

# Soil & Food Security baMEL

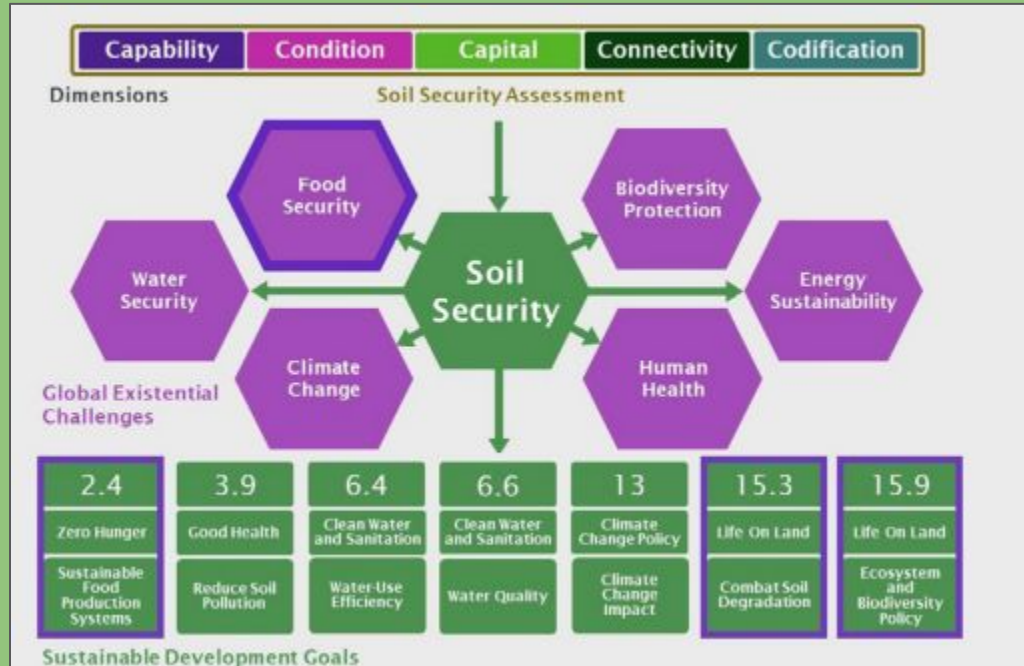


# What does Soil Science tell us about Food Security?

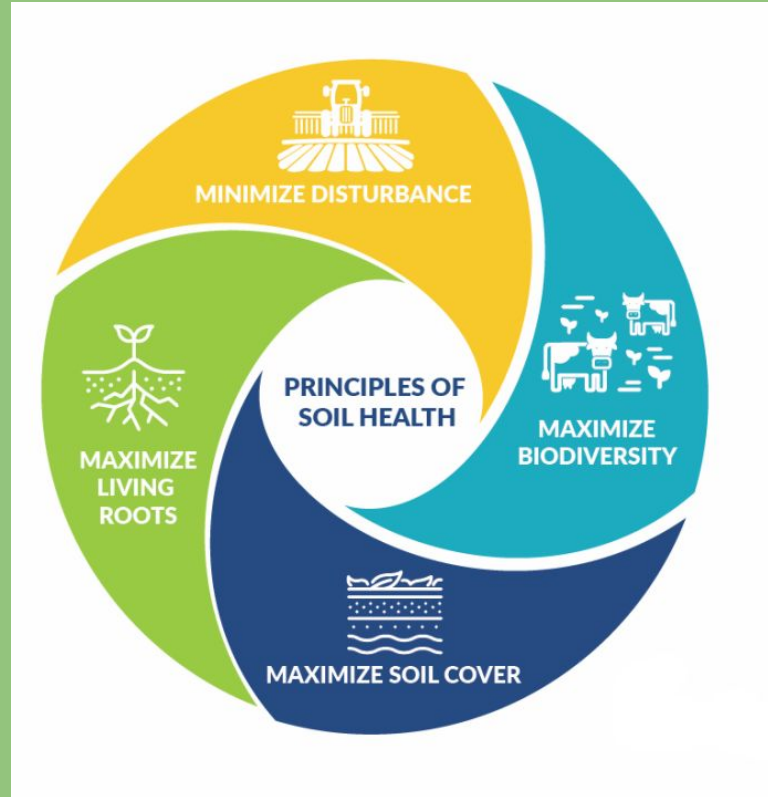
- Soil Security and Food Security are interconnected concepts
- Without healthy soil, nutritious food will be much harder to produce into the foreseeable future, and how we access food influences the relationship individuals and communities have with the soil
- The 5C's (dimensions) of the soil security framework for soil management:
  - soil condition
  - soil capability
  - soil capital
  - connectivity
  - codification (policy)



# What does Soil Science tell us about Food Security?



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*“The nation that destroys its  
soil destroys itself.”*

President Franklin D Roosevelt, on February 26, 1937,  
writing to all State Governors in the USA to make a case for  
effective soil management.

