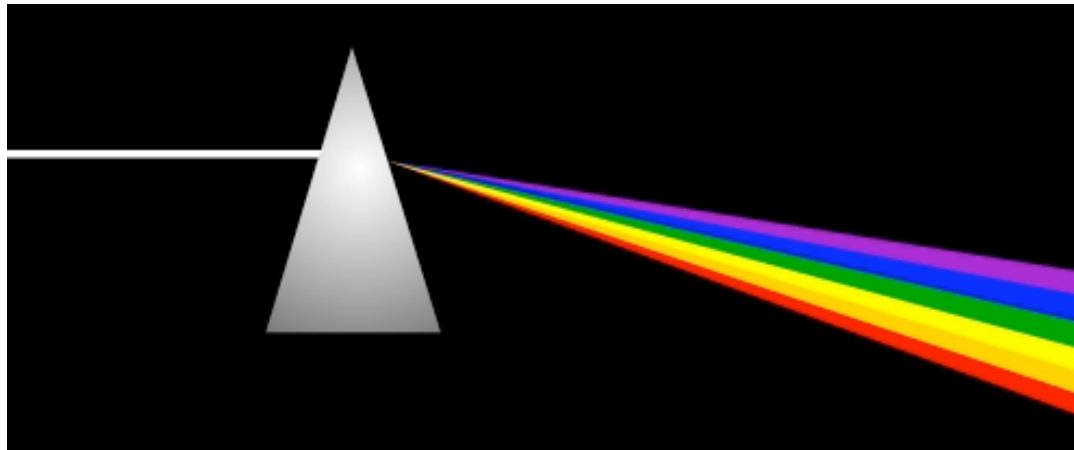


- Note that the visible part of the spectrum is only a small fraction of the E-M spectrum.
- If a source emits all the wavelengths of the visible part of the E-M spectrum, our brain interprets this as white light.

White Light

- This can be demonstrated in many ways. Newton used a prism and wrote out the first discussion of light, colors and waves.

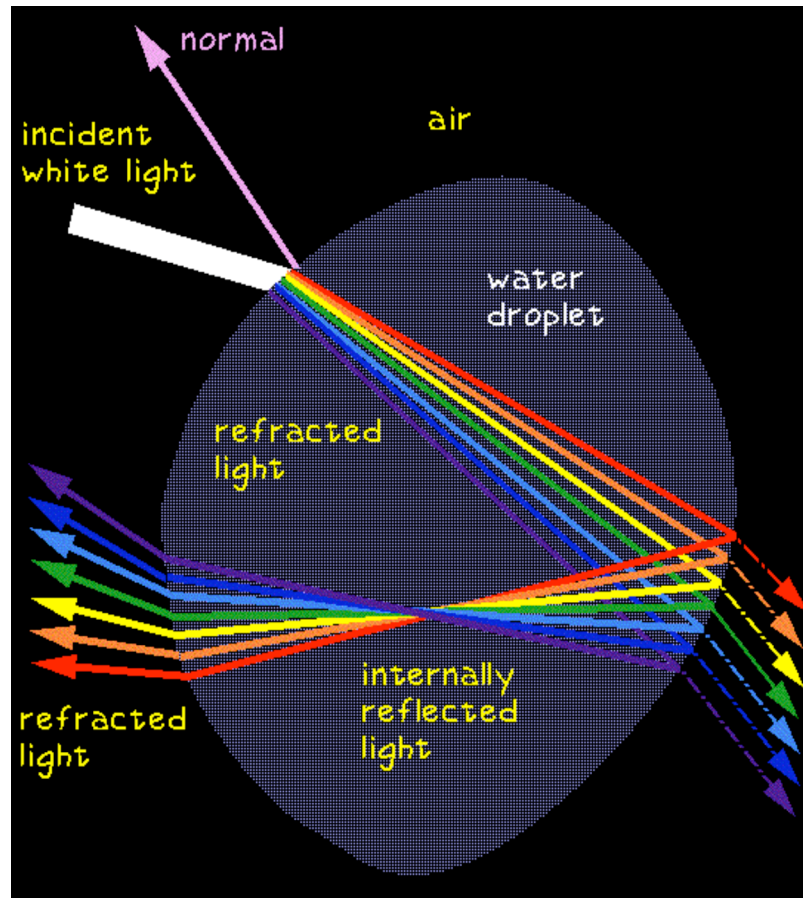


White Light



- Nature provides a beautiful means of dispersing white light into its constituent colors.

