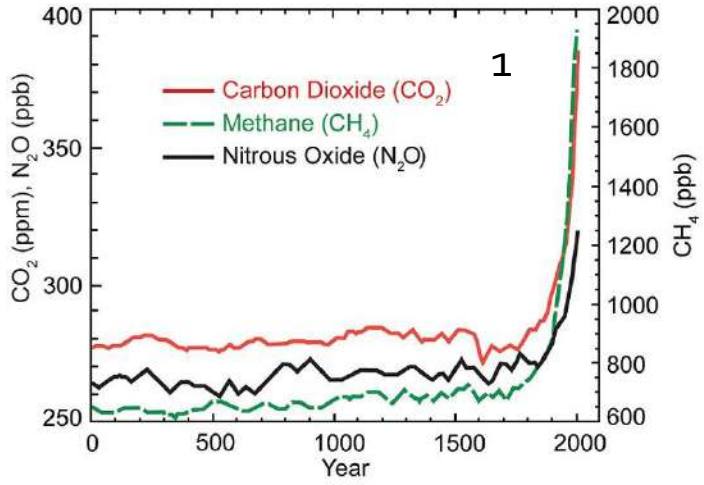
U2D8&9 – Greenhouse Effect Investigation

U2D8 – Bell Ringer – 11/5

Shown are 4 graphs from the article: [The Big Picture Breakdown of Greenhouse Gasses]

- Graph 1: What 3 gasses are shown on this graph? What is the trend in these gasses?
- Graph 2: What gas makes up the majority of human-produced greenhouse gasses?
- Graph 3: Based on this chart, do you think there is ONE answer to solve climate change?
- Graph 4: Which countries are the largest contributors to greenhouse gasses?

1



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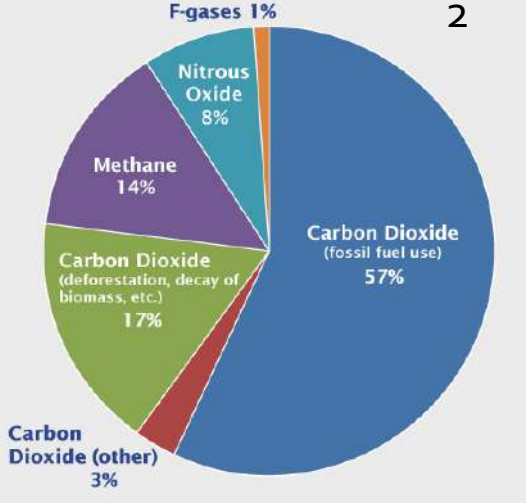

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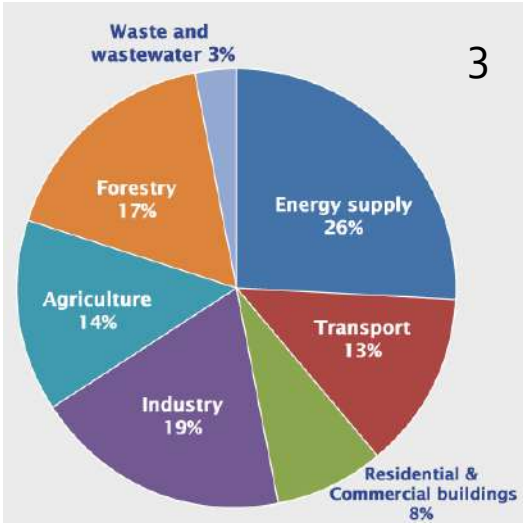

