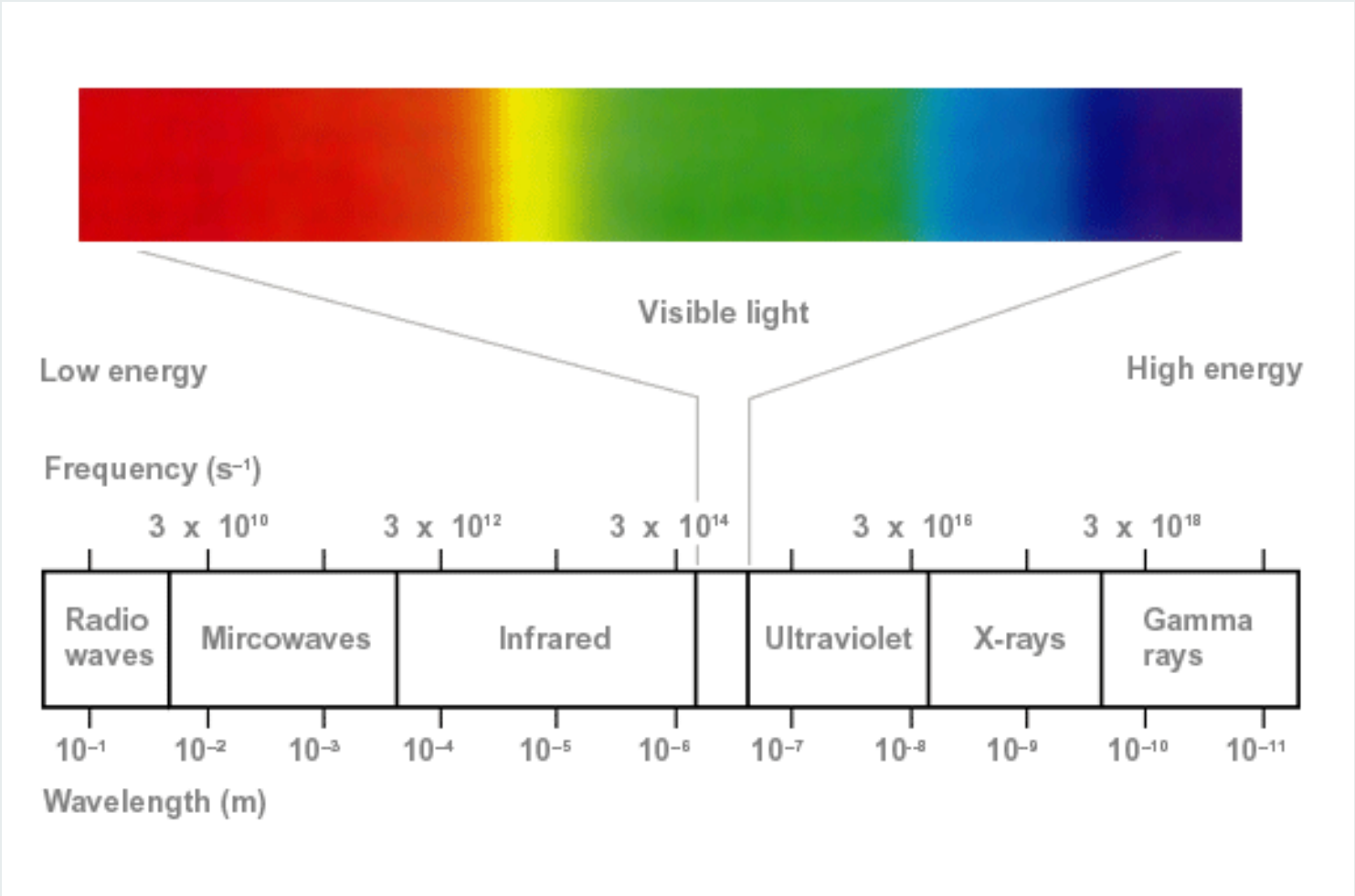
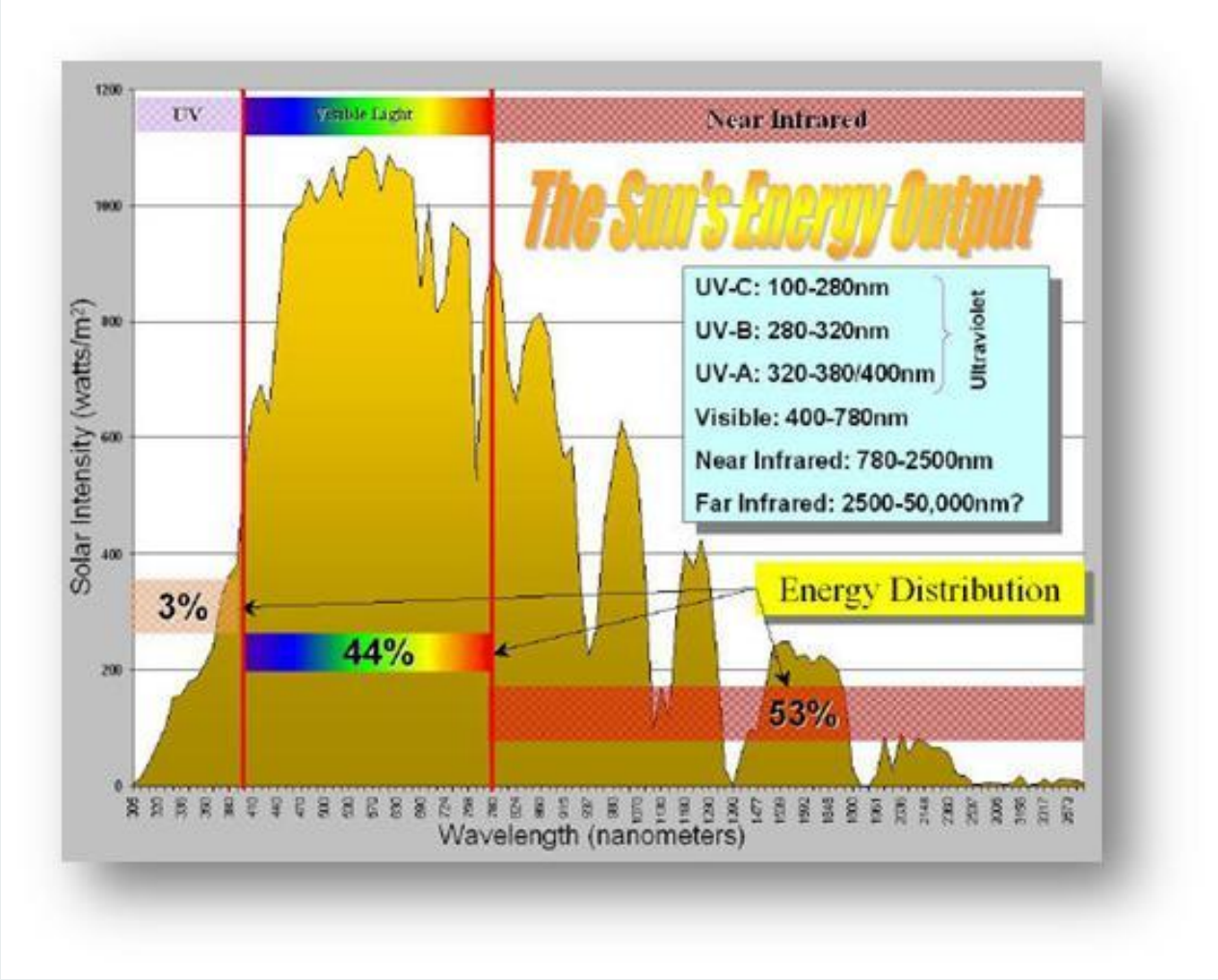
GLOBAL WARMING

