GREENHOUSE GAS RESONANCE Lab Name _____ hr __ /40

There are 3 greenhouse gases that we will simulate in this lab: **methane**, **water vapor**, and **carbon dioxide**. Fill in the chart below **BEFORE** you begin.

TASK 1 (5pts):

MOLECULE NAME	MOLECULE FORMULA
Methane	CH_4
Water Vapor	
Carbon Dioxide	

Matching:

C	Hydrogen
H	Oxygen
O	Carbon

TASK 2: ☐
Using the information above and the molecule kit, build a molecule of methane. Check with your teacher to make sure it's right, then get the box initialed.

TASK 3: ☐
Now build a molecule of water. Check with your teacher to make sure it's right, then get the box initialed.

Sphere color	Which atom? (3pts)
Yellow	
Black	
Red	

TASK 4: ☐
Now build a molecule of carbon dioxide. Keep in mind that open holes in the atoms are not allowed and bonds (springs) must be attached to an atom on both ends. Check with your teacher to make sure it's right, then get the box initialed.

TASK 5:
Hold a single yellow sphere. This is an atom. When attached to other atoms it becomes a molecule.
Which is bigger, an atom or a molecule? _____

TASK 6 (4pts):
SCIENTIFIC QUESTION- Which simulated greenhouse gas molecule responds (resonates, vibrates) to the fastest wavelength? Which one responds (resonates, vibrates) to the slowest wavelength?

To answer this question, hold the carbon dioxide molecule you just made by one of the oxygen atoms (hold it on one end). Wiggle the molecule until you find a perfect vibration speed. Down then up counts as 1 vibration. The molecule will wobble very consistently and if you try to make it faster or slower, it just won't wobble right. Be careful to not break apart your model. Once you have found the proper vibration frequency, have your partner count the number of vibrations that occur in fifteen seconds. For the second and third trial, let other group members "vibrate" the molecule. Fill in the CO_2 column below. Calculate the average of the 3 trials.

	CO_2	H_2O	CH_4
#vibrations (Trial 1)			
#vibrations (Trial 2)			
#vibrations (Trial 3)			
Average→			

TASK 7+8 (8pts)
Do the same for water and methane. Record your results in the chart above.

ARGUMENT/CONCLUSION (claim +evidence) (2pts)--

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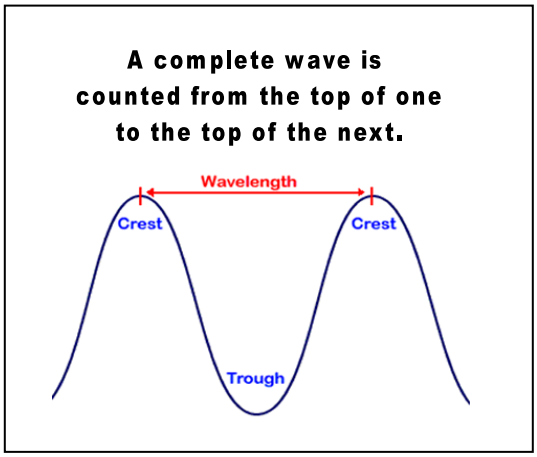
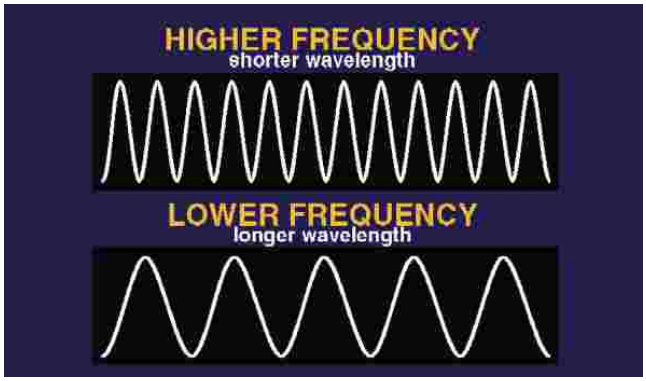
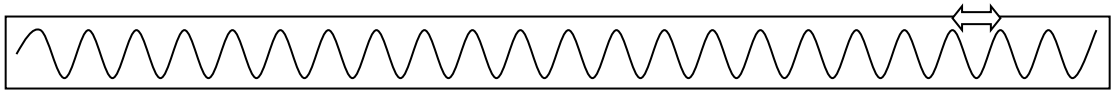
Every physical structure that is free to vibrate has its own natural period of vibration. When wavelengths that have a matching frequency interact with it, the structure will absorb that energy and begin to vibrate as well. Greenhouse gases in the atmosphere behave this way. When infrared radiation comes up from the Earth's surface, these longer wavelengths excite greenhouse gases causing them to vibrate and thus create heat. This is why short wavelength radiation from the sun doesn't interact with the greenhouse gases as it passes down through the atmosphere. --These short waves cannot make the greenhouse gases resonate (vibrate with them).





Let's say that a CFC molecule vibrates 22 times in 15 seconds. Its wave would look like this:



←----------15 second time period ----------→

TASK 9 (5pts):

Draw the wavelengths for CO_2

←----------15 second time period ----------→

Draw the wavelengths for CH_4

←----------15 second time period ----------→

Draw the wavelengths for H_2O

←----------15 second time period ----------→

1. Which molecule had the highest frequency? _____
2. Which molecule had the lowest frequency? _____

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TASK 10 (2pts):
This lab is ***only a simulation***, but the real data says:

> The range of infrared radiation (long waves) from Earth is 6 to 22 microns. Each greenhouse gas and water vapor absorbs radiation from different areas of the electromagnetic spectrum. Carbon dioxide and water absorb long wave radiation from 12 to 19 microns. Methane absorbs wavelengths 6 to 8 microns. Water blocks all radiation below 7 microns from being reflected back out into space.

Circle the wavelengths that get absorbed by the atmosphere: **(1pt)**
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

What is the window of possible infrared radiation (long waves from earth's surface) that can escape back out to space? Which wavelengths don't get captured and transformed into heat by the greenhouse gases? **(1pt)**

_____

TASK 11 (5pts):
Study the chart below, then answer the questions

Greenhouse Gas	Amount contributing to greenhouse effect	Main Sources
Methane	18%	Wetlands, swamps, cattle, rice paddies, forest and savanna burning, natural gas, landfills, termites, oceans, lakes, and tundra
Carbon Dioxide	49%	Burning wood and fossil fuels, plant and animal respiration, deforestation, auto exhaust
Nitrous Oxide	6%	Auto exhaust, fertilizers
Chlorofluorocarbons (CFC)	14%	Refrigerants, solvents, foamed plastic

1. Which greenhouse gases can be tied to human impact? _____

_____

2. What can be done to lower methane as a greenhouse gas?_____

_____

3. What can be done to lower carbon dioxide as a greenhouse gas?_____

_____

4. What can be done to lower nitrous oxide as a greenhouse gas? _____

_____

5. What can be done to lower Chlorofluorocarbons as a greenhouse gas?_____

_____

6. ARGUMENT WITH EVIDENCE: Make a claim based on the data table above. Use the data as your evidence. Is nature more of a cause for the greenhouse effect, or are humans more of a cause? (2pts)

_____

_____