Ecosystems Unit – Packet 2

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

Name: _____ Hour_____Date: _____

Date Packet is due: *after Part 5* Why late? _____

If your work was late, describe why

Driving Question: How do imbalances in matter and energy cause ecosystem disturbances?

Anchoring Phenomenon: The amount of CO_2 in the atmosphere has continued to rise with each passing year. Simultaneously, the earth's average surface temperatures also have risen over the past century. How are these trends related to each other?

Deeper Questions

1. How do ecosystems enable matter movement and energy transformation?
2. How do imbalances in matter and energy occur?
3. What happens when matter and energy are unbalanced?
4. How does human activity relate to these kinds of disturbances?

Schedule

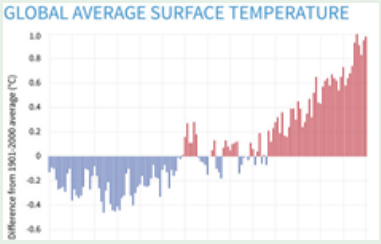
Part 1: Introduction
- Initial Ideas – Explaining Warming
- Data Dive – Greenhouse Gas Graphs
- Discussion & Developing Explanations

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

Part 3: Investigations
- GHG Simulation

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

Part 5: Life Connections
- Life Connections - Mendota Ice



NGSS Standards: HS-ESS2-2 Earth's Systems. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. HS-ESS2-4 Earth's Systems. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. HS-ESS2-6 Earth's Systems. Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. HS-ESS3-5 Earth and Human Activity. Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. HS-ESS3-6 Earth and Human Activity. Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Semester Schedule

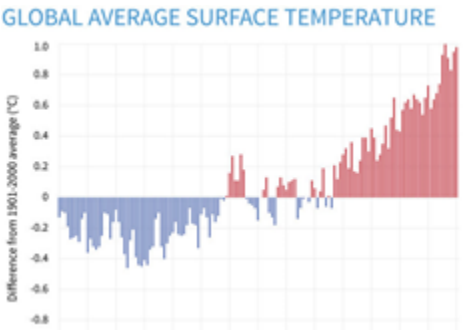
Matter & Energy
Week 1: What happens when something burns?
Week 2: What happens to molecules during burning?
Week 3: Unit Assessment

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: Intro – Why Warming?



Overview: In this activity, you will begin by discussing your initial ideas about how imbalances in matter and energy affect ecosystem function. You will then analyze data and develop your initial explanations.

Initial Ideas: Over the past decades, scientists have observed that average surface temperatures on the planet are continuing to warm (*see data* →).

1. Three students shared their ideas about why this warming is occurring. **Do you agree or disagree with each student's claim**?
    a. Mike: "The earth is simply going through a natural cycle like it always has." Agree/ Disagree
    b. Lucia: "I think that human activity is primarily responsible for this warming." Agree / Disagree
    c. Oscar: "I think that these changes are due to a variety of factors like sunspots, volcanic activity, natural cycles, and maybe human activity too." 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.

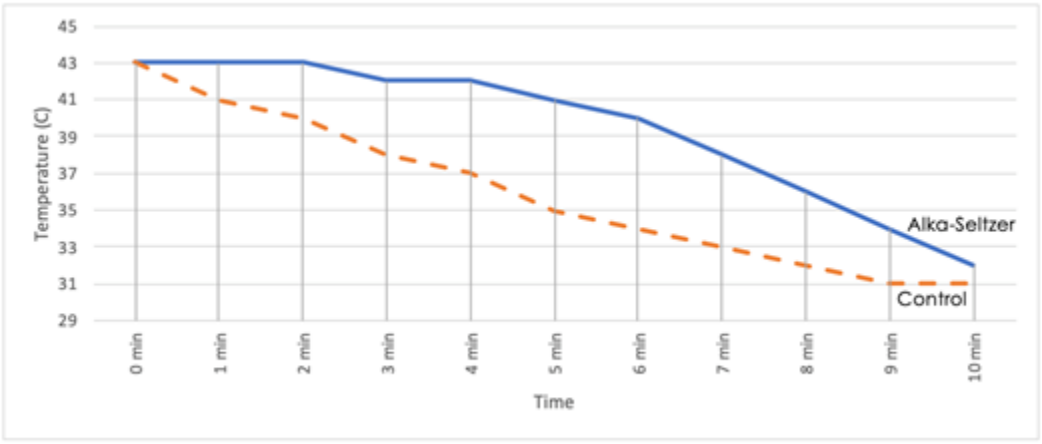
Videos: Next, watch this video (based on your teacher's instructions): https://youtu.be/SN5-DnOHQmE

Data Dive: Students increased the concentration of carbon dioxide inside a sealed beaker using water and Alka-Seltzer. They compared this to an untreated beaker with the same amount of water. They then heated both beakers to 43° C (110° F) and then turned off the heaters. They recorded the temperature in each bioreactor every minute. Their data is shown below.

