccurate scientific understanding people had at the time?

- What problem did this past understanding/belief lead to?

- Review the previous sections of your performance task organizer. What were some of the connections between historical problems with access to diverse and healthy foods and current problems in your community and or neighboring communities?

Part 2 - Exploring Current Innovations:

- Read about the innovation your group chose to explore. Annotate using the the following:
  - Underline ideas that relate to the problems within our community or our neighboring communities.
  - Circle ideas that relate to the science we learned during your investigations.
  - Write a question next to ideas they would like to clarify with classmates.
- Work with your group to create a poster that explains how the innovation addresses a current local problem and incorporates our revised scientific understanding. Be sure you use science related to **how matter and energy flows between and within systems**.

Part 3 - Implications for the Future:

- How does this innovation support a shift towards more anti-racist systems?

- How can it support equitable access for historically marginalized groups?
- Why do you think this innovation is a good fit for your community?
- Explain how the innovation can meet relevant social, economic and physical criteria and constraints

Unit 5 Reflection

Reflection - Part 1:

At the beginning of this unit you had an opportunity to generate some initial ideas about why some people suffered from pellagra and why others were ok and in some cases thrived, and then you refined your explanation as you gathered evidence from a variety of reliable sources. Reflect about your scientific practice by recalling the evidence that caused you to change or refine your initial ideas. Consider the following questions:

1. What was the evidence?

2. Where did it come from?

3. How and why did it change my thinking?

Reflection - Part 2:

1. How has your thinking changed about what it takes to construct a strong scientific explanation?

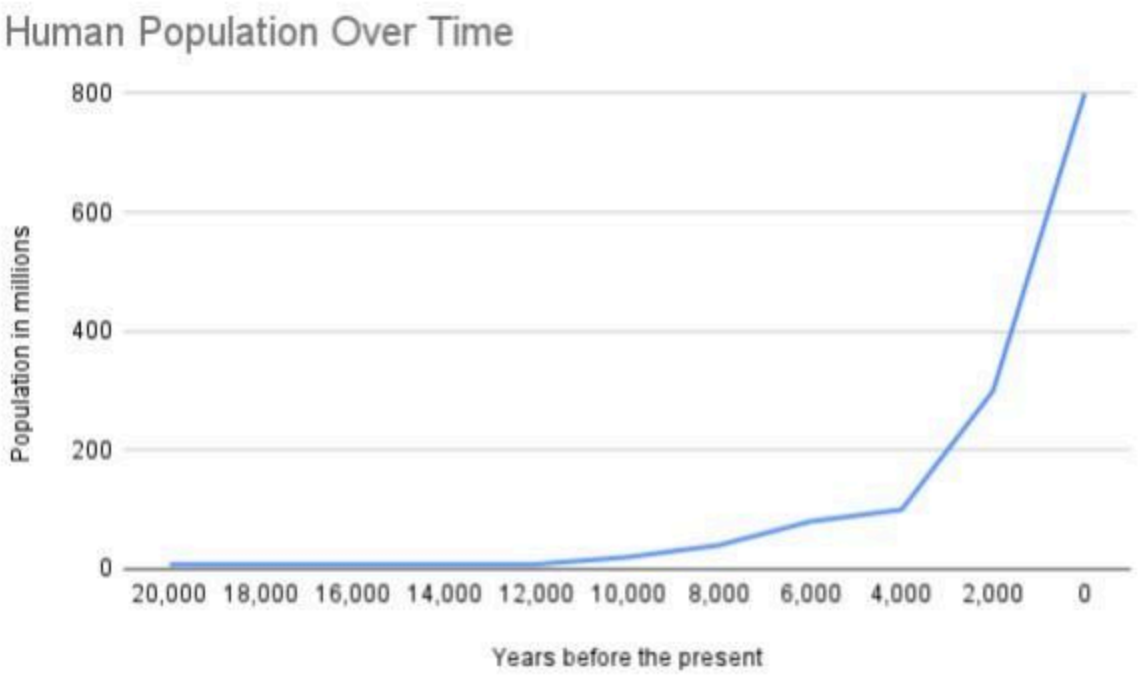
2. Why is constructing an explanation about something that happened in the past useful to us and local communities today?

3. What do you want to consider when you encounter new phenomena in the future?

Neolithic Revolution 3E

Unit 5 Food for All	Biology
Student Name:	

Human Population Graph



Human Poulation Over Time Graph

See	Think	Wonder

Mouse Population Investigation

Guiding Question(s)

Procedure:

1. Open up Population Dynamics of White Footed Mouse Simulation and explore the simulation.

What information does the simulation allow you to investigate?

What questions do you have about the simulation or how to use it?

2. With your partner, decide on two different environmental variables you will manipulate in the simulation. Identify them below.

3. Use the simulation to investigate how changing the identified variables impacted the population of the mice.
4. After using the simulation to investigate how those variables impacted the mouse population, collaborate with your table partners to record your observations on changing multiple environmental variables. Use the See-Think-Wonder organizer to record your ideas and questions.

See	Think	Wonder

Making Sense of the Mouse Population Simulation

Analysis Questions

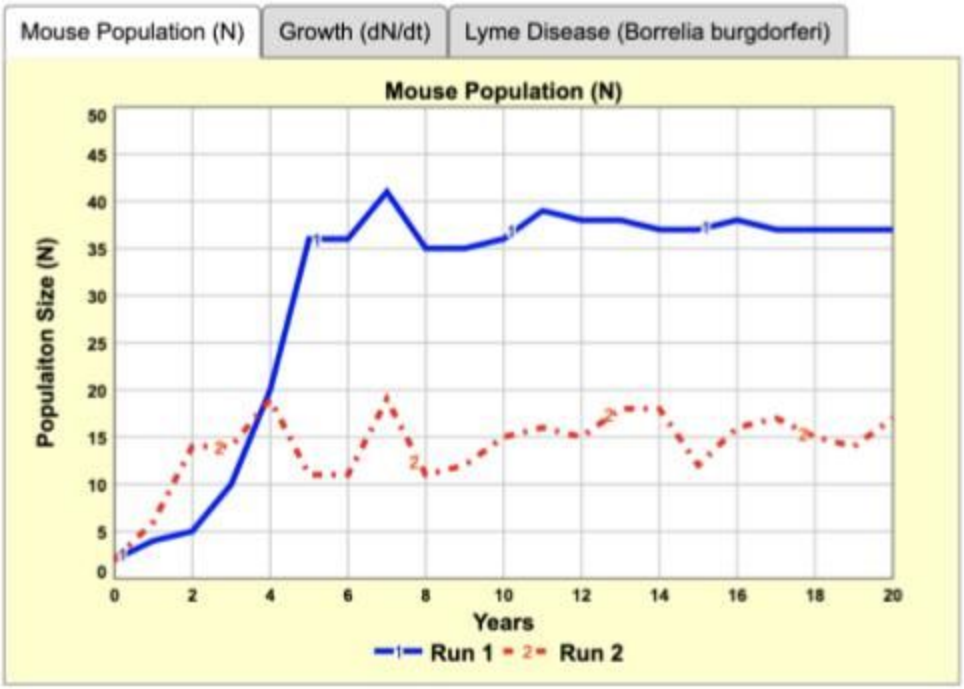
1. For each of the following environmental variables, describe how increasing or decreasing them impacted the mice population.

Predators

Hickory Masting (food availability)

Number of competitors (chipmunks)

Use the example graph below to respond to the prompts:



Population Dynamics of White Footed Mouse Simulation - Sample Graph

Run 1 is at ‘normal’ amounts of food (nuts)
Run 2 is after decreasing the amount of food (nuts)

2. Describe the trend seen in the graph.

3. What is similar between both of the lines in the graph? (run 1 and run 2)

4. How are these population graphs similar or different to the human population graph you analyzed in the Engage phase of this learning cycle?

Mouse Population Investigation Rubric

Student Rubric - Mouse Population Investigation

How did you do in the investigation?

	Student Self-Score Select one		
I know how this investigation connects to our current unit.	No - I need help.	Almost	Yes
I was able to contribute to the See-Think-Wonder and / or respond to the analysis questions.	No- I need help.	Almost	Yes
I used my time well in this investigation.	No	Mostly	Yes
I plan to come in for extra help to complete parts of the investigation or ask questions.	No		Yes

What other resources could you have used to get more out of this investigation?

- More time
- More resources
- More information
- More help from my partners
- More help from my teacher
- Other:

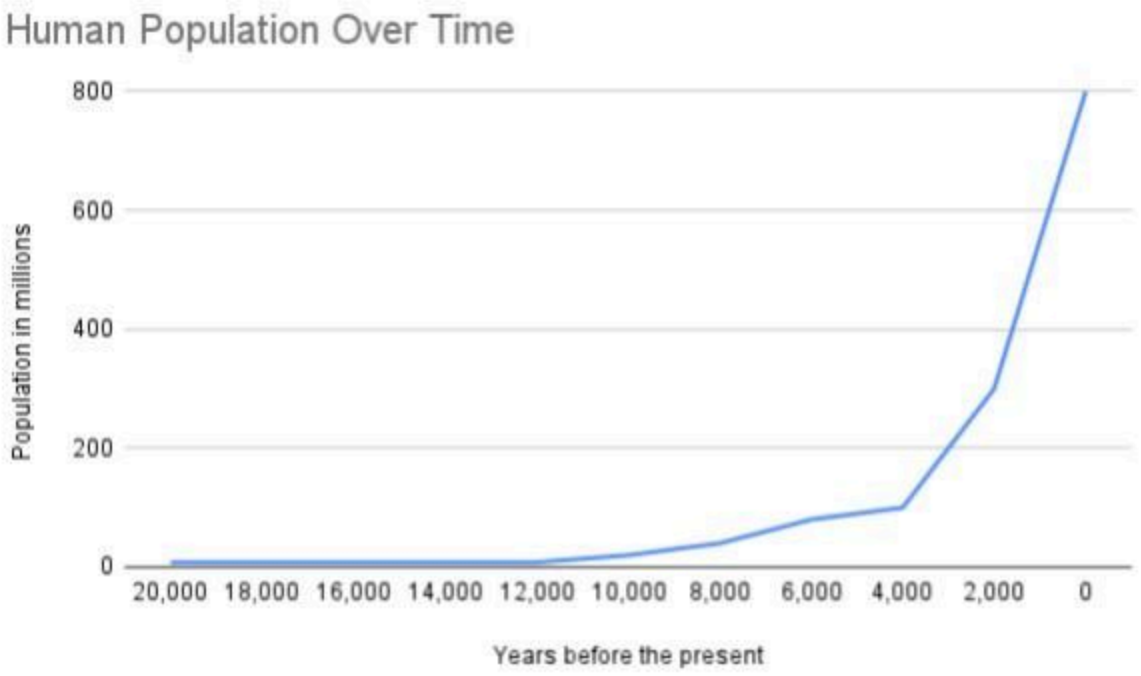
Partner Rubric - Mouse Population Investigation

How did your partners do in the investigation?

Directions: Think back to how your partners participated in the lab. For each of the four categories, write the name(s) of your partner(s) in the appropriate box.

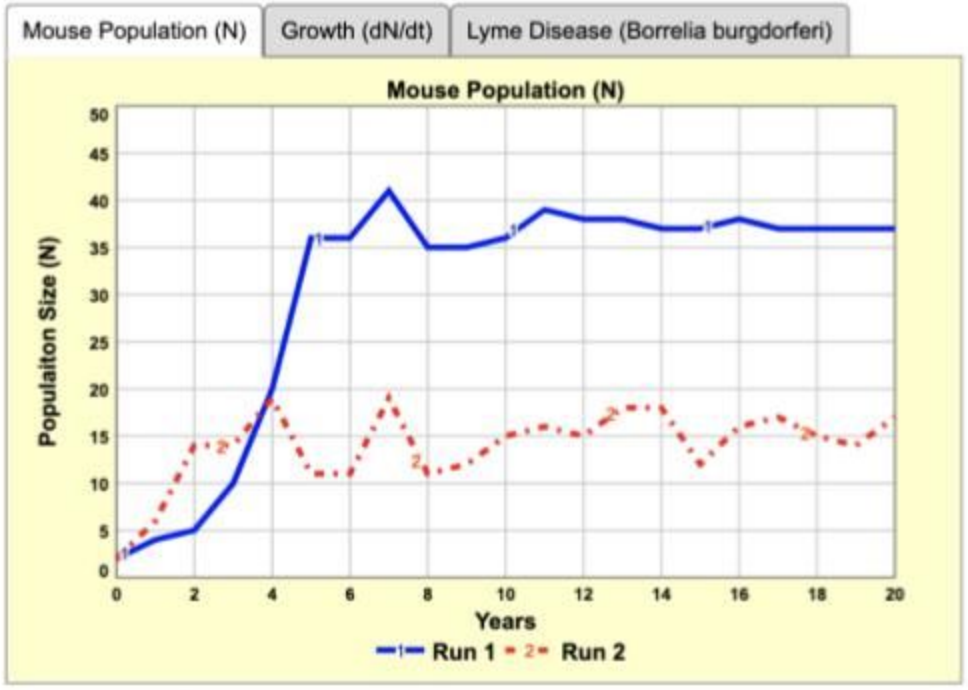
	Unsatisfactory	Pretty Good	Excellent
Contributions	Did not participate.	Did the minimum of what was required.	Provided useful ideas when participating in discussion.
Working with Others	Rarely listened to others. Disrupted or discouraged others' attempts to participate.	Usually listened to, shared with, and supported the efforts of others.	Listened to, shared with, and supported the efforts of others.
Time Management	Procrastinated, did not use school time or schedule provided to get work completed.	Mostly used time well and completed investigation on time.	Used time well to ensure things get done on time.

Population Graphs



Human Poulation Over Time Graph

Run 1 is at ‘normal’ amounts of food (nuts)
Run 2 is after decreasing the amount of food (nuts)



Population Dynamics of White Footed Mouse Simulation - Sample Graph

Population Graphs Text

Carrying Capacity

All organisms, including humans, need resources to survive. Some of those resources include food, water, and the space to carry out their normal activities. When organisms have sufficient resources, they reproduce and increase their population. Most resources are finite, which limits population growth. If a population has not reached the point that it has used all of its resources, it continues to grow. Other variables can act to limit population growth, such as predation, competition, and disease.

Thinking about the mice population you investigated, we could see that the mice would quickly reproduce, and the population would grow. Then, a **limiting factor**, such as food availability, would limit their population growth, and the population would decrease slightly. After the population decreased slightly, more food would be available for young mice. Therefore, the population would increase slightly – creating a dynamic equilibrium around a set point. The set point is called the **carrying capacity** of the mices' ecosystem.

For any given population, the carrying capacity is the average number of individuals that a specific ecosystem can support, based on the availability of resources and the presence of other limiting factors such as predators. The carrying capacity can change if more or less resources are available or there are changes to variables such as predators, disease, or environmental degradation.

Neolithic Revolution

The **Neolithic Era**, or New Stone Age, was the time period from about 9,000 B.C.E. to about 3,000 B.C.E.

Timeline of Prehistory

Paleolithic Era	Neolithic Era	Bronze Age
2,000,000 BCE- 9,000 BCE	9,000 - 3,000 BCE	3,000- 1,000 BCE

Timeline of Prehistory

The **Neolithic** (or "New" Stone Age) was a period in human history that came after the start of agriculture and before the development of the first civilizations during which people started creating and using metal tools, called the "Bronze Age." The inhabitants of a Neolithic village would have farmed using tools made of wood, stone, or bone. The Neolithic Revolution took place at different times in different regions, so the start of the Neolithic Era varies. The Neolithic Revolution was a turning point in history that changed the way Paleolithic people lived their lives. People shifted from hunting and gathering for food to agriculture. Instead of living as nomads, people settled down in permanent settlements. The Neolithic Revolution led to the first civilizations. Some of the first agricultural societies developed in the Fertile Crescent (located in modern day Iraq, Syria, Lebanon, Jordan, Israel, and Egypt) and later the first civilizations started here. After the Neolithic Revolution transformed life for people in the Fertile Crescent around 11,000 BCE, farming practices spread from here to North Africa, the Indian subcontinent, and Europe.

Therefore, prior to the development of agriculture, human populations were limited by food availability. Their populations maintained a dynamic equilibrium at the carrying capacity of their environment. As groups of people were able to grow more food, they settled in larger groups and then civilizations began to form as the population increased.

Summary Task

Today we completed a class consensus discussion. How did it go?

