LIGHT
Special topics.
1. Greenhouse effect
2. Ozone hole
3. Polarization
At ~300K (20°C) light emitted between 4-100 μm.

Light absorbed by Earth surface 300-2000 nm

Light re-emitted by Earth surface 5-100 μm

Thermal IR

Heat = IR light

Examples - Night Vision Goggles
- Heat seeking missiles
- Target marking laser
- Outdoor warming lamps
- Food warming lamps

\[ F_e = \int I(\lambda)\,d\lambda \]
\[ = \int \frac{\Delta T}{T_e} \, d\lambda \]
\[ \lambda = 5.87 \times 10^{-8} \, m^2 \, K^{-4} \]
\[ F_\lambda (1-A) \pi r^2 = \frac{4\pi r^2}{\pi} \frac{\Delta T}{T_e} \]
\[ \rightarrow T_e = \left[ \frac{(1-A)F_\lambda}{4\pi} \right]^{1/4} \]
\[ = -19°C \quad \text{Too Cold!} \]

Earth +36
Mars +6
Venus +505

The secret to a warm Earth. Tropospheric gases which can absorb thermal IR Absorb Thermal IR Radiate 1/2 Back to Earth

Tropospheric gases absorb thermal IR and radiate 1/2 back to Earth.
In 1780, the famous English chemist Joseph Priestley (right) found that plants could "restore air which has been injured by the burning of candles." He used a mint plant, and placed it into an upturned glass jar in a vessel of water for several days. He then found that "the air would neither extinguish a candle, nor was it all inconvenient to a mouse which I put into it". In other words, he discovered that plants produce oxygen.

A few years later, in 1794, the French chemist Antoine Lavoisier (left), discovered the concept of oxidation, but soon after was executed during the French Revolution for being a Monarchist sympathiser. The judge who pronounced sentence said "The Republic has no need for scientists".
Ozone hole

\[ \text{O}_2 + h\nu \rightarrow \text{O} + \text{O} \quad \text{for } \lambda < 242.4 \text{ nm} \]
\[ \text{O}_3 + h\nu \rightarrow \text{O}_2 + \text{O} \quad \text{for } \lambda < 280 \text{ nm} \]
\[ \text{O} + \text{O}_2 + \text{M} \rightarrow \text{O}_3 + \text{M} \]
\[ \text{O} + \text{O}_3 \rightarrow \text{O}_2 + \text{O}_2 \]
The Dobson Unit: DU

\[ 2 \text{DU} = 0.05 \text{mm} \text{O}_3 \text{ at 1 atm } 0^\circ \text{C} \]

\[ \frac{10^3 \text{cm}}{\text{m}} \times \frac{1 \text{ atm}}{\text{m}} \]

\[ = 1 \text{ cm} \text{ atm} = 1 \text{ DU} \]

Normal: \( \approx 350 \text{ DU} \)

Equivalent to 3.5 mm at surface

Remember \( PV = nRT \)

Recipe for \( \text{O}_3 \) Loss

1. Polar WINTER \( \rightarrow \) Polar VORTEX
   \( \rightarrow \) Stratospheric air
2. Low \( T \)
   \( \rightarrow \) Polar Stratospheric Clouds (PSC)
   \( \rightarrow \) Nitric acid (HNO3)
3. Surface Chemistry
   \( \rightarrow \) \( \text{O}_3 \)
   \( \rightarrow \) catalytic destruction of \( \text{O}_3 \)
4. Light returns
   \( \rightarrow \) \( \text{Cl}_2 \)
   \( \rightarrow \) Catalytic destruction of \( \text{O}_3 \)
Electromagnetic Radiation

Unpolarized light

Polarized light

Polarizing sun glasses reduce glare of polarized reflections from surfaces
Mirror image of hand

Polarization

Optical Isomer and Interaction with Light

Dextrorotatory- “d” isomer
Complex which rotates plane of polarized light to the right.

Levorotatory- “l” isomer
Complex which rotates plane of polarized light to the left.

Chiral molecules are optically active because effect on light...