1. **What is one conclusion that would be supported by this data?** What specifically suggests that your claim is accurate?

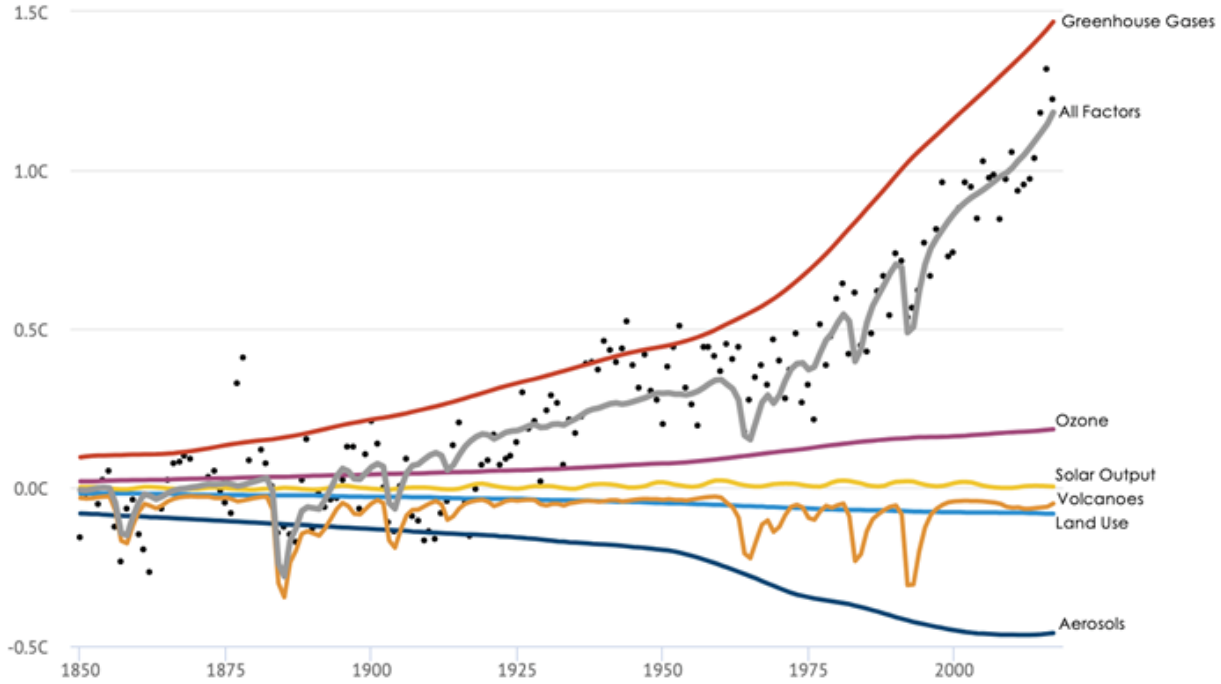
2. **What is a second conclusion that would be supported by this data?** What specifically suggests that your claim is accurate?

Time	Alka-Seltzer	Control
0 min	43	43
1 min	43	41
2 min	43	40
3 min	42	38
4 min	42	37
5 min	41	35
6 min	40	34
7 min	38	33
8 min	36	32
9 min	34	31
10 min	32	31