1. One thing that went well in the discussion:

2. One thing we can improve the next time we have a discussion:

3. One person who helped me learn today:

4. What did you learn from this person?

5. One idea that I contributed to my group or my class:

6. Describe how analyzing the data helped you explain the concept of carrying capacity at the different scales of human and mouse populations

The SuperFood that Changed the World 5E

Unit 5 Food for All	Biology
Student Name:	

Story of All of Us: Corn - See-Think-Wonder

Watch the video and consider the following prompt as you note your thoughts, observations, and wonderings.
How has corn played a role in human societies and population size?

See	Think	Wonder

Cob Sprouting in Water: See-Think-Wonder

Watch the video that shows corn growing and note observations. You will use those observations to identify evidence for developing an initial model of how corn grows.

See	Think	Wonder

How did it grow? Investigation

Background:
In this lab, you will investigate the process of how plants generate energy (photosynthesis) to fuel their own life processes like growth. We have already observed that glucose is made up of carbons, hydrogen, and oxygen but where do they come from?

In this investigation, we will track two gasses, oxygen and carbon dioxide in plants in order to better understand photosynthesis. In order to do this, you will use an **Elodea plant** and the indicator **Bromothymol Blue**. Bromothymol blue is used in this investigation because it is able to help us detect the presence of **CO_2** in solution.

In a test tube, you will see that:
- bromothymol blue + CO_2 = *green color*
- bromothymol blue = *blue color*

We will also use a common test for O_2, a splint test. In the presence of oxygen, a lit splint will flare up. This will be done as demonstration by your teacher for safety reasons.

Pre-Lab Questions:

1. What gas can bromothymol blue serve as an indicator for?

2. Predict what will happen to the color of the solution when you blow into the straw (causing the bromothymol blue + water solution to bubble). ***Explain*** your prediction.

3. Predict what color the tube with no plants in it will be after the experiment.

4. Predict what color the tube with plants but no light will be after the experiment.

5. Predict what color the tube with plants with light will be after the experiment.

Hypothesis:

Reactants: What do you think plants need to do photosynthesis? (Should include more than one product)

Products: What do you think plants give off/make with photosynthesis? (Should include more than one reactant)

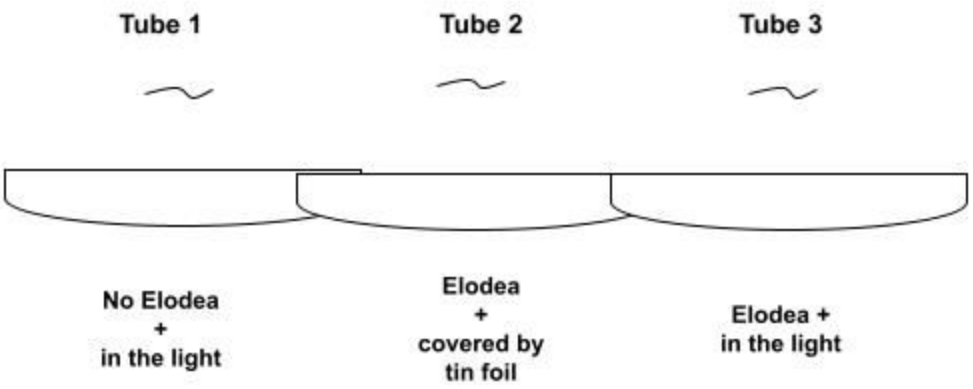
Procedure:

1. Pour 75 mL of water into a 250 mL beaker.
2. Add 25 mL of bromothymol blue to the water. It should be a blue solution.
3. Using a straw, GENTLY blow into the solution causing it to bubble for approximately 1 minute.

What happened?

What gas did you blow into the beaker, what process created the gas in your cells?

4. Label 3 large test tubes: 1, 2, & 3
   - Tube 1 will be the control (no Elodea) in the light
   - Tube 2 will be the Elodea in the dark
   - Tube 3 will be the Elodea in the light
5. Pour 25 mL of the bromothymol blue + water solution in each of the three test tubes.
6. Cover Tube 1 with tin foil (there is no Elodea in Tube 1) and place it in the test tube rack
7. Add a piece of Elodea to Tube 2. Using your straw, GENTLY push the Elodea to the bottom of the test tube. Then cover Tube 2 with tinfoil and place it in the test tube rack.
8. Add a piece of Elodea to Tube 3. Using your straw, GENTLY push the Elodea to the bottom of the test tube. Cover the test tube with plastic wrap or a stopper. Then place it in the test tube rack.
9. Place the entire test tube rack under a light source and allow it to sit overnight.



Experimental set-up

Results:

Unwrap Test Tube 1

1. What color was it?

---

2. Is there CO_2 in the solution?

Unwrap Test Tube 2

1. What color was it?

---

2. Is there CO_2 in the solution?

Unwrap Test Tube 3

1. What color was it?

---

2. Is there CO_2 in the solution?

Results from the splint test:

1. Test tube 1: is there oxygen present?

---

2. Test tube 2: Is there oxygen present?

3. Test tube 2: Is there oxygen present?

See-Think-Wonder

Use the graphic organizer below to record your ideas from the investigation.

See Things I see in the data collected	**Think** Ideas that this data makes me think about	**Wonder** Questions and wonderings I have about the data

Analysis Questions: Writing the Equation for Photosynthesis

1. What gas did you exhale?

For Test Tube 3 (light exposure)

2. So what gas did the Elodea plant take in? What evidence in your experiment demonstrated that?

3. What gas did the Elodea plant get rid of (produce)? What evidence in your experiment demonstrated that?

4. Based on what you know in your life (and from the corn-cobb), do plants take in water?

5. What is the goal of photosynthesis/what is it making? (hint: look at beginning of the lab)

Using test tube 3 as a demonstration of photosynthesis, use evidence from your experiment to write out an equation that represents photosynthesis.

Write the general chemical equation for photosynthesis:
(based on your above answers-you should end up with 2 reactants and 2 products)

_____+_____ (in the presences of light) = _____+_____

6. How were the results different for Test Tube 2 (no light exposure)? Explain your answer.

7. Do plants use both photosynthesis and cellular respiration to fuel their own life processes? How do you know?

How did it grow? Investigation Rubric

Student Rubric - How did it grow? Investigation

How did you do in the investigation?

	Student Self-Score Select one		
I know how this investigation connects to our current unit.	No - I need help.	Almost	Yes
I was able to contribute to the See-Think-Wonder and / or respond to the analysis questions.	No- I need help.	Almost	Yes
I used my time well in this investigation.	No	Mostly	Yes
I plan to come in for extra help to complete parts of the investigation or ask questions.	No		Yes

What other resources could you have used to get more out of this investigation?

- More time
- More resources
- More information
- More help from my partners
- More help from my teacher
- Other:

Partner Rubric - How did it grow? Investigation

How did your partners do in the investigation?

Directions: Think back to how your partners participated in the lab. For each of the four categories, write the name(s) of your partner(s) in the appropriate box.

	Unsatisfactory	Pretty Good	Excellent
Contributions	Did not participate.	Did the minimum of what was required.	Provided useful ideas when participating in discussion.
Working with Others	Rarely listened to others. Disrupted or discouraged others' attempts to participate.	Usually listened to, shared with, and supported the efforts of others.	Listened to, shared with, and supported the efforts of others.
Time Management	Procrastinated, did not use school time or schedule provided to get work completed.	Mostly used time well and completed investigation on time.	Used time well to ensure things get done on time.

How did it grow? Explanatory Model

Use what you learned from the investigation to develop a model in the form of a diagram that explains the following:

a. How the corn grew and where it gets its energy and nutrients from.
b. Where the glucose in corn comes from.

Individual Model

Summary Task

Today we completed a class consensus discussion. How did it go?

1. One thing that went well in the discussion:

2. One thing we can improve the next time we have a discussion:

3. One person who helped me learn today:

4. What did you learn from this person?

5. One idea that I contributed to my group or my class:

6. In the process of photosynthesis, how did energy drive the movement of matter from the soil and atmosphere into the biosphere (plants)?

7. Why was it useful to track matter inputs and outputs for the process of photosynthesis?

8. How does the chemical equation for the process of photosynthesis represent the idea that mass and energy are conserved?

Discovering Patterns in Pyramids Investigation

Discovering Patterns in Pyramids Investigation

What factors may have driven humans to develop and cultivate plants like corn and other grains? Using math to develop a model of food chains involving corn may help us answer that question.

Humans are not the only species who use the nutrients stored in corn as food. Mice, raccoons, and deer like to eat corn, too. Each of these animals is also food for other animals. During the first part of this investigation you will:

1. Quantify the number of organisms that might be present in a given area.
2. Create a model that reflects the quantities you have estimated.
3. Convert the model to a pyramid of biomass.

Urban farm - corn plants

1. Examine the image of corn growing in a garden in Brooklyn pictured above. Estimate the total number of corn plants growing in this space. (HINT: Count the number of rows and the number of corn plants visible in the first row. How might you use these two values to estimate the total number of plants?)

Mouse eating corn

2. What factors limit the amount of corn that can exist in that garden?

3. How many mice do you estimate might be present in this garden area?

4. Is the number of mice you estimated smaller or larger than the number of corn plants? Why do you think this is a good estimate of the mice population in the garden area?

5. What factors do you think limit the population of mice to that level?

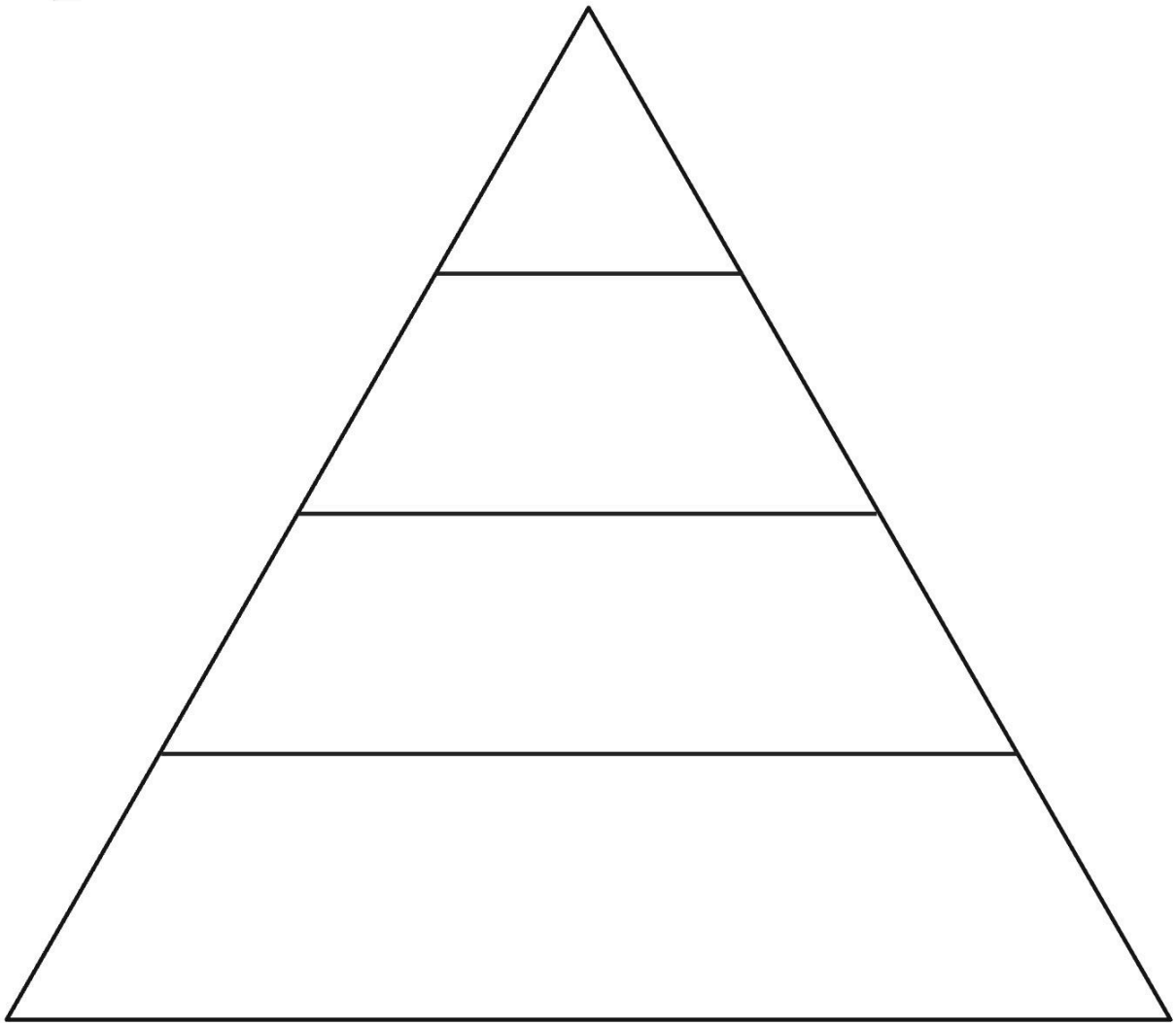
Owl

6. How many owls do you estimate might be present in the area?

7. Is the number of owls you estimated smaller or larger than the amount of mice? Why do you think this is a good estimate of the owl population in that area?

8. What factors do you think limit the population of mice to that level?

9. Write the name of the population (corn, mice, or owls) with the largest estimated number of organisms in the largest section of the diagram below. Write the name of the second largest group in the next largest section. Write the name of the group with the smallest number of organisms in the smallest section.



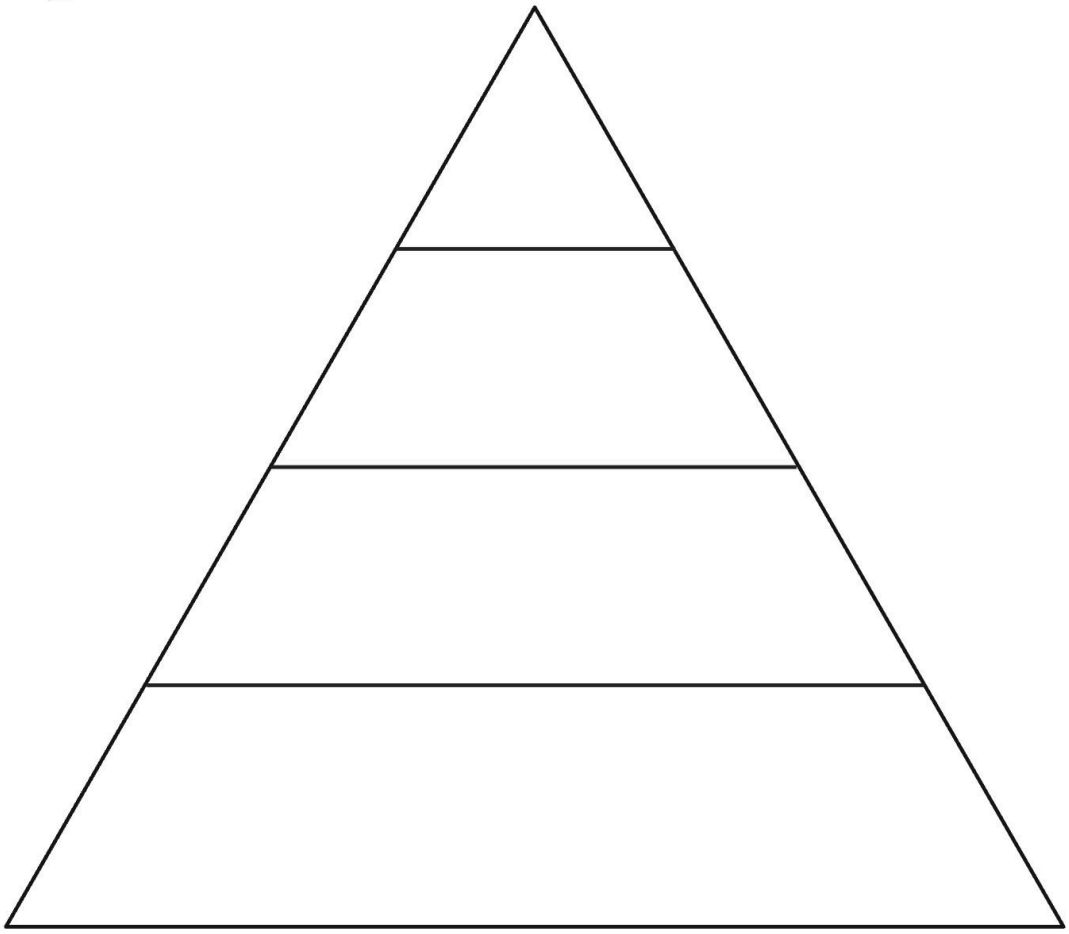
Energy Pyramid template. Created in https://BioRender.com

The model you have created is a “pyramid of numbers” for this food chain. Think of another food chain that might exist in this garden. How large would you estimate each population to be? Draw a model that represents the relative number of organisms at each level of your food chain in the space below.