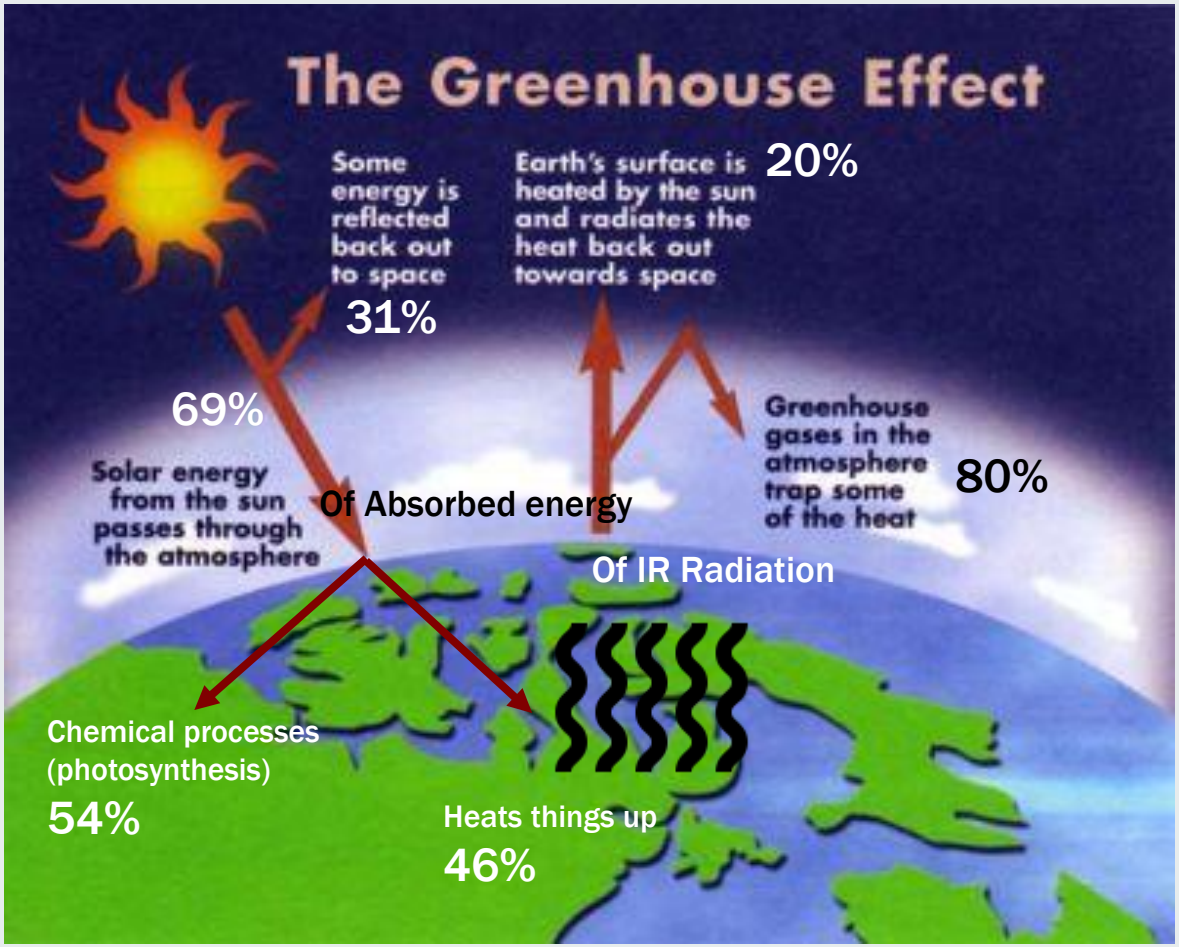
IS ALL ELECTROMAGNETIC RADIATION THE SAME?