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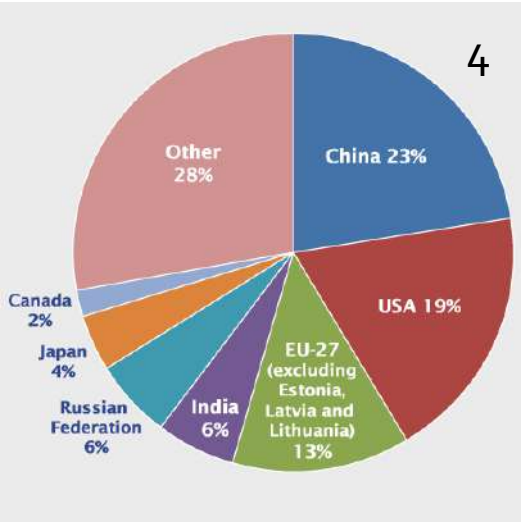


Objectives

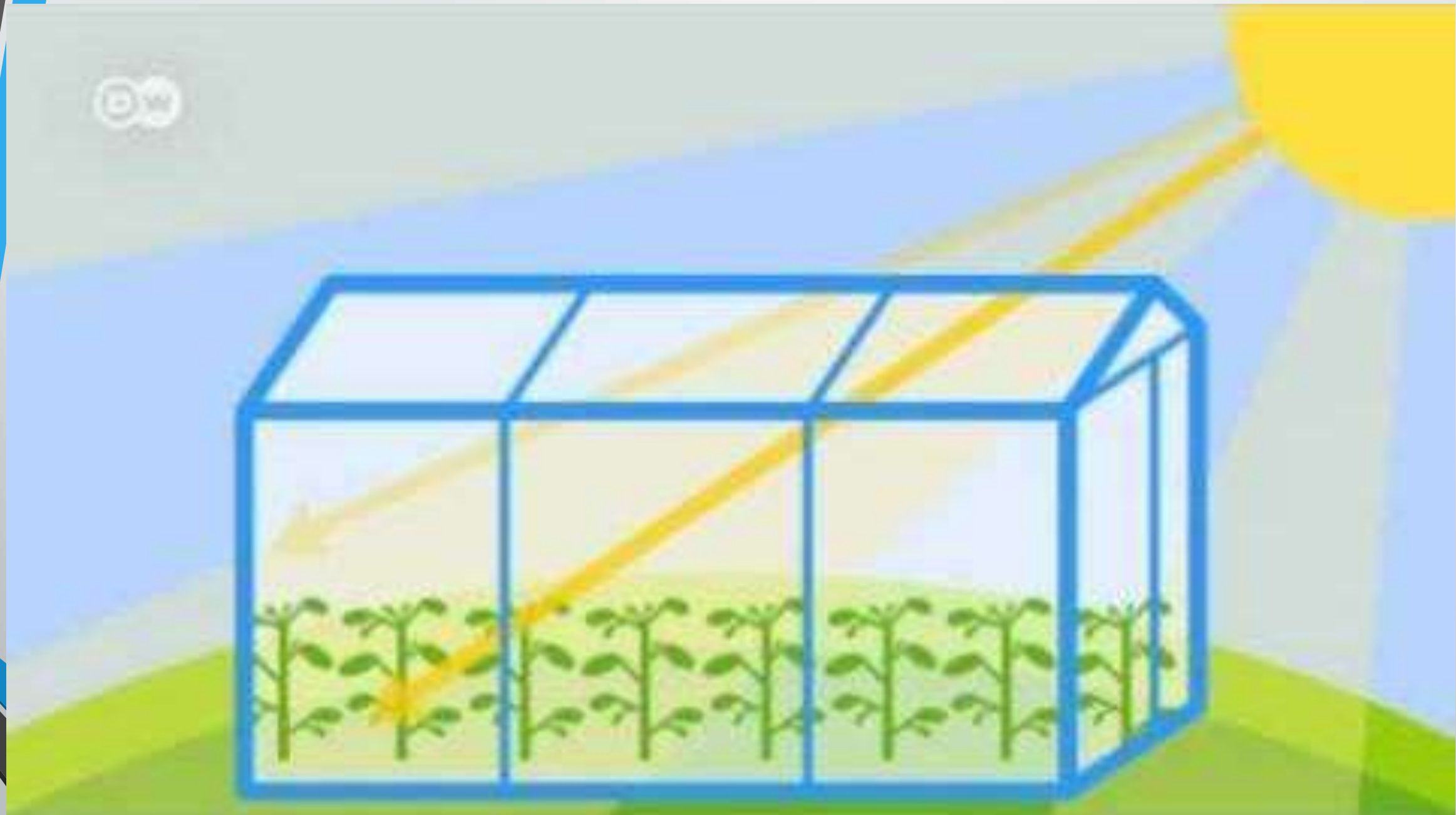
Content Objective:

I can identify elements of experimental design.