Part 2: Pyramid of Biomass

Use the values provided in the table below to create a pyramid of biomass for a food chain involving corn, mice, and owls. The weights provided are dry weight (all of the water has been removed from the organism).

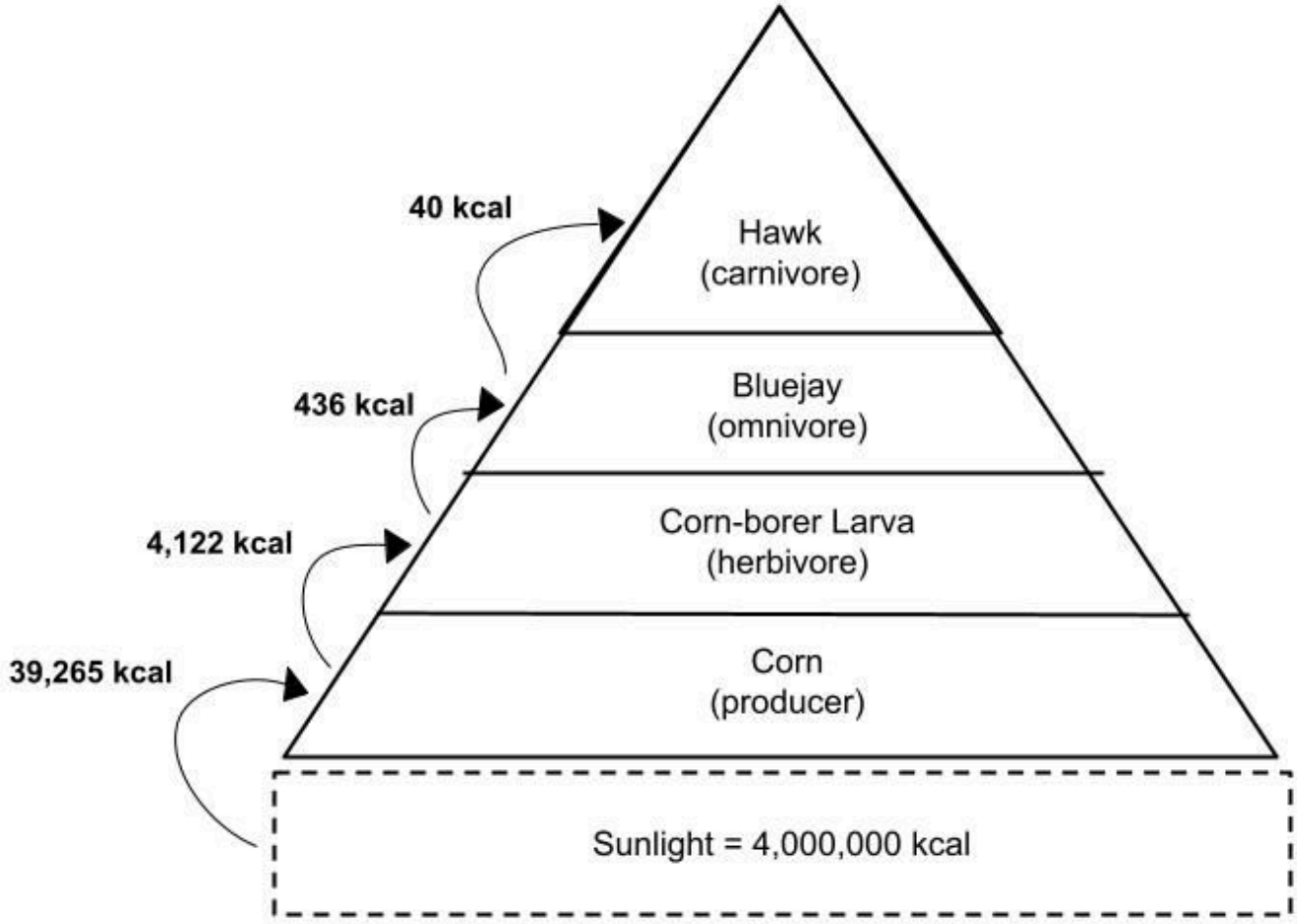
Organism	Average Total Mass of Each Type of Organism(g)
Corn	590
Mice	75
Owl(s)	8



Energy Pyramid template. Created in https://BioRender.com

Does the model used in this exercise (a pyramid or triangle) accurately reflect the biomass of each population in the table? If not, what might this indicate about how each population obtains energy? In other words, are the mice in this garden area likely to be the only food the owl(s) consume(s)? Why or why not?

Part 3: Pyramid of Energy



The image above represents another food chain that might exist in a field or garden plot of corn. Use the values in the model to answer the following questions:

1. A unit to measure energy is the kilocalorie (kcal).
    a. What is the source of all energy in the model above?

    b. How much energy does this source provide?

2. The arrows in the model above represent the energy available to the next level of the pyramid.
    a. What percentage of the sun's energy is absorbed by the corn plant? **(Available energy / sun's energy) x 100 = energy absorbed**

b. By what process do the corn plants capture this energy?

Corn-borer larva


Corn-borer adult

3. Corn-borer larvae, the larval form of the European corn borer moth, *Ostrinius nubilalis*, was first identified in North America in 1917, Corn borer larvae feed on corn, making tunnels in ears of corn that reduce agricultural yield. According to the model above, how much energy per year do the corn-borers obtain from eating the corn plants in one square meter of corn?

a. What percentage of the energy that was originally absorbed by the corn plants is passed on to the corn-borers? **(Available energy corn-borer/ available energy corn) x 100**

b. What percentage of the energy absorbed by the corn plants is not passed onto the corn-borers? **100% - % found in 3a**

4. Calculate the percentage of energy passed from the Corn-borer larvae to the Bluejay.

5. Calculate the percentage of energy passed from the Bluejay to the Hawks.

6. Calculate the average percentage of energy passed from each trophic level.

Making Sense of the Discovering Patterns in Pyramids Investigation

See-Think-Wonder

Use the graphic organizer below to record your ideas from the investigation.

See Things I see in the data collected	**Think** Ideas that this data makes me think about	**Wonder** Questions and wonderings I have about the data
What do you notice about the number of organisms as you move up the food chain? What happens to the amount of energy as you move up the pyramid? Do you see a pattern in the amount of energy lost from one level to the next? Which level of the pyramid includes the most energy efficient food sources?	What do you think that means about the amount of matter present at each level of the food chain?	

Analysis Questions:

1. For most food chains in nature, the average amount of energy passed from one trophic level in a pyramid of energy to the next is very similar to the number you calculated. This pattern is called “The 10% Rule.” State the 10% rule in your own words:

2. Why do you think this pattern is present in most food chains? In other words, why isn’t 100% of the energy available in one trophic level transferred to the next level? What happens to the energy each heterotroph obtains from the organisms in the level below it? (Remember, energy cannot be created or destroyed.)

3. How does the 10% rule impact how matter moves between systems of organisms at different trophic levels? What happens to matter as it cycles through organisms in a food chain?

4. In what way is energy a limiting factor for population sizes at each trophic level?

Discovering Patterns in Pyramids Investigation Rubric

Student Rubric - Discovering Patterns in Pyramids Investigation

How did you do in the investigation?

	Student Self-Score Select one		
I know how this investigation connects to our current unit.	No - I need help.	Almost	Yes
I was able to contribute to the See-Think-Wonder and / or respond to the analysis questions.	No- I need help.	Almost	Yes
I used my time well in this investigation.	No	Mostly	Yes
I plan to come in for extra help to complete parts of the investigation or ask questions.	No		Yes

What other resources could you have used to get more out of this investigation?

- More time
- More resources
- More information
- More help from my partners
- More help from my teacher
- Other:

Partner Rubric - Discovering Patterns in Pyramids Investigation

How did your partners do in the investigation?

Directions: Think back to how your partners participated in the lab. For each of the four categories, write the name(s) of your partner(s) in the appropriate box.

	Unsatisfactory	Pretty Good	Excellent
Contributions	Did not participate.	Did the minimum of what was required.	Provided useful ideas when participating in discussion.
Working with Others	Rarely listened to others. Disrupted or discouraged others' attempts to participate.	Usually listened to, shared with, and supported the efforts of others.	Listened to, shared with, and supported the efforts of others.
Time Management	Procrastinated, did not use school time or schedule provided to get work completed.	Mostly used time well and completed investigation on time.	Used time well to ensure things get done on time.

Where did the energy go?

Developing a Claim Based on Evidence from your Mathematical Model

1. Does corn provide more energy than birds, other animals, or dairy? Be sure to use evidence from your mathematical model of the energy pyramid.

2. What are the different ways that energy can be lost from corn?

    a. Do animals that eat corn eat all the plant?

    b. Is energy lost while the animal is eating and digesting the corn?

    c. How is energy lost between the point a bird or another animal eats the corn and when a human or another predator eats those animals? Consider what activities a bird might do after it eats corn, but before it's eaten by a bird or another predator.

Summary Task

Today we completed a class consensus discussion. How did it go?

1. One thing that went well in the discussion:

2. One thing we can improve the next time we have a discussion:

3. One person who helped me learn today:

4. What did you learn from this person?

5. One idea that I contributed to my group or my class:

6. In what ways is corn a more efficient source of energy?

7. Describe what happens to the energy that is not transferred between different levels of the energy pyramid?

8. Do you think mass and energy represented in the energy pyramid model is lost? Explain your answer.

9. Why was using a mathematical model useful in making claims in response to our question about whether corn provides more energy than other foods?

Staple Crops Around the World R-G-S-S

Directions for Read-Generate-Sort-Solve:

1. Read: Read the map, ORIGINS AND PRIMARY REGIONS OF DIVERSITY OF AGRICULTURAL CROPS silently. Consider where these foods and the foods from your community would be on your energy pyramid.
2. Generate: On your group's chart paper, generate ideas about concepts that are connected to the reading.
3. Sort: Have everyone in the group star one idea that they think is most relevant to the question.
4. Solve: As a group, discuss the ideas you deemed most important, and come up with a response to the questions.

- **Which other foods around the world are efficient sources of energy? Why?**
- **Why do you find different staple foods in different parts of the world?**

Generate Ideas.

Name:	**Name:**
Name:	**Name:**

- **Which other foods around the world are efficient sources of energy? Why?**
- **Why do you find different staple foods in different parts of the world?**

After discussion, individually record your answer to the prompts above.

Scientific Explanation Mini Rubric

Component	Developing	Proficient
Claim	Students articulate the explanation of the phenomena. • Claim does answer the prompt but it is inaccurate or incomplete.	Students articulate the explanation of the phenomena • Claim answers the prompt, is accurate, and is complete.
Evidence	Effectively and clearly identifies evidence that supports the explanation: includes **some** of the elements below: • At least 2 examples of evidence are provided • Provided evidence is **data** from an investigation or resource in the learning cycle • Evidence supports the explanation	Effectively and clearly identifies evidence that supports the explanation: includes **all** of the elements below: • At least 2 examples of evidence are provided • Provided evidence is **data** from an investigation or resource in the learning cycle • Evidence supports the explanation
Reasoning	Effectively and clearly demonstrates scientific reasoning that links the evidence to the claim. Includes **some** of the elements below: • Plants, like corn, form the lowest level of the food web • Photosynthesis in plants converts sunlight to stored chemical energy • The movement of energy & matter up each link in the food web is inefficient (only a small % is available to next rung) • However, energy and matter are conserved – it is used by organisms at each level for their own life processes, or released into the environment in the form of heat • Consuming food at lower levels of the food web (corn) is efficient and allowed for human population growth, so many societies relied heavily on cereal crops • The assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future • Includes a logic statement that links the evidence to the claim (including words such as because and therefore) that clearly demonstrates logical reasoning	Effectively and clearly demonstrates scientific reasoning that links the evidence to the claim. Includes **all** of the elements below: • Plants, like corn, form the lowest level of the food web • Photosynthesis in plants converts sunlight to stored chemical energy • The movement of energy & matter up each link in the food web is inefficient (only a small % is available to next rung) • However, energy and matter are conserved – it is used by organisms at each level for their own life processes, or released into the environment in the form of heat • Consuming food at lower levels of the food web (corn) is efficient and allowed for human population growth, so many societies relied heavily on cereal crops • The assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future • Includes a logic statement that links the evidence to the claim (including words such as because and therefore) that clearly demonstrates logical reasoning
Revision	Demonstrates **some** evidence of revision based on new data or information	Demonstrates evidence of revision based on new data or information

Student Self-Evaluation Circle one			**Teacher/Peer Evaluation** Circle one		
Claim	Developing	Proficient	**Claim**	Developing	Proficient
Evidence	Developing	Proficient	**Evidence**	Developing	Proficient
Reasoning	Developing	Proficient	**Reasoning**	Developing	Proficient
Glow			**Glow**		
Grow			**Grow**		

Infectious Agent or Insufficient Diet 5E

Unit 5 Food for All	Biology
Student Name:	

Goldberger's Investigation Part 1

Introduction:

According to historian Elizabeth Etheridge, as Dr. Goldberger traveled through the South, "he looked beyond the pellagrins (people that had pellagra) themselves to the way in which they lived in boxlike houses of mill villages or on tenant farms where cotton grew up to the doorstep and where there were few gardens and almost no cows in sight. He saw what the poor ate, cornbread, fatback, and syrup at almost every meal, and he noted that the well-to-do, the only group which as a class was free from pellagra, were not subjected to such dietary monotony.

Being an outsider was an advantage to him. Meat, meal and molasses looked very strange to him and so took on a significance that those who had seen it every day of their lives missed" (Etheridge, 1972, p. 70). Drawing on his observations, Dr. Goldberger designed a series of investigations to test his hypothesis about the root cause of pellagra.

Procedure:

1. Read and annotate the experiment and results summary assigned to you.
2. Identify any quantitative data obtained by researchers before, during and at the end of the investigation.
3. Create a table, chart, or other visual representation of the most important data from your assigned investigation.
4. Be ready to share the main ideas from your research summary and your data representation with your group.

Title:

Goldberger's Research Summaries

Experiment #1: The Prevention of Pellagra: A Test of Diet among Institutional Inmates (The Orphanage Study)

The Setting:
The study was conducted in 1915 at two orphanages in Jackson, Miss, identified as "M. J." and "B.J." by investigators. Children at both orphanages had been diagnosed with pellagra each spring for several years prior to the one in which the study was conducted. In the spring and summer of 1914, 79 cases of pellagra were observed in children residing at orphanage M.J. At orphanage B.J 130 cases were identified during the same time period.

Both institutions were overcrowded and had poor sanitary conditions. M.J. connected to the city sewer system, but B.J. relied on privy-type sewage disposal around which investigators found a great deal of soil pollution. In the initial stages of the study, investigators asked that no changes be made to the hygienic or sanitary conditions at either institution.

The Experiment:
The diets of children at both institutions were supplemented by the Public Health Service. Beginning in September of 1914, every child under the age of 12 was provided with 7 ounces of milk twice a day; for children under 6 years of age, milk was offered three times a day. Eggs were added to the morning meal. The proportion of foods containing protein from animals or legumes was also increased. The inclusion of fresh meat was increased from one to three or four meals each week. Beans and peas, which had only been served in the summer and fall, were added to every midday meal during all seasons.

The types and amount of carbohydrate in the residents' meals was also modified. The breakfast cereal was changed from grits (made from corn) to oatmeal, but corn was not wholly excluded from the diet. All children were allowed to have cornbread once each week, but they were no longer allowed to have cane syrup or molasses at every meal.

Results:
During the spring and summer of 1914, investigators observed 79 cases of pellagra at orphanage M.J. At least 67 of those children were still in residence at the orphanage in the summer of 1915. Following the change in diet, none of those 67 children showed symptoms of the disease the following Spring. Among the 99 residents who did not have pellagra in 1914, there were no new cases in 1915. In summary, except for newly admitted children, no cases of pellagra occurred at M.J. in 1915.

During the spring and summer of 1914, investigators observed 130 cases of pellagra at orphanage B.J. 105 of those children were still in residence in the summer of 1915. Among those 105 residents, 1 was diagnosed with pellagra during 1915. Among the 69 residents who did not have pellagra in 1914, no new cases emerged in 1915. In summary, with the exception of newly admitted residents, only one case of pellagra occurred at B.J. in 1915.