# Relevant NGSS Connections...

## MS Earth and Space Science DCIs

**ESS3.A.1:** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geological processes.

**ESS3.C.2:** Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

## HS Earth and Space Science DCIs

**ESS3.A.1:** Resource availability has guided the development of human society

**ESS3.C.1:** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

**ESS3.C.2:** Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

Can you think of other connections?



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Models



# 3 Explanatory Models.....

## **Model A**

Increased knowledge has resulted in improved farming methods and soil health. These improvements will solve food challenges.

## **Model B**

Our use of natural resources has negative effects on soil health. This places risks on food access for our growing population.

## **Model C**

Soil is not necessary for food security. Other farming methods that do not rely on soil will solve food security problems.



# Model Plausibility Ratings (MPR)



Investigating different ideas about the soils and their role in providing food for our growing global population.



## B. Model Plausibility Ratings

Food Security

Name: [REDACTED]	Date: 4/28/23
Teacher: Piper	Period: 1
Group members, if any: This Table	

Please work on this individually and read the following information carefully.

Humans create **models** to help explain things.

Below are three models. These provide different ideas about the role of soils in providing food for our growing global population.

**Model A:** Increased knowledge has resulted in improved farming methods and soil health. These improvements will solve food challenges.

A person who supports this model makes the following argument:

Human advances in agriculture and soil science will solve food security challenges. Farming is better when people take care of their soil in different ways. They can use soil improvement and conservation methods.

**Model B:** Our use of natural resources has negative effects on soil health. This places risks on food access for our growing population.

A person who supports this model makes the following argument:

As our population increases, so does the pressure placed on our natural resources. Together, these pressures affect soils, making them unusable to grow food. Soils are too wet, too dry, or lack the ingredients needed for crop production. Climate change is making the problem even worse.

**Model C:** Soil is not necessary for food security. Other farming methods that do not rely on soil will solve food security problems.

A person who supports this model makes the following argument:

While soil is important for farming, farming methods that don't use soil can provide new sources of food. These crops will be grown in water or come from ocean plants.

Plausibility is a judgment we make about the potential truthfulness of one explanatory model compared to another. The judgment may be tentative (not certain). You do not have to be committed to that decision.

Circle the plausibility of each model. [Make three circles, one for each model.]

	Greatly implausible (or even impossible) <span style="float: right;">Highly plausible</span>									
Model A	1	2	3	4	5	6	7	8	9	10
Model B	1	2	3	4	5	6	7	8	9	10
Model C	1	2	3	4	5	6	7	8	9	10

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Evidence Texts





# Read Through the Evidence Texts (~ 40 to 50 minutes)

Many methods: Jigsaw, short spurts, all-in-one day, independently, etc

Common method - read as a class, while breaking down the figures

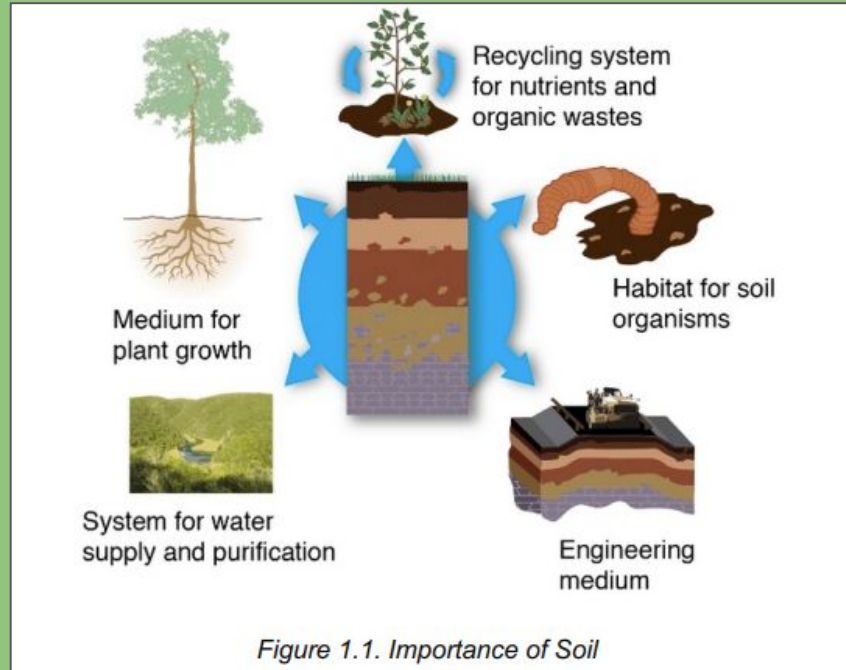
It may take a class period, depending on your grade-level, and other teaching contexts

Other possible methods?



