

Name: _____ Period: _____ Date: _____

Lesson 5: Is it normal that world temperatures are rising this fast?

Do Now: The following statements relate to the greenhouse effect. Write T or F depending on if the statement is true or false. **If the statement is false, correct it to make it true.**

- Greenhouse effect is a “bad” thing for planet Earth, and it is also known as global warming. **False - Greenhouse effect is important for planet Earth in moderation, and in excess it is called global warming. Greenhouse effect prevents infrared heat from escaping into outer space.**
- 100% of the visible light from the sun that enters Earth’s atmosphere will be absorbed by the planet’s surface. **False- About 70% of the solar radiation (not just visible light) will be absorbed by the atmosphere, the surface, and the oceans¹. This is variable depending on the amount of greenhouse gases. The remaining 30% ends up reflected to space.**
- Non-greenhouse gases can absorb and reradiate infrared heat. **False- only greenhouse gases can absorb and reradiate infrared heat**
- Most of the energy from the sun (insolation) is in the form of infrared heat. **Overall, true, the sum for all energy from the sun is greater for the infrared region than the visible region¹. Students can point out the strongest irradiance (peak of energy from the sun) occurs in the visible range.²**
- Greenhouse gases bounce or reflect infrared heat, and this is what keeps our planet warm. **False – Greenhouse gases absorb, then re-emit infrared heat. Reflection is different.**
- Visible light is absorbed and reradiated by greenhouse gases, warming our planet. **False- Infrared light is absorbed and reradiated by greenhouse gases.**

Why is the process discussed today called the greenhouse effect? Where does this name come from and how does the greenhouse effect work in that example? Use a greenhouse or a car as an example.

It’s called the greenhouse effect because this phenomenon was used in greenhouses to keep them warm. The entire greenhouse is made of glass, so solar radiation (specifically visible light) can enter. It is absorbed by the surfaces and reradiated back out as heat. That heat cannot go through glass, though, so it gets trapped, keeping the greenhouse warm. People realized the atmosphere does the same thing. Instead of glass, we have greenhouse gases



that do the same thing. If you've ever gotten into a car that's been out in the sun, you'll realize it is hotter in the car than outside. Same thing, the 'greenhouse gas' is the glass and it traps solar radiation inside of it.

Procedure: Jigsaw. Complete the table for your data set. Then, in your small groups, share information so that you have a summary of all of the data sets. **Teachers:** read the source articles if you get a chance for each data set (link under each source)

Data Set	Observations/Notes	Claims/Conclusions
1	-demand for oil/coal is going up -looks like coal levelled off for a bit (why?) -renewables are new -more people on Earth	-worldwide consumption of fuel is going up because population is increasing -the ups and downs have to do different economic factors (prices go up, a cheaper fuel is found, etc)
2	-global temp getting more red (getting warmer) and CO2 concentration is increasing -the temperature anomaly was 0 for a while, but then increased a lot THIS IS THE HARDEST DATA SET TO ANALYZE	-CO2 is increasing and we see a correlation with temperature, not causation yet.
3	-CO2 goes up and down with season and has its highest fraction in spring/summer in Mauna Loa (because plants absorb CO2, CO2 decreases once plants start blooming in May but builds over the winter) ³	-Overall CO2 is increasing in Mauna Loa
4		-CO2 concentrations (blue) and temperatures (red) follow each other closely and there is a huge spike in CO2 recently! Does not yet imply causation, just correlation.
5		-global temperatures are overall increasing but there are dips that do not match global fossil fuel emissions, but the general trend is the same

6	THIS IS A DIFFICULT DATASET	-observed (black) global temperature anomalies closely track model anomalies if the model includes anthropogenic sources of heat, and not just natural sources of heat. We have causation!!
7	-increase in pollutants since 1800 or so, which is approximately industrial revolution	-CO ₂ , CH ₄ , and N ₂ O have been increasing since the industrial revolution
8	-global warming potential is higher for methane but it's in the atmosphere for less time -MEDIUM DIFFICULTY Dataset	-CO ₂ is a more important greenhouse gas because it exists in higher concentrations and lasts longer than methane does

Scientific Explanation: Why is global warming happening and should we be concerned about it? Use evidence from the jigsaw and class discussion to support your answer.

We are increasing the amount of GHG emitted into the atmosphere because they come from fossil fuels and with a growing population we are using more fossil fuels (but renewables are increasing!). These gases, primarily CO₂ because CO₂ is high in concentration and has a long lifetime, trap heat on Earth causing temperatures to increase and other effects. We don't know all the impacts yet, so we should look at those to see if we should be concerned

Asking Questions: What are you wondering now?

Next Steps: What ideas did your class come up with for what we should investigate in our next lesson?



Extra References

1. NASA article saved as PDF called 'StudentActivityGuideRef1'. Link is:
https://earthobservatory.nasa.gov/Features/SORCE/sorce_02.php
2. Carnegie Mellon article saved as PDF called 'StudentActivityGuideRef2'. Link is
<http://environ.andrew.cmu.edu/m3/s2/02sun.shtml>
3. Monroe, 2013, UCSD. Article saved as 'StudentActivityGuideRef3'.
<https://scripps.ucsd.edu/programs/keelingcurve/2013/05/07/why-are-seasonal-co2-fluctuations-strongest-in-northern-latitudes/>