Language Objective:

I can use background information to write a hypothesis.

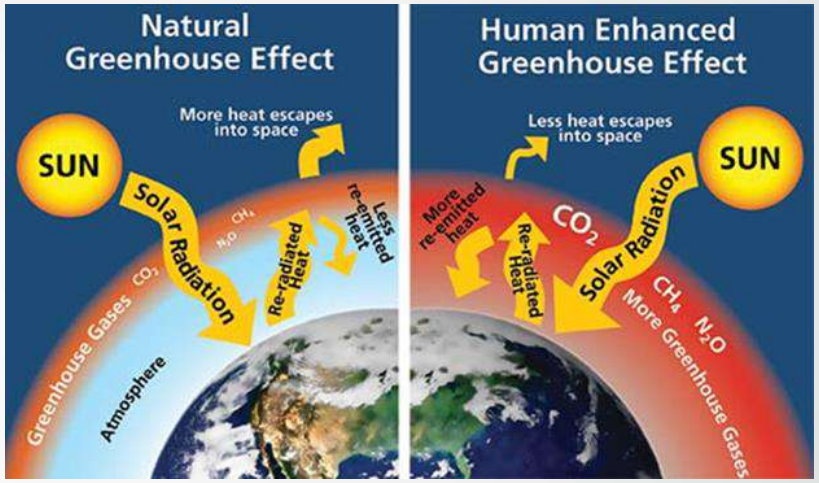
What is the Greenhouse Effect?



Pre-Lab Reading: What is the Greenhouse Effect

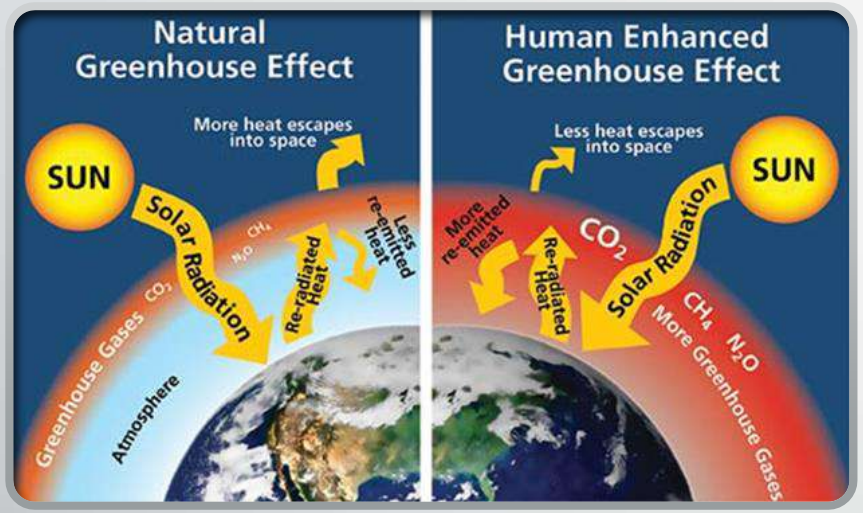
Unfortunately, the label has stuck, but the greenhouse effect in our atmosphere is not exactly like an actual greenhouse. A greenhouse lets in solar energy (mostly in the form of visible light), which keeps it warm and allows the plants inside to grow. The greenhouse stays warm primarily because its glass windows prevent the wind from carrying away the heat. This is very different from the greenhouse effect.