# Evidence Text #1

Soil is a non-renewable resource that degrades over time as humans grow crops



## Evidence Text #2

Farmers use different ways to increase soil health and make food grow. Most farming methods help soil health, but some methods do not work.

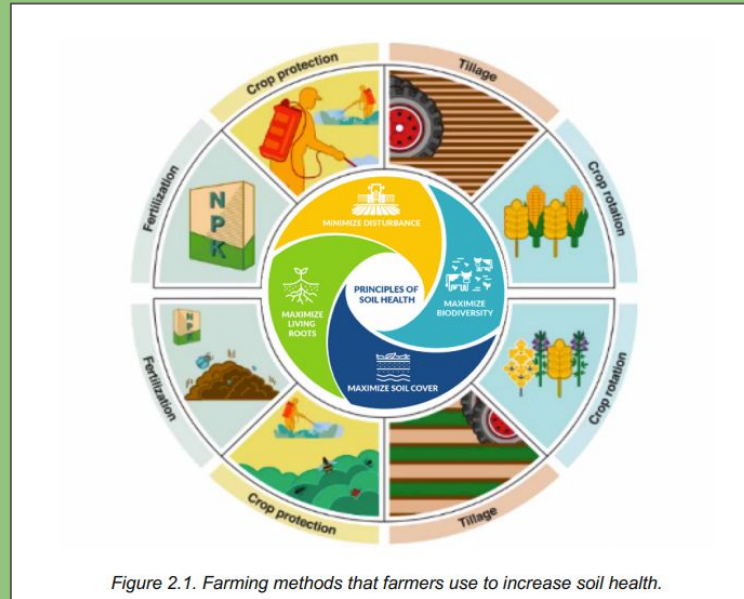
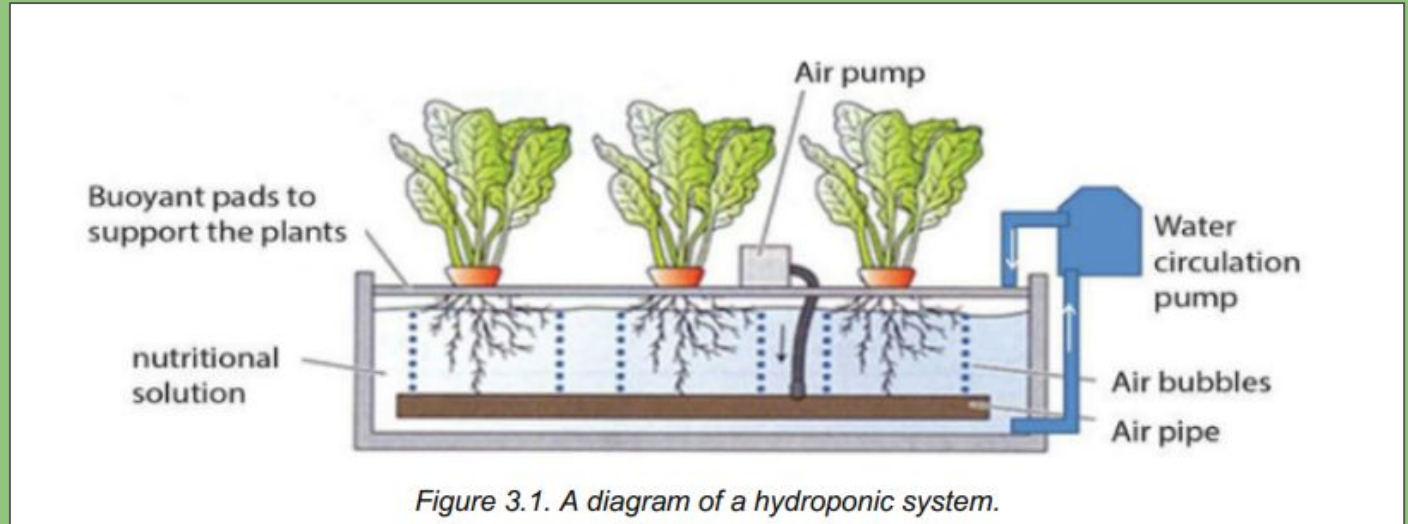


Figure 2.1. Farming methods that farmers use to increase soil health.



