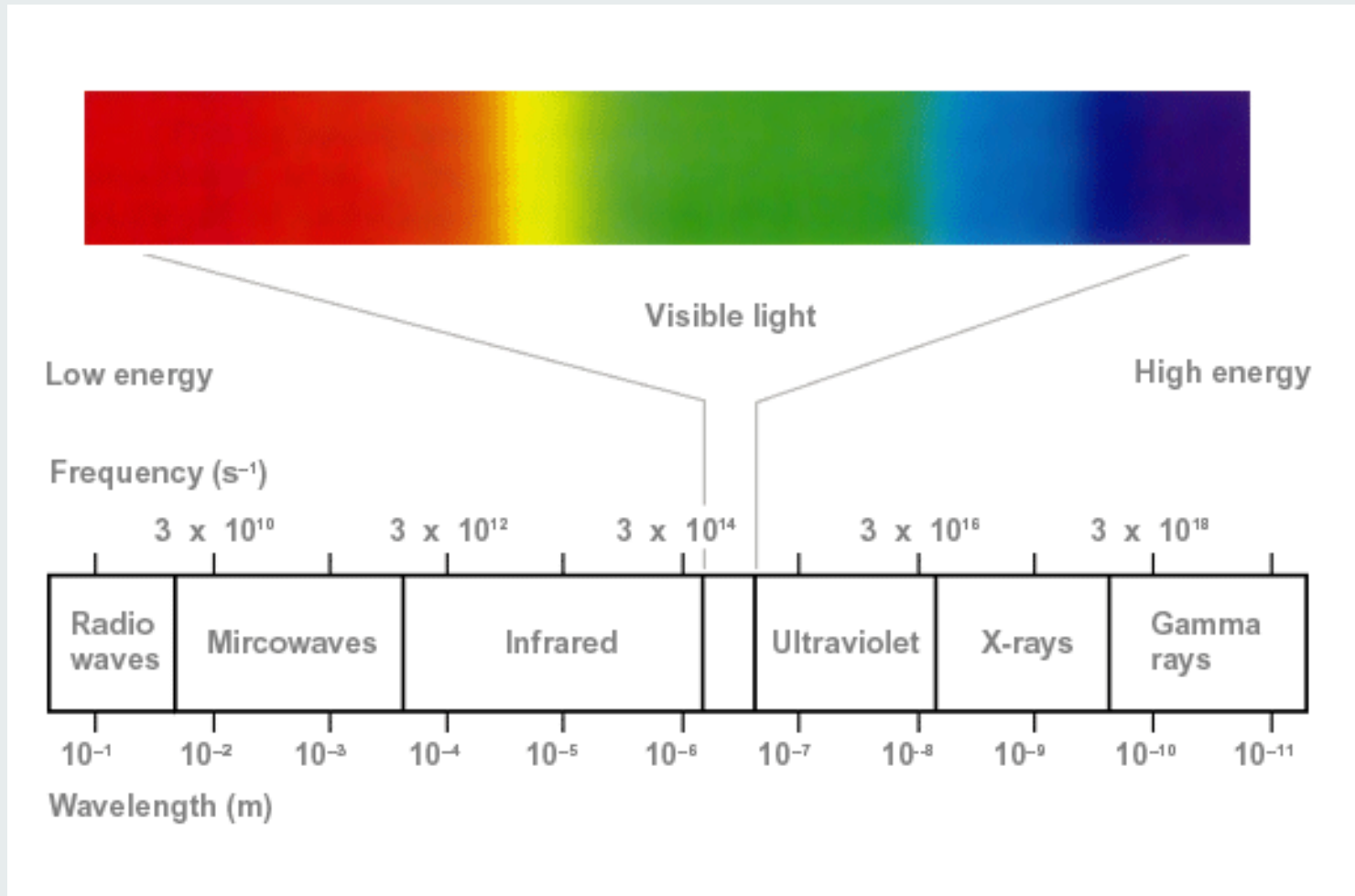


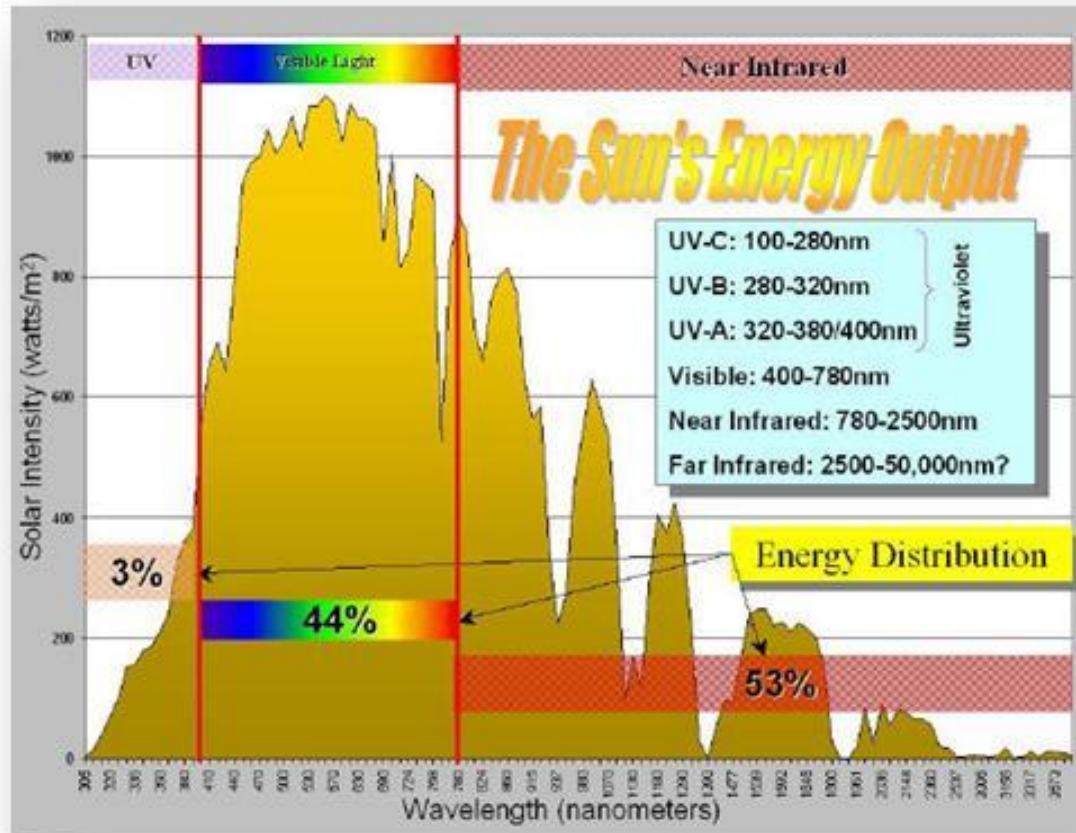
GLOBAL WARMING



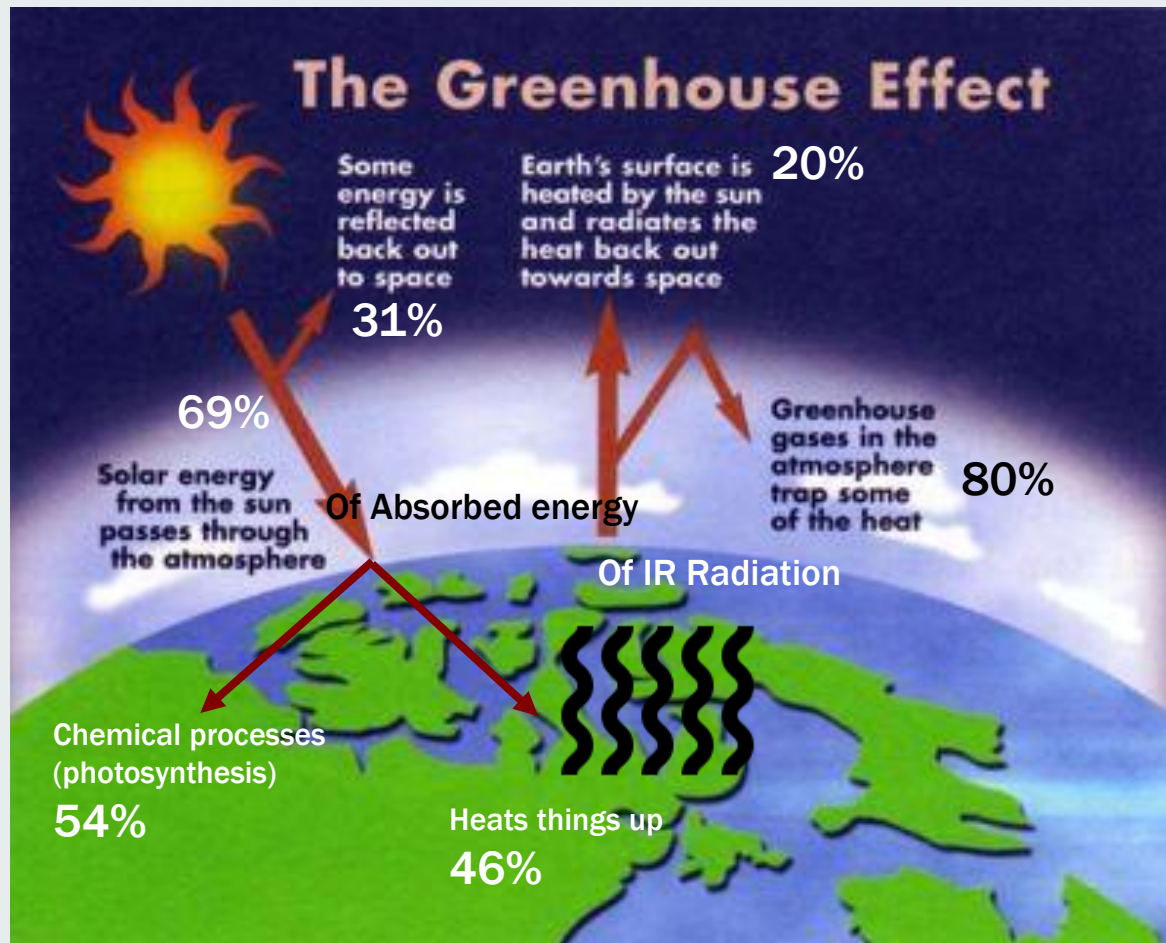
IS ALL ELECTROMAGNETIC RADIATION THE SAME?



WHAT TYPES OF ELECTROMAGNETIC RADIATION ARE COMING TO EARTH?



WHAT HAPPENS TO THE LIGHT WHEN IT GETS TO EARTH?

