Name _____ Teacher _____ Date _____

2.2: Expert Group A Worksheet

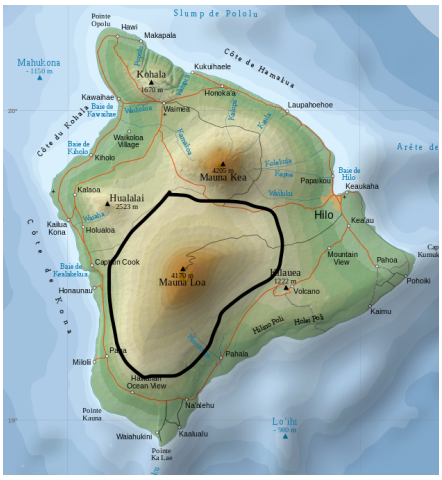
In your expert group, complete each task answer the questions related to each task. In the next activity, you will explain your phenomenon to your home group members. Be sure to ask questions about anything you don't understand about your phenomenon.

☐ **Task A: Read about the Phenomenon:** The CO_2 Annual Cycle

a. *What is atmospheric CO_2 concentration?* Gas concentrations are measured in units called parts per million (ppm), which means out of a million molecules of air how many are a particular gas, such as CO_2. So, if the CO_2 concentration of the air is about 400 ppm, that means that out of a million molecules of air, 400 of them are CO_2.

b. *How do we measure today's atmospheric CO_2 concentration? …Welcome to Hawai'i!*

- Watch just the first 1:20 in this video (know that when the speaker says "Noah" he is referring to NOAA, the National Oceanic and Atmospheric Administration, the government agency that monitors the ocean and the atmosphere): https://youtu.be/3jOAlC2dVtA.
  - Mauna Loa is a mountain on the main island of Hawaii where the facility in the video has been measuring atmospheric CO_2 continuously for 60 years. CO_2 **measurements from Mauna Loa are representative of the Northern hemisphere** for two reasons: 1) It is far from large continents and very high above the earth, so the air there is not affected by local sources of CO_2, which would make the measurements less representative of a larger area; and 2) Because of global air circulation the air within the northern hemisphere (same is true for southern hemisphere) mixes together every 1-2 months making one location representative of other locations in the hemisphere.



Hawai'i's main island with Mauna Loa circled in black. From Wikimedia Commons https://commons.wikimedia.org/wiki/File%3AHawaii_Island_topographic_map-fr.svg

c. *How do we know what the CO_2 concentrations were in the past? …Use ice to time travel!*

- As snow falls, air is trapped in spaces within the snow. Over time, more snow weighs down the older, deeper snow, compacting it into distinct layers of ice that maintain the trapped air in bubbles. Scientists drill cores out of the ice to understand the ancient climate. Most of these ice cores are from Antarctica, Greenland, and glaciers worldwide.
- Using ice cores, scientists can measure the concentration of CO_2 and other gases in the trapped air bubbles as far back as 400,000 years. Watch this video on ice cores https://youtu.be/oHzADI-XID8.

d. *Why is the atmospheric CO_2 concentration important?*

- Well, investigators, this one is on you to figure out as you learn more about the greenhouse effect in the next lesson!

☐ **Task B:** Watch a video about the global annual CO_2 cycle (http://sos.noaa.gov/Datasets/dataset.php?id=449), which represents data about the concentration of CO_2 in the lower atmosphere from 2000 – 2010. It lasts 1 minute and 14 seconds. In order to watch the video, you will need to download it onto your computer first. (Alternatively, watch the following video (https://www.youtube.com/watch?v=x1SgmFa0r04).

Look For: When you are watching the video, pay attention to these things:

1. *The date*. You can find this in the bottom of the screen. It moves quickly! (You can pause the video to show a particular month.)
2. *The colors*. Red and Yellow indicate higher CO_2 concentrations, and blue and purple indicate lower CO_2 concentrations.

Questions: Answer these questions about the Carbon Tracker video.

1. What is happening to CO_2 concentrations in North America from 2000-2010? (If you watch the alternative video, consider what is happening to CO_2 concentrations in North America across 2006.)

