**The Earth’s Atmosphere: Past, Present, and Future**

**Earth Science with Mr. Lanik**

Let’s explore the Atmosphere of the Future, and see what the years ahead might have in store for us. Please access (copy and paste if the live link does not work) the following website:

<https://www.esrl.noaa.gov/gmd/outreach/carbon_toolkit/basics.html>

This is a collection of information that has been put together by our dear friends at NOAA. Take the time to read the pieces of the site that I guide you to, and use all of the resources available to learn as much as you can.

The first page tosses out a variety of abbreviations and science terms that can be difficult to understand. Define each of the science expressions shown below, using any resources you can find.

Trace amount:

Greenhouse gas:

CCGG:

Which greenhouse gas is the most abundant in our atmosphere?

Carbon dioxide is the second most abundant greenhouse gas. What activities cause carbon dioxide gas to be added to the atmosphere?

How can carbon dioxide gas molecules be removed from the atmosphere?

What natural environmental conditions produce methane gas?

What human activities produce methane gas?

How can methane gas get removed from the atmosphere?

How is nitrous oxide gas produced naturally?

What human activities produce nitrous oxide gas?

How can nitrous oxide gas get removed from the atmosphere?

Grab some colored pencils and make a sketch that shows where energy from the sun goes once it enters the Earth's atmosphere. **An internet search should help you locate some good visual examples to use as models**. Be sure to show the percentage of the energy that is absorbed/emitted by different parts of the Earth (such as clouds, oceans, etc…)

What percentage of the sunlight that reaches the Earth is absorbed into the planet? \_\_\_\_

What percentage of the sunlight that reaches the Earth is scattered and reflected by clouds? \_\_\_

What percentage of the sunlight that reaches the Earth is absorbed by the gases in the atmosphere? \_\_\_\_

**How does the Earth cool itself?**

If the Earth didn’t have a way to cool itself, it would continue to get hotter and hotter as it absorbed energy from the sun, until eventually it would be too warm to support life. Luckily for us, the Earth does have a way to cool itself! “Cooling” is just a fancy word that means “releasing heat energy”. The Earth releases heat energy that is in the form of electromagnetic radiation.

Find the section of the website entitled “The Greenhouse Effect”.

What is the difference between “**shortwave radiation**” and “**longwave radiation**”? Give an example of each.

What is a GHG?

The key to understanding how the Greenhouse Effect works lies in recognizing that the energy that reaches the Earth from the Sun (ultraviolet/visible/infrared light) is DIFFERENT from the light that is released by the Earth as it cools. In our Heating/Cooling lab, we measured the rate at which the beakers cooled after the light was turned off. Just like the beakers, the Earth is constantly trying to cool itself to release energy that it has absorbed from the Sun.

What type of radiation is released by the Earth as it cools itself? (Hint: what kind of radiation does a warm object give off?)

Check your answer by reading through the “Greenhouse Effect” section of the NOAA website.

“Since Earth is much cooler than the Sun, it emits weaker radiation with longer wavelengths, in the infrared range. Some of this infrared radiation passes through the atmosphere unimpeded, ***but the majority is absorbed by GHGs and then reemitted in all directions-towards space, to other GHG molecules, and back to Earth's surface. In this way, GHGs block most of the infrared radiation within the atmosphere that would otherwise escape directly into space.*** “

The above statement is a direct quote from the website. It explains that the Earth tries to cool itself by releasing longwave, infrared radiation out into space. However, Greenhouse Gases (GHG’s) in the atmosphere ABSORB this infrared radiation, and then re-release it, BUT IN DIRECTIONS THAT USUALLY KEEP THE HEAT/RADIATION IN THE EARTH SYSTEM, INSTEAD OF LETTING IT GO OUT INTO SPACE TO COOL THE EARTH.

Why don’t greenhouse gases absorb most of the energy from the Sun that passes through the atmosphere on its way to the Earth’s surface?

Another quote from the website: “This process is naturally occurring and beneficial, as it maintains favorable living conditions for Earth's microbial, animal and plant inhabitants. The global average temperature is 14°C (57°F), which is approximately 33°C (59°F) warmer than temperatures would be without an atmosphere and GHGs.”

Would life be possible on Earth without the Greenhouse Effect? Justify your answer with FACTS!

If the Greenhouse Effect is crucial to allowing life on Earth to survive, then why do you think that scientists are currently so concerned about Greenhouse Gases in the atmosphere? What has happened over the past 150 years that is different from what has happened over the previous 4 billion years of the Earth’s history?

Return to the NOAA website (if you left it) and answer the following question: What is the *Enhanced* Greenhouse Effect?

Which greenhouse gas is the one that scientists are most worried about, in terms of atmospheric changes and climate impact? Why are they most concerned about this particular little molecule?

Use the website h[ttps://serc.carleton.edu/eslabs/carbon/2b.html](https://serc.carleton.edu/eslabs/carbon/2b.html)  to explain what the Carbon Cycle is, using the terms “reservoir”, “source”, and “sink” in your response.

Give an example of the terrestrial biosphere acting as a carbon sink.

Give an example of the terrestrial biosphere acting as a source of CO2.

Give an example of the ocean acting as a carbon sink.

Give an example of the ocean acting as a CO2 source.

Over the past 800,000 years, the amount of carbon dioxide gas in the atmosphere remained consistently below 300 ppm (carbon dioxide molecules per million gas particles in the atmosphere)-- up until about 150 years ago. Beginning 150 years ago, the amount of carbon dioxide has been rising at an accelerating rate… it is currently about 40% higher than it was in 1850.

What human activity that began around 1850 has been directly linked to this rise in CO2 levels in the atmosphere?

Are there any quick, easy ways to reduce the levels of carbon dioxide in the atmosphere? Explain.

Please watch the video at the following website:

<http://www.esrl.noaa.gov/gmd/ccgg/trends/history.html>

What does the video show?