Ecosystems Unit – Packet 1

Name: _____ Hour_____Date: _____

Date Packet is due: *after Part 5* Why late? _____
If your work was late, describe why

Score
- ☐ Above & Beyond
- ☐ Fully Complete
- ☐ Mostly Complete
- ☐ Incomplete – *fix the following pages*:

Driving Question: How do living organisms affect each other?

Anchoring Phenomenon: We will investigate how living organisms interact with each other and with the non-living resources where they live. Specifically, we are wondering why the population of predators is so much smaller than the population of their prey. We'll also consider what factors determine how many organisms can live in an area.

Deeper Questions

1. How do living species interact with each other and their environment?
2. What determines how many species can live in an area?
3. What happens when the movement of matter and the flow of energy through living organisms becomes disrupted?

Schedule

Part 1: Introduction
- Initial Ideas – Wolf vs. Moose Populations
- Data Dive – Isle Royale Populations
- Discussion & Developing Explanations

Part 2: Core Ideas
- Core Ideas
- Revisions of Part 1 Explanations

Part 3: Investigations
- Part 3A: Fox Meadow Simulation
- Part 3B: Tabletop Ecosystems

Part 4: Review & Assessment
- Ranking Your Readiness
- Assessments (Formative Assessment & Mastery Check)

Part 5: Life Connections
- Life Connections - Three Burritos

NGSS Standards:
HS-LS2-2. Modeling factors that affect biodiversity and populations in ecosystems at different scales.
HS-LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

Semester Schedule

Matter & Energy
Week 1: What happens when something burns?
Week 2: What happens to molecules during burning?
Week 3: Unit Assessment

Animals
Week 1: What are animal cells made from?
Week 2: What happens to food when it is consumed?
Week 3: What happens inside animal cells?
Week 4: Unit Assessment

Plants
Week 1: How do plant cells differ from animal cells?
Week 2: How do plants get their food and gain mass?
Week 3: How do plants get other needed molecules?
Week 4: Unit Assessment

Ecosystems
Week 1: Why do some places have more species than others?
Week 2: How does human activity affect living species?
Week 3: Unit Assessment

Part 1: Introduction – Isle Royale

Overview: In this activity, you will begin by discussing your initial ideas about how living species interact with each other and with their environment. You will then analyze data and develop your initial explanations.

Initial Ideas: Isle Royale is an island in Lake Superior. It is protected as a US national park and is mostly undisturbed by human activity. Due to its isolation, it makes an ideal location to study how organisms can affect each other. Wolves and moose live and interact with each other on this island.

1. Three students shared their ideas about wolf and moose populations. They disagree about how wolf and moose populations would compare in size. **Do you agree or disagree with each student's claim**?
   a. Mike: "There will be fewer moose than wolves because the wolves eat moose." *Agree / Disagree*
   b. Lucia: "I think the population of moose and wolves should be about the same." *Agree / Disagree*
   c. Oscar: "There should be more moose than wolves or there will be problems." *Agree / Disagree*

2. **Work in your small groups to discuss your ideas.** How are your ideas similar or different? Decide as a group whether each statement is correct (and why). Be prepared to present your ideas to the class.

Videos: Next, watch the following videos individually or as a class (based on your teacher's instructions):
Video 1 – Isle Royale Wolf & Moose Data: https://www.youtube.com/watch?v=mIwSAvHsxrs
Video 2 - Isle Royale Wolf & Moose Researchers: https://www.youtube.com/watch?v=Ts2CVIhMWhY

Data Dive: Here you can see data comparing the sizes of the wolf and moose population, and how they fluctuate over time. Which population is larger? How does each population change over time?

1. **Begin by individually attempting to make sense of this data**. What trends or patterns do you notice? How does this relate to any prior knowledge or experience that you have?

2. **Next, work in your teams to discuss your ideas**. Where do you agree? Where do you disagree? Can you use this data to reach an agreement? Do others have prior knowledge or experience that could help?

3. **Based on this data, what is one conclusion that would be supported by this data?** How is this conclusion supported by this data? What specifically suggests that your claim is accurate?

4. **Based on this data, what is a second conclusion that would be supported by this data?** How is this conclusion supported by this data? What specifically suggests that your claim is accurate?

5. **How does this data pertain to the three claims in Initial Ideas on the previous page?**

6. **<u>Discussion & Developing Ideas</u>**: As a class, discuss your ideas about this data. What are the ideas that most agreed on? Where did your ideas differ as a class? Record your ideas in the spaces below.