The greenhouse effect occurs on our planet because the atmosphere contains greenhouse gases. Greenhouse gases are special in that they absorb infrared radiation and release that energy as heat. In doing so, they warm the atmosphere around them. Not all gases are greenhouse gases. In fact, nitrogen and oxygen - the most abundant gases in the atmosphere - aren't greenhouse gases. Fortunately for life on Earth, which depends on some atmospheric warming to exist, other gases *are*, including water vapor, carbon dioxide, and methane. Without its greenhouse atmosphere, Earth's temperature would plummet to well below freezing.



We know that Earth has been a habitable planet for over 3 billion years. This means that there has always been a greenhouse effect. The carbon dioxide that humanity is adding to the atmosphere today isn't creating the greenhouse effect, it's simply intensifying it.

How the Greenhouse Effect Works



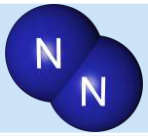
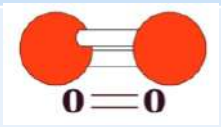
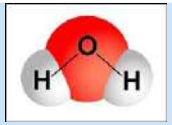
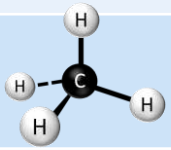
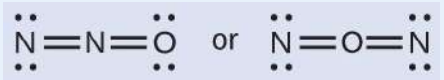
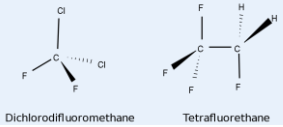
Greenhouse gases allow sunlight to pass through the atmosphere and heat the Earth, but they interfere with the loss of heat from the land and ocean, redirecting some of that heat back to the surface.

1. Earth absorbs solar energy and warms up
2. Like all warm objects Earth begins to radiate (emit) heat.
3. Heat radiating from Earth encounters greenhouse gas molecules in the atmosphere.
4. The molecular structure of greenhouse gasses allows them to absorb infrared wavelengths that would otherwise radiate back into space.
5. The absorbed heat causes the atmosphere to warm. As a result, it too radiates heat.
6. Some of this heat is radiated out into space, but the rest is radiated back to Earth's surface This extra energy warms Earth to higher temperatures.
7. In the natural greenhouse effect, the energy radiated into space very nearly balances the solar energy absorbed by Earth.
8. Currently, however, Earth is radiating slightly less heat into space than it is receiving from the Sun, because of the recent addition of greenhouse gases to the atmosphere. Consequently, the planet is warming.

Notes: Greenhouse Gasses

Match the name of the gas in the atmosphere with its molecular formula/abbreviation:

CO_2, N_2, O_2, H_2O, CH_4, CFC (abbreviation, not formula), O_3 N_2O

Name	Picture of Molecule	Formula	Greenhouse Gas? Y/N
Nitrogen			
Oxygen			
Water (vapor)			
Carbon Dioxide			
Methane			
Nitrous Oxide			
Ozone			
Chlorofluorocarbon			

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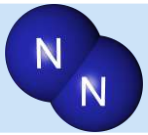
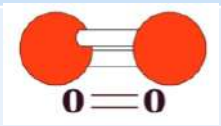
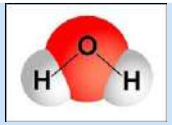
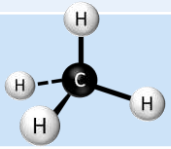
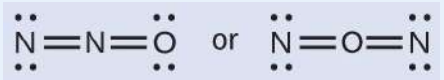
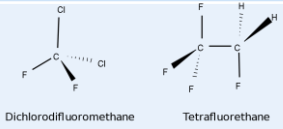
Nitrogen		N_2	
Oxygen		O_2	
Water (vapor)		H_2O	
Carbon Dioxide		CO_2	
Methane		CH_4	
Nitrous Oxide		N_2O	
Ozone		O_3	
Chlorofluorocarbon		CFC	