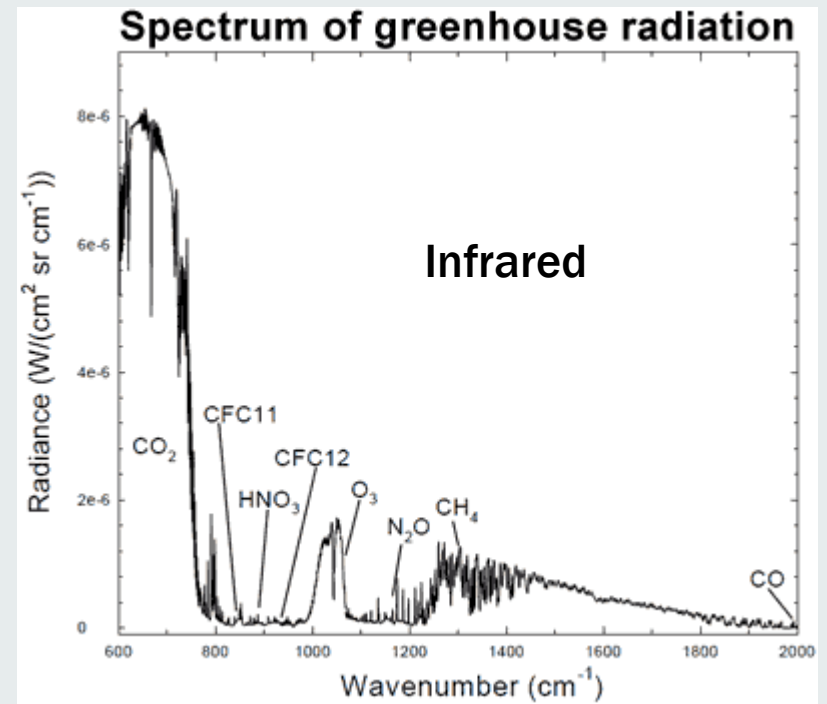
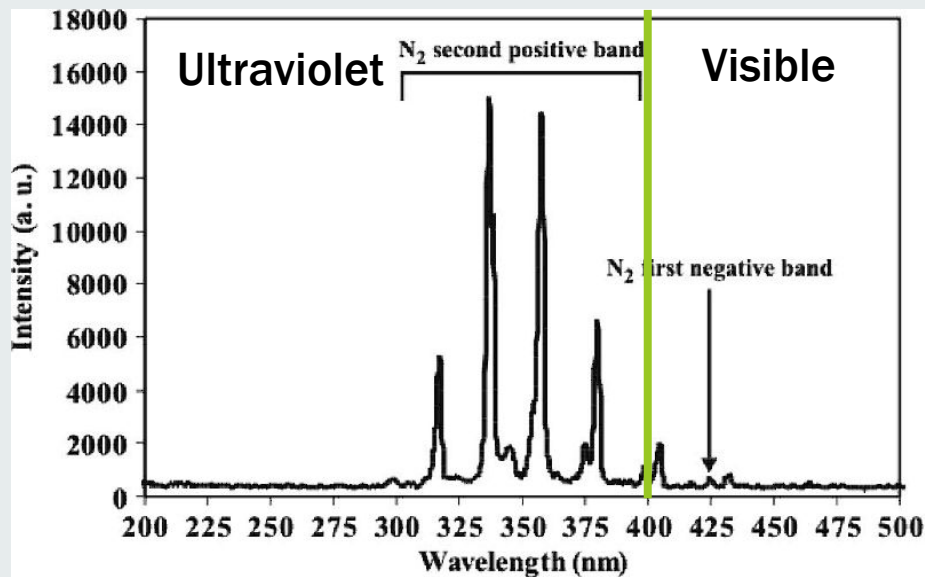


WHAT ARE THE GASES IN OUR ATMOSPHERE?

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 ₂ O	0.000050
Xenon	Xe	0.0000087