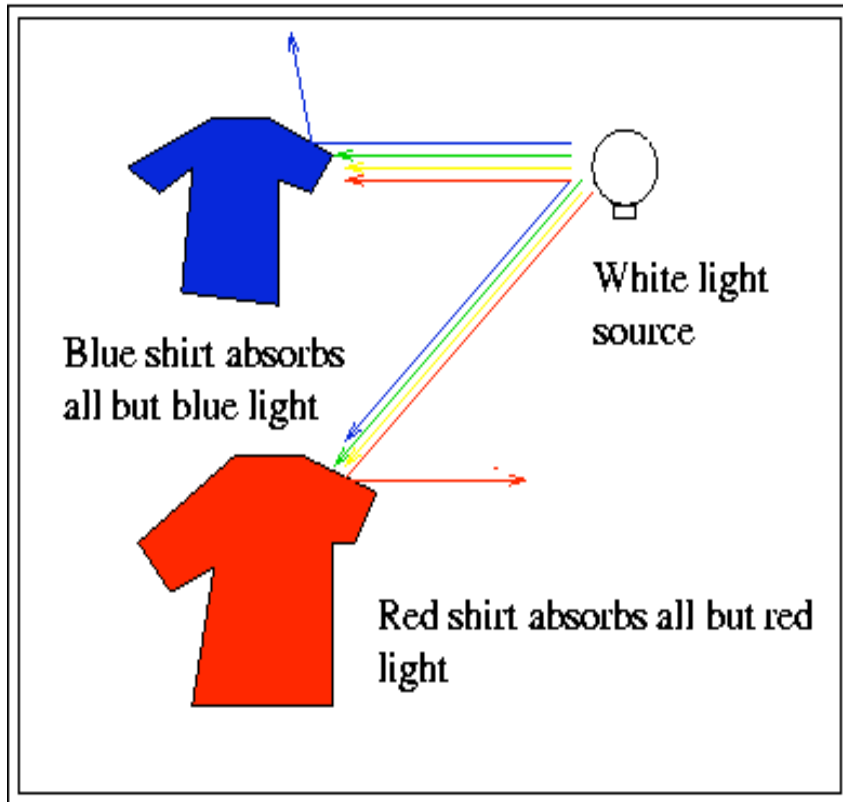
Rainbows



- Rainbows are caused when sunlight enters raindrops and reflect off the back surface. Different wavelengths of light travels at different velocity in the drop and are bent different amounts and therefor separated on the sky

Double rainbows occur for two reflections in the raindrops (note the reversed order of the colors).





- Most colors we see are in reflected light. The different colored objects in the room are reflecting some components of the white light and absorbing the rest.
- Black shirt absorbs all wavelengths
- Blue reflects blue wavelengths, absorbs the rest -- a blue shirt demonstrates that white light contains blue light.

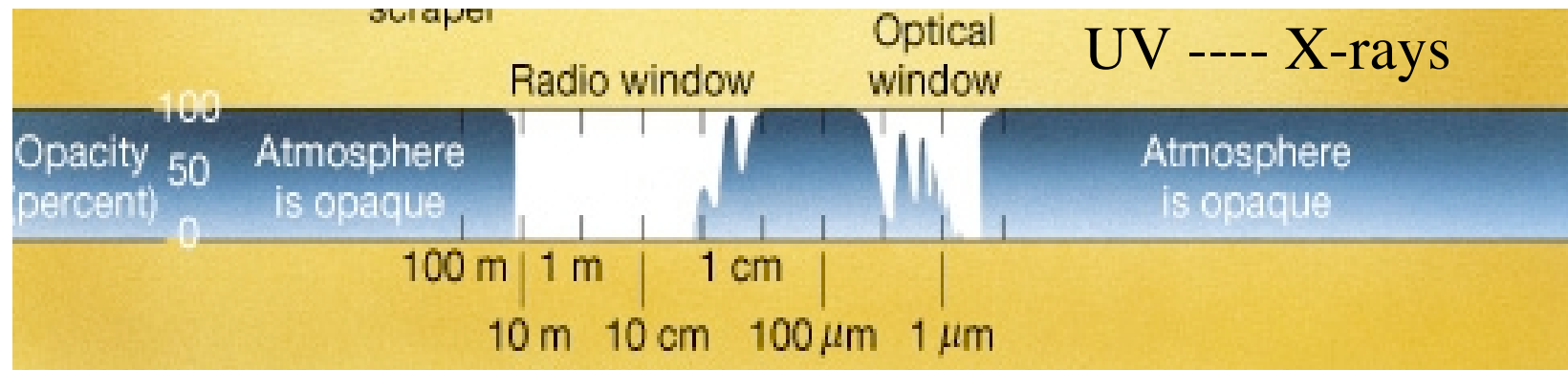
Q. What wavelengths are reflected by a white shirt?