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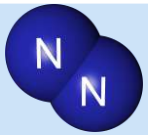
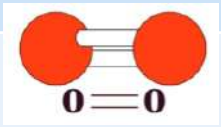
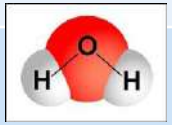
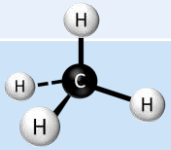
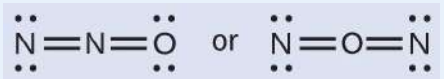
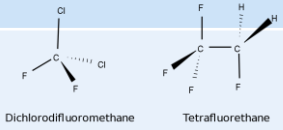
Nitrogen		N_2	N
Oxygen		O_2	N
Water (vapor)		H_2O	Y
Carbon Dioxide		CO_2	Y
Methane		CH_4	Y
Nitrous Oxide		N_2O	Y
Ozone		O_3	Y
Chlorofluorocarbon		CFC	Y

Experimental Design

Independent Variable:	
Dependent Variable:	
Control Group:	
Experimental Group:	

Hypothesis

If...(what you think is true) If Greenhouse gases increase temperature

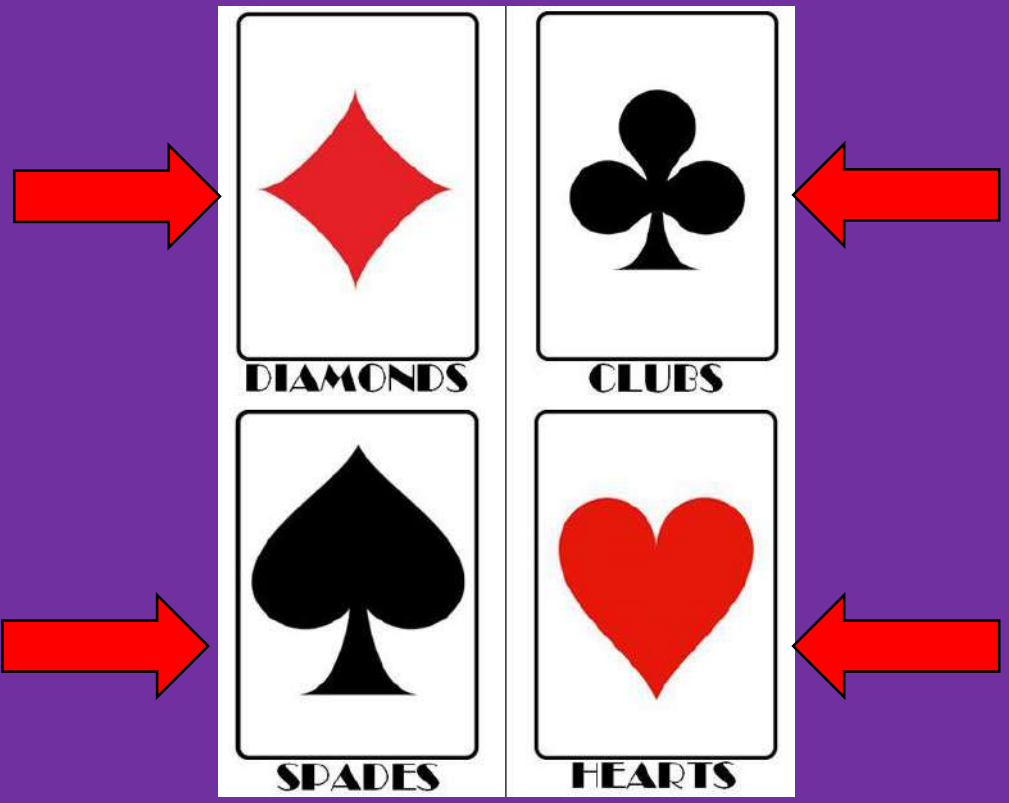
Then...(what you expect to see happen) Then, the atmosphere with greenhouse gases will have a higher temperature.

