

On the Bright Side Notes

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Prepared by Dr. Brad Moser

- Tell us about you!
 - Teach physics
 - Climbing mountains
 - Yoga
- What exactly is light? (/how it's made)
 - Light is a wave
 - Slinky wave
 - But light is E and B fields
 - "Electromagnetic waves are produced when free charges accelerate or when electrons bound to atoms and molecules make transitions to lower energy states."
 - Grab an electron and shake it
 - Faster shake is higher frequency, more blue
 - Or, electron excitation model
 - Blackbody radiation
 - This is a pretty tricky topic, mathematically and conceptually speaking. But generally, the temperature of an object defines its radiative output, or light emission, profile.
 - Examples: stove top, flame
- So why is our sun yellow... but some stars are blue or red?
 - Stars are blackbodies
 - Nuclear fission → gamma emission → absorption/re-emission → blackbody radiation
 - Max wavelength = constant/T (Wien's displacement law)
 - For our sun's temperature of 5800K, max wavelength is about 500 nm
 - PhET: https://phet.colorado.edu/sims/html/blackbody-spectrum/latest/blackbody-spectrum_en.html
 - Warmer or cool leads to different colors
 - Our vision
 - Earliest vision was just lights and darks
 - Steadily evolved from there
 - We evolved to see the peak wavelengths of the sun
 - What if we went to another planet with a red or blue star?

- Our own eyeballs pick up visible light, that good old ROYGBIV. How does visible light translate into the colors that we see? (a basic intro would be great and then pigment vs structural color... which I'm super stoked to learn about too!)
 - "The absorption of a light photon in a photoreceptor triggers an electrical signal to the brain (an action potential)."
 - IR not energetic enough to trigger photoreceptor
 - UV absorbed before reaching the retina
 - Three types of cones in the eye that respond to different parts of spectrum, RGB
 - About 400-700nm for humans
 - Birds have a 4th cone that is sensitive to UV
 - Butterflies have 5 (visible, UV, enhanced distinguishing)
 - Mantis shrimp have 16 (visible, UV, and polarization)
 - How does that light get to our eyes?
 - Usually Reflection (describe)
 - Diffuse reflection from pigments
 - A green object is one that absorbs reds and blue but reflects green.
 - Some animals make use of structural color
 - Birds and butterflies
 - Bluebirds
 - Blue is a hard pigment to make in nature (it was also the last LED color)
 - Scattering: small structures scatter light
 - Air molecules scatter light, sky appears blue since blue is scattered more than red and green
 - Bluebirds only have brown pigment, but air pockets and feather structure scatter blue while absorbing other colors
 - Interference
 - Soap bubbles and oil on driveway
 - Light reflects from top layer AND bottom layer of material
 - Thickness of material results in only certain wavelengths constructively interfering.
 - Birds, butterflies: air layers between structures of feathers
 - Technology trying to take advantage of this
 - Screens where each pixel can vary distance from front and back surface, leading to different colors

- Encryption technology
- Rainbows. A great example of visible light at it's finest. What's going on there?
 - Refraction
 - Describe regular refraction
 - Put a spoon or straw in a glass of water
 - Rainbow from refraction/reflection in circular drop
 - Double rainbow
- My favorite fun fact about light is that it's both a particle and a wave... how does this work?
 - Talk off the cuff
- What has been your favorite sunrise or sunset that you've ever seen?
 - Love the Maine sunrises
 - The brilliant reds and oranges are due to scattering
 - Moonrises are awesome too
 - Blood red moon, scattering
- Do you have any other adventures or memories where cool light events stand out?
 - Moon halo
 - Scattering of light through ice crystals
 - Week in Banff national park in Canada
 - Rainbow from a mountain top
 - Blue lake waters in the mountains
 - You'll like this. Water from glacial melt is muddy with rock, gravel, and silt. Most sinks to bottom of lake, but fine particles of rock (like baking flour) remain suspended in the water.
 - This rock flour absorbs most colors, but scatters blue and green. This is a structural color!