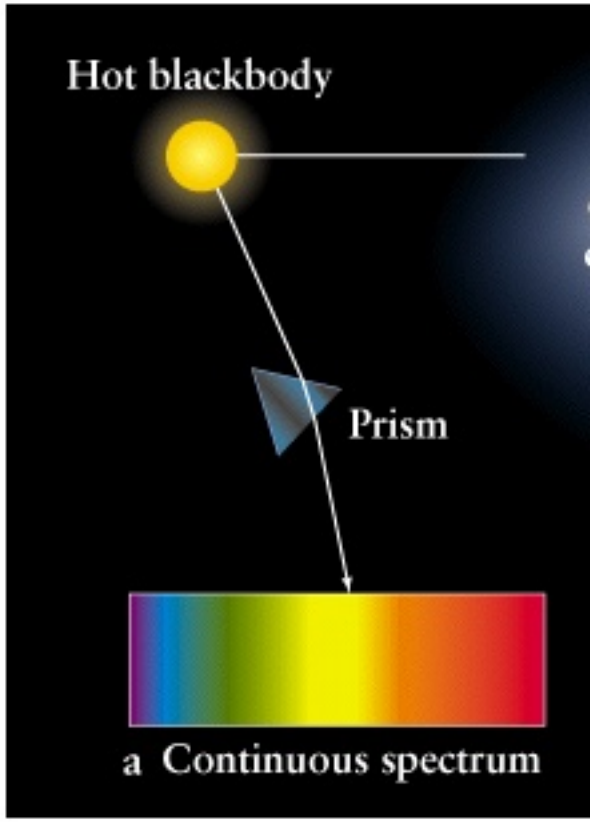
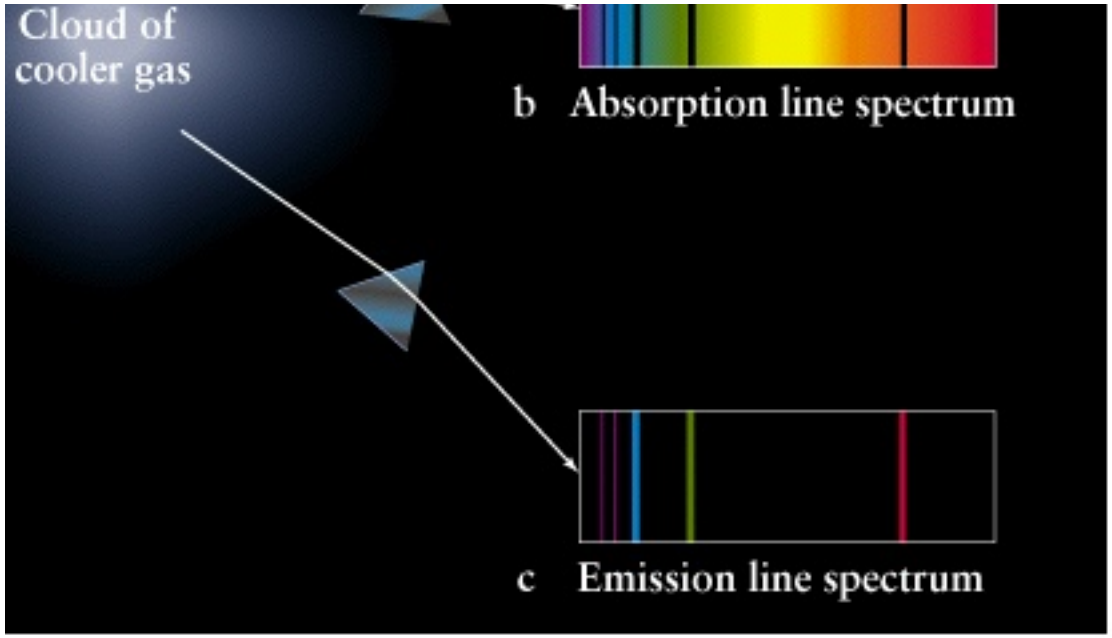
Light Demonstration