We all agree that…	We disagreed or are unsure about…

7. **How does the size of wolf populations compare to moose populations? Why?** Write down your initial explanation below. Don't worry if you aren't completely sure about your answer! You will come back and revise this explanation as you gain more information during this unit.

   Wolf population sizes are usually ***smaller / larger / similar*** *compared to moose populations because…*

   _____

   _____

Throughout this packet, you will be updating this explanation as you gain more information and more experience. When you complete this packet, compare your early versions to your final version. You should see distinct improvement with each revision.

Part 2: Core Ideas

Overview: In this activity, you will begin with a short slideshow presentation. This will provide you with core ideas that will help you clarify your initial ideas. Your instructor will decide on how to implement this portion depending on your previous experience and capabilities with this content.

You will then work in small teams to answer the questions listed below. You should take notes in a notebook, on a dry erase board, or on scratch paper so that you are prepared to deliver your responses during the class discussion that will follow. *Note: your instructor may assign specific questions to your group if time is limited.*

Core Ideas Presentation: Ecosystems Packet 1 Core Ideas

Driving Questions:

1. What is an ecosystem? In what ways do living species depend on each other as well as the non-living components of their environments?
2. What is biomass? How does the biomass of organisms relate to glucose molecules and soil minerals?
3. What is the difference between producers and consumers? How is a primary consumer different from a secondary consumer? How do these terms relate to trophic levels?
4. If a growing animal consumes 10 kg of plant biomass over the course of a week, how much mass would be added to the animal's body? Explain using the term 10% Rule.
5. True or false: the amount of plant, moose, and wolf biomass should be relatively equal in order for Isle Royale to be a stable ecosystem. Explain.
6. What is the carrying capacity of an ecosystem? How does carrying capacity relate to biomass production and to the 10% Rule?
7. What is biodiversity? How do levels of biodiversity relate to carrying capacity and biomass production?
8. Tropical rainforests tend to have large numbers of different species per square mile. Why does more biodiversity exist in these ecosystems compared to most other regions of the planet?
9. What is ecosystem resilience? What is an ecosystem disturbance? How are these terms related?
10. How do changes to carrying capacity and biodiversity affect ecosystem resilience?
11. Tundra and alpine ecosystems are often quite fragile. Why might it take years or even decades for these ecosystems to recover after disturbances? Why aren't they more resilient?
12. **Revising Explanations**: Return to your original explanation that you created at the end of Part 1. Based on this new information, how would you now respond to this question?

    Wolf population sizes are usually ***smaller / larger / similar*** *compared to moose populations because…*

    _____

    _____

Throughout this packet, you will be updating this explanation as you gain more information and more experience. When you complete this packet, compare your early versions to your final version. You should see distinct improvement with each revision.

Part 3A Investigation: Fox Meadow Simulation

Adapted from materials by Carbon TIME

Introduction: This activity requires you to use a computer simulation to explore how changing populations of producers and consumers affects the stability and composition of a hypothetical ecosystem. Your instructor may choose to demonstrate how this program works for the entire class before letting you work in your groups.

Pre-Investigation Questions: Work as a group to determine the best response to each question. Be prepared to provide verbal responses for these questions for your instructor before you complete the investigation.

1. *What is the carrying capacity of an ecosystem? How does carrying capacity relate to biomass production and to the 10% Rule?*
2. *What is biodiversity? How do levels of biodiversity relate to carrying capacity and biomass production?*
3. *Tropical rainforests tend to have large numbers of different species per square mile. Why does more biodiversity exist in these ecosystems compared to most other regions of the planet?*
4. *What is ecosystem resilience? What is an ecosystem disturbance? How are these terms related?*

When you think you are ready, **raise your hand**. Your instructor will listen to your verbal responses.