Water*	H ₂ O	0.001%-5%

WHAT ARE GREENHOUSE GASES?

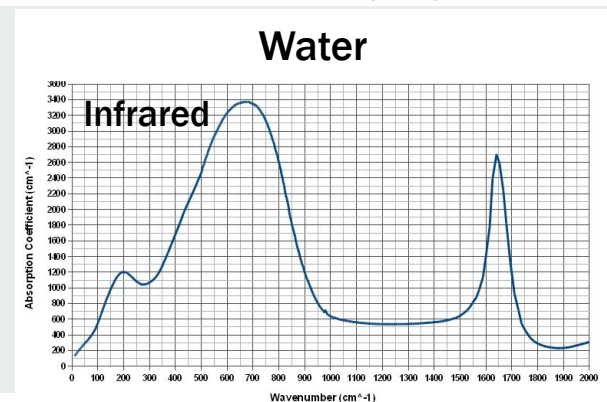
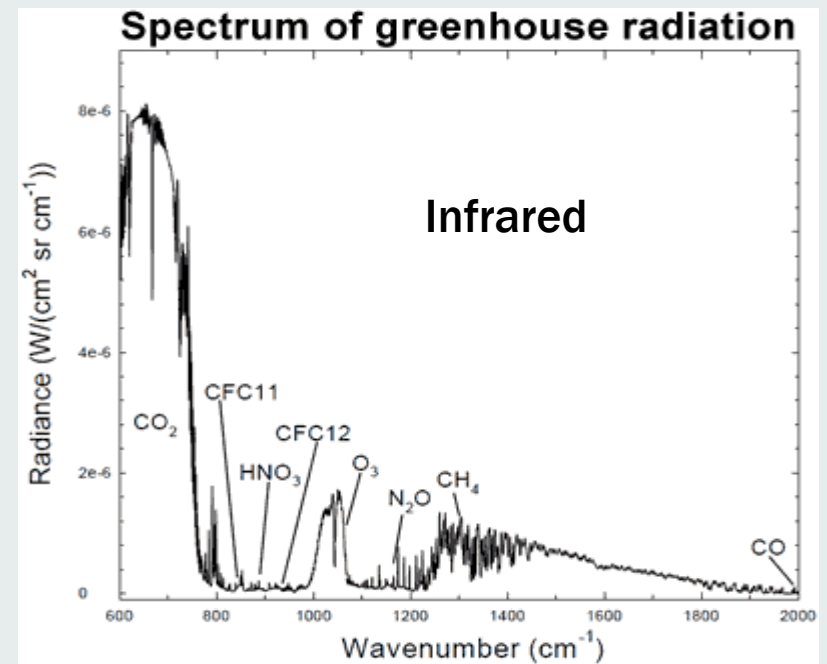
- Greenhouses Gases: Gases that absorb in the IR region of the electromagnetic spectrum.