- In our class demo, will use diffraction grating glasses instead of prisms…

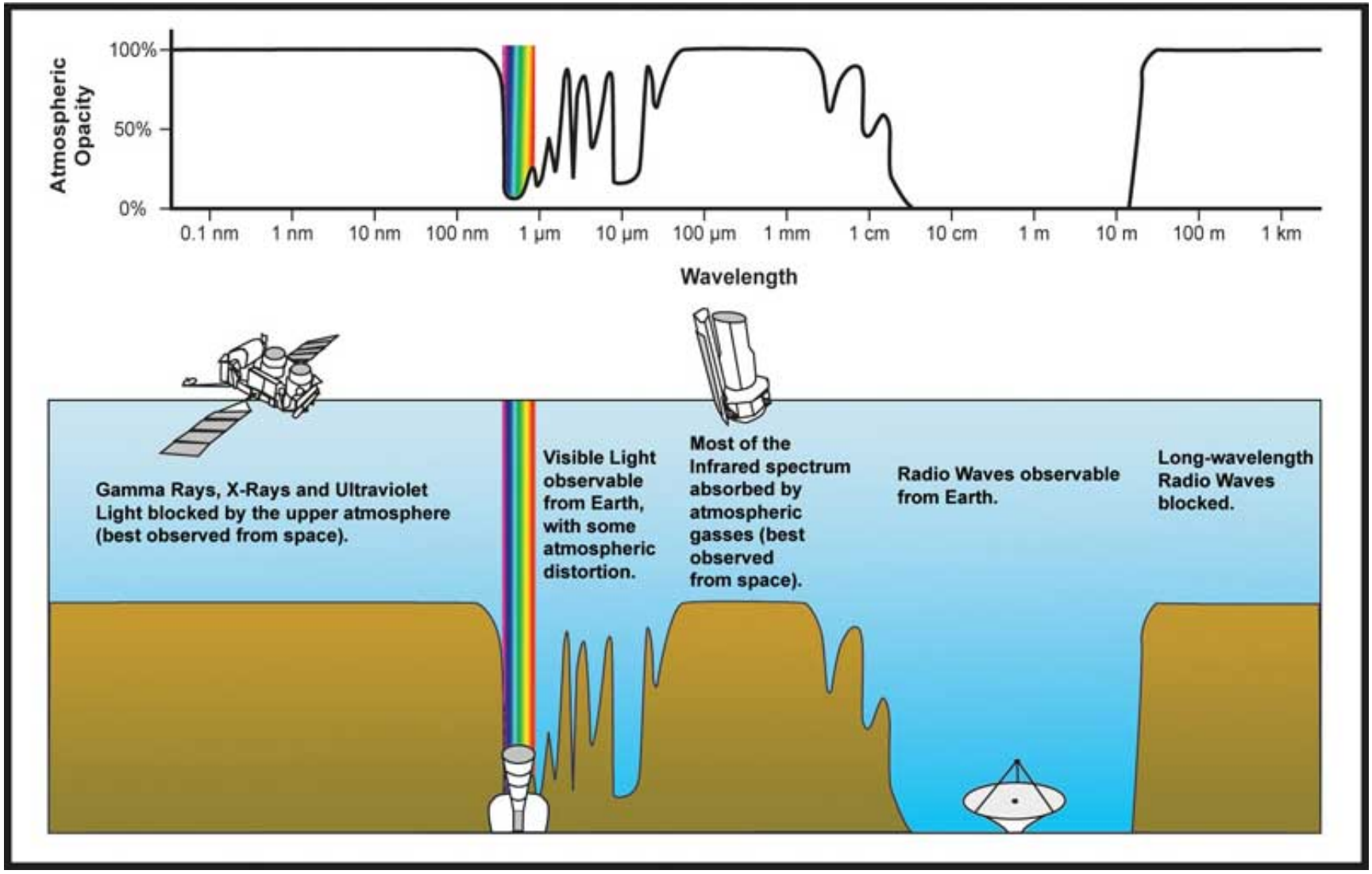




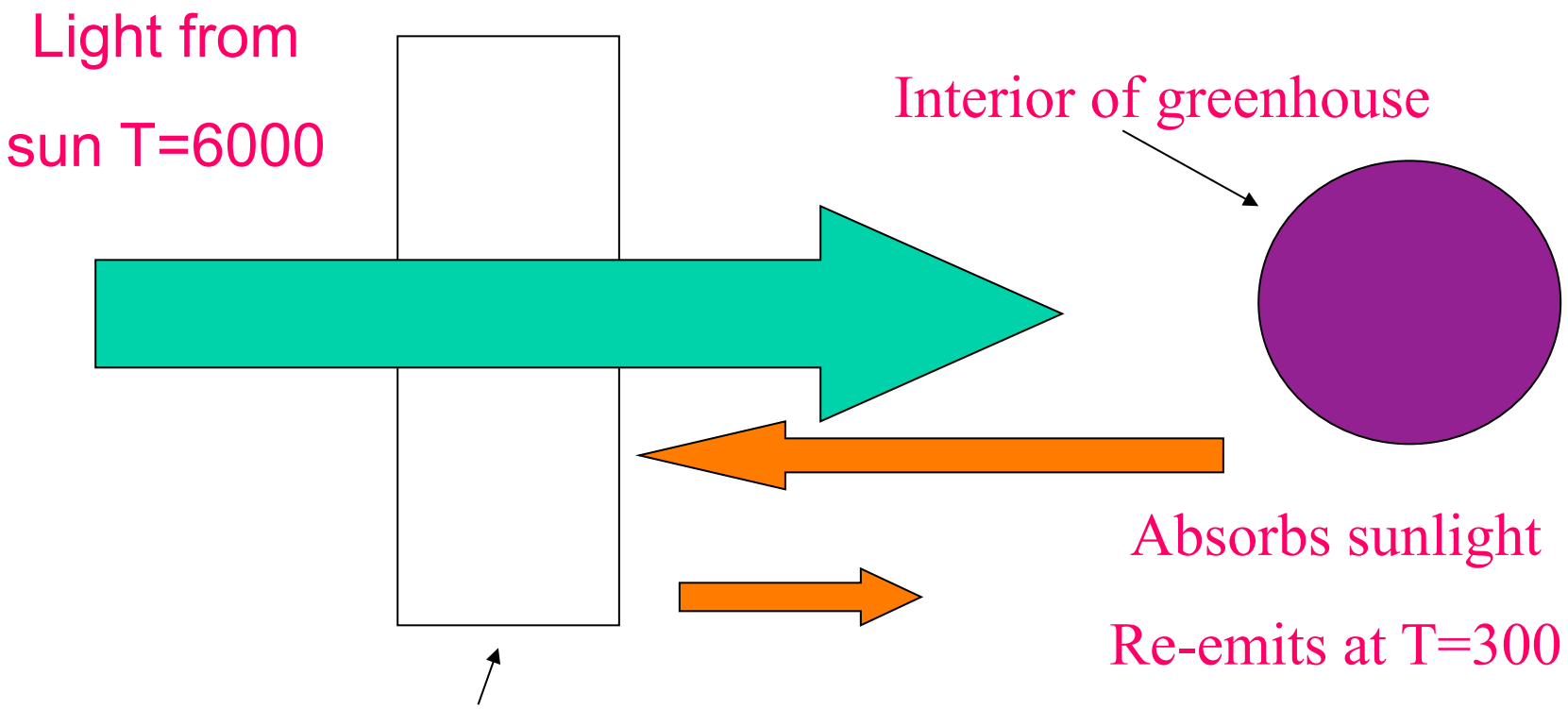
Absorption of Light

- "Clear" → doesn't absorb
- "Opaque" → absorbs
- Depends on frequency. Glass is clear in the visible but opaque in the infrared. Can cause **greenhouse effect.**
- Microwave ovens work by operating at a frequency near a water absorption line
- Atmosphere only clear in visible, radio, and part of infrared

