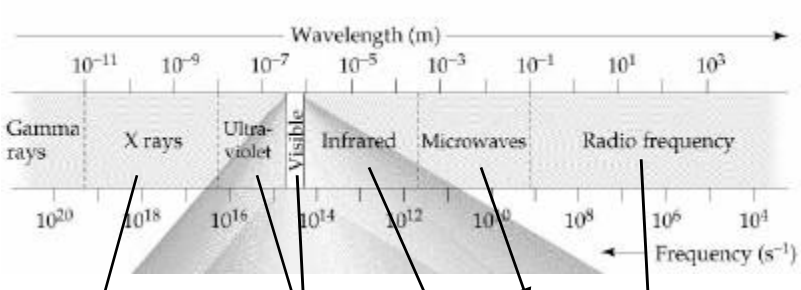
Announcements – 11/20/00

- **Exam #3**
  - Grading will be done today
  - Solution Key is online
- **Tuesday review/problem session?**
- ***Demos Today!***

1

What can we "see" with Spectroscopy?



Inner shell *electrons*
(core *electron energies*)

Outer shell *electrons*
(*electron configurations*)

Molecular *vibrations*
(*bond lengths/angles*)

Molecular *rotations*
(*bond strengths/structure*)

Nuclear spin states
(*electron density near nucleus*)

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Infrared Absorption

- Probes the *vibrational modes* of a molecule
- *Resonance* view works well here:
  -in order for a molecule to absorb IR EMR, there must be a *change in the dipole moment* during the vibration
  - **Why?**
    - If dipole moment *changes* during a vibration, then the molecule has an *electric field* oscillating at the frequency of the vibration
    - If IR EMR is at the same freq as the molecular vibration, then the two oscillating electric fields can interact and exchange energy (molecule *absorbs* IR EMR)

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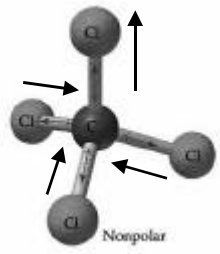
What Molecules Absorb IR?

- Almost ***all*** molecules have at least *one* vibrational mode which results in a changing dipole
- Even molecules with no dipole moment? Yes!



CCl_4

✓Not all vibrational modes will be symmetrical

BUT: All *homonuclear diatomic* molecules are **IR INACTIVE**

(all vibrational modes are symmetrical)

So: N_2, O_2, H_2, F_2, etc. do not absorb in the IR

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Environmental Aspects of IR Absorption

- Although N_2 and O_2 *don't* absorb IR, molecules such as *CO_2 and H_2O* ***DO***
- So:
  - Light from the sun enters the atmosphere and reaches the surface of the Earth
  - The surface of the Earth *absorbs* the EMR, and *reradiates it as IR* (**blackbody radiation**)
  - Molecules such as CO_2 and H_2O in the atmosphere *absorb* some of the IR, preventing it from leaving the atmosphere (**radiation trapping**)

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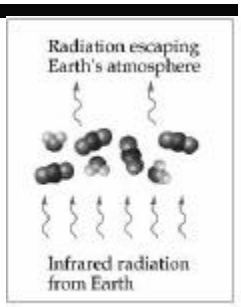
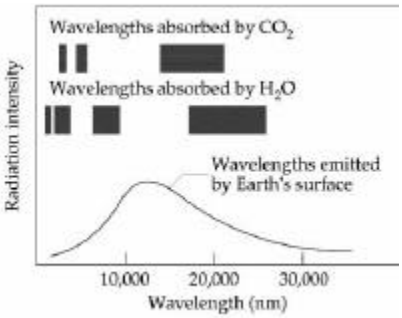
The Greenhouse Effect





- The greenhouse effect is responsible for life on this planet:

  -the avg temp of the Earth is ***30 - 35º higher*** than it would be without the greenhouse effect

  -without the greenhouse effect, *the oceans would be frozen year 'round*

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So, the Greenhouse Effect is good?

- Yes . . . and no . . .
- *What if the amount of "greenhouse gases" began to increase?*

-increased temperature
-increased H_2O vaporized into atmosphere
-more IR absorption

RUNAWAY GREENHOUSE EFFECT

Example: Venus

-Surface temp: ~450°C (would be 100°C w/o GHE)

-Atmosphere is *96% CO_2* (clouds are made of H_2SO_4)

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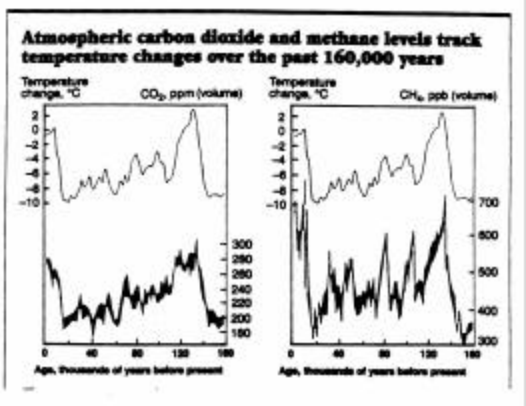
"Global Warming"?

- Atmospheric CO_2 and CH_4 levels correlate well with global temperatures over the past 160,000 years:



CO_2 and CH_4 values: meas. in air bubbles from 1 mile deep Antartic ice core

Temperature values: inferred from *deuterium* levels in the ice core (deuterium is enriched at higher temperatures)

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Why is the Earth's Temp Increasing?

- Hypothesis: *increased* CO_2 in atmosphere
- Arrhenius Model (1900): **doubling CO_2** in atmosphere will increase temps by **5-6 degrees**

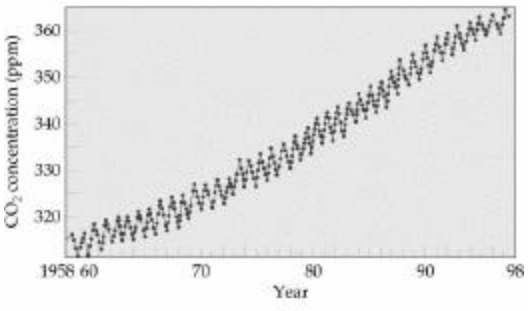
CO_2 levels:

-constant (280 ppm) until early 1800's

-steadily increasing

-about *25% increase* over the past 100 years

-about *0.7°C temp increase* over the past 100 years



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