Visible starts at $\sim 14,000 \text{ cm}^{-1}$

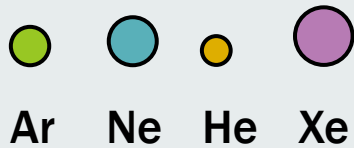
WHICH GASES ARE GREENHOUSE GASES?

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 ₂ O
Xenon	Xe
Water	H ₂ O

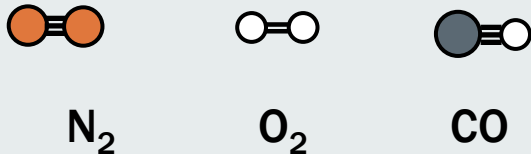


WHAT CAUSES A GAS TO BE A GREENHOUSE GAS?

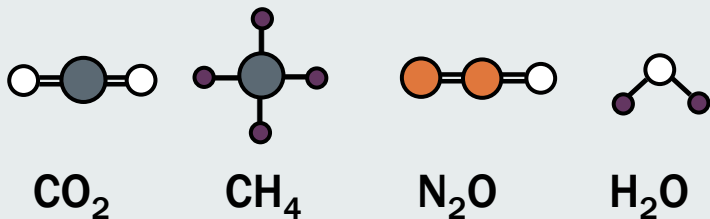
Monatomic:



Diatomic: N₂, O₂, CO



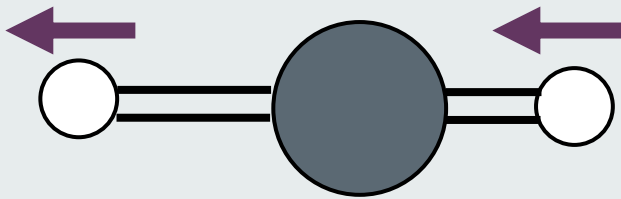
Triatomic and Above:



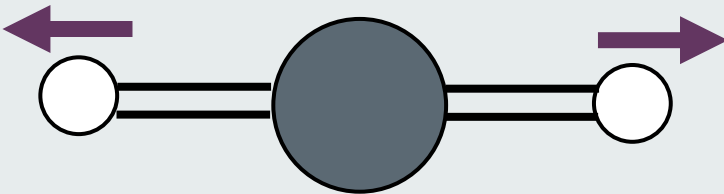
Gas	Chemical Symbol
Nitrogen	N ₂
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Argon	Ar
Carbon Dioxide	CO₂
Neon	Ne
Helium	He
Methane	CH₄
Krypton	Kr
Carbon Monoxide	CO
Nitrous Oxide	N₂O
Xenon	Xe
Water	H₂O

WHAT CAUSES A GAS TO BE A GREENHOUSE GAS?