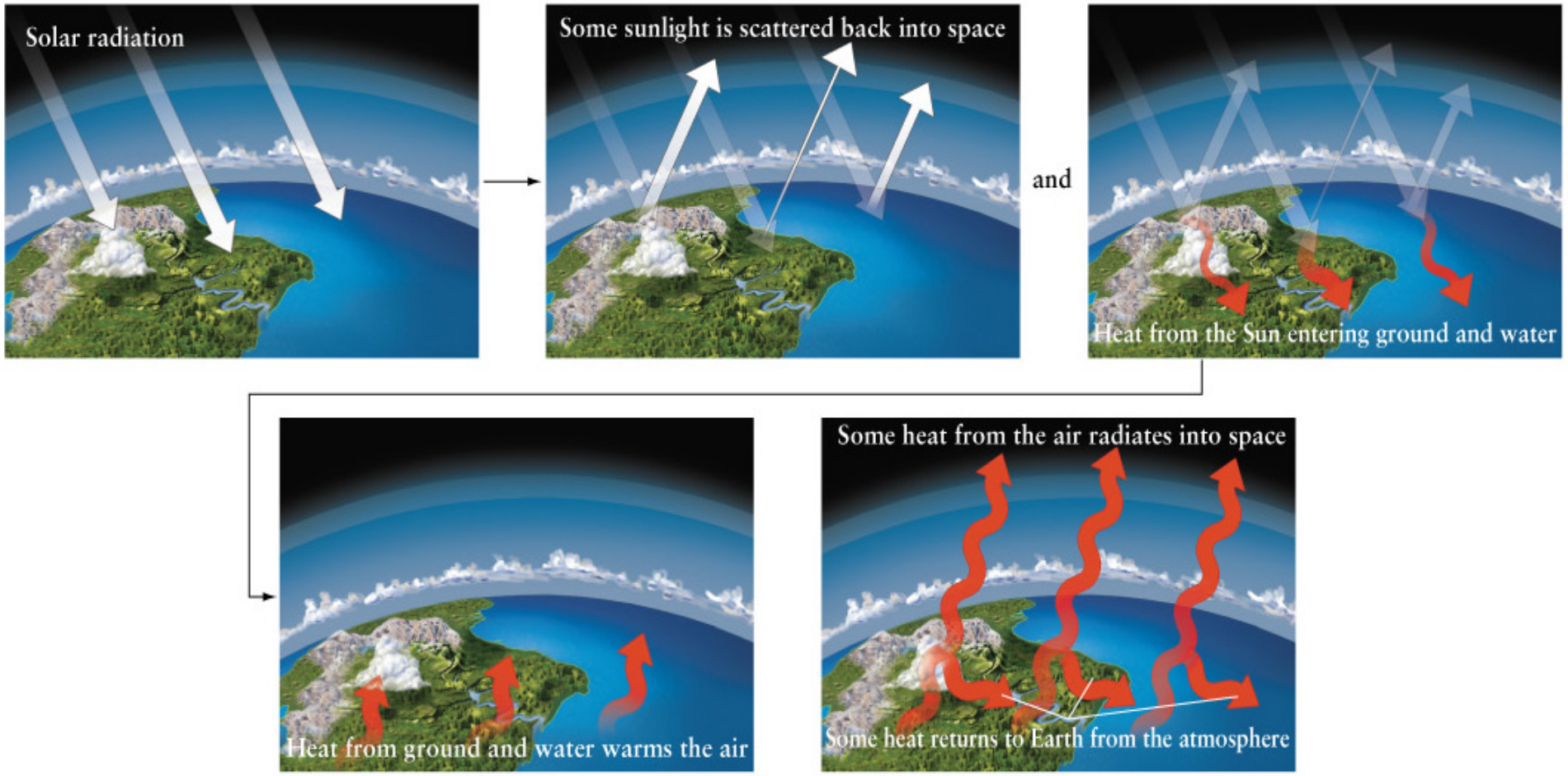
Absorption of Light in Atmosphere



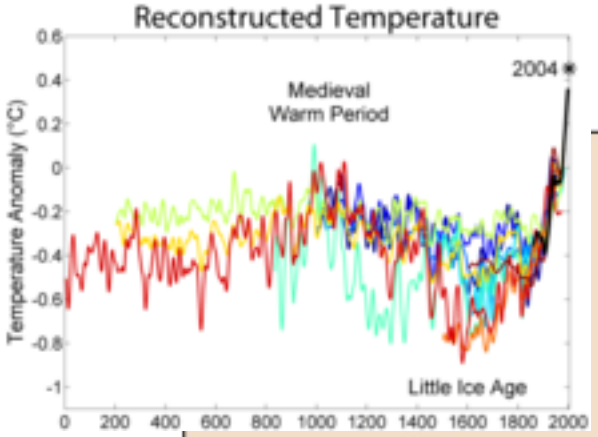
Greenhouse Effect



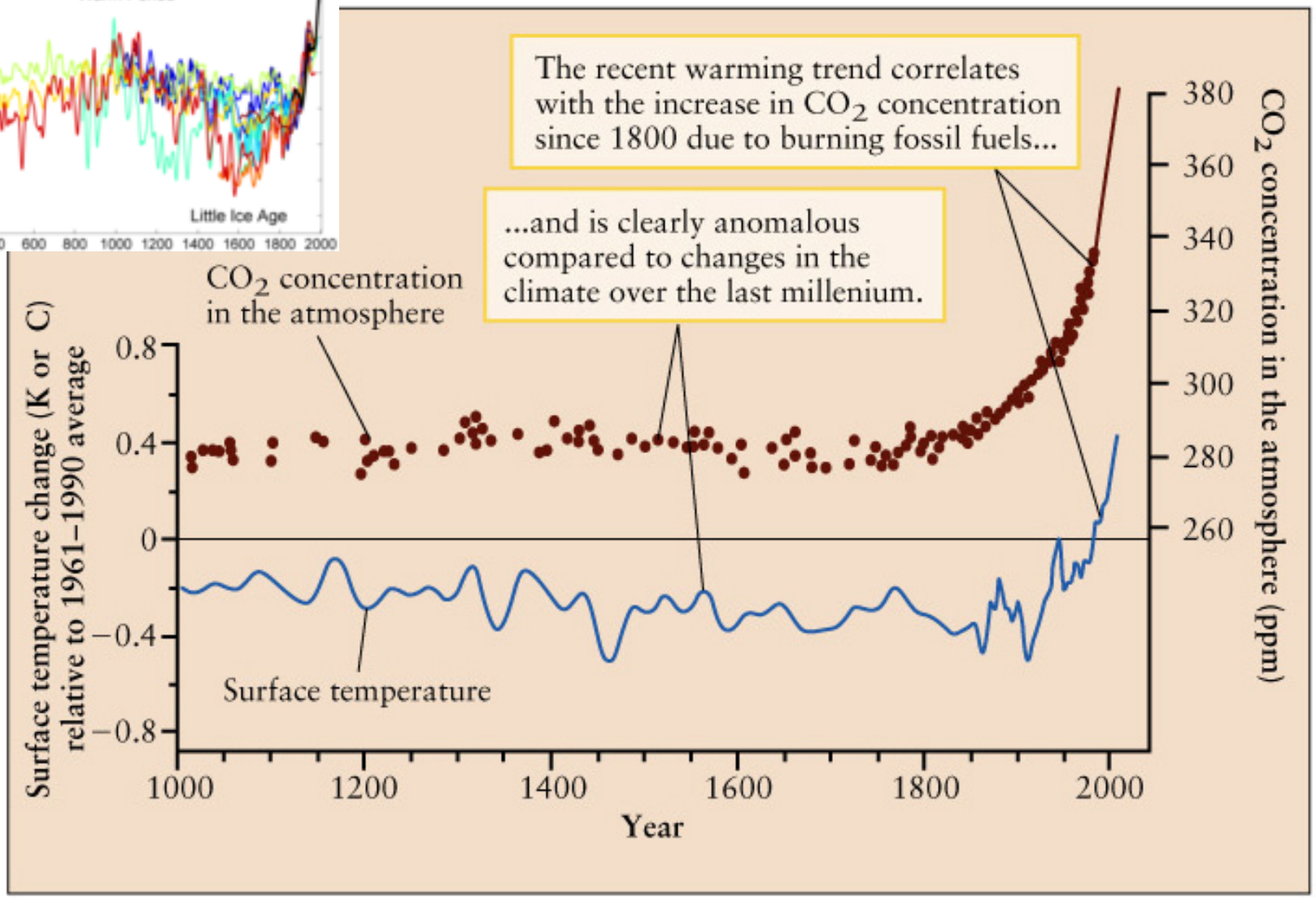
Greenhouse effect in Earth's Atmosphere



Greenhouse effect in Earth's Atmosphere



Climate proxy methods with instrumental temp. record



Greenhouse Effect in Earth's Atmosphere

- Primary "greenhouse gas" in atmosphere is water vapor
- It presence helps to keep Earth's average temperature above freezing
- Water's absorption frequencies depend mostly on the mass of Hydrogen
- Carbon Dioxide absorption frequencies depend on the masses of C and O → different than water and so "fill in" parts of the spectrum and so add to the absorption in the Infrared

Greenhouse Effect countered by clouds?