Experiment #2: The Prevention of Pellagra: A Test of Diet among Institutional Inmates. A study at the Georgia State Sanitarium

The Setting:
Investigators from the Public Health Service worked closely with the clinical director and staff of the Georgia State Sanitarium to study if changes in diet might reduce recurrent cases of pellagra. The women observed for this study were segregated by race. In October 1914, 40 Black female patients at the Sanitarium who had previously been diagnosed with pellagra were admitted to one experimental ward; 40 white women who had been diagnosed with pellagra during the previous year were admitted to a second ward. To increase the possibility that participants would remain hospitalized throughout the experiment, women with more severe mental illness were selected for the study.

The Experiment:
The diets of patients in both wards were changed as prescribed by investigators. Instructions were given to the nurses to supervise patients more closely than usual during meals. Changes to each patient's diet included the addition of 7 ounces of sweet milk at breakfast; buttermilk was given at other meals. The proportion of foods containing protein from animal or legumes was increased through the addition of half a pound of fresh beef and dried field peas or beans added to each patient's daily ration.

Oatmeal replaced grits (made from corn) as the breakfast cereal and syrup was eliminated. The amount of corn-based foods in the diet was greatly reduced. Aside from dietary changes and increased watchfulness by nurses and attendants, the routines of patients were not altered. Patients were permitted and encouraged to go outside as frequently as their physical condition and the weather permitted.

Results:
Of the 80 patients admitted to each ward during October and December of 1914, a total of 72 (36 Black and 36 white) were still under observation by investigators in October of 1915. Of the 36 Black patients, 8 had histories of contracting pellagra at least 2 times prior to the experiment; among the 36 white patients, 10 had contracted pellagra at least twice prior to the experiment. By October 1915, none of the 72 patients on either experimental ward had shown any signs of a recurrence of pellagra since beginning the experimental diet.

Among female patients not selected for the experiment, a group of 17 Black pellagrins (individuals who have had pellagra in the past) was observed for comparison. Of this group, 9 experienced a recurrence of pellagra during 1915. A similar group of 15 white pellagrins was also observed; 6 experienced recurrent pellagra during 1915. A review of sanitarium records revealed that in the four years prior to the experiment, 52.5% of Black pellagrins experienced a recurrence of the disease; the recurrence rate during the same period for white female patients was 37.5 per cent.

Experiment #3: Experimental Pellagra in the Human Subject Brought about by a Restricted Diet

The Setting:
The experiment was carried out at the farm of the Mississippi State Penitentiary, east of Jackson, Miss. which housed between 70 and 80 convicts, all of whom were white males. Prior to the experiment, there was no history of pellagra on the prison farm. White adult males were selected for the experiment because they were least susceptible to the disease.

The experiment:
Twelve convicts ranging in age from 24-50 years responded to the offer of a pardon by the Governor of Mississippi for their participation in the experiment. In February 1915, the volunteers were isolated in a small, screened cottage away from other inmates and guarded day and night. The men were observed medically between February 4 and April 19 and no evidence of pellagra was seen. Beginning on April 19, the diet of the volunteer group was restricted to consist primarily of carbohydrates. An example of one day's meals is shown below:

Breakfast: Biscuits, fried mush, grits and brown gravy, syrup, coffee with sugar
Lunch: Corn bread, cabbage, sweet potatoes, grits, syrup.
Supper: Fried mush, biscuits, rice, gravy, cane syrup, coffee, sugar.

The sugar was white granulated, the syrup a "homemade" cane syrup. No vegetable fats entered into the diet. The cornmeal and grits were of the best quality obtainable in the local market. In addition to the volunteers, the entire population of the prison camp was observed for signs of pellagra with a smaller group of 20 men receiving routine medical examinations comparable to examinations of the volunteers.

The volunteers kept about the same hours and did about the same kind and amount of work as the other convicts. The general sanitary environment was the same for volunteers and other inmates, but the hygienic environment, personal cleanliness, cleanliness of quarters, and freedom from insects, particularly bedbugs, was decidedly better for the volunteers due to the conditions of their housing.

Results.
On July 1, one volunteer was diagnosed with an unrelated illness (prostatitis) and released from the study. Of the 11 remaining volunteer participants, 6 developed dermatitis consistent with pellagra between September 12 and September 24, 1915. Nervous and gastrointestinal symptoms among those diagnosed with pellagra were mild but distinct. The diagnosis in the above cases was concurred by the Secretary of the Mississippi State Board of Health and a former superintendent of the Mississippi State Hospital for Insane. The experiment ended on October 31, 1915.

Experiment #4: The Transmissibility of Pellagra: Experimental Attempts at Transmission to the Human Subject

The Setting:
A series of experiments was conducted during the Spring of 1916 at four separate locations: the United States Pellagra Hospital, Spartanburg, S. C., the State Hospital for Insane at Columbia, S. C., the Washington Asylum Hospital, Washington, D. C., and at the Charity Hospital, New Orleans, La. The experiments were conducted across seven days during which different groups of volunteers were assembled.

A total of 16 individuals, 15 men and one woman, ranging in age from 26 to 42 years, volunteered to take part in the experiments. Thirteen of the volunteers were physicians. No restraints were imposed on the habits or activities of the volunteer participants during the period in which the experiments were conducted.

The Experiments:
Materials including blood, nasopharyngeal secretions (mucous), epidermal scales from pellagrous lesions (skin rash), urine, and feces were obtained from individuals with diagnosed cases of pellagra. During each of the seven experiments, one or more volunteers received the material in varied ways. Blood was drawn from one or more individuals with pellagra and administered to volunteers by intramuscular or subcutaneous injection.

Nasopharyngeal secretions swabbed from pellagrous patients were applied to the interior of the nose and throat of volunteers. Urine and feces obtained from persons with pellagra were mixed with flour to make a small cake that was ingested by volunteers. Scales were obtained by scraping pellagrous lesions, mashed into a powder, and ingested by volunteers. Both urine and feces were ingested by 15 of the volunteers, 5 of whom also took blood, nasal secretions, and scales.

The Results:
In the days immediately following injection, application, or ingestion of pellagrous materials, volunteers experienced symptoms ranging from soreness and stiffness at the injection site to nausea and diarrhea lasting from one to three weeks. Following the series of experiments, the volunteer subjects were observed over a period of five to seven months by others in the group. Each volunteer also submitted reports of their experience including any symptoms. During the observation period, none of the 16 volunteers developed any evidence to suggest that they had contracted pellagra.

Goldberger's Investigation Part 2

Introduction:
Individuals working in textile mills (factories that processed cotton into cloth, thread, and other products) and their families were known to have high rates of pellagra. In addition to their experimental investigations, Dr. Goldberger and his team conducted detailed surveys of families living in six textile mill villages in South Carolina. The data included in the images below was published in 1920.

Procedure:

Analyze the information found in the Graph and Data Table below. Use your See-Think-Wonder graphic organizer to record your findings.

Figure 1.

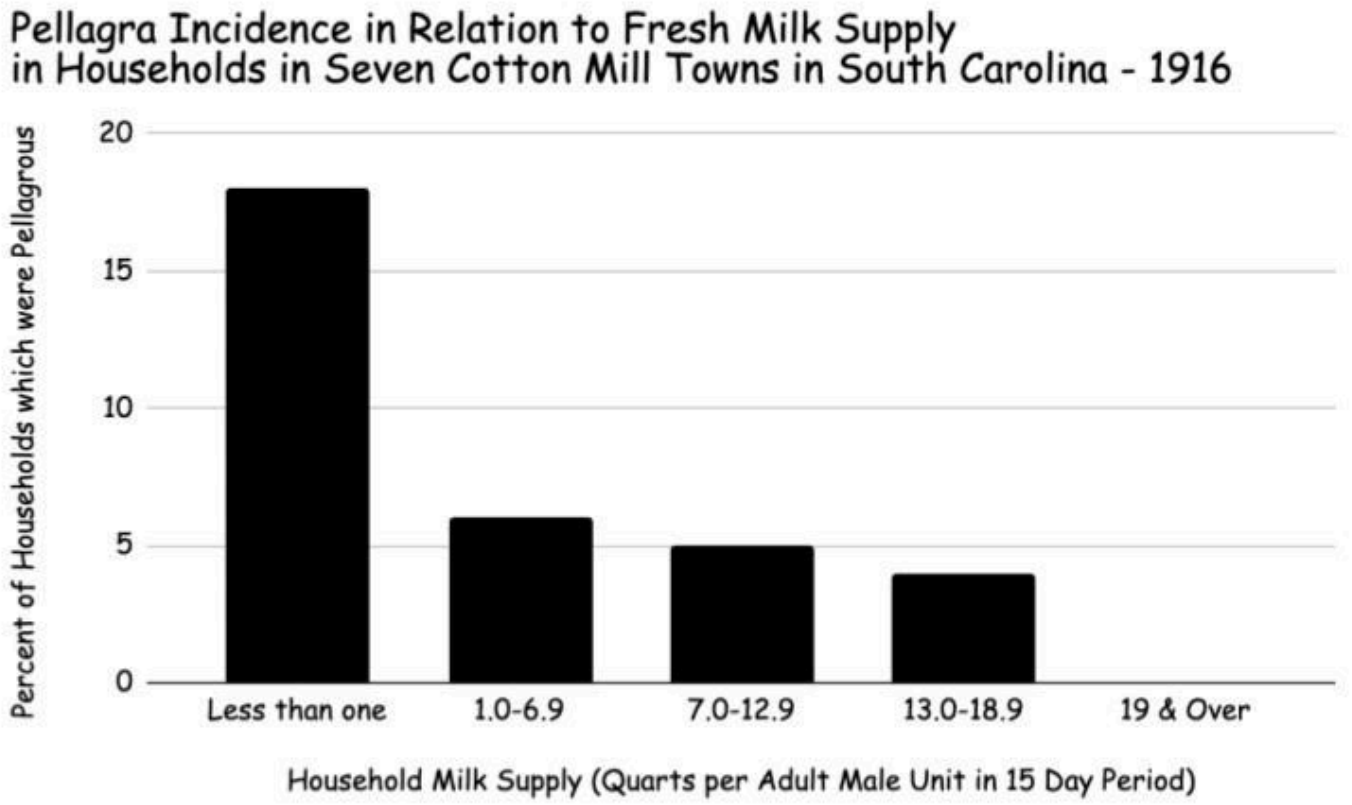


Figure 1

Data Table 1.

Number of definite cases of pellagra and rate per 1000 among persons of different income classes in seven cotton-mill villages of South Carolina in 1916.

Half-month family income per adult male unit	Total			Males			Females		
	Number of persons	Number of Cases	Rate per 1000	Number of persons	Number of Cases	Rate per 1000	Number of persons	Number of Cases	Rate per 1000
Less than $6.00	1,312	56	42.7	650	20	30.8	662	36	54.4
$8.00-$7.99	1,037	27	26.0	521	6	11.5	516	21	40.7
$8.00-$9.99	784	10	12.8	376	4	10.7	408	6	14.7
$10.00-$13.99	736	3	4.1	363	0	0.0	373	3	8.0
$14.00 and over	291	1	3.4	161	1	6.2	130	0	0.0
All incomes	4,160	97	23.3	2.701	31	14.9	2,089	66	31.6

Making Sense of Goldberger's Investigation

See	Think	Wonder

Considering the summaries from all studies, individually respond to the following prompts:

1. How significant or widespread was this problem, based on the scale or proportion of affected patients? Use numerical evidence to support your statement.

2. What change was common to all the studies that appeared to solve the pellagra epidemic? Use specific evidence and cite which study the evidence came from.

3. Based on that evidence, construct an initial explanation of what caused the pellagra epidemic.

Goldberger's Investigation Rubric

Student Rubric - Goldberger's Investigation

How did you do in the investigation?

	Student Self-Score Select one		
I know how this investigation connects to our current unit.	No - I need help.	Almost	Yes
I was able to contribute to the See-Think-Wonder and / or respond to the analysis questions.	No- I need help.	Almost	Yes
I used my time well in this investigation.	No	Mostly	Yes
I plan to come in for extra help to complete parts of the investigation or ask questions.	No		Yes

What other resources could you have used to get more out of this investigation?

- More time
- More resources
- More information
- More help from my partners
- More help from my teacher
- Other:

Partner Rubric - Goldberger's Investigation

How did your partners do in the investigation?

Directions: Think back to how your partners participated in the lab. For each of the four categories, write the name(s) of your partner(s) in the appropriate box.

	Unsatisfactory	Pretty Good	Excellent
Contributions	Did not participate.	Did the minimum of what was required.	Provided useful ideas when participating in discussion.
Working with Others	Rarely listened to others. Disrupted or discouraged others' attempts to participate.	Usually listened to, shared with, and supported the efforts of others.	Listened to, shared with, and supported the efforts of others.
Time Management	Procrastinated, did not use school time or schedule provided to get work completed.	Mostly used time well and completed investigation on time.	Used time well to ensure things get done on time.

Pellagra Text

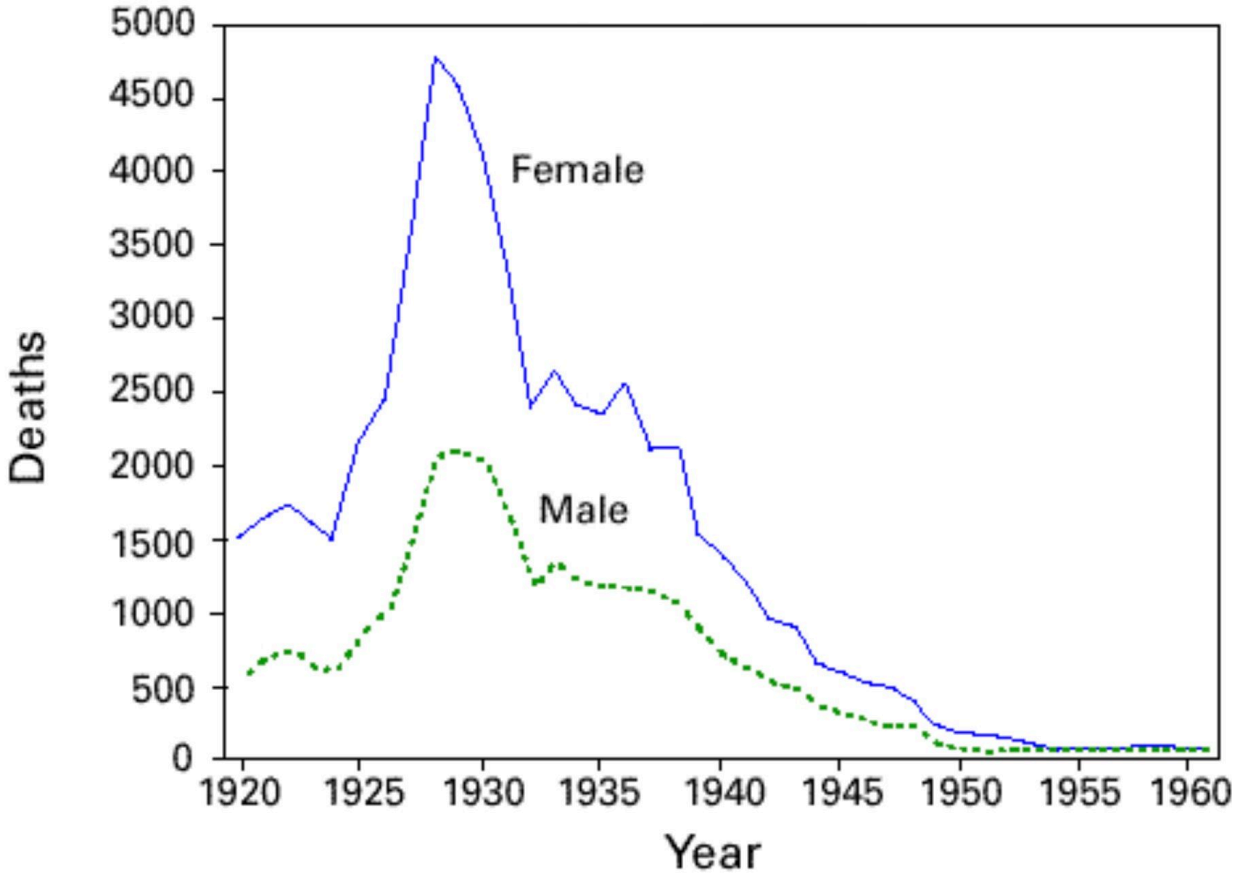
The Discovery

As research by the Public Health Service established inadequate diet, not infectious agents, as the root cause of pellagra, disagreements arose over what to do with that knowledge. Drawing on his findings, Goldberger insisted that leaders must "improve economic conditions, increase wages, reduce unemployment" and make non-carbohydrate foods "cheap and readily accessible" to reduce rates of pellagra.

