Name _____

Lesson 6: How does human activity affect the trend of warming temperatures on Earth?

Do Now Prior Experiences:

In the last lesson, we investigated what the world's temperature trend was in the distant past to find out if the recent increasing temperature is a trend or not. What do we now understand from the previous lesson?

_____

_____

_____

Exploring Greenhouse Gases (GHGs):

- Use the **PhET The Greenhouse Effect simulation** to model the relationship between greenhouse gases, especially CO_2, and the temperature: https://phet.colorado.edu/en/simulation/greenhouse
- Complete the data table and then investigate your own scenarios using the simulation.

Time	**CO2 Concentration** (ppm=parts per million)	**Temperature** (in °F and °C)	**Amount of Infrared photons (heat) compared to other times** Circle one:	**Amount of sunlight photons compared to other times** Circle one:
Ice Age (2.6 million to 11,760 years ago)			More Same Less	More Same Less
1750 (pre-industrial revolution)			More Same Less	More Same Less
Today (post-industrial revolution)			More Same Less	More Same Less

Making Sense:
What patterns do you observe about the relationship between the concentration of CO_2, along with the other GHGs, and temperature?

Which time is the concentration of CO_2 in the atmosphere the highest? Where do you think the source of extra CO_2 came during this time?

Which time is the concentration of CO_2 in the atmosphere the lowest? What do you think the reason is why CO_2 is not as high during this time?

Understanding GHGs and the Greenhouse Effect (GHE):

Watch **"The Greenhouse Effect"** video to connect CO_2 and its role in the warming Earth: https://cleanet.org/resources/42808.html

In the space below, draw a diagram or write a brief explanation describing what the GHE is and how it works. Use the following prompts, for ideas:

- Explain what the GHE is and why it's important.
- How does the level of CO2 in the atmosphere affect the Earth's temperature?
- Describe how human activities affect the natural GHE.

Summary:

_____

_____

_____

_____

_____

Human Activities that Emit CO_2 and Other GHGs:

Using the Data Sheet, work with a partner to analyze the **U.S. GHG Emissions Flow Chart (Figure 6.1)** to figure out details about the human activities that release GHGs.
http://cleanet.org/resources/47840.html

List the top three GHGs emitted the most from human activities and their percentages:

1. _____
2. _____
3. _____

List the top three sectors that release GHGs (e.g. Industry).

1. _____
2. _____
3. _____

Identify the top three end use/activities that release GHGs (e.g. Landfills).

1. _____
2. _____
3. _____

Write one fact about human-caused GHG emissions that surprised you.