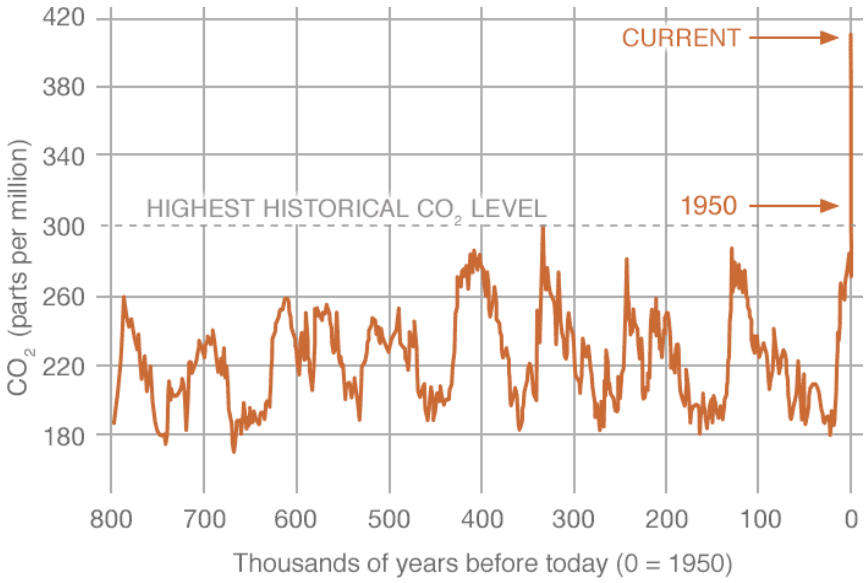


Data Dive 2: The earth's average surface temperature is shown in the graph below as a series of dots. Scientists compared the impact of six different factors that affect temperature, including: 1) land use (*such as deforestation*), 2) ozone levels, 3) greenhouse gases, 4) solar energy output, 5) aerosols, and 6) volcanic activity.

3. **What are two conclusions that are supported by this data?** How does this data support these claims?



Data Dive 3: This NASA graph shows changes in CO_2 levels over the previous 800,000 years based on ice core data.



4. **What was the maximum CO_2 level before the 1900s?**
5. **What is the current level of atmospheric CO_2?**
6. **Why do you think CO_2 is so much higher now?** Why is CO_2 being released at a faster rate than it is being absorbed?

7. **How and why do greenhouse gases affect temperature?** *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.*

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 2 Core Ideas

Driving Questions:

1. How did an asteroid strike 65 million years ago disrupt all ecosystems? How did this result in the extinction of the dinosaurs? Address factors at the molecular, cellular, organismal, and ecosystem levels.
2. What is necessary for ecosystems to function in regards to changes to matter and energy?
3. How do current rates of CO_2 emissions compare to rates of CO_2 absorption? Why is this occurring?
4. Why does the moon have more widely fluctuating temperatures compared to the earth if both are roughly the same distance from the sun?
5. True or false: CO_2 is only a small percentage of the earth's atmosphere; therefore, changes to CO_2 concentrations are unlikely to have a major impact on temperature. Explain.
6. What is a greenhouse gas? What two criteria determine if a molecule can act as a greenhouse gas?
7. What is the greenhouse effect? What is infrared radiation? How do both light and infrared radiation relate to the greenhouse effect?
8. Could changes in global temperatures be part of a natural cycle? Use the term *Milankovitch Cycles* in your response.
9. What is climate change? How does it relate to changes in CO_2 concentrations?
10. How do changing CO_2 levels affect ecological factors such as vegetation, oxygen, precipitation patterns, and ocean acidification?
11. True or false: while rising CO_2 levels are affecting ecosystems, human activity is largely unaffected by climate change. Explain.
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?

    How and why do changes to greenhouse gas concentrations affect temperature?

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: GHG Simulation

Adapted from materials by Carbon TIME

Introduction: This activity requires you to use a computer simulation to explore what makes a molecule a greenhouse gas, and how changing the concentration of a greenhouse gas affects temperature. .

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. *How can imbalances in matter and energy result in an ecosystem disruption?*
2. *What is a greenhouse gas? What is the greenhouse effect? What makes a molecule a greenhouse gas?*
3. *How do we know that changes to the earth's climate aren't just part of a natural cycle?*
4. *How do changes in greenhouse gas levels disrupt ecosystems? Provide specific examples.*

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 *PhET Greenhouse Gas Simulation,* or click the URL below: https://phet.colorado.edu/sims/cheerpj/greenhouse/latest/greenhouse.html?simulation=greenhouse Use the worksheet on the following pages to record your responses.
2. Find detailed instructions by clicking here or by visiting your instructor's website / Google classroom.

Questions for Part A: Investigating how different gases in the atmosphere interact with light:

1. Observe how the infrared and visible light photons respond when they encounter CO_2 and N_2 molecules. **Then circle the descriptor below that best describes the movement of each kind of photon when it strikes each kind of gas molecule below**:

When a visible light photon hits CO_2, the photon's movement is…	**Unchanged**	**Scattered**
When an infrared photon hits CO_2, the photon's movement is…	**Unchanged**	**Scattered**
When a visible light photon hits N_2, the photon's movement is…	**Unchanged**	**Scattered**
When an infrared photon hits N_2, the photon's movement is…	**Unchanged**	**Scattered**

2. **How did interactions with CO_2 and infrared photons differ from interactions with light photons?**

_____

_____

3. **How and why did the infrared photons react differently with CO_2 compared to N_2?**
(Hint: how many atoms & elements are in each molecule? Which molecule meets the criteria to be a greenhouse gas?)