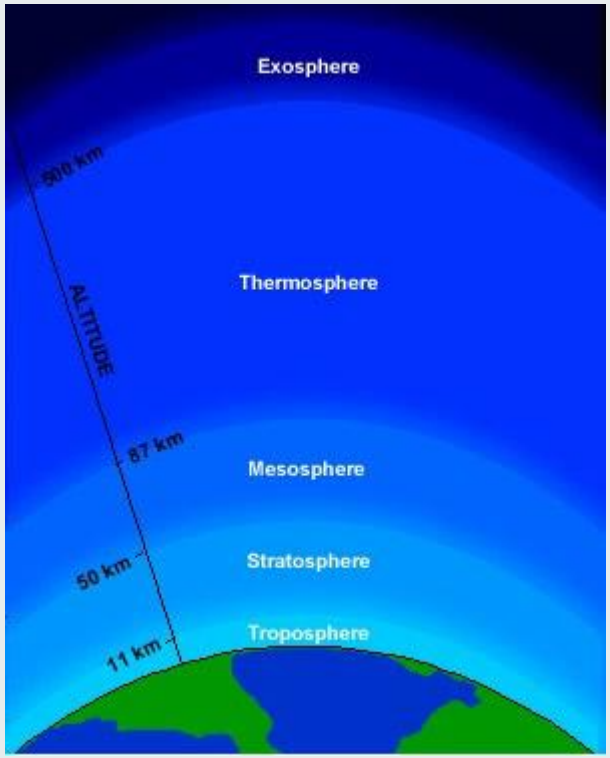
WHAT TYPES OF ELECTROMAGNETIC RADIATION ARE COMING TO EARTH?