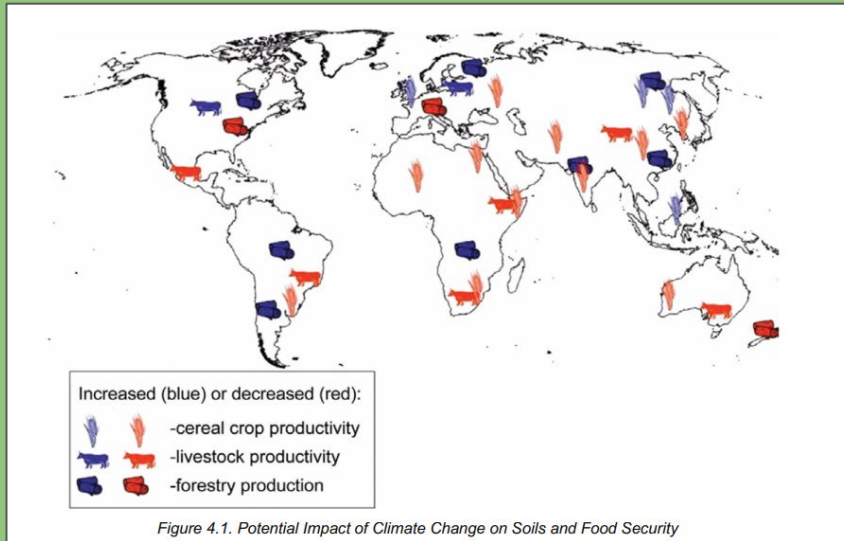
## Evidence Text #3

Hydroponics is a way to grow crops indoors in nutrient-rich water without soil. Not all crops can grow using hydroponics.



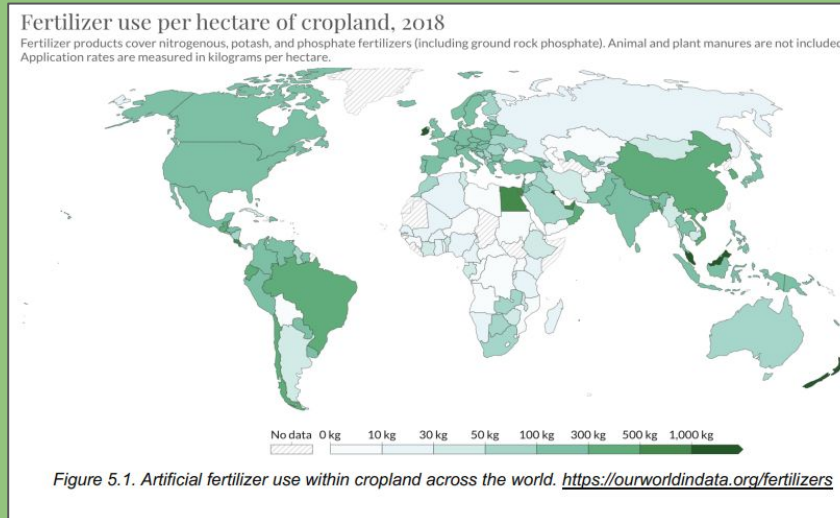
## Evidence #4

Climate change has led to changes in temperature and precipitation amounts around the world. Temperature and precipitation changes could make soils unusable for growing crops.



## Evidence Text #5

Farmers use fertilizer to chemically balance soils and improve soil health. When fertilizers are used on a land plot too long, the soil can be harmed.



# Evidence Text #6

The ocean covers 70% of our planet's surface. The ocean has many natural resources to solve food security problems, such as plants and animals for food.

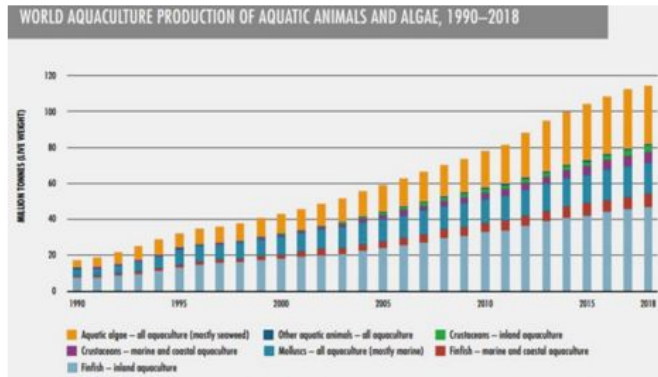


Figure 6.1. Growth of Aquaculture Industry, 1993-2018. [www.shorturl.at/jwCP4](http://www.shorturl.at/jwCP4)