Over time, those who had argued pellagra was infectious slowly admitted that it was more likely the disease was related to diet. Little changed, however, in the labor practices of the South. In the summer of 1920, pellagra cases declined for the first time in a decade. A banquet was held in Spartanburg, SC, to honor Dr. Goldberger and celebrate the death of pellagra. The guest of honor was not convinced that the epidemic was conquered. World War I had created a boom in the cotton industry and he suspected that higher wages allowed families to eat a more diverse diet.

Examine the graph below. Did the pellagra epidemic end in 1920?

FIGURE 2. Number of reported pellagra deaths, by sex of decedent and year — United States, 1920–1960



As the graph indicates, the pellagra epidemic did not end in 1920. Instead, in the early 1920's, cotton prices fell and cases of pellagra skyrocketed. Published reports brought the situation to the attention of the U.S. President who called for the American Red Cross and Congress to respond by sending aid to the region. Southern leaders, however, refused their help, claiming that no one in the "New South" who was willing to work was starving.

Frustrated, Dr. Goldberger returned to his lab to search for a cure for the disease. While dietary experiments had helped researchers identify foods to treat and prevent pellagra, the specific molecule missing from the diet of pellagrins remained elusive. In 1937, eight years after Joseph Goldberger's death from cancer, **niacin** was determined to be the "pellagra-preventing factor." Six years later (1942), at the height of World War II, the federal government began requiring the addition of niacin, thiamine, and riboflavin to milled wheat and corn. Adding niacin to the milled grains used to make carbohydrate-rich foods effectively ended the U.S. pellagra epidemic.

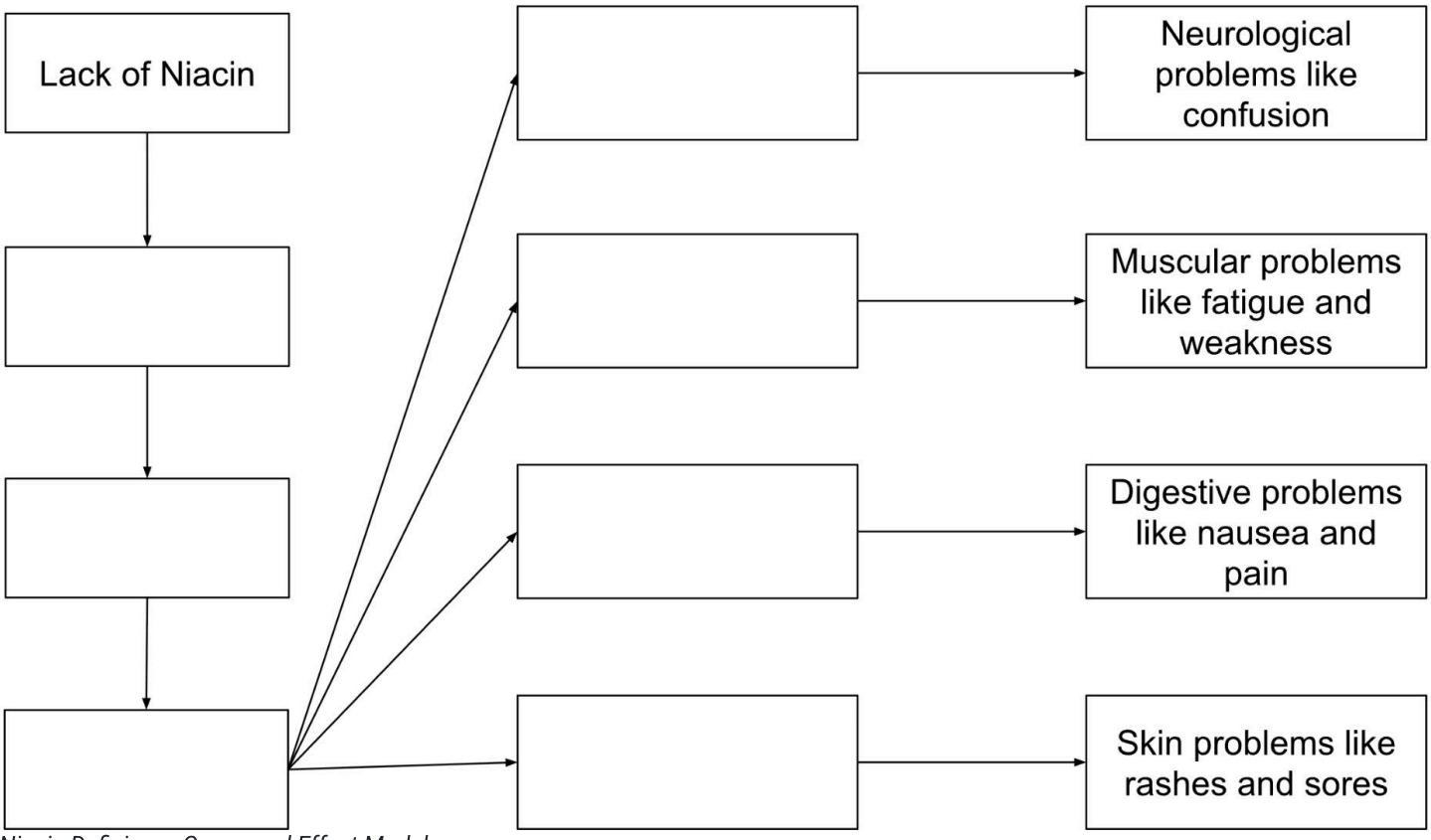
What is Niacin?

Niacin, or Vitamin B3, is used by organisms including humans to make NAD, a molecule cells use for both anaerobic and aerobic cellular respiration. In cells, NAD acts as a carrier molecule. Just like workers in a factory are neither consumed nor produced, NAD is neither an input nor output of cellular respiration. Without NAD, however, neither aerobic nor anaerobic cellular respiration occurs. In other words, if niacin is not available cellular respiration does not occur, even when cells have plenty of glucose and oxygen.
As you learned in Unit 1, cells use energy in the form of ATP to function and reproduce. In multicellular organisms, cells that have the highest need for energy are most affected by limited amounts of niacin. In the human body, cells in the nervous system need energy to conduct messages within the brain and throughout the body. Skin cells and cells that line the digestive tract are replaced frequently by cellular division, a process that requires energy.

The Role of Niacin

Modeling the role of Niacin

Use what you read about the role of niacin combined with what you already know about cellular respiration and the symptoms of pellagra to model the role niacin plays in the disease.



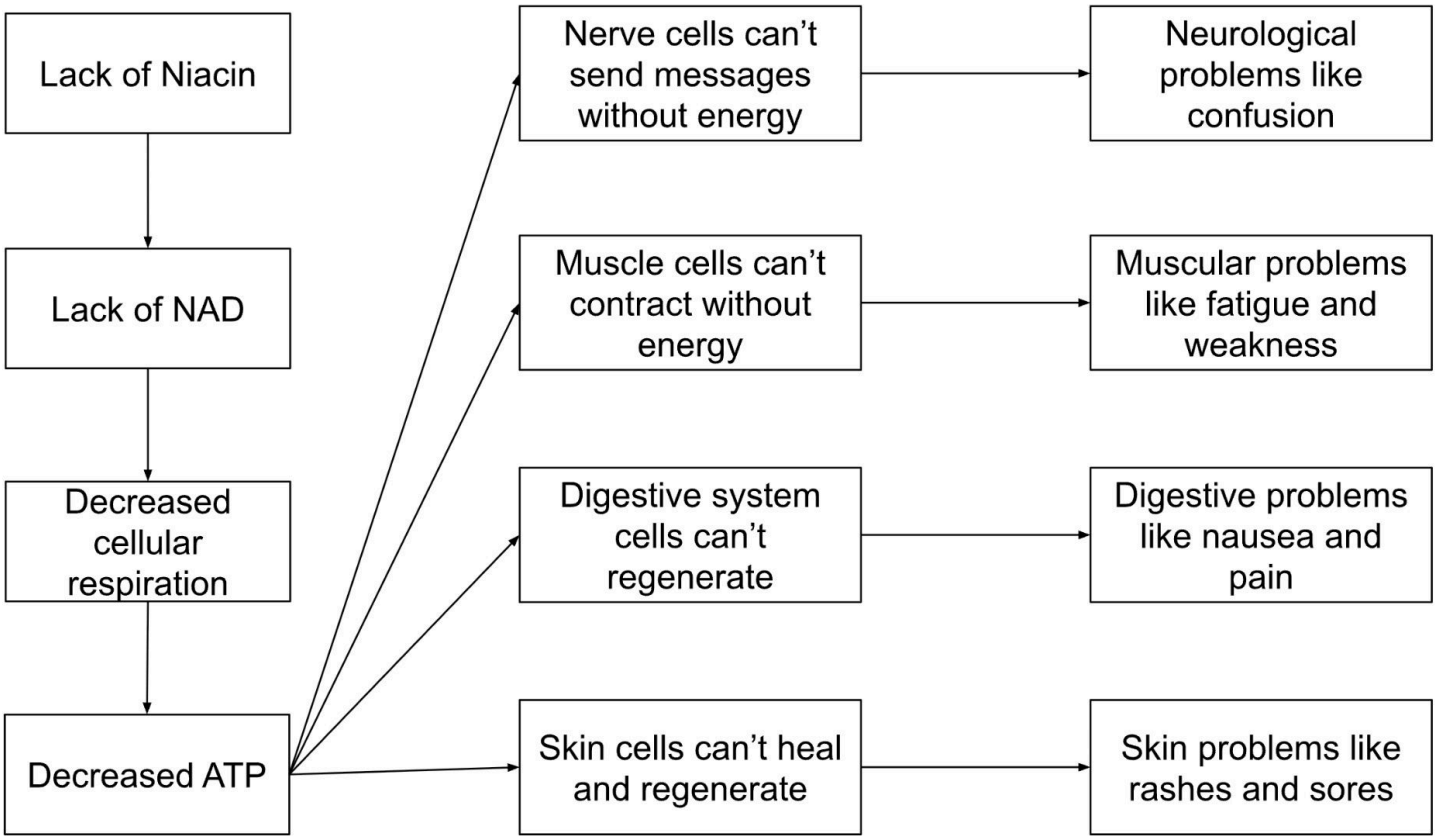
Niacin Deficiency Cause and Effect Model

Explaining the Pellagra Epidemic

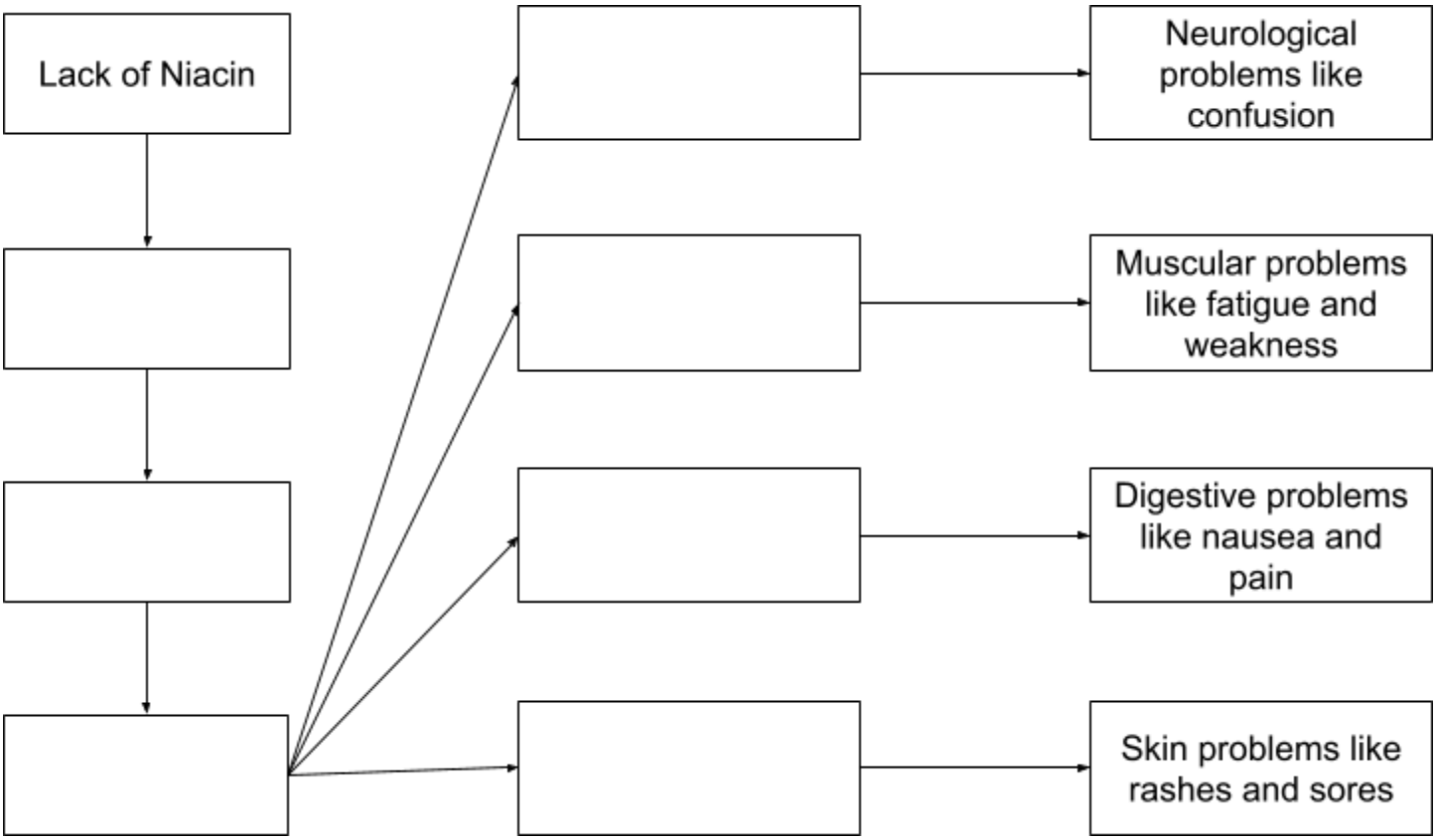
Using evidence from the studies, the text, your model, and any other relevant sources, explain the pellagra epidemic including:

- The significance of the epidemic based on its scale and the proportion of affected people
- The cause of the disease and how it was discovered
- How the cause of the disease resulted in the symptoms observed in patients

Niacin Deficiency Cause and Effect Model Student Work



Niacin Deficiency Cause and Effect Model Student Work


Lack of Niacin
Neurological problems like confusion
Muscular problems like fatigue and weakness
Digestive problems like nausea and pain
Skin problems like rashes and sores

Decomposition Investigation

Introduction:

In this investigation we are going to compare the decomposition (the breakdown) over time of two different types of foods. A bowl of fruit and vegetables, and a fast food burger and fries.

Prediction

1. Observe the two images below.

Fast Food Hamburger and Fries

Bowl of Fruit and Vegetables

2. Predict which one will decompose faster. What other differences do you expect to observe during the decomposition of these two types of foods?

Observing Decomposition

1. Observe decomposition, using the Time Lapsed Fruit and Vegetable Decomposition Video and The Decomposition Of McDonald's Burgers And Fries . Note that the first video is shot over 74 days and the second is over 56 days.

2. Use the See-Think-Wonder graphic organizer to record your observations and questions

See	Think	Wonder
• What is causing the changes in both videos? • Which one is happening faster? • Does the size of the food change? • How does the process look different in each video?		

Making Sense of the Decomposition Investigation

Analysis Questions:

Use your observations from the Decomposition Investigation to respond to the following prompts:

1. What do you think is ‘escaping’ or being released from the food?

2. Where do you think the matter in the food is going?

3. Why do you think a plant is growing out of the decaying vegetables, but not the burger and fries?

4. Where do you think the energy for this process is coming from?

Decomposition Investigation Rubric

Student Rubric - Decomposition Investigation

How did you do in the investigation?

	Student Self-Score Select one		
I know how this investigation connects to our current unit.	No - I need help.	Almost	Yes
I was able to contribute to the See-Think-Wonder and / or respond to the analysis questions.	No- I need help.	Almost	Yes
I used my time well in this investigation.	No	Mostly	Yes
I plan to come in for extra help to complete parts of the investigation or ask questions.	No		Yes

What other resources could you have used to get more out of this investigation?

- More time
- More resources
- More information
- More help from my partners
- More help from my teacher
- Other:

Partner Rubric - Decomposition Investigation

How did your partners do in the investigation?