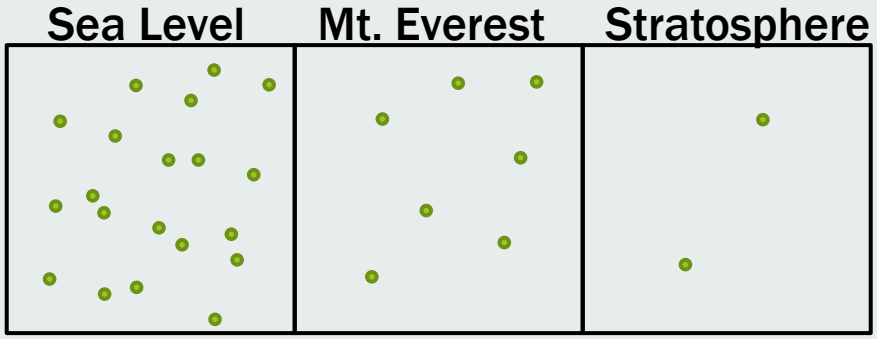
WHAT HAPPENS TO THE LIGHT WHEN IT GETS TO EARTH?



PRESSURE IN THE ATMOSPHERE



Gas	Average Pressure
Sea Level	1 atm
Top of Mt. Everest	0.3 atm
Troposphere	0.09 atm
Stratosphere	0.05 atm
Mesosphere	0.005 atm
Thermosphere	9×10^{-7} atm



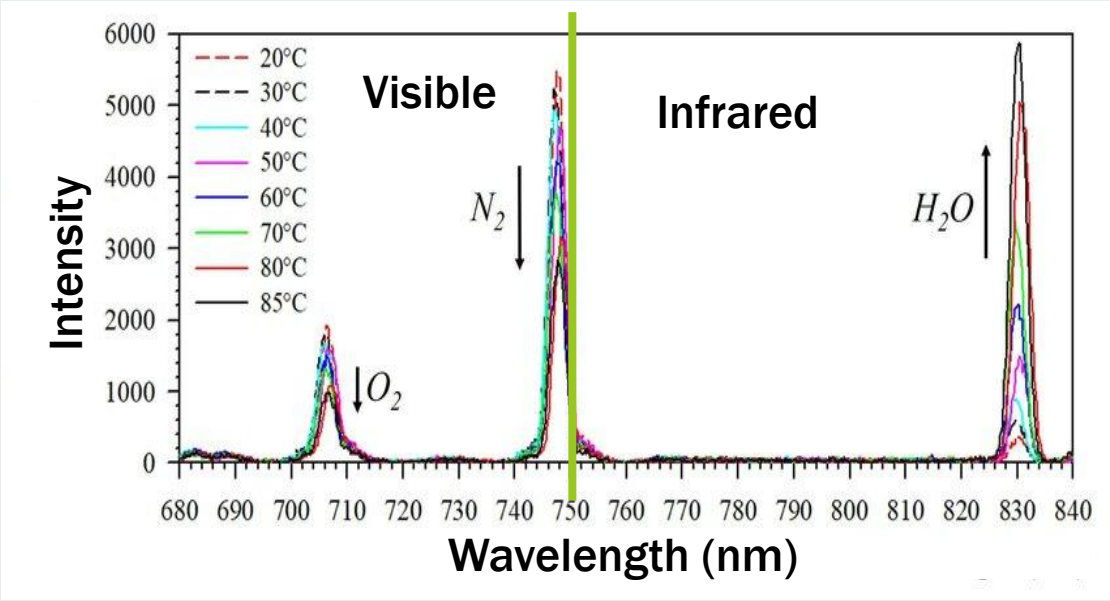
*Relative number of particles

WHAT ARE THE GASES IN OUR ATMOSPHERE?