_____

_____

Questions for Part B: Investigating how different gases in the atmosphere affect the Earth's temperature:

1. **Complete the table below to record your observations from this activity:**

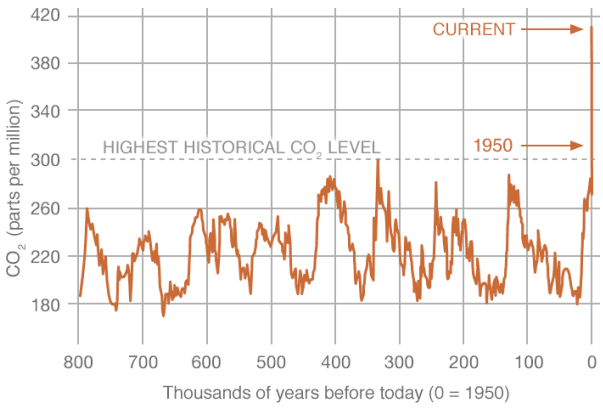
	Impact on Yellow Light Photons	Impact on Red Infrared Photons	Temperature Range
Low GHG's			
High GHG's			

2. **How did the movement of yellow light photons differ from the movement of red infrared photons in this simulation?**

3. **How do your observations in this exercise relate to the Greenhouse Effect?**

4. **What happened to the temperature as the concentrations of greenhouse gases were increased? How is this similar to what is currently happening in the earth's atmosphere?**

5. Observe this NASA graph showing the changes to CO_2 concentrations over the past 800,000 years. **Predict how ongoing changes to CO_2 might affect your future:**



Part 4: Review & Assessment

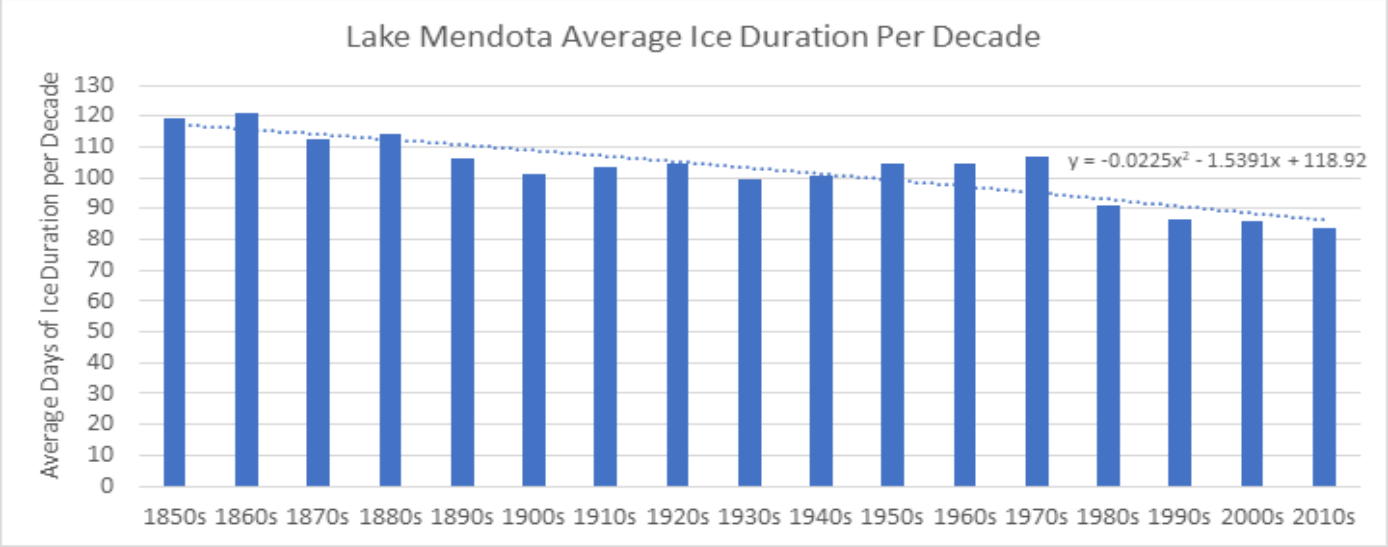
Overview: Rank each Driving Question in Part 2 as a 1 (*completely unsure*), 2 (*somewhat unsure*), or 3 (*completely sure*) based on your comprehension. Then work in teams to review each item and prepare a response. Next, write a final explanation below. You will conclude by completing a formative assessment.