Directions: Think back to how your partners participated in the lab. For each of the four categories, write the name(s) of your partner(s) in the appropriate box.

	Unsatisfactory	Pretty Good	Excellent
Contributions	Did not participate.	Did the minimum of what was required.	Provided useful ideas when participating in discussion.
Working with Others	Rarely listened to others. Disrupted or discouraged others' attempts to participate.	Usually listened to, shared with, and supported the efforts of others.	Listened to, shared with, and supported the efforts of others.
Time Management	Procrastinated, did not use school time or schedule provided to get work completed.	Mostly used time well and completed investigation on time.	Used time well to ensure things get done on time.

Decomposition Text

A constant competition

Have you ever competed with a friend or family member for the last piece of pizza or slice of pie? You may not be aware of them, but you also compete with bacteria and fungi for food. All living things require energy to grow and reproduce. While some plant-like bacteria get energy from the sun or from chemicals in their environment, most bacteria and all fungi are heterotrophs that obtain energy from other living things or dead organic material.

What do bacteria and fungi do with our food? The same thing we do! They break down large organic molecules found in food (e.g. carbohydrates and proteins) into smaller molecules (e.g. glucose and amino acids) that they use to obtain energy or as building blocks for cellular structures. Bacteria are prokaryotic, lack mitochondria, and use anaerobic cellular respiration to transform the energy in glucose into molecules of ATP. Fungi are eukaryotic. If oxygen is present, fungi like mold and mildew use the process of aerobic respiration to produce ATP. If oxygen is not present, they can perform anaerobic cellular respiration. Like other organisms, bacteria and fungi use the ATP made through cellular respiration to carry out cellular processes. The other output, carbon dioxide is released into the atmosphere where it can be used by autotrophs as a source of carbon for photosynthesis.

Molecular recycling centers

While competing for food with microscopic organisms may seem like a nuisance, bacteria and fungi play a crucial role in our environment. They are molecular recycling centers. In forests, grasslands, rivers, and oceans, bacteria and fungi use dead organisms as a source of energy and nutrients. Along with other decomposers, bacteria and fungi break down dead leaves, logs, and animal carcasses in the same way they digest and consume “our” food. Once the organic material is broken down, they use some of the molecules to build new structures and convert the energy in glucose into ATP.. As they decompose dead organisms, the release elements including nitrogen, sulfur, and phosphorus into the air and soil which can then be used by plants and other autotrophs to make new structures. Parts of those plants become food for animals and other heterotrophs - and the cycle continues.

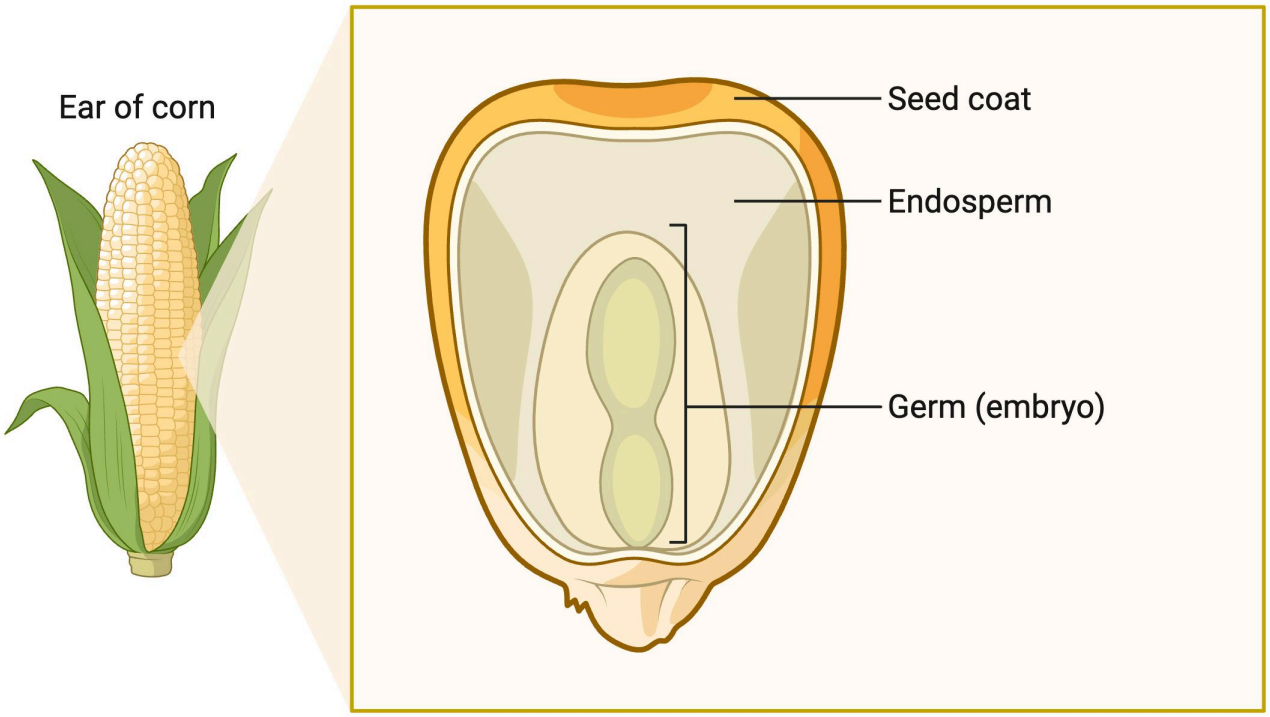
Winning the battle?

Microscopic bacteria and fungal spores are everywhere, including in and on our food. We only become aware of them when they reproduce to the point that we can see them or smell the gasses they produce. To preserve food and prevent disease, humans have developed methods of food preservation that inhibit the growth of bacteria and fungi. Traditional food preservation methods create an environment in which bacteria and fungi are less likely to grow. Examples include chilling, salting, drying, and fermentation. Some food processing methods also make nutrients easier for our body to digest, absorb, and utilize.

Food Processing and Pellagra

As foodways became industrialized in the early 20th Century, food scientists invented new processes and machinery to preserve food. Some of the new processing methods removed nutrients bacteria and fungi need to grow and reproduce. The Beall Degerminator, patented in 1901, is an example. When corn kernels go through the degerminator, the machine removes the plant embryo and other nutrient rich parts of the corn kernel (seed). The cornmeal produced by this process is almost exclusively starch, or long chains of glucose. Degermination prevents “spoiling” (being consumed by fungi and bacteria) and increases the “shelf life” of cornmeal, making it possible for it to be shipped and sold far from where it was grown, but the nutritional value of corn is greatly reduced. One of the nutrients removed in this process is niacin, the missing nutrient in the diet of people suffering from pellagra. Today, ultra-processed foods made from artificial chemicals that bacteria and fungi cannot use as nutrients make up a significant portion of the human diet.

Anatomy of Corn Kernel



Corn Kernal Structure. Created in https://BioRender.com

C-E-R Graphic Organizer

1. Prewriting:
What is your question?

Support for your explanation

Claim based on the evidence (What is the answer to your question based on your evidence?)	Evidence (Observations/data that answers your question)	Scientific Reasoning (Why you think this happened based on background research)

2. Peer Review
Have a peer read your work and provide comments on what you plan to write.

3. Drafting
Write your explanation in paragraph form.

Scientific Explanation = Claim + Evidence + Science Reasoning
My claim is (fill in with above claim) because (evidence and science reasoning)

C-E-R Rubric

Component	Not Evident	Level 1: Beginning	Level 2: Developing	Level 3: Advancing	Level 4: Proficient
Claim	Does not make a claim	Claim does not answer the question (i.e., describe the relationship between the 2 variables)	Claim does answer the question but it is inaccurate.	Claim answers the question, and is accurate, but is incomplete	Claim answers the question, is accurate, and is complete. Completely describes the trend in the relationship between the IV and DV where appropriate.
Evidence	Does not provide evidence	Only provides inappropriate evidence (evidence does not support the claim)	Provides appropriate, but insufficient evidence to support the claim. May include some inappropriate evidence	Provides appropriate and sufficient evidence to support the claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support the claim
Reasoning: Science Concepts	Does not include reasoning	Restates evidence and does not include explanation of science concepts	Includes explanation of science concepts but all are inappropriate concepts that do not link evidence to claim	Includes explanation of some science concepts that link evidence to the claim, but are insufficient (one or more concepts that should have been included are not included) or some are inappropriate	Includes explanation of science concepts that link evidence to the claim (concepts are appropriate), and they are sufficient (no omission of key science concepts) and are clearly stated and accurate.

Reasoning: Logic	Does not include reasoning	Restates evidence or claim and does not include a logic statement that links the evidence to the claim	Attempts to include a logic statement that links the evidence to the claim but does not adequately link the evidence to the claim.	Includes a logic statement that attempts to link the evidence with the claim but needs to be more clearly stated to demonstrate logical reasoning	Includes a logic statement that links the evidence to the claim (including words such as *because* and *therefore*) that clearly demonstrates logical reasoning

Summary Task

Today we completed a class consensus discussion! How did it go?

1. One thing that went well in the discussion:

2. One thing we can improve the next time we have a discussion:

3. One person who helped me learn today:

4. What did you learn from this person?

5. One idea that I contributed to my group or my class:

6. Develop a model that represents how photosynthesis and cellular respiration play key roles in the cycling of matter and flow of energy in an ecosystem.

7. Describe the role decomposers play in the model you generated above, OR add decomposers to your model.

8. Considering your model, as matter cycles through organisms, how does it change forms and where is it stored, and what role does energy play in those transformations?

9. What evidence did you use to create your model? Hint: think back to investigations you have done in the previous learning cycle and in earlier units (Marathon Runner).

RGSS Organizer

Indigenous people in Meso-America relied heavily on corn, yet there is no evidence that they suffered from pellagra. How did they process the corn they ate, and how did they avoid pellagra?

Guiding prompt: How did indigenous knowledge protect many populations from diet related diseases such as pellagra? Frame your response in terms of changes of energy and matter in the system.

1. **Watch** the video and/or **Read** the text.
2. **Generate** ideas on which claim is better supported by the scientific ideas presented in the texts, video, or evidence from your investigation.

Name: _____	**Name: _____**	**Name: _____**

1. **Sort -** Discuss each solution or idea and ⍰star⍰ or highlight the ideas that seem the most useful.
2. **Solve -** Individually compose your response to the prompt incorporating the most useful ideas from the sorting process! Use evidence from the investigation and reasoning from the texts to support your claim.

Ultra-processed Food Data

Reflect

Based on his data collection in 1916, Dr. Goldberger recommended that leaders make a diversity of foods "cheap and readily accessible"

Do you think we follow that advice today? What types of foods are cheap and readily available in your community?

American's Diet

Researchers wanted to know more about how much ultra-processed food Americans eat, and if the amount has increased over time. They used surveys to collect USA diet information from 2007-2012.

Use the See-Think-Wonder graphic organizer to record observations and questions about the data below.

Data Table 1. Changes in the dietary contribution of ultra-processed foods (% or total energy intake) from 2007-2012.

Year	2007-2008	2009-2010	2011-2012
% of ultra processed food of total energy intake in the diet	57.6	58.9	59.7

See-Think-Wonder Graphic Organizer

See	Think	Wonder

Revised Explanation Mini Rubric

Component	Developing	Proficient
Claim	Students articulate the explanation of the phenomena. • Claim does answer the prompt but it is inaccurate or incomplete.	Students articulate the explanation of the phenomena • Claim answers the prompt, is accurate, and is complete.
Evidence	Effectively and clearly identifies evidence that supports the explanation: includes **some** of the elements below: • At least 2 examples of evidence are provided • Provided evidence is **data** from an investigation or resource in the learning cycle • Evidence supports the explanation	Effectively and clearly identifies evidence that supports the explanation: includes **all** of the elements below: • At least 2 examples of evidence are provided • Provided evidence is **data** from an investigation or resource in the learning cycle • Evidence supports the explanation
Reasoning	Effectively and clearly demonstrates scientific reasoning that links the evidence to the claim. Includes **some** of the elements below: • Decomposition helps change matter and energy in an ecosystem • Through decomposition, matter becomes available to other organisms which recombine chemical elements in different ways to form different products • Cellular respiration provides the energy for life processes – the energy was first converted from sunlight through photosynthesis • The assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future • Includes a logic statement that links the evidence to the claim (including words such as because and therefore) that clearly demonstrates logical reasoning	Effectively and clearly demonstrates scientific reasoning that links the evidence to the claim. Includes **all** of the elements below: • Decomposition helps change matter and energy in an ecosystem • Through decomposition, matter becomes available to other organisms which recombine chemical elements in different ways to form different products • Cellular respiration provides the energy for life processes – the energy was first converted from sunlight through photosynthesis • The assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future • Includes a logic statement that links the evidence to the claim (including words such as because and therefore) that clearly demonstrates logical reasoning
Revision	Demonstrates **some** evidence of revision based on new data or information	Demonstrates evidence of revision based on new data or information
Student Self-Evaluation Circle one		**Teacher/Peer Evaluation** Circle one

Claim	Developing	Proficient	**Claim**	Developing	Proficient
Evidence	Developing	Proficient	**Evidence**	Developing	Proficient
Reasoning	Developing	Proficient	**Reasoning**	Developing	Proficient
Glow			**Glow**		
Grow			**Grow**		

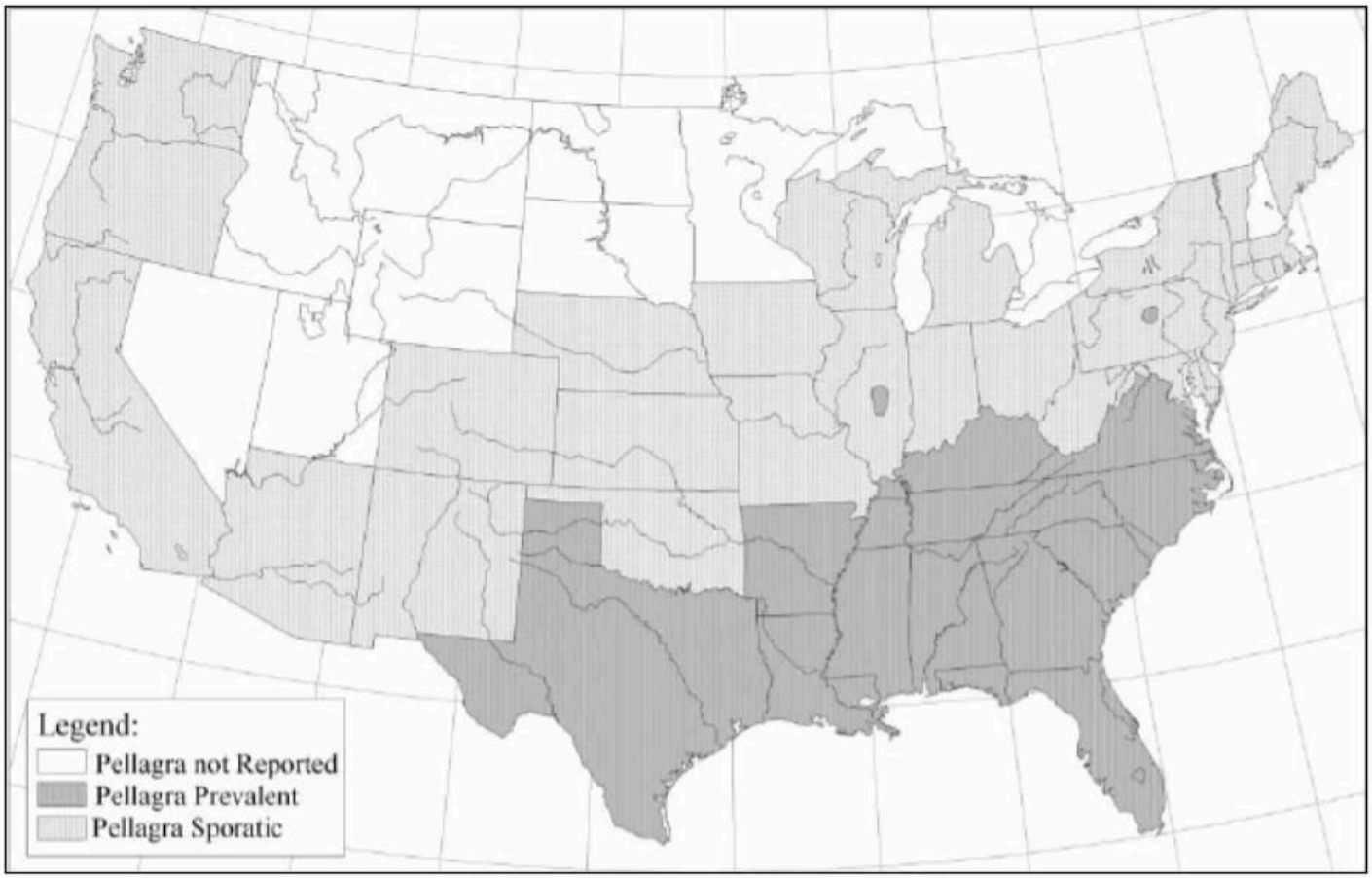
Food for Plants 5E

Unit 5 Food for All	Biology
Student Name:	

Inequity of Pellagra

Introduction: Through our investigations so far, we've learned that people eating a monotonous diet, mainly consisting of processed corn, were not getting sufficient niacin, which led to people suffering from pellagra. You'll now have a chance to investigate some remaining questions about what groups were impacted most by pellagra and why. Examine the map and graph below and use your observations to complete the See-Think-Wonder.