Gas	Chemical Symbol	Percentage in Air
Nitrogen	N_2	78.08
Oxygen	O_2	20.95
Argon	Ar	0.934
Carbon Dioxide	CO_2	0.033
Neon	Ne	0.0018
Helium	He	0.00052
Methane	CH_4	0.00020
Krypton	Kr	0.00011
Carbon Monoxide	CO	0.000015
Nitrous Oxide	N_2O	0.000050
Xenon	Xe	0.0000087
Water*	H_2O	0.001%-5%

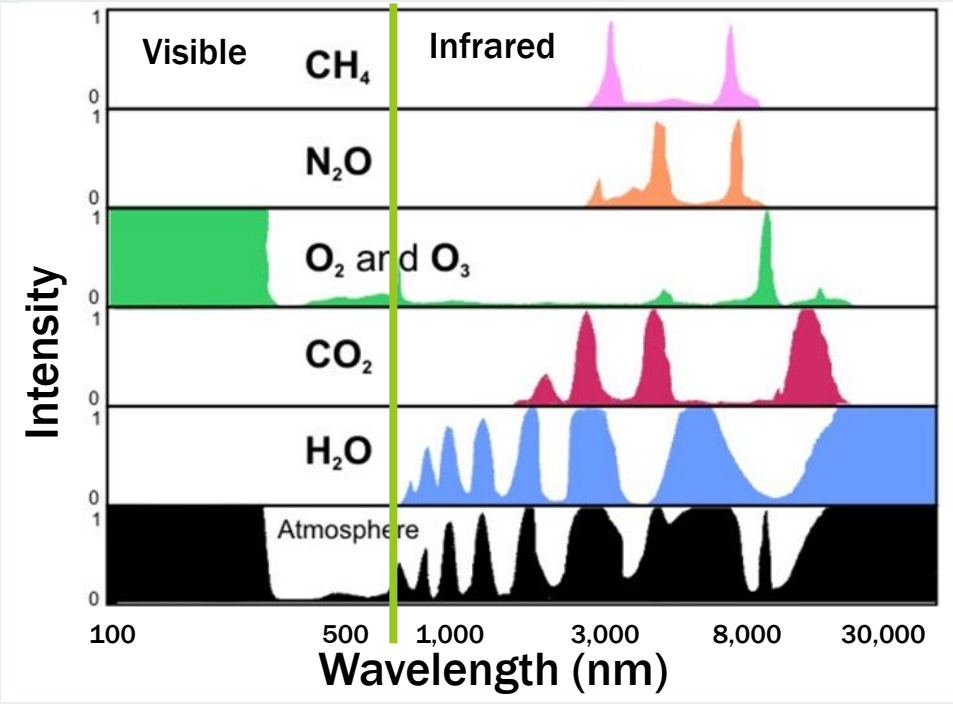
WHAT ARE GREENHOUSE GASES?

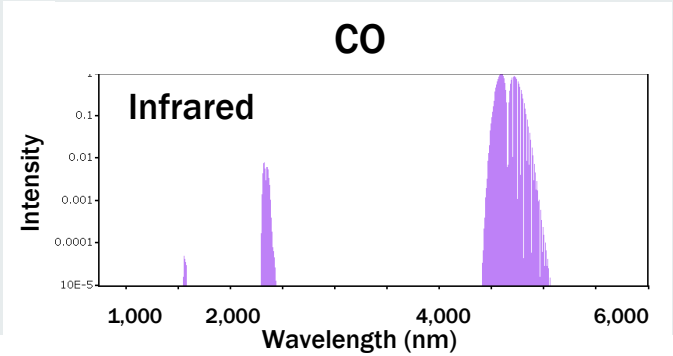
- Greenhouses Gases: Gases that absorb in the IR region of the electromagnetic spectrum.
- Are the three most prevalent gasses in the air greenhouse gasses?



