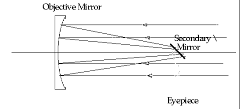
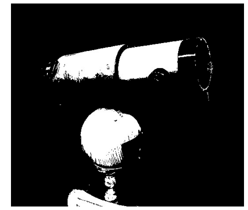
If you have no air-conditioning, you can always cool yourself down by taking a bucket of ice out of the fridge and blowing a fan across it

1. Good idea?

Newton' other contribution: understanding light



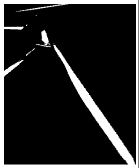
- the reflecting telescope
- precursor of all modern telescopes



Some conversions: basic unit is metre (m)

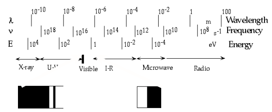
- kilo: 1 km = 1000 m
- milli 1mm = 10^{-3} m = 0.001m
- micron: 1μm = 10^{-6} m = .000001m
- nano 1nm = 10^{-9} m=.000000001m
- pico: 1pm = 10^{-12} m=.000000000001m
- fempto: 1fm = 10^{-15} J=.000000000000001m

and splitting up light into it's constituent colours



- Red (wavelength of 800 nanometres = 0.8 microns)
- Green ~520 nm
- Blue ~400 nm

- Light is part of the whole electromagnetic spectrum



- All waves satisfy fλ=c
- (frequency ×wavelength = speed)

Can take photos in IR

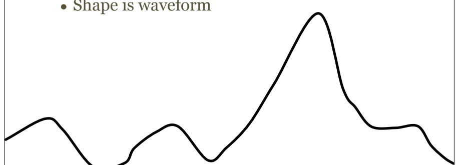
- Snake eats mouse

What is this "wavelength"?

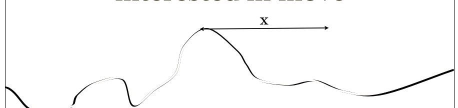
- Easiest to visualize are water waves or waves in string: One dimensional waves: e.g.
- Waves in slinky
- Waves in string
- Sound waves
- Light Waves

Waves can be any shape

- Shape is waveform



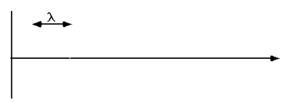
Most waves we are interested in move



- Speed (velocity) is distance that a peak moves in a second
- so if it moves distance x in time t
- v=x/t

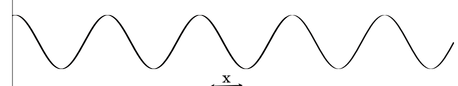
Mostly (for light anyway) we are interested in "periodic waves"

- Define wavelength λ = distance between peaks (or troughs: it doesn't matter)
- Amplitude is "height" of wave



Again can define speed

- (need to be careful since it repeats)



- so if it moves distance in time
-

Danika Borda

Why do we see a rainbow when white light passes through a prism?

Why?
I've noticed rainbows on the floor from light coming through a window sometimes, but only under particular circumstances. Is the same phenomenon responsible for rainbows in the sky (can rain act as a prism)? Can any transparent material do this?

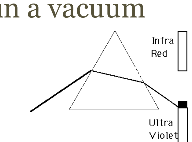
Difficulty:
2: I assume the answer is not too complicated and my professor should be able to explain it easily.

Text

Fraunhofer

- Sunlight split by prism shows dark lines
- Picture taken through bus-shelter glass!

For any E.M wave in a vacuum



- speed
- c = 3×10^8 m/s
- =300,000 km/s
- In transparent material, it will move slower:
- e.g. in water it's about 225,000 km/s
- but different colours move at different speeds
- slower moving light gets bent more

Often talk about frequency

- Frequency is number of "crests" that go past you each second
- Measured in Hertz (Hz)
- e.g. sound waves: "concert A" is 440 Hz
- e.g radio waves:
- CBC broadcasts at 91.5 megaHertz (MHz)

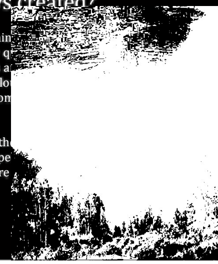
SO yellow light (say sodium light)

- λ=589 nm
- = 589×10^{-9} m
- so frequency is f=c/λ
- = 5 $\times10^{14}$ Hz = 500 TeraHertz (THz)

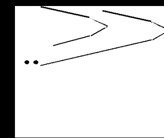
Sarah Clarke (also Jasminder Sandhu, Peter Smelters) How are rainbows created?