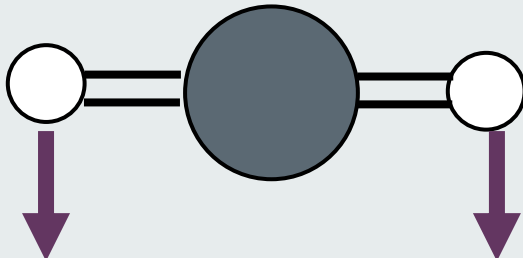
■ CO₂ Movements



Asymmetric Stretching



Symmetric Stretching

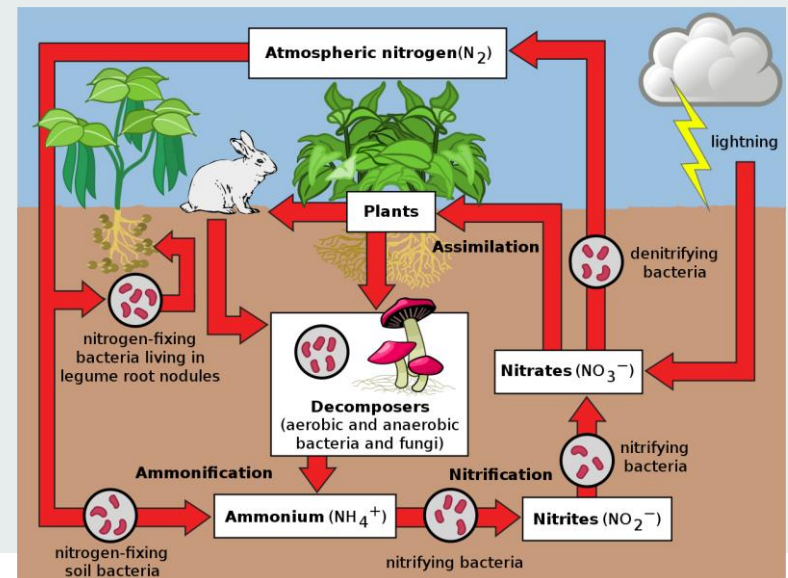


Need charge imbalance to be a greenhouse gas

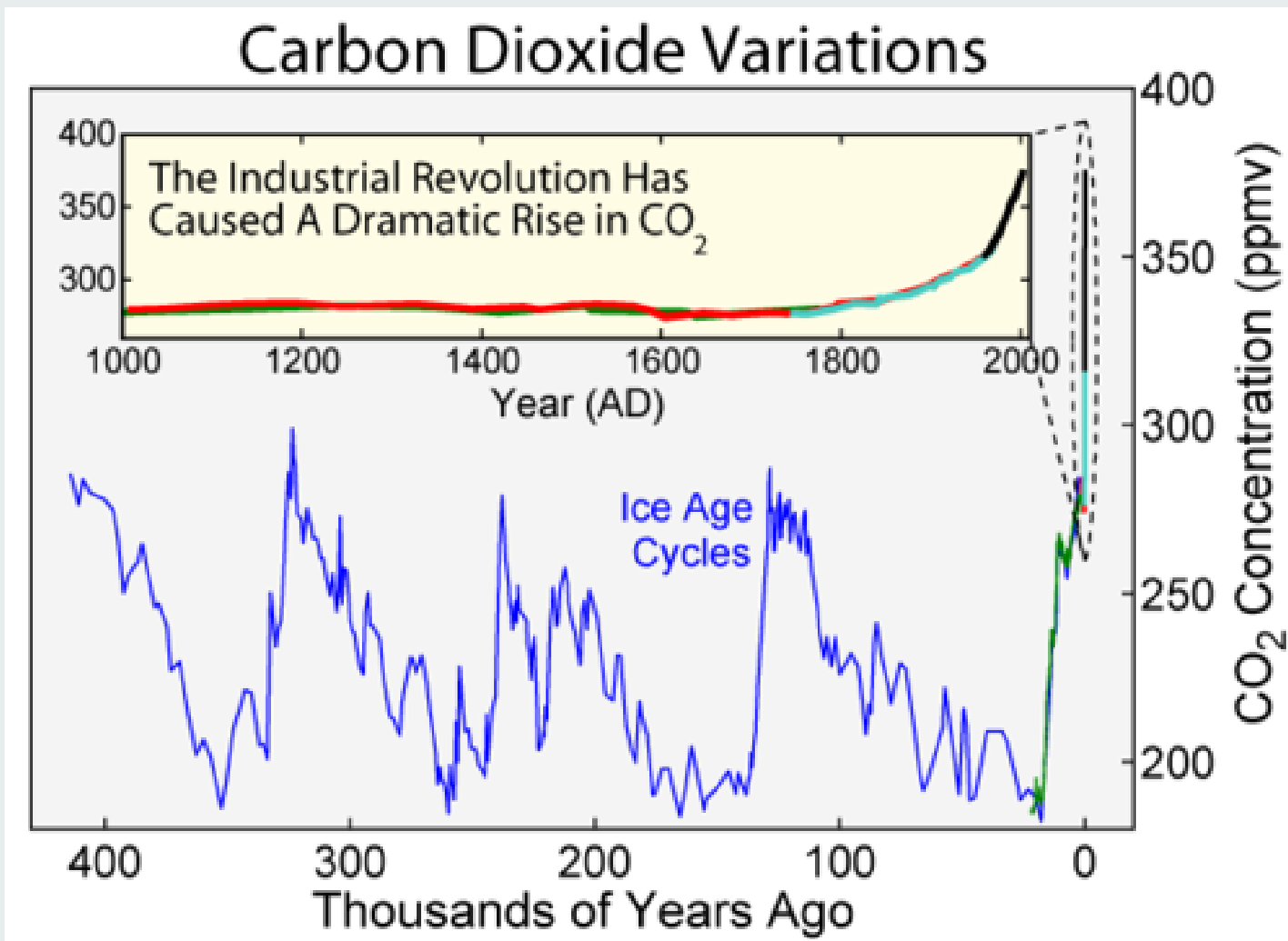
WHY DO WE CARE ABOUT CO₂?