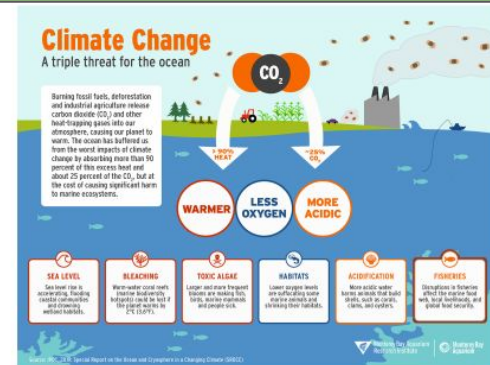


Figure 6.2. Impacts of Climate Change on Earth's Oceans. <https://www.mbari.org/climate-change/>



## Evidence #7

An alternative farming method is to grow crops in underwater bubbles. Crops grown this way do not need soil.



Figure 7.1. Picture of Nemo's Garden



## Evidence Text #8

Farmers are finding new ways to use nitrogen-fixing bacteria to help grow food.

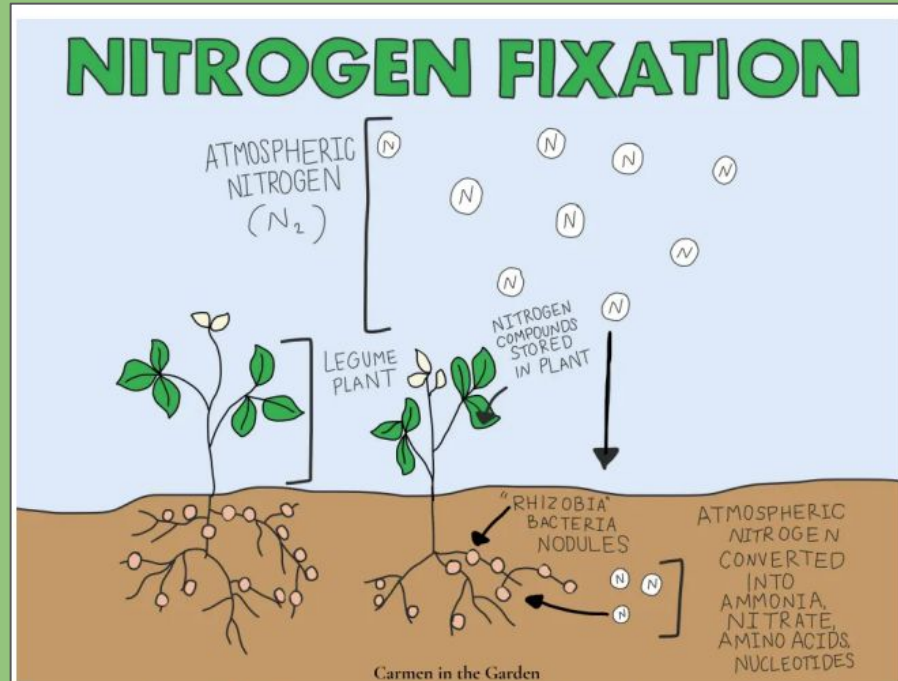


Figure 8.1. The process of Nitrogen Fixation in plants and soil.

# baMEL - Evidence Statements & Evidence Texts

Use a modified jigsaw strategy to read the Evidence Texts.....



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Next Steps...



# MEL Diagrams

Given the option to select two of the three models, this can be done in many ways which can still provide student autonomy

- Class votes which models to analyze, then groups choose evidence to compare
- Group chooses everything
- Students complete the task on their own, and then meet in groups for consensus discussions
- You (teacher) selects two models, and the students select a third. This ensures the “Scientific” model is included.



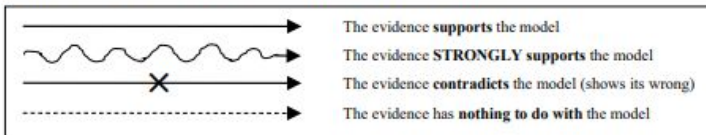
# baMEL Diagram

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Teacher: \_\_\_\_\_ Period: \_\_\_\_\_

If you worked with other students, their name(s): \_\_\_\_\_

**Directions:** Write the number of each evidence you are using and for each model you have selected in the boxes below. Then draw 2 arrows from each evidence box, one to each model. You will draw a total of 8 arrows.