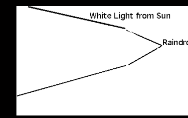
This is a good question because rain... beautiful occurrences yet they are q... end of the rainbow if there even is a... up after rain? Why are they the colo... such a natural entity that it is uncon... think about how they are made.

This is a level 2 question because th... answer to all these questions but pe... simple answer to how rainbows are...



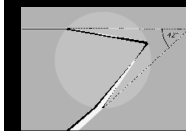
1. combination of refraction and total internal reflection in raindrop.

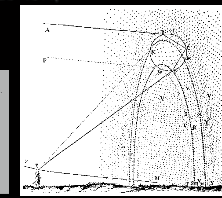




Text

1. Rainbow will always form when rain drops are in opposite direction to sun, at angle of 42°
2. Probably first correct explanation due to Qutb al-Din al-Shirazi (1236–1311)
3. This is Descartes





Wikimedia

Can get get double rainbows

1. Need two reflections inside drop
2. Note colours reversed
3. Also sky is darker outside primary bow

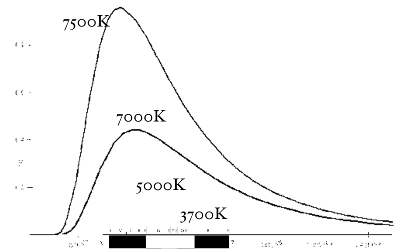
Text

Heat and Radiation

- Electromagnetic radiation transfers heat very effectively at high temps.
- Black-body radiation: the radiation emitted by all hot bodies is (almost) exactly the same. Must measure temperature in degrees absolute
- T(K) = T(°C) + 273
- so that room temperature (~20°C) is ~ 290 K

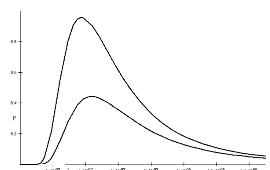
And the most important thing we learn is from barbecues

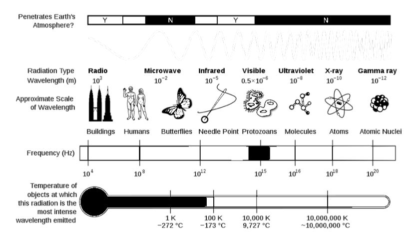
- What's hot and what's not: roughly
- red is 800°C
- orange is 1500°C
- yellow is 2000°C
- blue is 15000°C
- X-rays are 1 million °C



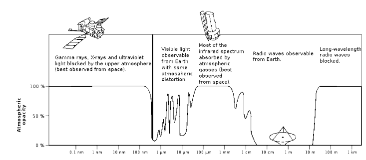
- Two fundamental laws:
- Stefan- Boltzmann law
- Total Power radiated/unit area
- i.e double the temp, 16 times the energy

- Wien's law:
- Wavelength of peak i.e. as we heat up objects, they go
- black ⇒ red ⇒ orange ⇒ yellow ⇒ white



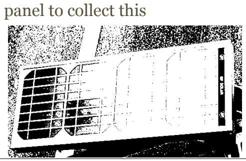


- Atmosphere is mostly opaque except to visible light & radio waves
- Our eyes have evolved to see only parts of the spectrum that can make it through
- Why can't we "see radio waves?



Solar Power

- At top of atmosphere we get about 1400W/m² from the sun
- Clouds, day-night and latitude cut this down
- Average on earth ~ 150 W/m²
- Can use a solar panel to collect this



- Solar panels are about 20% efficient, so **average** power ~ 30W/m²
- **Peak** power ~ 140 W/m²
- Canada uses ~60GW
- so would need 2 billion square metres
- 2000 km²: is this too much?
- Note there are other issues:
- we'd get far too much in summer and too little in winter.
- cost ~$700/m² ~1 trillion $ for Canada!

If you have no air-conditioning, you can always cool yourself down by taking a bucket of ice out of the fridge and blowing a fan across it

1. Good idea?
2. No! you always use more energy to freeze the water to ice than you'll get back
3. Your kitchen gets even hotter than it would normally