■ Greenhouse gases in the atmosphere from most to least abundant:

- H₂O
- CO₂
 - $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$
- CH₄
 - Breakdown of dead organic materials
- N₂O
 - Too much fertilizer
 - Burning fossil fuels
 - Breakdown of organic materials

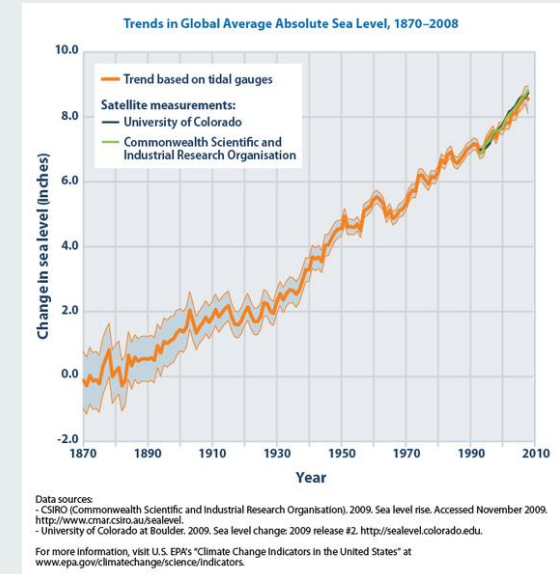
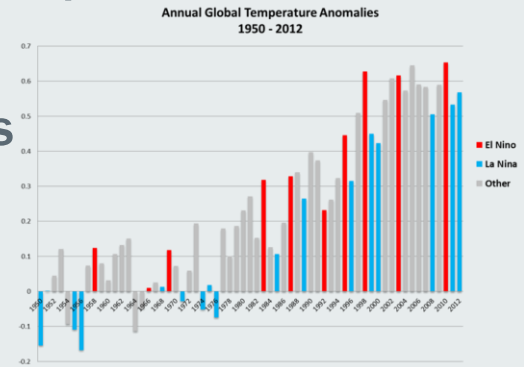


WHAT IS HAPPENING TO CO₂ LEVELS?



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.)



WHY SHOULD WE BE CONCERNED?

- CO₂ is stored in three places: oceans, land, atmosphere.
 - Oceans
 - Store 93% of the CO₂
 - Land
 - Glaciers store CO₂ (and CH₄)