WHICH GASES ARE GREENHOUSE GASES?

Gas	Chemical Symbol
Nitrogen	N_2
Oxygen	O_2
Argon	Ar
Carbon Dioxide	CO_2
Neon	Ne
Helium	He
Methane	CH_4
Krypton	Kr
Carbon Monoxide	CO
Nitrous Oxide	N_2O
Xenon	Xe
Water	H_2O



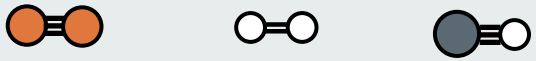


WHAT CAUSES A GAS TO BE A GREENHOUSE GAS?

Monatomic:

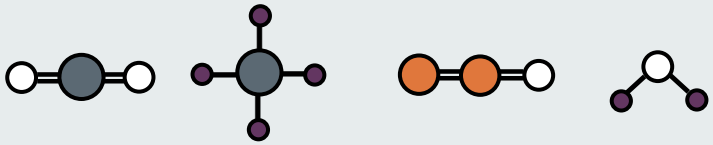
Ar Ne He Xe

Diatomic: N_2, O_2, CO



N_2 O_2 CO

Triatomic and Above:

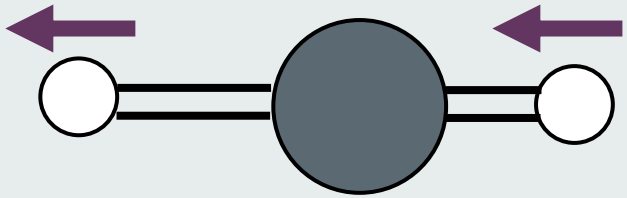


CO_2 CH_4 N_2O H_2O

Gas	Chemical Symbol
Nitrogen	N_2
Oxygen	O_2
Argon	Ar
Carbon Dioxide	CO_2
Neon	Ne
Helium	He
Methane	CH_4
Krypton	Kr
Carbon Monoxide	CO
Nitrous Oxide	N_2O
Xenon	Xe
Water	H_2O

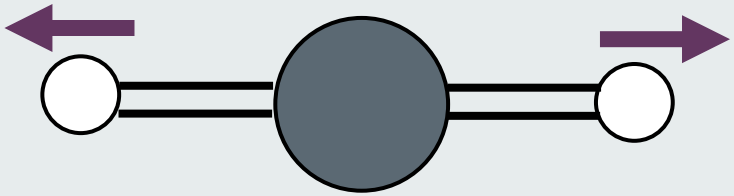
WHAT CAUSES A GAS TO BE A GREENHOUSE GAS?