**Key:**



Evidence # \_\_\_\_\_

Model \_\_\_\_\_

Evidence # \_\_\_\_\_

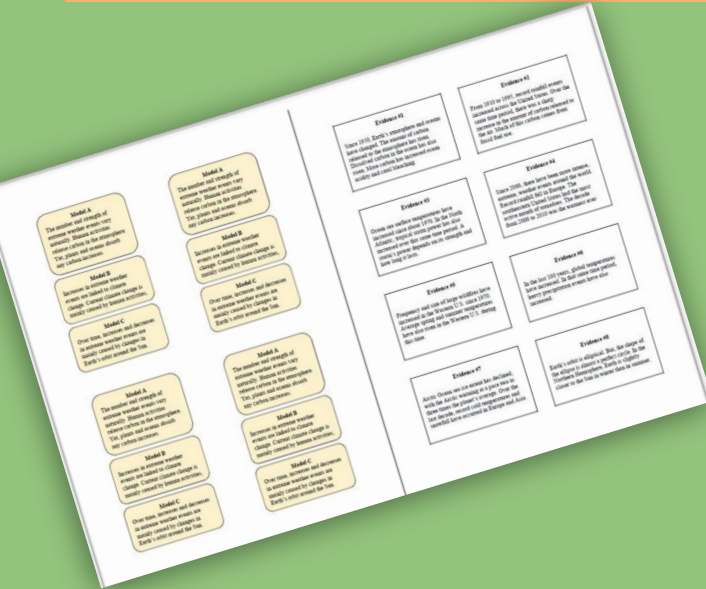
Evidence # \_\_\_\_\_

Model \_\_\_\_\_

Evidence # \_\_\_\_\_



# Time to select Models and Evidence Texts



## 2 of 3 Models and 4 of 8 Evidence Texts

## baMEL Task

1. Meet with your team, and refine your choices of 2 models and 4 lines of evidence.

2. Discuss the lines of evidence, and identify the connections to each model

Note: The results of your consensus discussion does not require that all team members have the same diagram.

# baMEL diagram (note the missing connection...)

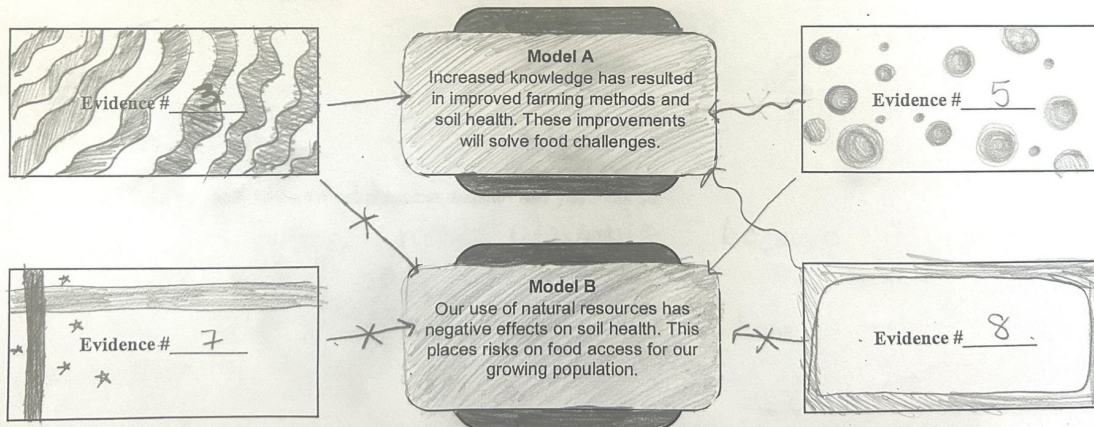
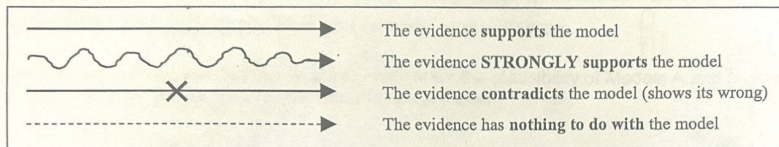
Name: \_\_\_\_\_