Because...(your reasoning) greenhouse gases absorb radiation and re-emit heat back to earth.

Greenhouse Effect Investigation Group Roles

Primary Investigator:
Makes sure group is on task. Reads each step.

Facilitator:
Make sure everyone's ideas are heard.



Timer:
Time experiment; every 2 minutes.

Recorder:
Records temperature every 2 minutes.

Materials and Methods

1. Fill two pans with 100 mL of soil (already done).
2. Mount the clamp lamp on a support stand 20-30 cm above the top of the containers. Arrange it so that it will shine equally on both containers.
4. Using a spray bottle, dampen the soil but do not oversaturate it (about 4 sprays).
5. Place a wooden block and the thermometer inside the container making sure the bulbs of the thermometers are elevated off the bottom of the container (bulb end up).
6. Carefully place the plastic lid on one container.
7. Take your initial temperature (time zero) to the nearest ½ ˚C **before** turning on the lamp.
8. Turn on the lamp and start the stopwatch at the same time.
9. Doublecheck that your lamp is shining equally on both containers.
10. Record temperatures in the data table every two minutes for 20 minutes to the nearest ½ ˚C.
11. When completed take lid off and let containers cool down for the next class.
12. Graph your data and complete the conclusion below.

U2D9 – Bell Ringer – 11/6

1. Review: What are 3 types of energy transfer in the atmosphere?

2. Which two human-produced greenhouse gasses are most responsible for the human-enhanced greenhouse effect?

3. Visit the class spreadsheet and make sure your group's data from yesterday is entered.

https://hsd1-my.sharepoint.com/:x:/g/personal/kberry_helenaschools_org/EYymwV_o2s1NtXt6x3Ov0uYBO6g1rg2TAgPRVlDqVD0m_g?e=i6Wv02

Objectives

Content: I can cite specific evidence to support the claim that greenhouse gasses increase temperature.

Language: I can combine claim, evidence, and reasoning into a scientific argument.

Graph your data!

Open a new excel spreadsheet.

Copy and paste the link to that spreadsheet into your Greenhouse lab so you don't lose it!

Copy the class average data from the class spreadsheet.

Paste that class average data into YOUR spreadsheet.

Select all of the data you just pasted. (there should be a green box around it)

Click insert → chart → column to create a graph

Use the toolbar above to edit your graph so it has the correct title, axis labels, scale, and key.

There should be two lines graphed, one for Lid and one for No Lid.

Evidence: scientific data (quantitative or qualitative) that supports the claim.

Directly supports the claim (*relevant* data)

Data is cited in some or all of the following ways:

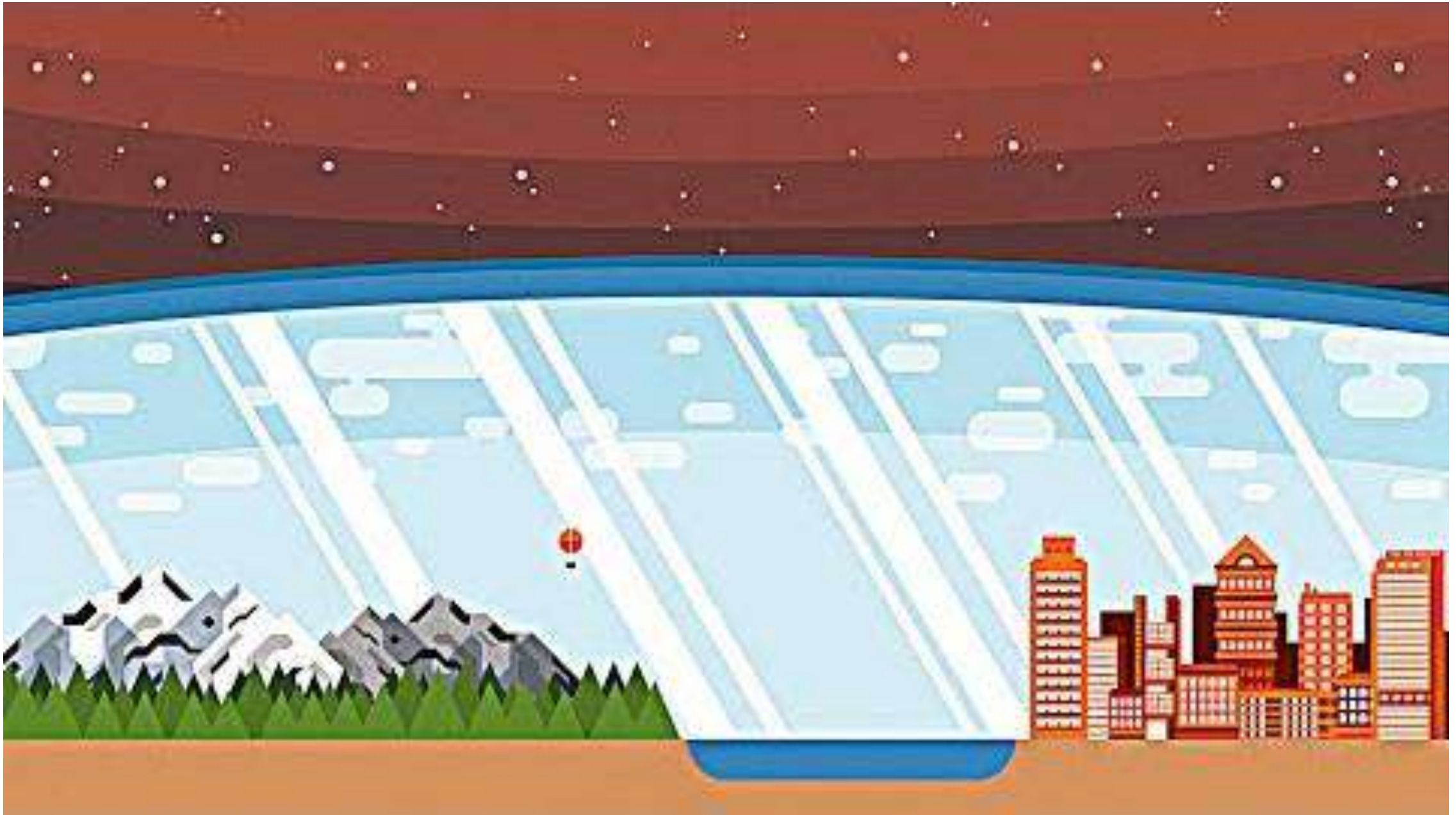
- **Cites specific data (e.g. When the water was 25°C, it took 15 seconds for the tablet to dissolve.)**
- Describes trends in the data (e.g. As the temperature of the water increased, the time to dissolve decreased.)
- Compares and contrasts data (e.g. The tablet took 10 seconds longer to dissolve in the 25°C water than in the 50°C water.)

Claim A claim is a statement that answers the original question.

It is clear to the reader what the question was without having to look at the question.

Uses specific language (avoids vague pronouns like “it” and “that”)

Greenhouse Effect: In-Depth



Reasoning: a justification that connects the evidence to the claim.

Uses scientific principles (facts that have already been established)(e.g. Certain types of molecules absorb infrared radiation and re-emit heat to the surface.)

Allows the reader to easily follow the logic (e.g. Therefore, when the lid was on the box, more infrared radiation was absorbed, and heat was reflected to the surface, which increased the temperature. This is different than the box with no lid, where more radiation was reflected into space, which explains why the temperature didn't increase as quickly.)

Clearly connects back to the claim(e.g. The atmospheric condition that absorbed radiation and re-emitted it to the surface increased temperature more, showing an atmospheric condition with more greenhouse gasses will have a higher temperature.)

Exit Ticket: Greenhouse Effect

1 thing you're still confused about

2 new ideas you learned

3 new words you've learned