This activity was completed _____ (*instructor signature*)

Directions:

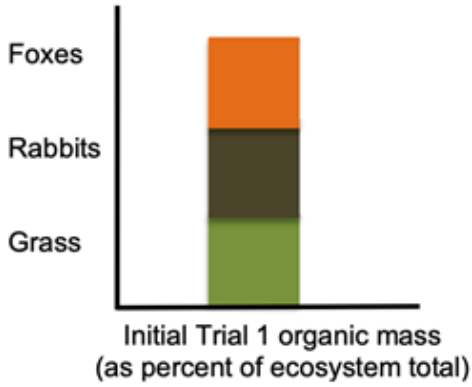
1. In an internet search engine, type *Carbon TIME Meadow Simulation,* or click the URL below: https://carbontime.create4stem.msu.edu/sites/default/files/simulations/eco-simulation/index.html Use the worksheet on the following pages to record your responses.
2. Set the initial mass for each population by dragging the sliders or typing in the boxes. Note that the maximum initial organic mass for each population is 1000 kg.
3. Click the start arrow in the top right corner of the screen to run the simulation. On the simulation screen, use the buttons on the stopwatch at the bottom to pause the simulation (middle button), move ahead one year (right button), or to start a new run (left button)

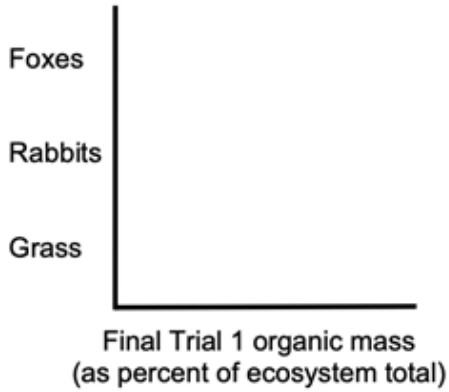
Questions:

1. Trial 1 – **Set the following initial conditions, run the simulation, and complete the table below**. *Note: After a run, you can click on the graph to make a line appear. Drag the line to the year that you want to record the data for, and it will appear in the data table below the graph*.

Fox Organic Mass:	t = 0: *500 kg*	t ~ 50: _____	t = 99: _____
Rabbit Organic Mass	t = 0: *500 kg*	t ~ 50: _____	t = 99: _____
Grass Organic Mass	t = 0: *500 kg*	t ~ 50: _____	t = 99: _____

2. The next page has an organic mass diagram representing the initial conditions for trial 1. **Sketch the final organic mass diagram for trial 1 in the blank graph (lower right).** *Note: the program's lab book records the data for each run. Access this by clicking the left button of the stopwatch.*





3. **Why did the organic mass change the way that it did in trial 1?** Explain your reasoning.

_____

_____

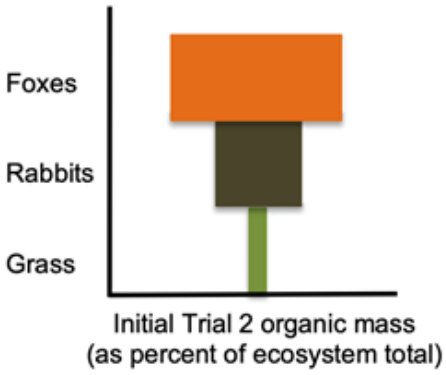
4. **Trial 2 – Set the following initial conditions, run the simulation, and complete the table below.**

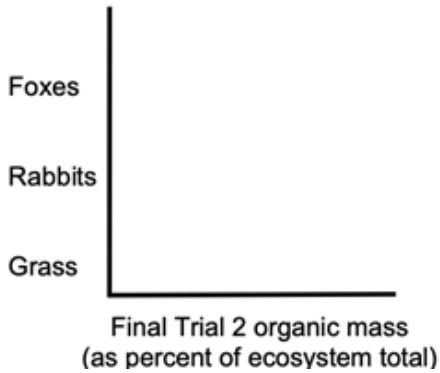
Fox Organic Mass: t = 0: *1000 kg* t ~ 50: _____ t = 99: _____

Rabbit Organic Mass t = 0: *500 kg* t ~ 50: _____ t = 99: _____

Grass Organic Mass t = 0: *100 kg* t ~ 50: _____ t = 99: _____

5. **Sketch the final organic mass diagram for Trial 2 in the blank graph (lower right).**





6. **Why did the organic mass change the way that it did in trial 2?** Explain your reasoning.