How and why do changes to greenhouse gas concentrations affect temperature?

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 - Mendota Ice

Overview: Lake Mendota in Madison, WI is one of the most studied lakes in the world. Scientists have been collecting data on this lake since the mid-1800s. One of the types of data they have collected is ice duration, or the number of days during which the lake was completely frozen over. The average annual days of ice duration per decade is shown in the graph below. Interpret this graph to identify patterns and trends. Then answer the questions below.



1. **What are two conclusions that would be supported by this data?** How does this data support this?
2. A dotted trendline is on this graph. A *trendline* shows patterns on a graph based on the average values of the data. **What does this trendline suggest? How does this relate to the topics from this week?**
3. This trendline equates to a quadratic formula that can be used to predict the number of years remaining before a specific outcome. Let's assume that a minimum of 30 days of ice is needed to reliably go ice fishing (two weeks for ice to form and two weeks to melt). If we determine that y = 30, then x (the number of years until this outcome) is about 37; i.e., this data suggests that within your lifetime, ice fishing on this lake may not be feasible. **How does this impact your views about climate change?**

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Ecosystems Unit, Packet 2 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. **Briefly summarize how and why imbalances in matter movement and the flow of energy from an asteroid strike caused the dinosaurs to go extinct.** Explain how and why these changes occurred at the ecosystem, organismal, cellular, and molecular-atomic levels.

_____

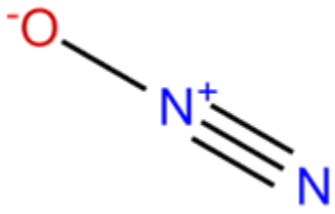
_____

_____

_____

Writer's Name:

2. This is Nitrous Oxide (N_2O). It consists of two elements (oxygen and nitrogen) and has three atoms. **A) If atmospheric levels of N_2O increase on Planet X by 50%, how would this affect the movement of light and infrared radiation? B) How would this change conditions on the surface of the planet?** Explain & justify w/ evidence. Include the following: *greenhouse gas; molecular properties; greenhouse effect; infrared radiation.*



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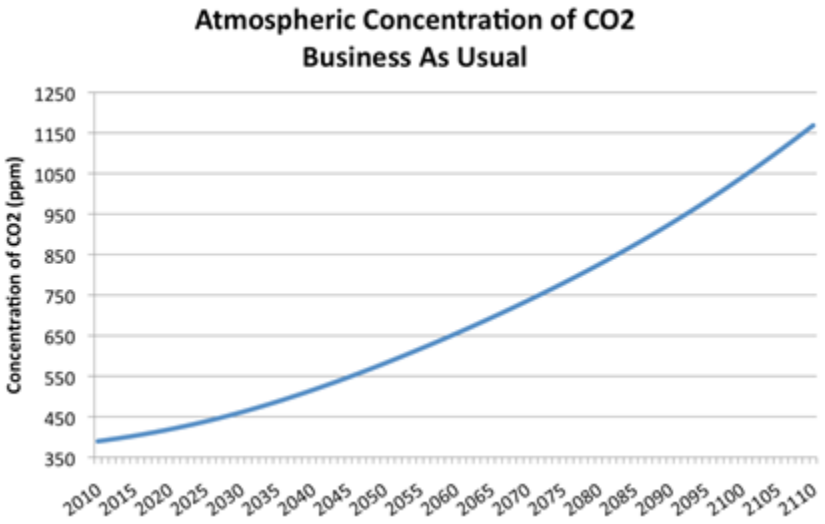
Writer's Name:

3. The graph shows how CO_2 levels will change under a "business as usual" scenario (i.e., no changes to the current CO_2 emissions). **What are some outcomes that we would expect if CO_2 levels were to continue to increase at this rate?** In your response, explain a) the relationship between CO_2 and temperature, and b) how changing levels of CO_2 result in different kinds of ecosystem disturbances.



Writer's Name:

4. **Are the changes that are now happening in climate due to natural cycles? Are they due to other natural factors like volcanoes or sunspots?** Support your ideas using evidence and reasoning.

Writer's Name: