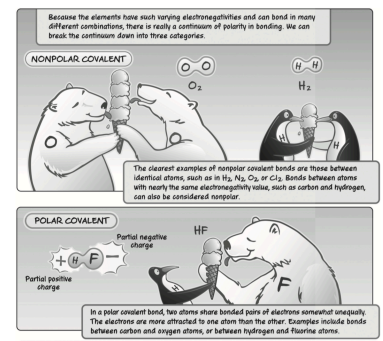


Greenhouse gasses and the greenhouse effect

1. Go to the [Molecules and Light simulation](#). Examine how the different photons in the simulation affect each molecule. Record whether the molecule **absorbs or does not absorb** that type of energy. If the molecule absorbs light, it will vibrate with energy until, then it will re-emit a photon back out in a random direction. If it does not absorb the energy the photon will travel past the molecule



Molecule	Infrared (Heat Energy)	Visible light	Draw Lewis structure (remember your HONC rules)	Does it have any polar bonds (two different elements sharing electrons) ?	Does it follow the HONC rule?	Green house gas?
CO			$:C \equiv O:$			yes
N ₂						No
O ₂						no
CO ₂						yes
CH ₄						yes
H ₂ O						yes
NO ₂						yes
O ₃ Ozone						yes

- Describe what a greenhouse gas molecule does with energy and what about its molecular structure makes it do that?
- Look at the table - Chlorofluro carbons like CCl_2F_2 have a very high global warming potential. Draw the structure for CCl_2F_2 why do you think it has such a high global warming potential?

Data from The National

Greenhouse gas	Concentration in 2017	Global warming potential (over 100 years)	Duration in the atmosphere
Water vapor	Variable with temperature	<1	9 days
Carbon dioxide	407 ppm	1	Highly variable (ranging from years to hundreds of years)
Methane	1.85 ppm	25	12 years
Nitrous oxide	.33 ppm	300	114 years
Chlorofluorocarbons	0.0007 ppm	1,600 to 13,000	55 to >500 years

PART 2, Go to the PhET [Greenhouse Effect Simulation](#). Click on photons Start sunlight, click on all the boxes, Observe

- In what direction are all the yellow photons moving?
- In which directions are the red photons moving?
- Which color photons represent sunlight?
- Which color photons represent heat(infrared)?
- Does the Earth emit visible light or heat(infrared)
- Take Data - Use the right tool bar to click on different atmospheres during different times. Fill out the chart

	Surface temp in C	CO ₂ ppm	CH ₄ ppm	N ₂ O ppm	What is shown in this time period	Net arrow up (more out) or down (more in)
Today (2020)						X
1950						X
1750 (pre-industrial revolution)						X
Ice age						X
Adjustable concentration – slide greenhouse gas concentration to none		None	None	None	X	
Adjustable concentration – slide greenhouse gas concentration to Lots		Lots	Lots	Lots	X	

- What are three observations you can make about the data above?
- Look at today and the ice age
 - What has changed about CO₂ composition
 - What has changed about temperature?

- c. Where do you think the CO₂ went during the ice age? (Hint from Chem- Gases are more soluble in water at lower temperatures)
- d. Within Earth's atmosphere, these naturally occurring greenhouse gasses interact with heat energy trying to radiate from the Earth back into space, slowing the process down. But what happens to the energy balance when humans add even more of these (and other) gasses to Earth's atmosphere?

12. Click and unclick the cloud - what effect does the cloud have on the sun and infrared photons?

13. As the planet warms more water vapor, evaporates into the atmosphere. But as more water vapor enters the atmosphere, more clouds form. Using this information and the simulation, explain why there is debate about whether more water vapor in the atmosphere will lead to more warming or more cooling of the Earth's surface.

14.

15. Click on Layer Model

- a. Use the slider for surface albedo and fill out the following table

Surface albedo	Temperature after adjusting the albedo	surface represents ice or soil	Describe what happens with the sunlight photons
0			
0.9			

- b. Albedo is a measure of the reflectivity of a surface, Sea ice has a high albedo(0.7) , Bare soil (0.17) and open ocean (0.06) have very low albedo. Explain how you observe this in the simulation
- c. One of the effects of global climate change due to the greenhouse effect is arctic ice melting. How do you think the melting of the ice will affect temperature? What will happen to the ice as a result of that temperature change (explain if this is positive or negative feedback)
- d. What happens to the carbon dioxide that is dissolved in the arctic ice as the ice melts? How does that affect the temperature of the atmosphere? (is this a positive or negative feedback)

Click on Layer model

	Temperature of surface
No absorbing Layers	
1 absorbing layer	
2 absorbing layer	
3 absorbing layer	

16. Why do people spend more money to install double or triple pane windows in their houses instead of using single pane windows?

17. What do you think the infrared layers are representing?

18. Why do you think the greenhouse effect is named as such?