_____

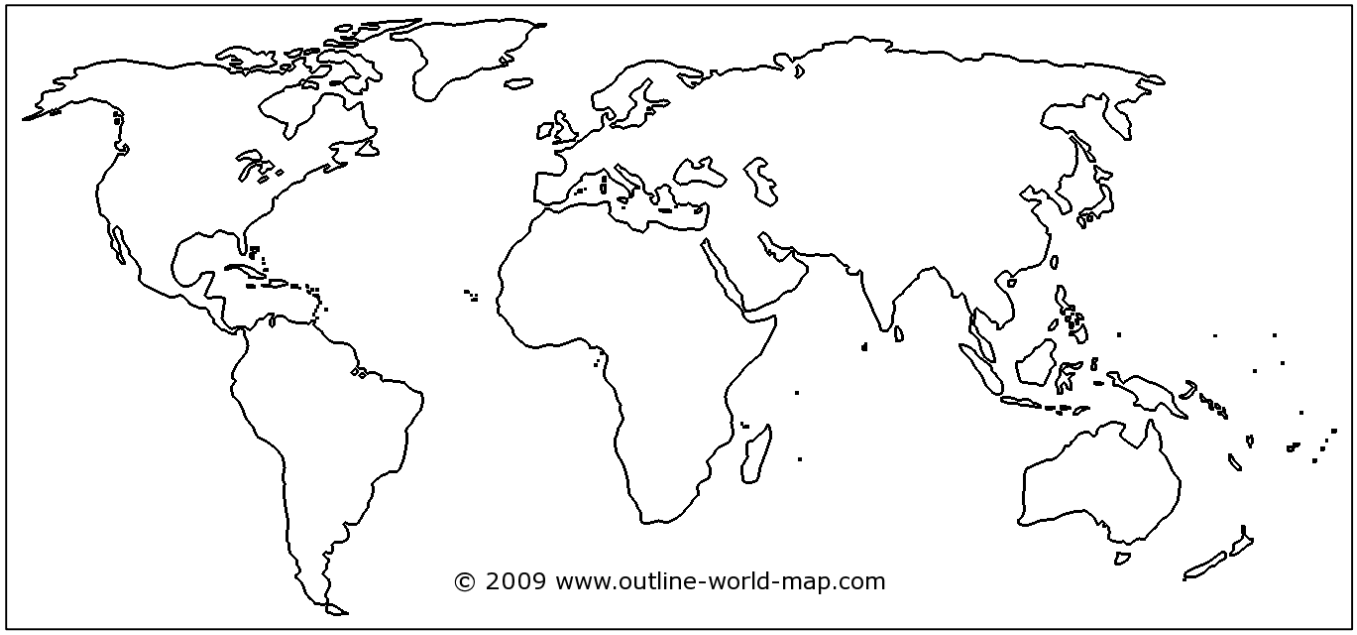
_____

_____

_____

Brainstorm:
Think, pair, share what do you think happens after CO_2 is released into the atmosphere?

- Watch the **"Following Carbon Through the Atmosphere" visualization** to see where CO_2 goes after it is emitted (released) into the air: https://www.nasa.gov/feature/goddard/2016/eye-popping-view-of-CO2-critical-step-for-carbon-cycle-science
- On the world map, sketch the pattern that you observe of how CO_2 travels:



Source: http://www.outline-world-map.com/blank-thick-white-world-map-b3c

Summary:

_____

_____

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_____

_____

Connecting CO_2 and the Carbon Cycle:

Brainstorm:
Think, pair, share about where you think the CO_2 that is released into the atmosphere originally comes from and where it eventually goes?

- Using the Data Sheet, discuss the patterns modeled on **The CO_2 and the Carbon Cycle diagrams (Figure 6.2 and Figure 6.3)**. Explain what you observe:

CO_2 and the Carbon Cycle Observations

Carbon Cycle Reservoirs:

- Launch and explore the online **Carbon Dioxide and the Carbon Cycle** interactive animation (or review the printed screenshots if computer access is unavailable): https://rmpbs.pbslearningmedia.org/resource/pcep14.sci.ess.co2cycle/carbon-dioxide-carbon-cycle/#
- Using the interactive animation, observe each web page and read each informational link and summary to build an understanding about CO_2 and the Carbon Cycle.
- Answer the questions on the following page.

As you go through each web page, record the main areas where carbon is stored (sinks) and which processes release CO_2 (sources) into the atmosphere:

List the main reservoirs (sinks) where carbon is stored on Earth from largest to smallest:

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

What form is carbon stored in the atmosphere?

_____

_____

Which reservoir has the biggest direct impact on climate?

_____

_____

Which reservoir has the least impact on climate?

_____

_____

How do human activities affect the fossil fuel carbon reservoir?