Geographic distribution of Pellagra cases in the United States, 1911



Demographic distribution of Pellagra deaths in the United States, 1912-1940

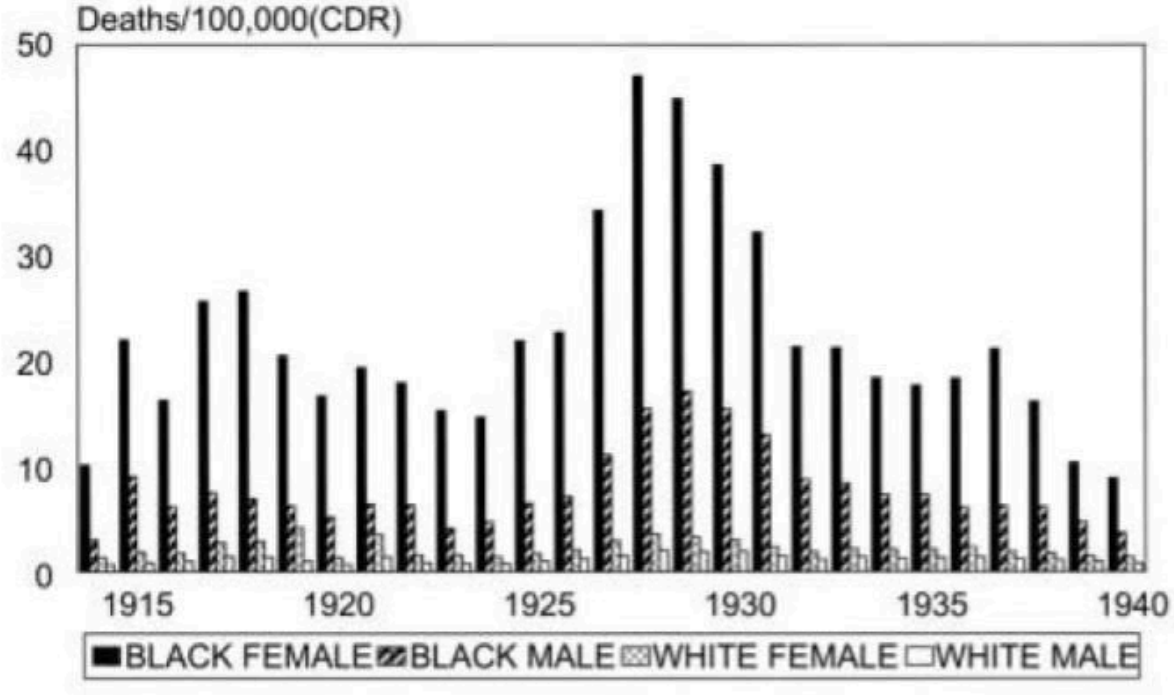


Fig. 1. Pellagra mortality: 1914–1940 (U.S. Bureau of the Census, Mortality Statistics, 1914–1940). CDR = crude death rate.

See	Think	Wonder
What do you notice about the scale of the geographic distribution of pellagra in 1911? What do you notice about the scale of the pellagra death rates? Are some populations impacted disproportionally?		

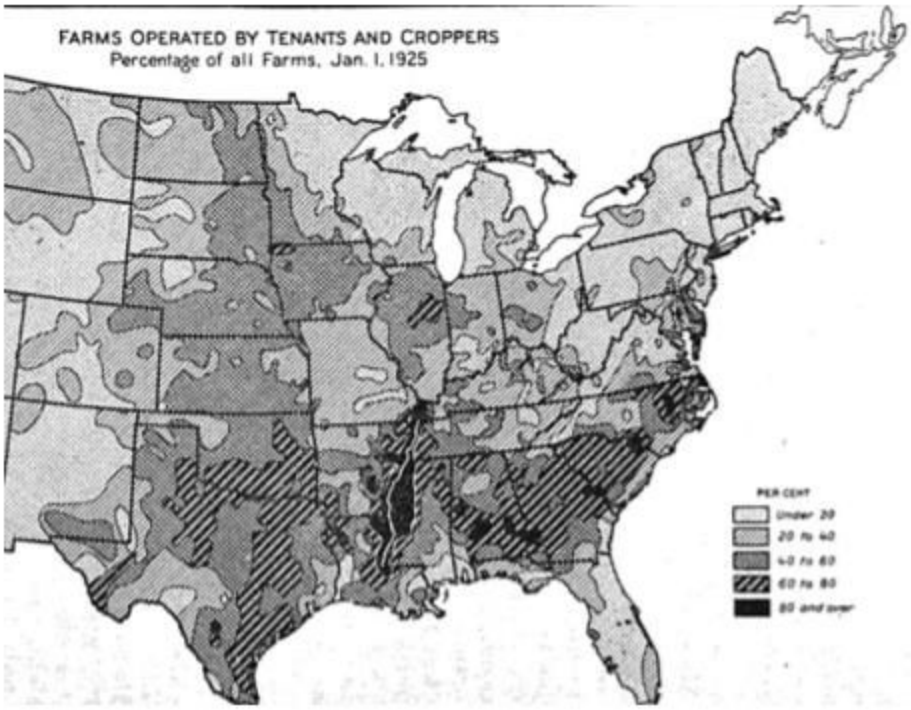
Agricultural Practices in the SE US Investigation Launch

The class previously noticed that the pellagra epidemic was concentrated in the southern and southeastern US and that Black people were impacted disproportionately compared to their white counterparts. In order to better understand these trends the class will learn about what life was like for many Black people in the south and southeastern US during the pellagra epidemic.

1. Watch the video, Life in the South After the Civil War , and using your observations, respond to the following prompt: What was life like for Black people after the civil war?

2. Examine the map, image, and graphs below and use your observations below each image.

The map below shows the percentage of farms operated by tenant farmers and sharecroppers in the beginning of 1925



Observations:

The image below is of a typical tenant farmer plot of land, where cash crops (non-food or low nutrition crops) such as cotton were grown.

Sharecropper's cotton farm

Observations:

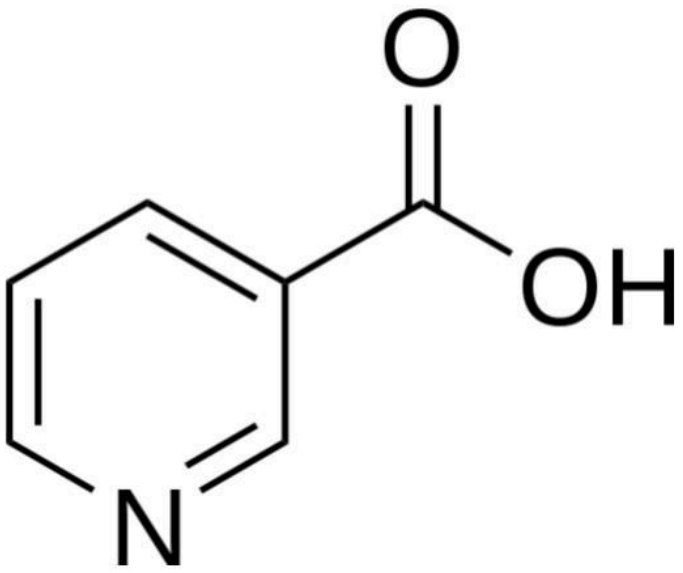
Agricultural Practices in the SE US Investigation

Part 1: Where do plants obtain the building blocks for niacin and other molecules including amino acids?

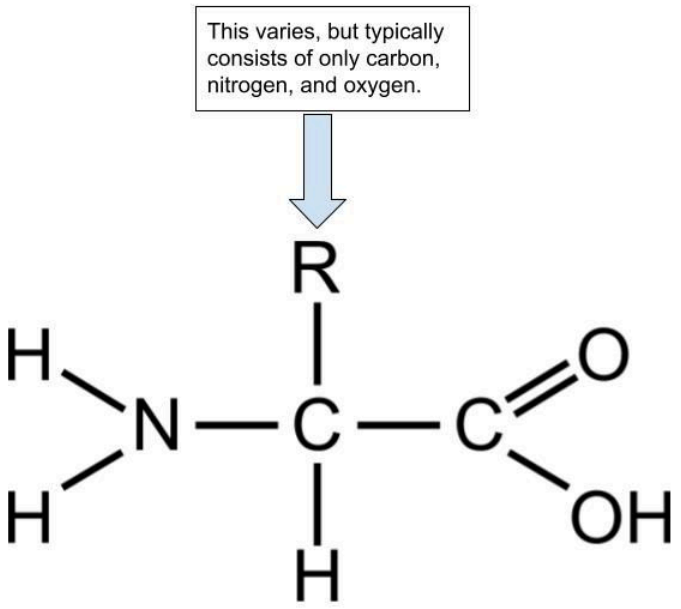
In the previous 5E, we discovered that without niacin in corn, people may suffer the deadly symptoms of pellagra. So how do we ensure that our agricultural practices do not cause negative health consequences due to a lack of niacin and essential amino acids?

In order to make better decisions about farming practices, we will need to better understand where nutrients like niacin and amino acids come from. Examine the structure of Niacin and a typical amino acid structure below.

1. What are the building blocks of Niacin? What elements does it contain?



Niacin



Amino Acid

2. Where do you think a plant gets all the building blocks for Niacin? Revisit your models from the first investigation. Can you account for all the sources of all the elements that Niacin is composed of?

Part 2: How do different farming practices affect yields and the amount of building blocks plants need for niacin and other molecules including amino acids?

1. Each image and table pair below illustrate a different approach to farming: monoculture farming and crop rotation (polyculture) farming. What differences do you notice in the two approaches?

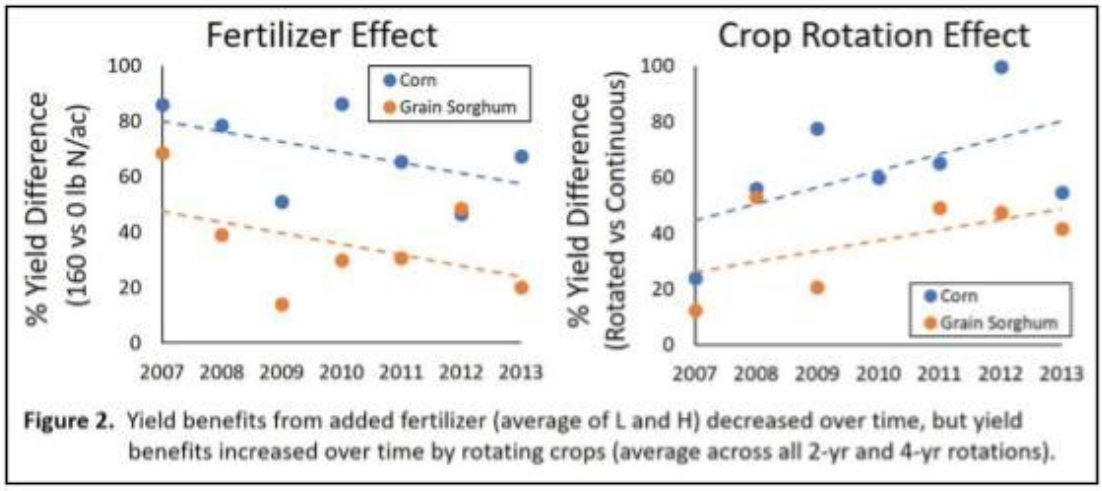
Example of Monoculture Chart				
	Crop bed 1	Crop bed 2	Crop bed 3	Crop bed 4
Year 1	corn	corn	corn	corn
Year 2	corn	corn	corn	corn
Year 3	corn	corn	corn	corn

The same crop is grown in the same bed of soil every year.

Example of Vegetable Crop Rotation Chart				
	Crop bed 1	Crop bed 2	Crop bed 3	Crop bed 4
Year 1	corn	soybean	grain sorghum	oat/clover
Year 2	oat/clover	corn	soybean	grain sorghum
Year 3	grain sorghum	oat/clover	corn	soybean

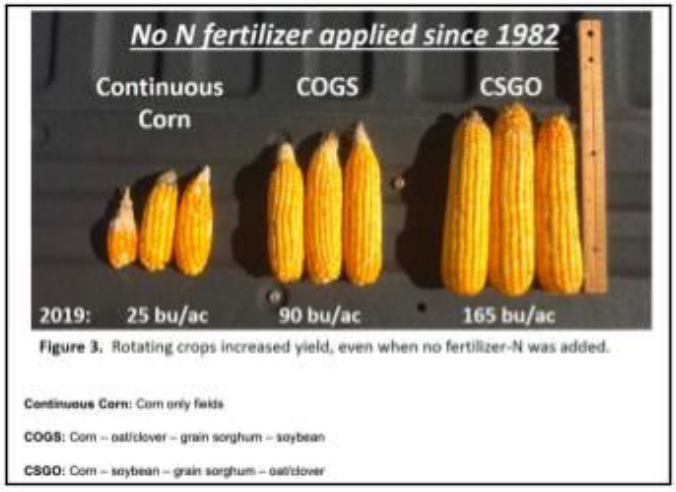
These crops are rotated each year so they grow in different soil beds.

1. The graphs, graphic, and table that follow provide data related to the effects of using a crop rotation approach versus a monoculture approach with or without fertilizer. Note observations in the space provided below each.



Fertilizer Effect vs Crop Roattion Effect

Observations:



Rotating Crop Effect (with no fertilizer)

Observations:

Management	Treatment Description	Soil Organic Carbon (ton C/acre)			Soil Total Nitrogen (ton N/acre)		
		Soil Depth (inches) 0-3"	Soil Depth (inches) 0-12"	Soil Depth (inches) 0-60"	Soil Depth (inches) 0-3"	Soil Depth (inches) 0-12"	Soil Depth (inches) 0-60"
Continuous indicates there was no crop rotation. When two or more crops are indicated, those crops are rotated.	Continuous corn	7.4	24.0	48.1	.69	2.28	5.40
	Continuous grain sorghum	7.7	25.2	57.9	0.70	2.36	6.11
	Continuous soybean	8.3	25.7	51.9	0.78	2.45	5.58
	Corn - soybean	8.0	25.6	62.5	.74	2.41	6.47
	Grain sorghum - soybean	8.1	24.1	47.8	0.76	2.36	5.44
	Corn - soybean - grain sorghum - oat/clover	9.0	27.9	65.1	0.84	2.63	6.83
	Corn - oat/clover - grain sorghum - soybean	8.8	26.5	60.5	0.83	2.54	6.47

Data source: https://cropwatch.unl.edu/2021/more-diverse-crop-rotations-improve-yield-yield-stability-and-soil-health

Observations:

Making Sense of Agricultural Practices in the SE US Investigation

See	Think	Wonder
What did you notice about the building blocks of niacin and amino acids?	Where do you think those building blocks come from?	

Analysis Questions

1. How do you think nitrogen becomes available to plants? Where do you think it comes from, and what do you think happens to it as plants are eaten and matter moves through the food chain?

2. How do you think fertilizer and crop rotation change the soil, and why does that matter to plants?

Agricultural Practices in the SE US Investigation Rubric

Student Rubric - Agricultural Practices in the SE US Investigation

How did you do in the investigation?

	Student Self-Score Select one		
I know how this investigation connects to our current unit.	No - I need help.	Almost	Yes
I was able to contribute to the See-Think-Wonder and / or respond to the analysis questions.	No- I need help.	Almost	Yes
I used my time well in this investigation.	No	Mostly	Yes
I plan to come in for extra help to complete parts of the investigation or ask questions.	No		Yes

What other resources could you have used to get more out of this investigation?

- More time
- More resources
- More information
- More help from my partners
- More help from my teacher
- Other:

Partner Rubric - Agricultural Practices in the SE US Investigation

How did your partners do in the investigation?

Directions: Think back to how your partners participated in the lab. For each of the four categories, write the name(s) of your partner(s) in the appropriate box.

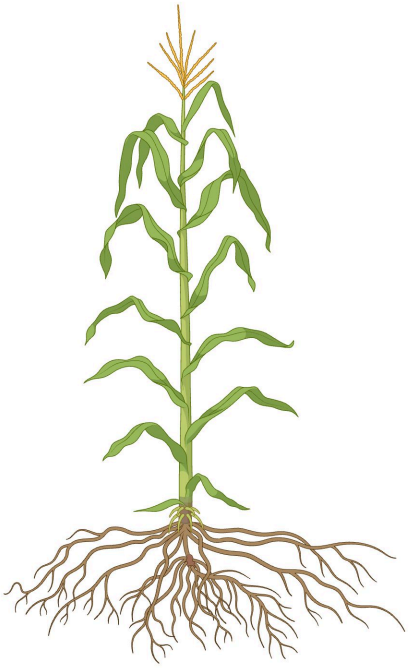
	Unsatisfactory	Pretty Good	Excellent
Contributions	Did not participate.	Did the minimum of what was required.	Provided useful ideas when participating in discussion.
Working with Others	Rarely listened to others. Disrupted or discouraged others' attempts to participate.	Usually listened to, shared with, and supported the efforts of others.	Listened to, shared with, and supported the efforts of others.
Time Management	Procrastinated, did not use school time or schedule provided to get work completed.	Mostly used time well and completed investigation on time.	Used time well to ensure things get done on time.

How do Agricultural Practices Impact Crops?

How can farming practices impact the amount and health of crops grown?

1. Recreate the model you developed in the previous investigation to show how plants recombine chemical elements to make glucose and oxygen.

2. Based on the investigation you just conducted, what would you add to your model to show how chemical elements are recombined to make products like niacin and amino acids. Be sure to cite evidence from the investigation.



Model Template - Corn Plant. Created in https://BioRender.com

Evidence that supports your model:

3. Develop a model based on evidence from the investigation to show how farming practices impact the amount and health of crops like corn. Be sure to include the chemical elements and molecules that are inputs and outputs in plant growth processes.

Continuous Corn or Cotton	**Corn Mixed with other Crops and Ground Cover**

Summary Task

Today we completed a class consensus discussion. How did it go?

1. One thing that went well in the discussion:

2. One thing we can improve the next time we have a discussion:

3. One person who helped me learn today:

4. What did you learn from this person?

5. One idea that I contributed to my group or my class:

6. Describe how corn grew and where it gets its energy and matter?

7. Describe the flow of energy and matter into plants and what sources of energy and matter a plant produces as a result.

8. What role did energy have in driving the cycling of matter in your model for how plants produce glucose, oxygen, niacin, and amino acids?

Ella May Story Notecatcher

Guiding prompts for the text

- How was Ella's childhood diet more able to meet her nutritional needs than the diets of Ella's children, and why?
- How did some factors (causes) have larger effects than others, and what is the significance of the scale at which causes occur?

Directions

1. Read your assigned text on the story of Ella May to find more information on your guiding questions
2. Respond to the guiding questions in the space below
3. Record additional questions you have about the text or about the impact of pellagra on Ella May or her family
4. Consider and discuss how evidence from the entire unit helped you explain why the diet Ella is described as eating in her childhood provided better nutrition compared to the diet her children ate. .

Response:

Additional questions:

Ella May Story Texts

Text #1 Historical Description

No matter how hard she worked it was never enough. Six twelve hour shifts at the mill only earned Ella May nine dollars each week and her five children needed food, clothing, and shoes. She had borne nine children, but four had died from pellagra and other ailments. Although she was white, Ella and her children lived in a cabin in the Black community near the mill where she worked. She was comfortable in a place where so many others were struggling and neighbors helped each other.

Had things been this hard for her parents? She didn't remember it that way. Growing up on a small farm in the Smoky Mountains, Ella loved playing in the forest and streams. The family's garden provided corn, squash, and beans to eat in the summer or can for the long, cold winters. Dried corn could also be used for hominy, the nutritious porridge her mother prepared using methods the Cherokee had practiced for centuries. Her father hunted rabbits, squirrels, and deer, and the family raised pigs for meat. Above all, Ella had fond memories of sitting on the porch learning the old songs mountain folks loved to sing.
When Ella's father learned that logging companies were hiring, the family left the farm to live in newly built logging camps along the North Carolina and Tennessee border. It was in these camps that teenage Ella began to sing and write songs to entertain others. The demand for lumber was high and the trees came down quickly. One fell the wrong way killing Ella's father. Ella's new husband was also injured in a logging accident so the young family left the mountains for the cotton fields and textile mills of the Carolinas.

Initially, Ella picked cotton in South Carolina but eventually found work as a spinner in the textile mills of Gaston County, North Carolina. Her husband left the family and she struggled to feed her children and prevent the dreaded rash that appeared on their faces, hands, and feet each Spring. Conditions at the mill were difficult and wages rose and fell with the price of cotton. Ella soon heard that union organizers from New York were coming to the region to help the workers demand better wages. Perhaps if they all banded together those who owned and managed the mills would have to pay them more. Along with hundreds of others, Ella joined the union and became a leader in what would become one of the largest labor uprisings to occur in the Southeastern United States.

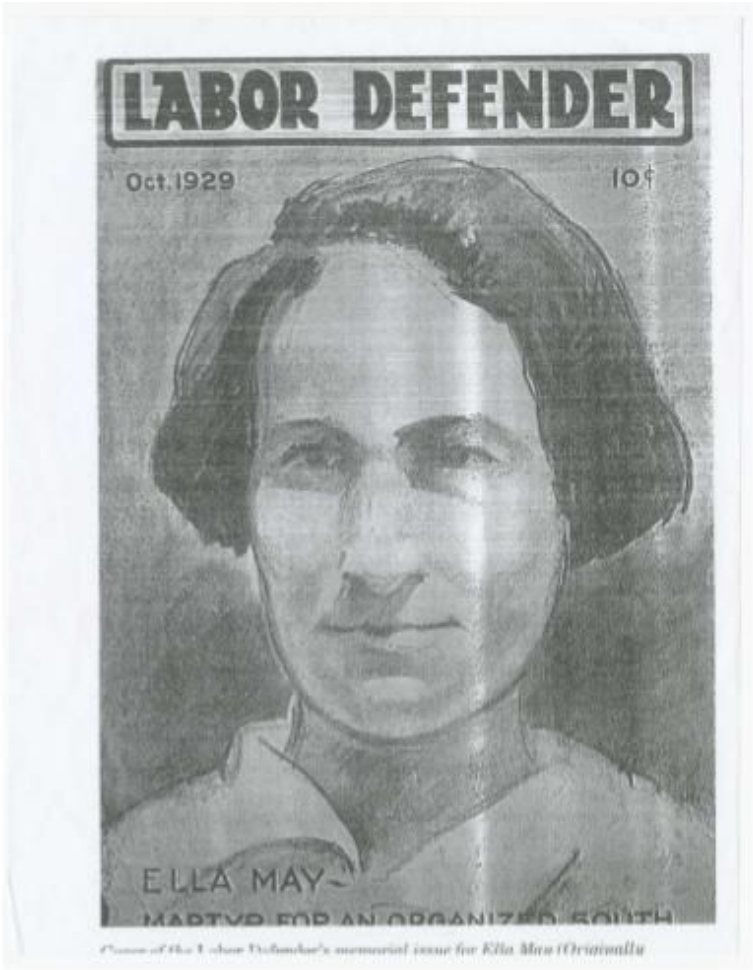
Like the dreaded rash, the strike began in April and stretched on through a long, hot summer. A valued leader and organizer, Ella wrote ballads and sang them at union rallies. Her most popular tune was Mill Mothers Lament. Ella also became known for recruiting Black workers to the strike. At that time, few mills employed African Americans for anything other than janitorial work, but the mill near Ella's community was fully integrated and she encouraged her Black coworkers and neighbors to join the union. In the eyes of many, cross-racial organizing presented an even greater threat than mill workers seeking higher wages. An integrated strike would not be tolerated.

On September 14, 1929, Ella May was on her way to a meeting with other union organizers when the truck in which she was riding encountered a barricade. Ordered to turn around, the driver complied with the demand, but the truck was pursued and eventually crashed. A group of white men approached the truck and a single shot rang out. Ella May fell dead, shot through the heart as she stood on the truck bed facing the mob. Ella May and an unborn child were buried on her 29th birthday, September 17, 1929.

Text #2: Images

Ella May's children

Ella May Wiggins ' Tombstone



Ella May Wiggins as pictured on the cover of the Labor Defender, October 1929

Text #3: Song Lyrics

Mill Mother's Lament
– by Ella May Wiggins

We leave our home in the morning,
We kiss our children good-bye,
While we slave for the bosses,
Our children scream and cry.

And when we draw our money,
Our grocery bills to pay,
Not a cent to spend for clothing,
Not a cent to lay away.

And on that very evening,
Our little son will say,
"I need some shoes, dear mother,
And so does sister May."

How it grieves the heart of a mother,
You every one must know,
But we can't buy for our children,
Our wages are too low.

Now listen to me, workers,
Both women and men,
We are sure to win our union,
If all would enter in.

I hope this will be a warning,
I hope you will understand,
And help us win our victory,
And lend to us a hand.

It is for our little children,
That seem to us so dear,
But for us nor them, dear workers,
The bosses do not care.

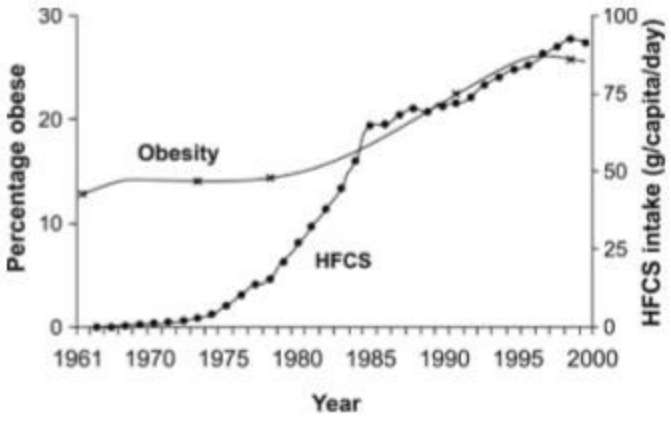
But understand, all workers,
Our union they do fear,
Let's stand together, workers,
And have a union here.

Inequitable Food Systems Resources

High Fructose Corn Syrup (HFCS)

HFCS is a highly processed sweetener made from corn. Research has shown that there is a relationship between consumption of HFCS and type 2 diabetes. HFCS is found in many heavily processed foods such as candy, packaged sweets like cupcakes, sodas, and fast food. The United States consumes the most HFCS, with an average of 55 pounds of the sweetener per person per year.

Figure 1. Association between high-fructose corn syrup and obesity in the United States.



Food Deserts

Food deserts are geographic areas where residents have few to no convenient options for securing affordable and healthy foods — especially fresh fruits and vegetables. Disproportionately found in high-poverty areas, food deserts create extra, everyday hurdles that can make it harder for kids, families and communities to grow healthy and strong.

Generally speaking, food deserts are more common in areas with:

- smaller populations;
- higher rates of abandoned or vacant homes; and
- residents who have lower levels of education, lower incomes, and higher rates of unemployment.

Food deserts are also a disproportionate reality for Black communities, according to a 2014 study from Johns Hopkins University. The study compared U.S. census tracts of similar poverty levels and found that, in urban areas, Black communities had the fewest supermarkets, white communities had the most, and multiracial communities fell in the middle of the supermarket count spectrum.

Final Pellagra Explanation Mini Rubric

Component	Developing	Proficient
Claim	Students articulate the explanation of the phenomena. • Claim does answer the prompt but it is inaccurate or incomplete.	Students articulate the explanation of the phenomena • Claim answers the prompt, is accurate, and is complete.
Evidence	Effectively and clearly identifies evidence that supports the explanation: includes **some** of the elements below: • At least 2 examples of evidence are provided • Provided evidence is **data** from an investigation or resource in the learning cycle • Evidence supports the explanation	Effectively and clearly identifies evidence that supports the explanation: includes **all** of the elements below: • At least 2 examples of evidence are provided • Provided evidence is **data** from an investigation or resource in the learning cycle • Evidence supports the explanation
Reasoning	Effectively and clearly demonstrates scientific reasoning that links the evidence to the claim. Includes **some** of the elements below: • During photosynthesis, plants use carbon dioxide to create sugar molecules • The hydrocarbon backbone of sugar molecules can be recombined and used to create larger molecules (such as proteins) • Nitrogen and other nutrients from the soil are incorporated into living things • Depleted soils may not be able to provide the essential building blocks of organic molecules • The assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future • Includes a logic statement that links the evidence to the claim (including words such as because and therefore) that clearly demonstrates logical reasoning	Effectively and clearly demonstrates scientific reasoning that links the evidence to the claim. Includes **all** of the elements below: • During photosynthesis, plants use carbon dioxide to create sugar molecules • The hydrocarbon backbone of sugar molecules can be recombined and used to create larger molecules (such as proteins) • Nitrogen and other nutrients from the soil are incorporated into living things • Depleted soils may not be able to provide the essential building blocks of organic molecules • The assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future • Includes a logic statement that links the evidence to the claim (including words such as because and therefore) that clearly demonstrates logical reasoning
Revision	Demonstrates **some** evidence of revision based on new data or information	Demonstrates evidence of revision based on new data or information
Student Self-Evaluation Circle one		**Teacher/Peer Evaluation** Circle one

Claim	Developing	Proficient	**Claim**	Developing	Proficient
Evidence	Developing	Proficient	**Evidence**	Developing	Proficient
Reasoning	Developing	Proficient	**Reasoning**	Developing	Proficient
Glow			**Glow**		
Grow			**Grow**		

Unit Closing

Unit 5 Food for All	Biology
Student Name:	

Final Task Rubric

Component	Developing	Proficient

Making Connections	Effectively and clearly makes connections between historical and modern phenomena. Includes **some** of the elements below:
	• Describes the incomplete scientific understanding that lead to the pellagra epidemic
	  • De-germination of corn would provide a healthy and cheap food source
	  • People could subsist on energy-rich food alone
	• Describes how new evidence/ new scientific understanding lead to the realization of:
	  • Ultra-processed corn lacked niacin, an essential ingredient for cellular respiration
	  • Without sufficient ATP, people became very ill
	  • People need a diverse diet to be healthy and thrive
	• Provides at least one example of a connection between a historical problem of inequity/ lack of access to food and a current one.
		Effectively and clearly makes connections between historical and modern phenomena. includes **all** of the elements below:
		• Describes the incomplete scientific understanding that lead to the pellagra epidemic
		  • De-germination of corn would provide a healthy and cheap food source
		  • People could subsist on energy-rich food alone
		• Describes how new evidence/ new scientific understanding lead to the realization of:
		  • Ultra-processed corn lacked niacin, an essential ingredient for cellular respiration
		  • Without sufficient ATP, people became very ill
		  • People need a diverse diet to be healthy and thrive
		• Provides at least one example of a connection between a historical problem of inequity/ lack of access to food and a current one.

Current Innovations	The poster effectively and clearly explains how the innovation addresses a current local problem.Includes **some** of the elements below:
	• A local problem is described
	• The innovation is described and an explanation provides:
	  • How the innovation addresses the local problem
	  • The explanation is based on scientific understandings discussed throughout the unit
	  • The explanation incorporates how matter and energy flows between and within systems
		The poster effectively and clearly explains how the innovation addresses a current local problem.Includes **all** of the elements below:
		• A local problem is described
		• The innovation is described and an explanation provides:
		  • How the innovation addresses the local problem
		  • The explanation is based on scientific understandings discussed throughout the unit
		  • The explanation incorporates how matter and energy flows between and within systems

Implications for the Future	A clear discussion on implications is provided that includes **some** of the following components: • How it supports a shift towards more anti-racist systems. • How it supports equitable access of healthy food for historically marginalized groups • How it is a good fit for their community • How it addresses relevant criteria and constraints (social, economic, physical)	A clear discussion on implications is provided that includes **all** of the following components: • How it supports a shift towards more anti-racist systems. • How it supports equitable access of healthy food for historically marginalized groups • How it is a good fit for their community • How it addresses relevant criteria and constraints (social, economic, physical)