- CO_2 Movements



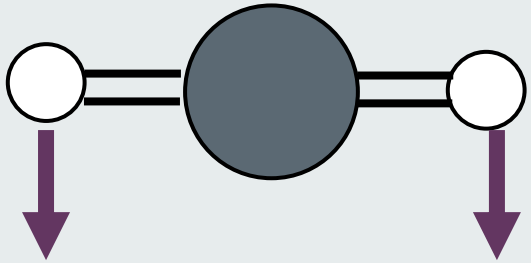
Asymmetric Stretching

IR Active



Symmetric Stretching

Not IR Active

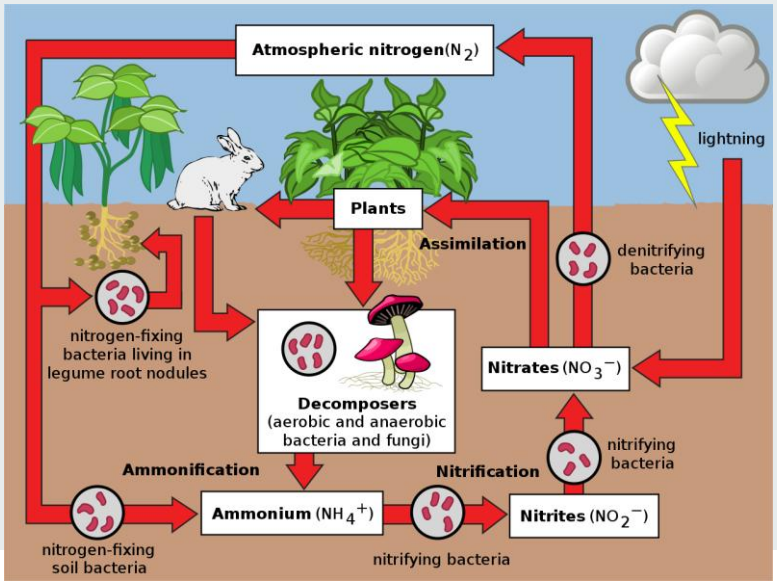


IR Active

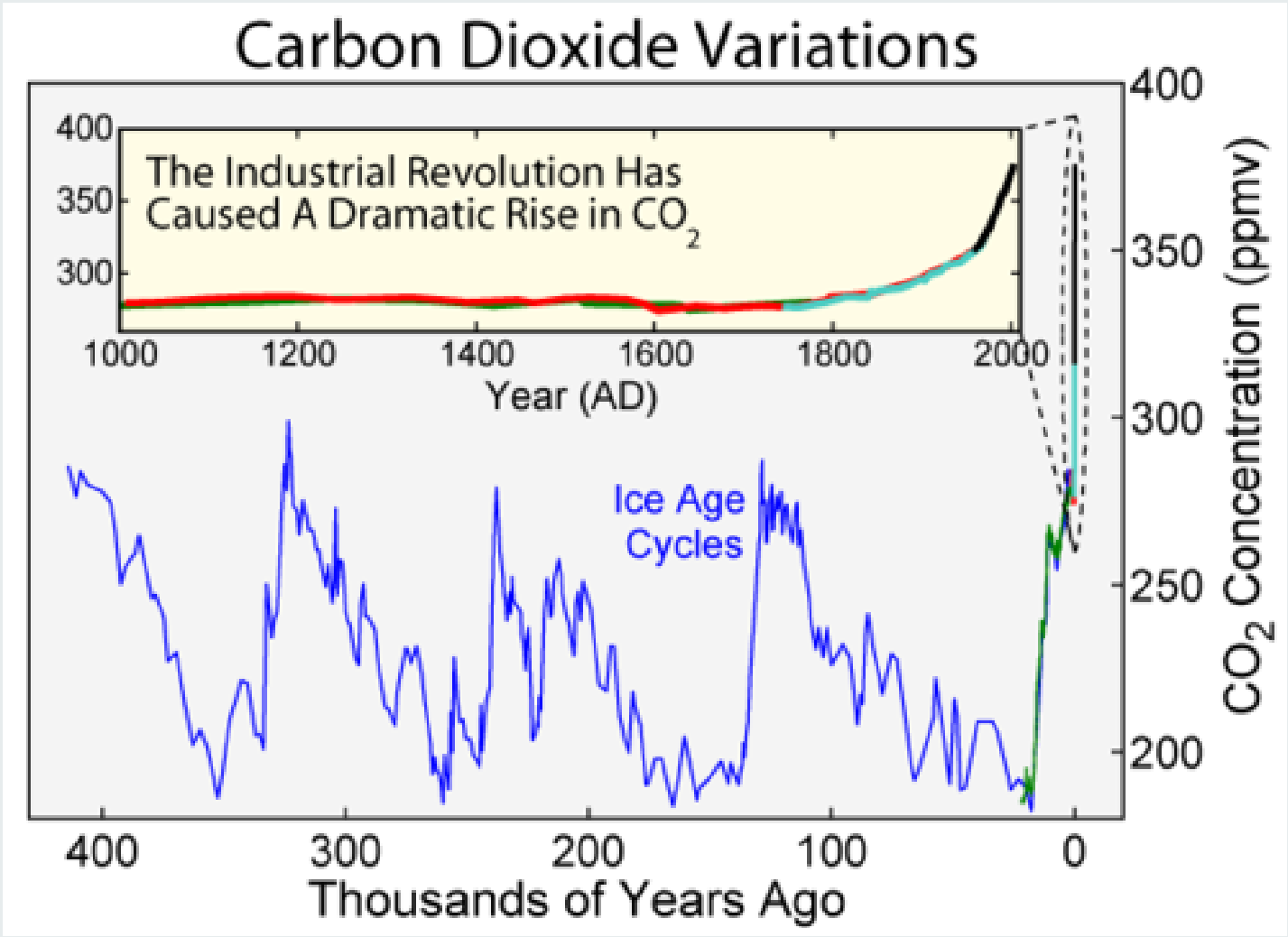
Motion needs to create a change in the overall dipole moment (change in charge) to be IR active

WHY DO WE CARE ABOUT CO_2?