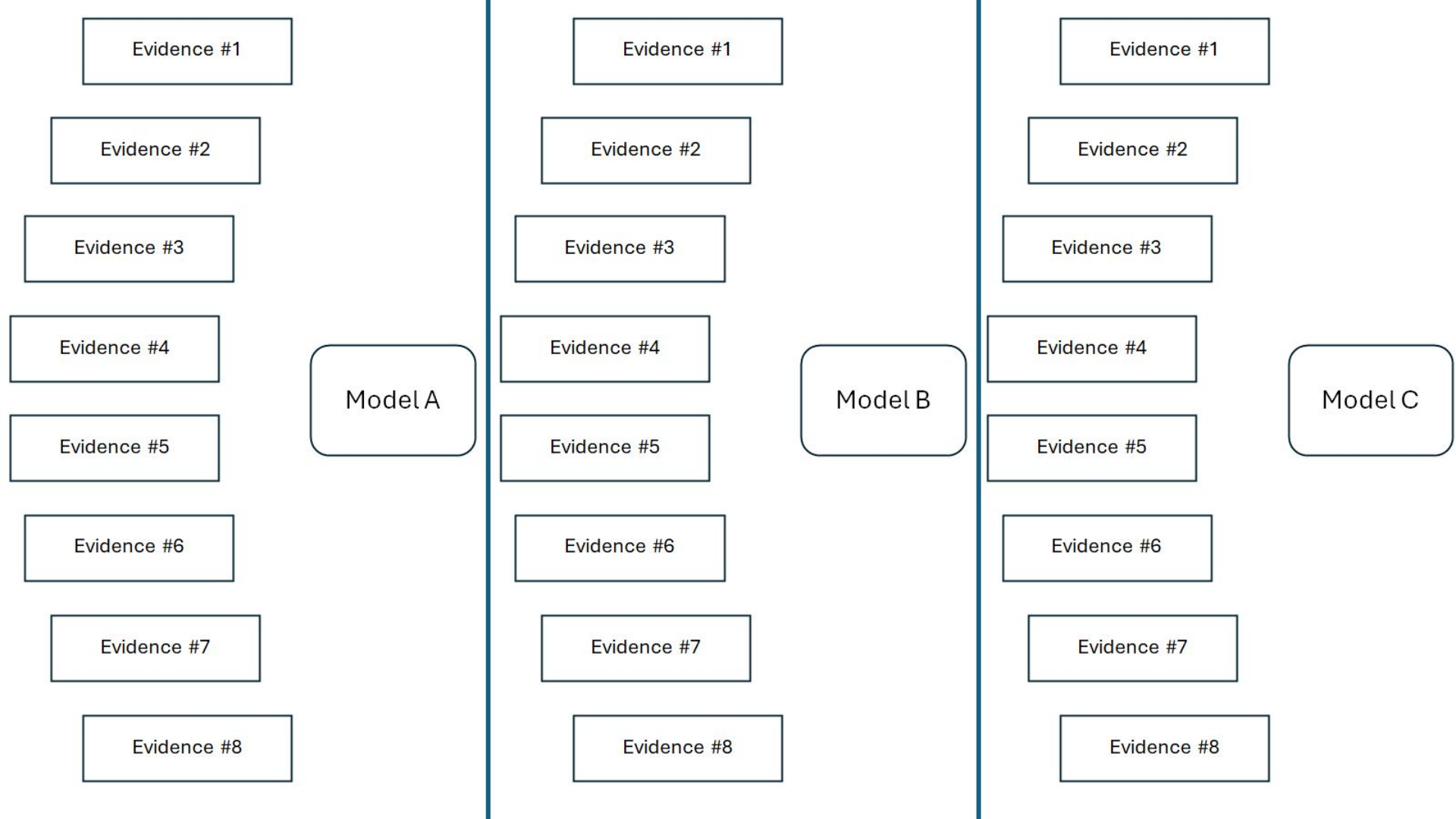
Date: 5-5-2023 Teacher: Mr. Piper Period: 1

If you worked with other students, their name(s): TEAM NAME

**Directions:** Write the number of each evidence you are using and for each model you have selected in the boxes below. Then draw 2 arrows from each evidence box, one to each model. You will draw a total of 8 arrows.

**Key:**





# Explanation Task

Students are asked to:

1. Re-rate the plausibility of each model.
2. Why they feel one model is more plausible than another.  
→ At this point, return their original plausibility ratings ←
3. Students complete one or two “slotted” prompts asking which evidence/model connection was most compelling in strongest in either changing their views or solidifying what they already believed.  
→ As part of a summative I asked that they complete the prompt and then either **Explain**, **Give Examples**, or **Extrapolate** (go beyond the evidence a bit) to support their answer.  
→ They could also explain how their opinion differed from their groups.



# Debrief

- What challenges came up while doing this activity? How were they resolved?
- How is a baMEL different from a pcMEL?
- What connections do you see with your course content?

Task: With your team, brainstorm implementation strategies for a baMEL



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Questions and Comments...



# ACKNOWLEDGEMENTS



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# Questions 1 and 2....

1. Now that you have completed the diagram, reconsider the plausibility of Models A and B (and C, if there is one). Circle the plausibility of each model. [Make one circle for each model.]