- Clouds reflect light/heat – more warming produces more clouds? (major "systematic" uncertainty) – related to the "nuclear winter" scenarios earlier…
- Centuries past there has been a close correlation between global temperatures and solar activity.. But small (hundredths of degree)

Cosmic rays are deflected by solar activity (magnetic fields) – they may be able to seed clouds - CLOUD experiment at CERN – no evidence so far…

Brightness → Luminosity → Magnitude

Absolute:

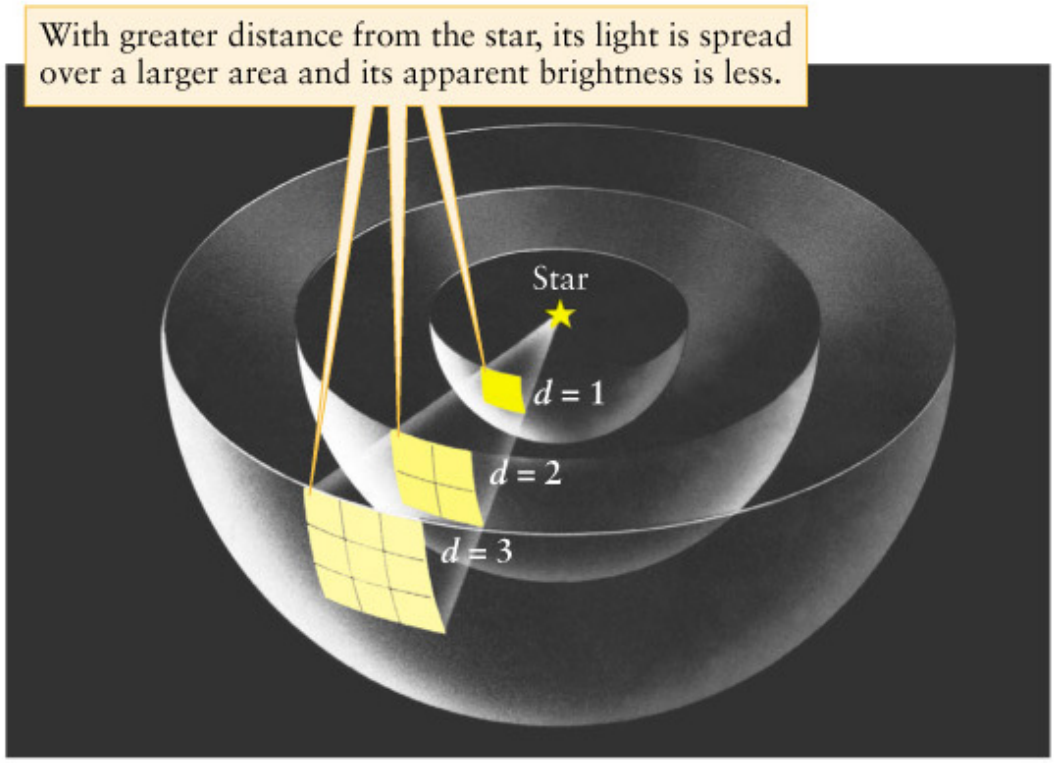
intrinsic brightness

Ex. 25W vs 100W light bulb

30 m away

20 m away

10 m away



Apparent:

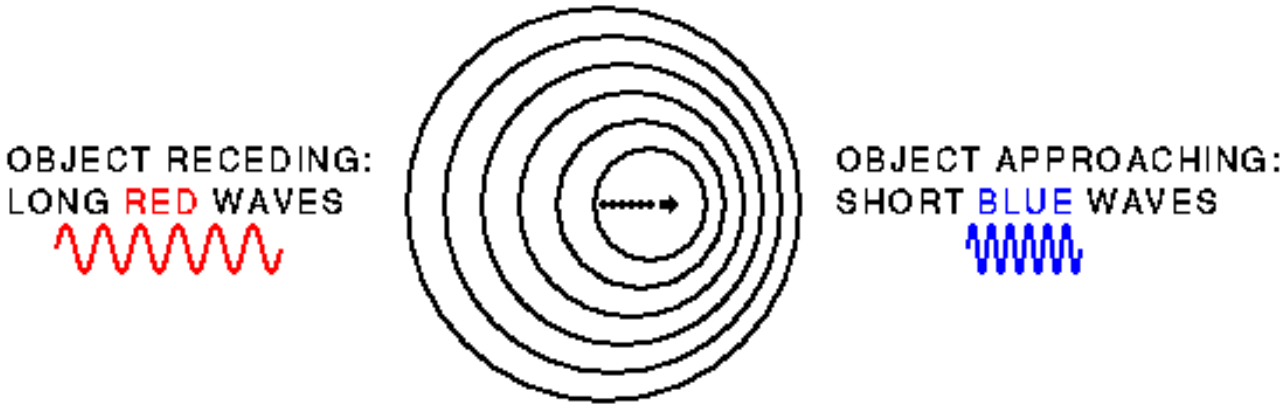
observed brightness

depends on absolute brightness and how far away you are

Doppler Shift

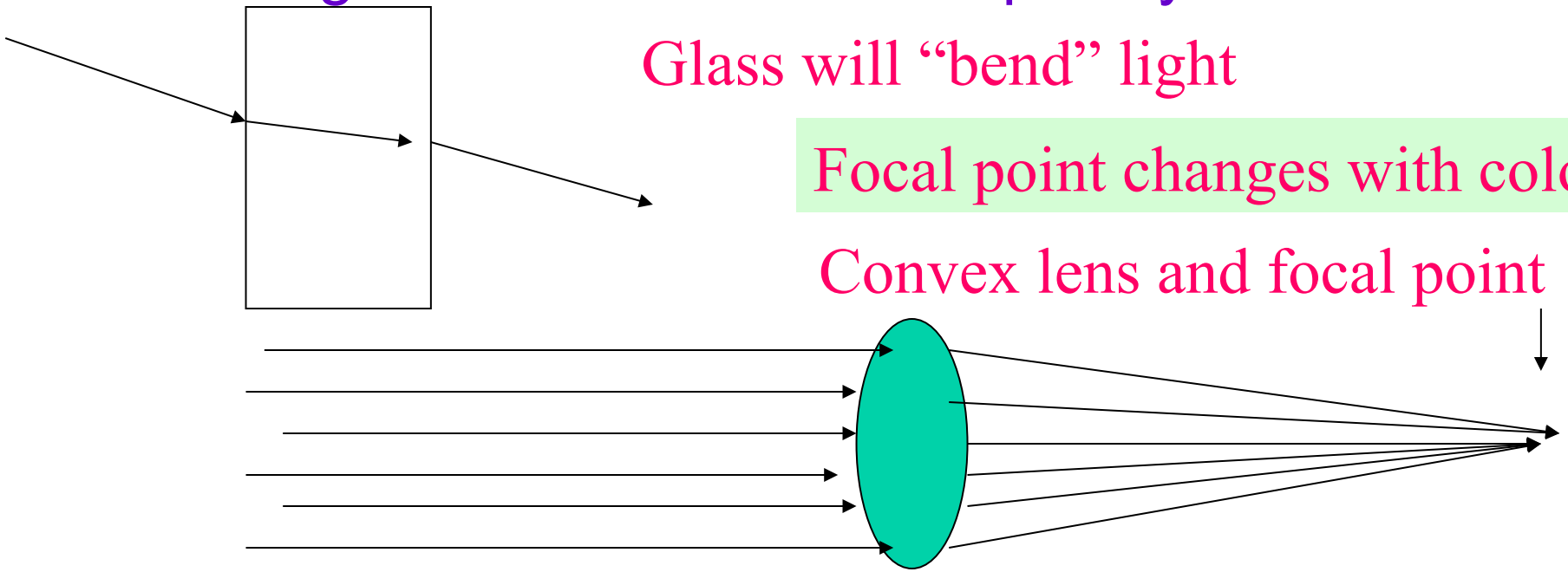
Change in frequency of light due to relative motion of the source to the observer

- Red Shift - changes to lower frequency if source is moving away from observer
- Blue Shift - changes to higher frequency if source is moving towards observer
- Easy to measure even if object very far away



Lenses, Mirrors,Telescopes

- Refraction: light is bent at the surface between two media
- spherical (parabolic) surfaces can focus light-collect over large area and gather to small
- bend angle varies with color/frequency



Reflecting Mirrors

Most big telescopes made from mirrors

- Easier to make (especially if large up to 10 m). Only one “good” surface needed
- Same focal point for all frequencies
- Can make out of many (1000s) of small elements which can be computer controlled to adjust focal point (improves resolution)