- Greenhouse gases in the atmosphere from most to least abundant:
  - H_2O
  - CO_2
    - $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
  - CH_4
    - Breakdown of dead organic materials
    - Agriculture
    - Natural Gas Extraction
    - Landfills
  - N_2O
    - Too much fertilizer
    - Burning fossil fuels
    - Breakdown of organic materials

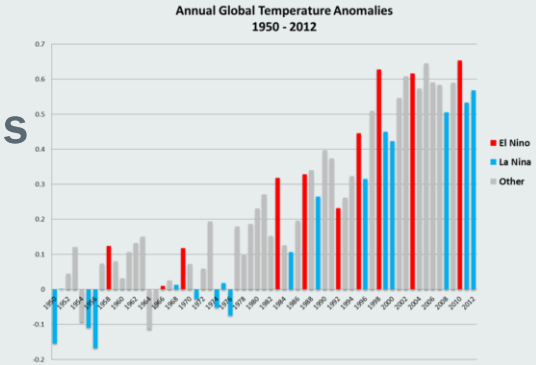


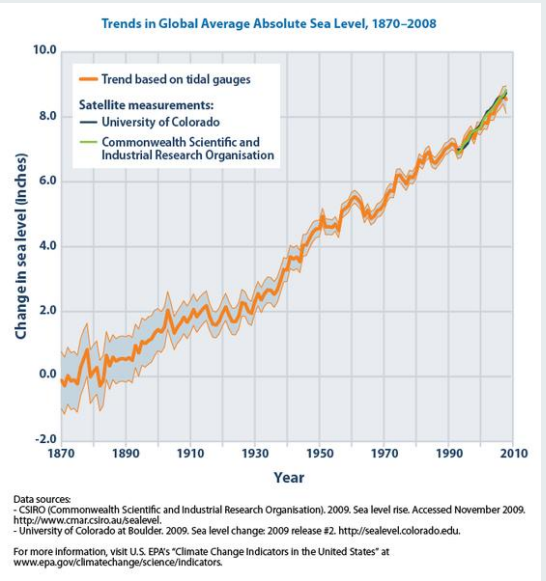
WHAT IS HAPPENING TO CO_2 LEVELS?



IS IT HAPPENING?

- Measure the average temperature of the atmosphere
- Measure the average temperature of the seas
- Sea Level
- Timing of Spring events (seeding, etc.)





http://www.pmel.noaa.gov/co2/story/What+is+Ocean+Acidification%3F

http://www.waterencyclopedia.com/Bi-Ca/Carbon-Dioxide-in-the-Ocean-and-Atmosphere.html

WHY SHOULD WE BE CONCERNED?

- CO_2 is stored in three places: oceans, land, atmosphere.
  - Oceans
    - Store 93% of the CO_2
  - Land
    - Glaciers store CO_2 (and CH_4)

CONSEQUENCES OF GLOBAL WARMING

- More drought and heat waves
  - This disproportionately effects, elderly, children and economically disadvantaged.
- Sea level rising
  - The sea level has risen 8 inches since 1880 scientist predict that it will rise at least another foot (maybe even up to 6.6 ft) by 2100
- Longer wildfire seasons
  - For Santa Barbara cost of living will go up due to higher insurance.
- Hurricanes will become stronger and more Intense
  - This happens because the warmer the ocean water the more energy the storm gets and the stronger the winds and the heavier the rainfall.
- Change in precipitation patters
  - For California this mean the extremes in both storms and droughts
- Artic is Very Likely to Become Ice-Free
  - Think about the polar bears.
- Frost-Free Season (and Growth Season will lengthen)