	Greatly implausible (or even impossible)								Highly plausible	
<b>Model A</b>	1	2	3	4	5	6	7	8	9	10
<b>Model B</b>	1	2	3	4	5	6	7	8	9	10
<b>Model C</b> (if there is one)	1	2	3	4	5	6	7	8	9	10

2. For the model you selected as most plausible, explain why you think so.

I pick model B bc our soil is going bad and scientists have already proved that by 2050 90% will go bad. Though technology might keep us up, but we will never get that natural flower and health benefits like what will technology do -

Please Make Sure to Complete Page 2



## Question 3

### E. Explanation Task

3. Which arrows changed your plausibility judgments about the models? If your plausibility judgment did not change, which arrows supported your original plausibility judgments? Consider 2 lines of evidence. For each line, does it support, strongly support, or contradict one of the models? Why? When writing your explanation, consider the following:
- Use the specific information from the evidence text and figures to support your response. Ex: when looking at graphs or figures, be sure to describe the patterns in the data.
  - Describe any cause-and-effect relationships found in the text.

Evidence # 5 strongly supports (supports) contradicts | has nothing to do with Model A because:

it shows how farmers smart thinking and ideas show new ways to increase good farming.

Evidence # 5 strongly supports (supports) contradicts | has nothing to do with Model B because:

it shows how many people on our planet use resources that could be harming farmlands.

# Questions 1 and 2....(ummm - thoughts?!)

Please work on this part individually after you complete your diagram.

1. Now that you have completed the diagram, reconsider the plausibility of Models A and B (and C, if there is one). Circle the plausibility of each model. [Make one circle for each model.]

	Greatly implausible (or even impossible)										Highly plausible	
Model A	1	2	3	4	5	6	7	8	9	10		
Model B	1	2	3	4	5	6	7	8	9	10	11	
Model C (if there is one)	1	2	3	4	5	6	7	8	9	10		

2. For the model you selected as most plausible, explain why you think so.

Our use of natural resources is greatly impacting our effects on our soil health. For example our use of water, (to make electricity) causes gases to escape into the atmosphere. The ocean absorbs much of these harmful gases, which causes ocean acidification. This change can make the ocean waters warmer. This confuses fish like whales, who migrate to warmer waters to stay in the same waters. Whales have an brilliant way of gathering prey. Humpbacks stir up dirt which makes a school of fish confused, which then allows whales to have their meal. When whales graze, they usually find themselves near kelp forests. Kelp forests get fertilized by the dirt that gets stirred up. The kelp forest grows abundantly which allows other animals like sea otters to have a better habitat. During storms sea otters get swept up to the shore. A type of wolfed sea wolves live on islands and survive on washed up sea otters. BACK

Please Make Sure to Complete Page 2



# Question 3 (Basic)

## E. Explanation Task

3. Which arrows changed your plausibility judgments about the models? If your plausibility judgment did not change, which arrows supported your original plausibility judgments? Consider 2 lines of evidence. For each line, does it support, strongly support, or contradict one of the models? Why? When writing your explanation, consider the following:
- Use the specific information from the evidence text and figures to support your response. Ex: when looking at graphs or figures, be sure to describe the patterns in the data.
  - Describe any cause-and-effect relationships found in the text.

Evidence # 5 strongly supports (supports) contradicts | has nothing to do with Model A because:

it shows how farmers smart thinking and ideas show new ways to increase good farming.

Evidence # 5 strongly supports (supports) contradicts | has nothing to do with Model B because:

it shows how many people on our planet use resources that could be harming farmlands.

## Question 3: (advanced)

### E. Explanation Task

3. Which arrows changed your plausibility judgments about the models? If your plausibility judgment did not change, which arrows supported your original plausibility judgments? Consider 2 lines of evidence. For each line, does it support, strongly support, or contradict one of the models? Why? When writing your explanation, consider the following:
- Use the specific information from the evidence text and figures to support your response. Ex: when looking at graphs or figures, be sure to describe the patterns in the data.
  - Describe any cause-and-effect relationships found in the text.

Evidence # 8 strongly supports | supports | contradicts | has nothing to do with Model A because:

because model A is saying that increased knowledge can help us find new ways to improve soil health and evidence 8 is talking about a new way to improve soil health called nitrogen fixing bacteria and you need to have lots of knowledge to do that.

Evidence # 4 strongly supports | supports | contradicts | has nothing to do with Model B because:

I think evidence 4 supports model B because evidence 4 is saying that climate change is affecting soil and model B is saying that natural resources affect the soil (both in a negative way) so they are both saying soil is being affected but it is not strongly supporting because both are natural but climate change isn't necessarily a resource.