

Chapter 12

Light, Color and Atmospheric Optics

White and Colors

- Review:
 - Nearly half of radiation from sun is visible light (what wavelengths are longest?)
 - Four possible fates of light as it enters atmosphere (absorbed, reflected, scattered, transmitted)
- So what wavelengths is all white light? Black light?
- Reflection – occurs when sunlight bounces off a surface at same angle
- Scattering – occurs when sunlight is deflected in all directions
 - Why is the bottom of thunderstorms dark?

Blue Skies and Hazy Days

- Selective scattering – ability of molecules to scatter one wavelength better than others
 - The larger the particle, the more they scatter all wavelengths. Haze is white because of this
- Crepuscular rays – scattering of sunlight by dust and haze to produce white bands of light

Red Suns and Blue Moons

- Sun can appear red because it travels through more atmosphere near sunset than at midday
- Blue moon and suns can happen if the particle is the same size as visible light (scattered red more)
- Volcanoes can cause red suns for many days

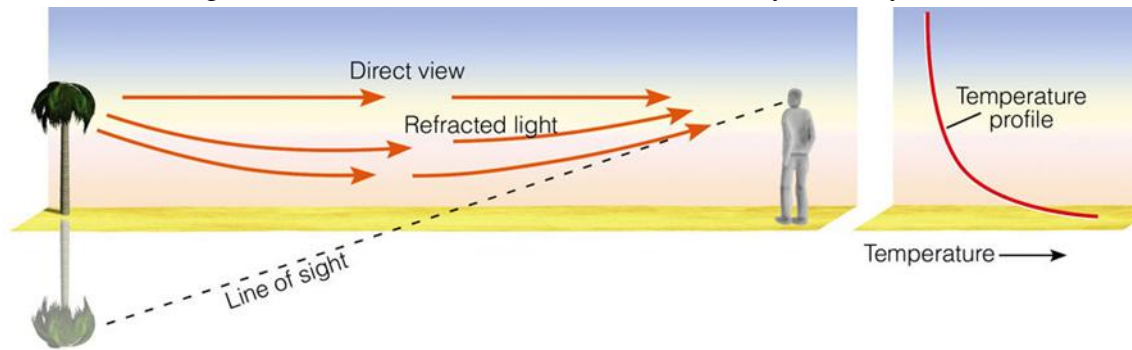
The Mirage: Seeing Is Not Believing

- Refraction – bending of light due to density changes
- Light that travels from less to more dense loses speed, and vice versa
- Lights twinkle due to refraction
- Twilight occurs due to refraction
- Mirage – an image that appears displaced from its true position
- Caused by light moving through different air densities
- Inferior mirage – images that appear lower and inverted from original
- Superior mirage – images that appear higher than original

Inferior Mirage

- Warm surface, decreasing temperatures aloft

- The proper conditions for an inferior mirage are commonly found over a hot road surface during summer, or over an unfrozen lake on a very cold day.



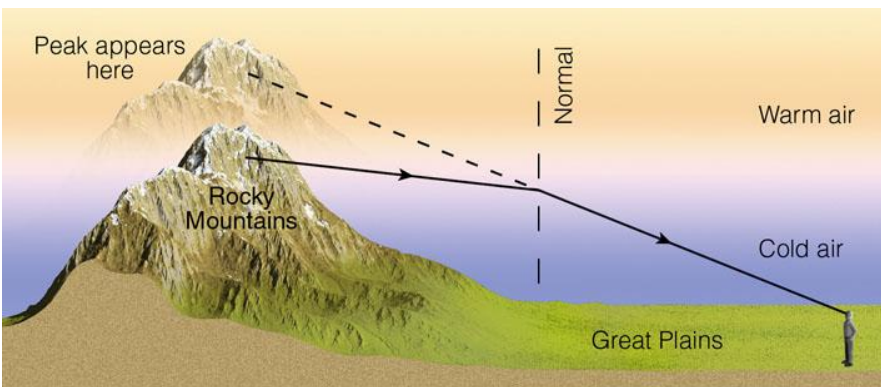
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Superior Mirage

- Cold surface, warmer temperature aloft
 - The proper conditions for a superior mirage are commonly found over water and over snow-covered surfaces.



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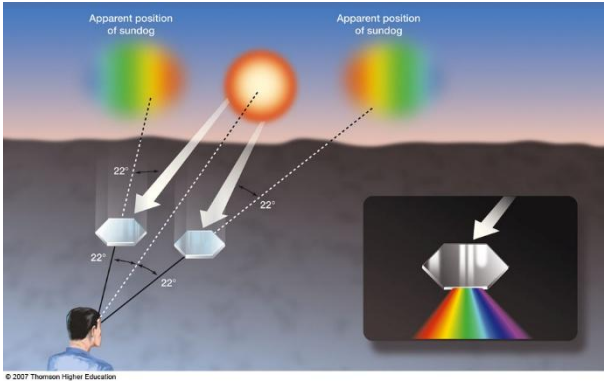
Halos

- Halo – Ring of light encircling sun or moon

- Ice crystals refract light to create halo
- Dispersion – breaking up of light into different wavelengths (prism)

Sundogs

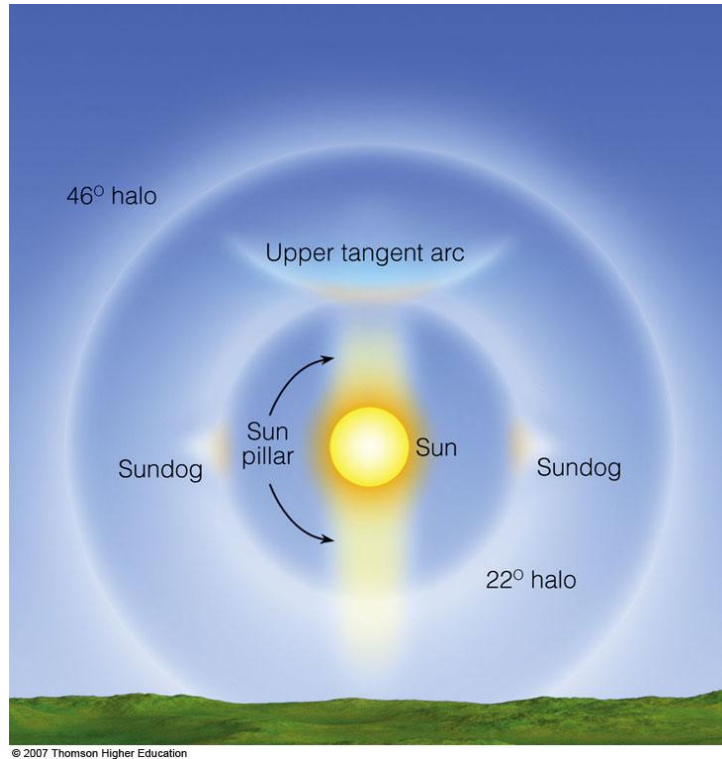
- Created by hexagonal ice crystals oriented horizontally
- Ice crystals act like a prism
 - Sundogs are commonly seen when cirrostratus clouds are in the sky.



Sun Pillars

- Caused by reflection of light off ice crystals
 - Sun pillars can be seen shortly after sunrise or shortly before sunset on very cold days.



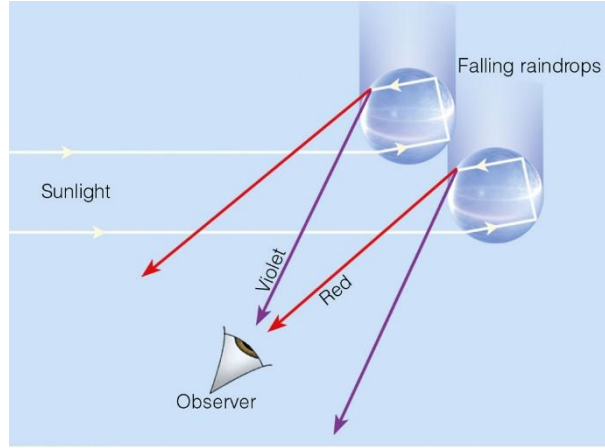


Rainbows

- Water droplet phenomenon
- When sunlight enters rain drop, it refracts and disperses
 - Red refracts less than violet
 - This light is reflected off backside of raindrop at critical angle
 - Each wavelength is reflected at different angle to our eyes (dispersed)
- It takes many different raindrops to produced a rainbow (each raindrop gives a different wavelength)
- Must face the falling rain with sun at your back
- The primary rainbow, the brightest of the rainbows

The Secondary Rainbow

- Two internal reflections (secondary rainbow)
 - A tertiary rainbow also exists, but it is too faint to be seen with the human eye.



Coronas and Cloud Iridescence

- Diffraction – bending of light around objects
- Corona – Bright ring of light around the moon or sun
- Blue appears on inside of ring, red on outside
- Need a cloud that has droplets of similar size
- New clouds are the best corona producers



- Iridescence - bright areas produced by diffraction
- Associated with thin clouds within 20 degrees of sun

The Glory

- Sun must be to your back, cloud in front of you

It is very common to see a glory from the window of an airplane. Make sure you are sitting on the side opposite the sun.