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_____

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2. Which month of the year has the highest CO_2 in Canada? Hint: use the slider at the bottom of the screen to browse through the video. (Circle one).

January February March April May June July August September October November December

3. Which month of the year has the highest CO_2 in the southern hemisphere? (Circle one)

January February March April May June July August September October November December

4. What questions do you have about the video or the data it represents?

_____

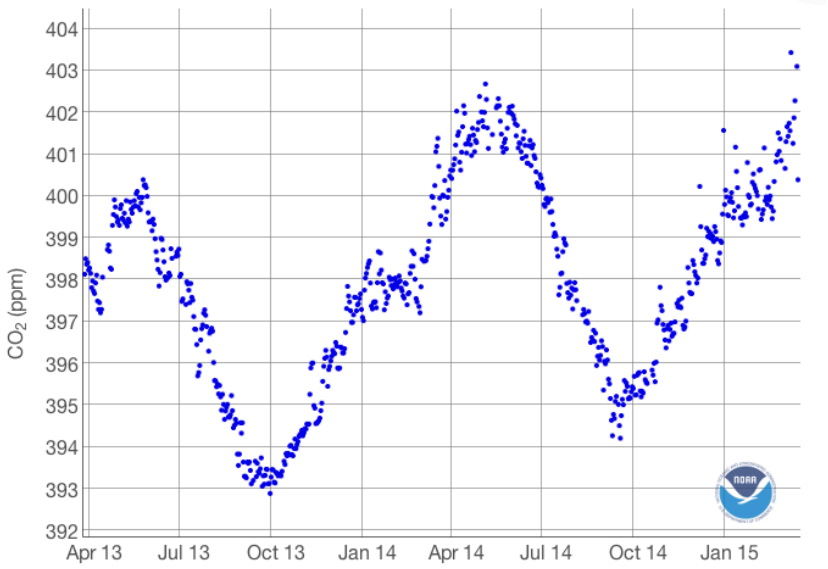
_____

_____

☐ **Task C:** Read a graph about the annual CO_2 cycle in the northern hemisphere.

Mauna Loa Daily CO_2 Concentration Averages
http://www.esrl.noaa.gov/gmd/ccgg/trends/graph.html

To simplify things a bit, we are going to focus on data collected at one point on the earth (only one of the white dots). Mauna Loa is a mountain in Hawaii where a facility for measuring atmospheric CO_2 has been continuously collecting measurements since 1958. The scale on the left (y-axis) represents parts per million (ppm) of CO_2 in the atmosphere. One ppm of CO_2 means that if you had one million grams (1000 kg) of well-mixed atmospheric gases, one gram of it would be CO_2.



5. What does each dot on the graph represent?

_____

_____

_____

_____

6. Which months of the year have the highest and lowest CO_2 concentrations?

Highest: _____ Lowest: _____

7. Describe how atmospheric CO_2 concentration is related to the seasons of the year. Scientists call this the "annual cycle" because it is so predictable.

_____

_____

_____

_____

8. Mauna Loa is in the northern hemisphere. A seasonal CO_2 cycle is observed in the southern hemisphere, although the difference between the high and low CO_2 concentrations is less prominent. Remember that the seasons are opposite in the southern hemisphere. Summer is from December to March and winter is from June to September. Which months would you predict have the highest and lowest CO_2 concentrations in the southern hemisphere?

Highest: _____ Lowest: _____

☐ **Task D:** Complete the charts below. Discuss anything you don't understand with your group or teacher. Use this to explain your phenomenon to your home group.

Representation

	What variables are represented?	**Which part(s) of the Earth are represented?**	**What time period is represented?**
Carbon Tracker Video			
CO_2 graph from Mau			

Generalizability

What information does the video tell us that the graph leaves out?	**Which of the Earth's regions are included?**	**What does this data tell you about global patterns?**

Short-Term Variability vs Long-Term Trends

Describe the short-term variability in the data. Is it predictable or unpredictable?	**Describe the long-term trend in the data. Is it predictable or unpredictable?**