_____

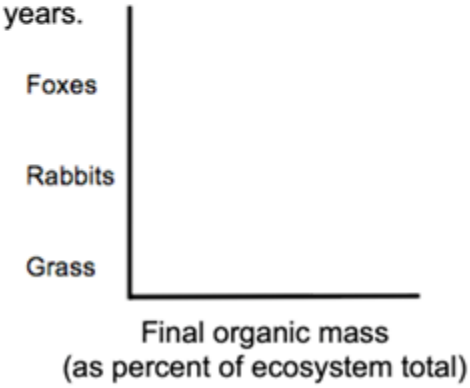
_____

7. Use the simulation to determine the maximum organic mass of foxes that the meadow ecosystem can support. **Record your data for the initial final organic mass for each population in the table on the next page.**

	Trial 1 Initial	Trial 1 Final	Trial 2 Initial	Trial 2 Final	Trial 3 Initial	Trial 3 Final	Trial 4 Initial	Trial 4 Final
Foxes								
Rabbits								
Grass								

8. Record the data and draw the organic mass diagram for the conditions that resulted in the highest organic mass in the fox population at the end of 100 years.

	Initial	Final
Foxes organic mass		
Rabbits organic mass		
Grass organic mass		



Part 3B Investigation: Tabletop Ecosystems

Overview: In this activity, you will investigate tabletop ecosystems containing three kinds of organisms. The most obvious organisms are **brine shrimp** swimming throughout your container. There are also **phytoplankton**. These are single-celled organisms that can *photosynthesize* and may give the water a greenish color. Lastly, there are microscopic **bacteria** and **fungi**. These *decomposers* break down the shrimp, phytoplankton, and other microbes when they die. This provides plants with minerals and another source of CO_2.

Directions: observe your tabletop ecosystem. Address the questions below using your observations to guide your thinking. Use a notebook, dry erase board, or scratch paper to record your ideas. When you think you are ready, raise your hand. Your instructor will listen to your verbal responses.

1. How are light, motion, chemical, and heat energy being transformed within the cells of these organisms?
2. How is biomass being created from inorganic molecules (like CO_2 and H_2O) in this tabletop ecosystem? In what ways is biomass being converted back into CO_2 and H_2O in this ecosystem?
3. These ecosystems are in sealed containers. Will your ecosystem run out of oxygen? Why or why not?
4. What is more important to the function of this ecosystem – the phytoplankton or the shrimp? Why?
5. Which should have greater populations – the phytoplankton or the shrimp? Why?
6. Is your tabletop ecosystem very biodiverse? Explain.
7. What primarily determines the carrying capacity for shrimp within this ecosystem?
8. Do you think that this tabletop ecosystem is resilient? What factors determine resiliency in this case?

When you think you are ready, **raise your hand**. Your instructor will listen to your verbal responses.

This activity was completed _____ (*instructor signature*)

Part 4: Review & Assessment

Overview: Rank each Driving Question in Part 2 as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comprehension. Then work in teams to review each item and prepare a response. Next, write a final explanation below. You will conclude by completing a formative assessment.

Wolf population sizes are usually ***smaller / larger / similar*** *compared to moose populations because…*

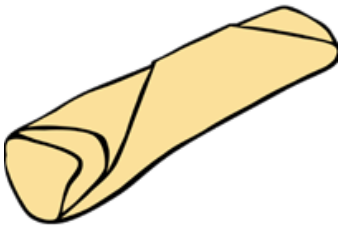
_____

_____

Go back and compare your early versions of your explanation to your final version above. You should see distinct improvement compared to your first attempts.

Part 5: Life Connections - Three Burritos

Directions: For this activity, read the paragraph below. Then decide which arguments sound most accurate. Be prepared to explain why.



Overview: *Three students are hungry for a burrito. They are struggling to decide what kind of burrito to eat. They have learned in their science classes that their choice of food can have an impact on the function and health of ecosystems around the planet.*

These students have three options on the menu – 1) a vegetarian burrito (beans, cheese, and rice), 2) a chicken & cheese burrito, and 3) a beef & cheese burrito. They are aware that different types of food production will require different amounts of land and fuel. They also have heard that carbon dioxide levels are increasing, which can negatively affect human activity (including food production

- *Nina thinks that the bean burrito will be the most environmentally friendly option because it is a vegetarian option, which she argues is synonymous with being better for the environment.*
- *Daryll thinks that the bean burrito will have the highest carbon dioxide emissions because beans need to be harvested by a tractor, which burns diesel fuel. He intends to order the beef burrito because cattle eat grass, which absorbs CO_2.*
- *Marcos thinks that the chicken burrito is the best option because chickens are small. As such, they need less land and would exhale less CO_2 than cattle, and don't require a tractor that burns fuel.*

Who do you agree with and why? It's ok to pick more than one person. Explain your thinking. In your explanation, provide evidence and reasoning that helps support your claim.