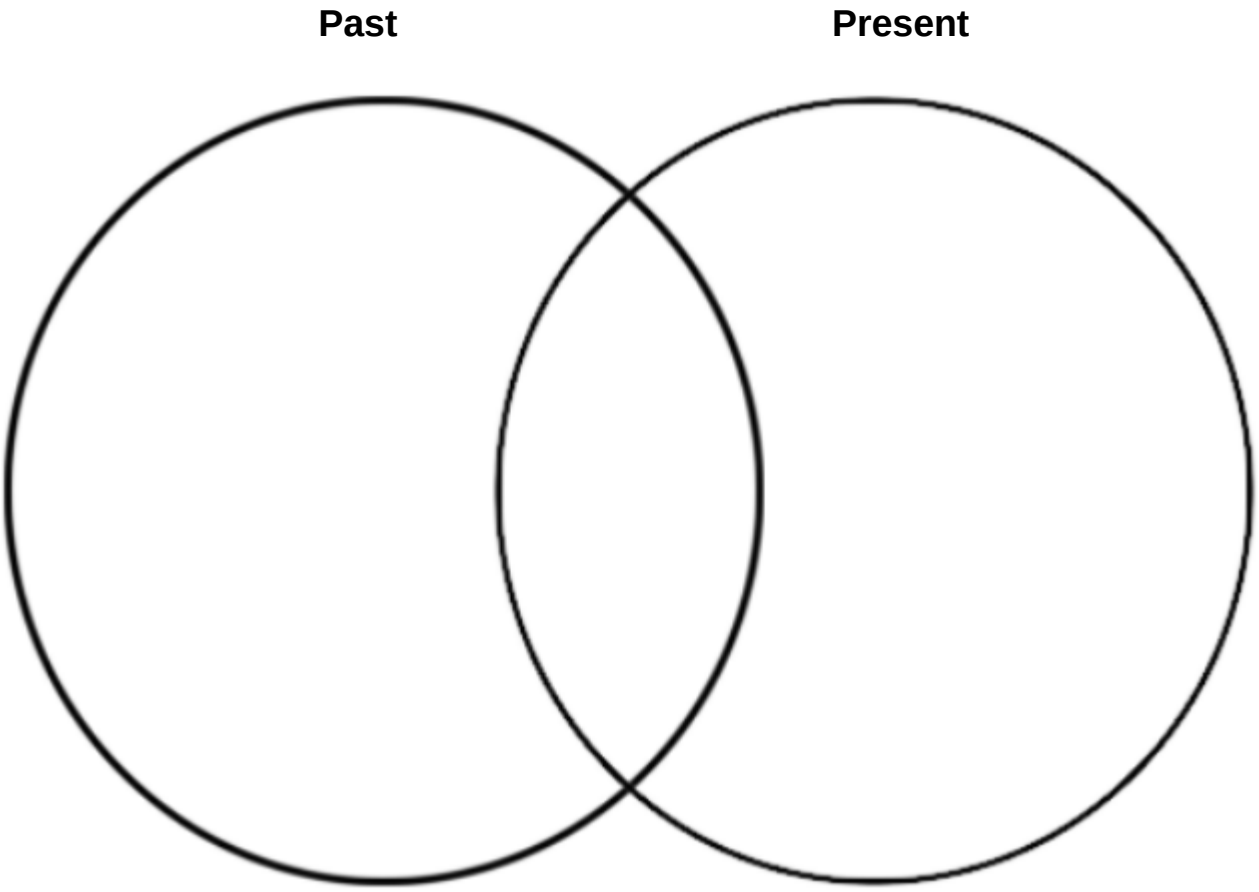
_____

_____

_____

CO_2 and the Atmosphere 300 Years Ago vs. CO_2 and the Atmosphere Present Day

Use the diagram and table to compare and contrast the sources of CO_2 in the atmosphere and how their amounts have changed over time:



CO_2 and the Atmosphere 300 Years Ago	CO_2 and the Atmosphere Present Day

Temperature and CO_2:

Read each summary and analyze each graph about CO_2 in the atmosphere and temperature over the past 1000 years. Describe the patterns and trends you observe over time in the table:

	Year 1000-1800	**Year 1800-Present**
CO_2 Concentrations		
Temperature Change		
CO_2 and Temperature Relationship		

CO_2 and Climate Change Connections:

As a class, watch and then discuss the connections between GHGs, the GHE, and what adding more CO_2 to the atmosphere from burning fossil fuels does to the natural balance of Earth's temperature.
Climate Change Basics video: http://cleanet.org/resources/45172.html

Next Steps:

What have we learned from this lesson and what should we investigate next?

Word Bank: atmosphere, carbon dioxide (CO2), Carbon Cycle, decrease, emissions, fossil fuels, greenhouse effect (GHE), greenhouse gases (GHGs), increase, sink(s), source(s), temperature.

Describe what we have learned about the connection between human activities, CO_2, and Earth's temperature? You can use the word bank terms (above), if needed.
What should we investigate next to understand how Earth's temperature are warming?