A. All of the visible-light wavelengths.

Q. What color is a yellow banana illuminated with blue light?

A. Black. It is yellow because it reflects yellow light and absorbs other colors.

E-M Radiation and the Atmosphere



- The atmosphere only passes certain 'spectral windows' (either way).
- The atmosphere is transparent to visible light (do you think it is a coincidence that our eyes are sensitive to visible light?), some parts of the radio and some parts of the Infrared.

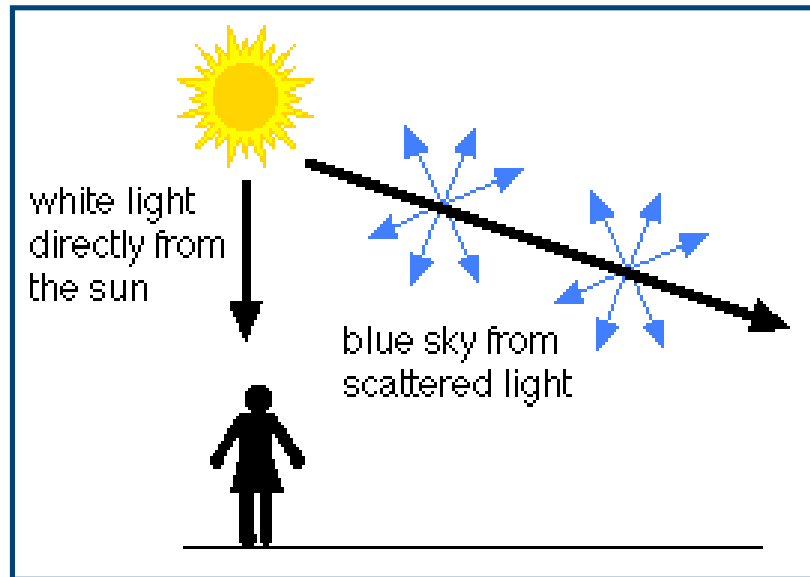
- Fortunately, the atmosphere is opaque to UV, X-rays and gamma rays. All are harmful to humans and other animals and plants.
- The Infrared between 10 and a few 100 microns is also absorbed by the atmosphere.
- To make observations of the Universe at these wavelengths requires going into space. Satellites, rockets and balloons all provide platforms.

Sidetrip: Why is the Sky Blue?

- When you look *at* the Sun, it appears yellow-white.
- When you look into the sky AWAY from the Sun, the sky *should* appear black as there is no light source.

So, why is blue?

Blue Sky cont.



- The reason the sky is blue is that molecules and small particles in the upper atmosphere scatter blue photons more efficiently than red ones.
- When you look away from the Sun, you see blue light that has bounced off the upper atmosphere into your line of sight.

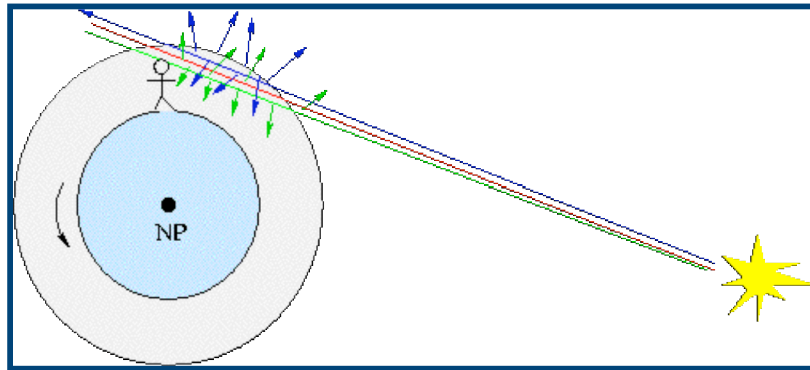
Q. What color is the sky (away from the Sun) as seen by an astronaut on the Space Shuttle?

BLACK

Q. What color is the sky (away from the Sun) as seen from the surface of the Moon?

BLACK

Sidetrip: Why is the Sun red at sunset?



- For the same reason the sky is blue - scattering of blue photons.
- The long pathlength through the atmosphere when the Sun is low means there are more molecules and particles to scatter out all the blue light leaving only red.



The Green Flash

- One more interesting sidelight occurs because the atmosphere acts like a prism. Red light is less bent than green light which is less bent than blue light. The image of the Sun in these different colors is therefore separated. When the Sun is low on the horizon, the red Sun sets first, then the green Sun. By then, all the blue light is scattered out so there is no 'blue' flash.