I most agree with the following: _____ *because…*_____

_____

_____

Be prepared to discuss your ideas in small groups and as a class.

Plants Unit, Packet 1 Formative Assessment

Name: _____Hour____Date:_____Score:_____

Directions: A 3x5 notecard with *handwritten* notes can be used to guide your answers. Your instructor may allow you to work in assigned groups. If so, have a different person write each response while others assist.

1. The image at the right shows that in order to gain 1.5 lbs. of body mass per day, this animal has to consume roughly 15 lbs. of food. **Why does only a small percentage of the mass of the consumed food stay inside the animal's body?**

For a steer to gain 1.5 lbs. per day...

...it must consume 15 lbs. of food.

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_____

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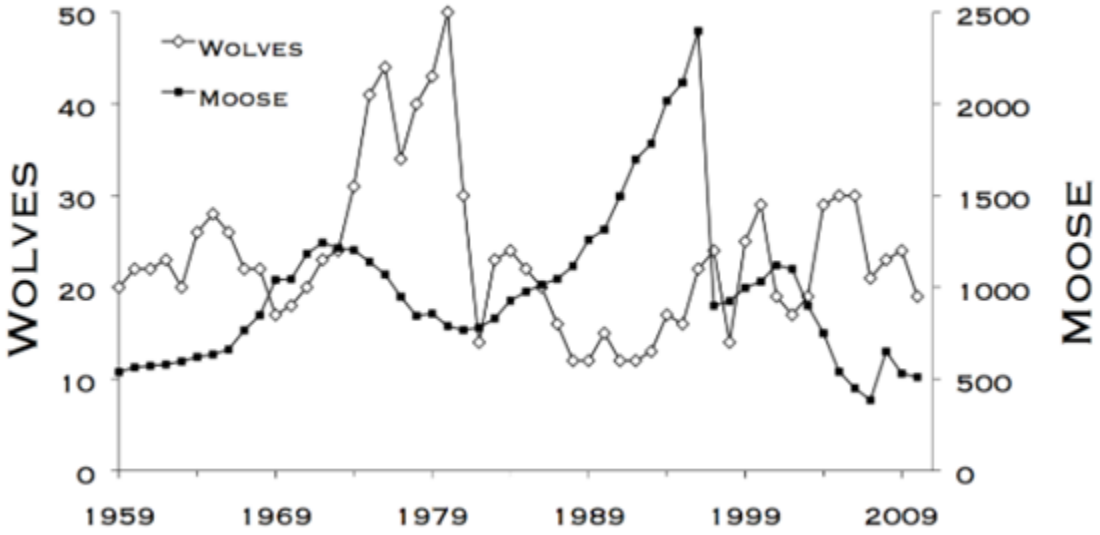
_____

_____

_____

Writer's Name:



2. Three students make predictions before looking at data for Isle Royale's wolf and moose populations. **Circle "Agree" or "Disagree" for each of the three claims below based on the data above.**
   - Mike: "There will be more wolves because the wolves eat the moose." *Agree/ Disagree*
   - Lucia: "I think the population of moose and wolves should be about the same." *Agree / Disagree*
   - Oscar: "I think that there should usually be far more moose than wolves." *Agree / Disagree*

3. **How do trophic levels & the 10% Rule affect the number moose & wolf this island can support?**

_____

_____

_____

Writer's Name::

4. A study found that forests similar to those in Isle Royale contain an average of 135,000,000 g of plant biomass per hectare (*a hectare is roughly the size of 2.5 football fields*). **What is the maximum grams of a) primary consumer biomass and b) secondary consume biomass that could be supported per hectare of Isle Royale forest? Explain your answers.** **(Source: Tang *et al.*, 2010).**

_____

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_____

Writer's Name:

5. Tropical rainforests are more biodiverse, can support more species, and are more resilient compared to polar ecosystems. **Why does biodiversity, carrying capacity, and resiliency differ between these ecosystems?** Include & underline the following: *biomass production; 10% rule; producers; consumers*.

_____

_____

_____

_____

Writer's Name:

6. Oil spills have occurred in both Alaska and in Louisiana, resulting in extensive ecological disruption. **Which ecosystems would recover more slowly, those in Alaska or those in Louisiana? Why?**

_____

_____

_____

Writer's Name: