ABINGDON SCIENCE PARTNERSHIP

13. Exploring Starlight (Part 3.2 - Observing in other wavelengths)

Edexcel GCSE Astronomy Course

Inspirational starter activity:

Have a look at this link and investigate for yourself how the appearance of our own Milky Way Galaxy changes when viewed in different wavelengths of the EM spectrum:

http://www.chromoscope.net/

13.28 Understand why some infrared telescopes can operate in high-altitude locations, on the Earth's surface

Go to this link and watch the very informative video about the science of infrared radiation - look for answers to the questions that follow:

https://science.nasa.gov/ems/07_infraredwaves (5m:22s)

- Which famous astronomer discovered and named infrared?
- Are infrared wavelengths longer or shorter than visible light?
- What emits infrared radiation?

There are two problems with observing in the infrared from the Earth's surface (i) the atmosphere absorbs a large range of infrared wavelengths (ii) the Earth itself and the atmosphere emit infrared, interfering with signals from space.

- As a great deal of the absorption and emission is due to water vapour in the lower atmosphere, where is the best place to locate infrared observatories on the surface?
- What are the two other places that infrared observatories have been located/

  https://www.nasa.gov/mission_pages/SOFIA/overview/index.html

  https://www.jpl.nasa.gov/news/press_kits/spitzer/

13.30 Understand the detrimental effect of the Earth's atmosphere on the quality of images formed by telescopes on the Earth’s surface

What are the four ways in which the Earth’s atmosphere affects observations in visible light?

Make a list and write down an explanation for each one - this page will help:

https://www.space.fm/astronomy/earthmoonsun/atmosphericeffects.html

13.31 Understand why telescopes operating outside the optical and radio ‘windows’ need to be sited above the Earth’s atmosphere

Taking X-rays as an example, this link discusses some of the problems with trying to observe at wavelengths that are absorbed by the Earth’s atmosphere:

https://imagine.gsfc.nasa.gov/observatories/technology/observing_platforms1.html

- What material can stop most X-rays of interest to astronomers?
- What three methods have been used to make X-ray observations?

Although gamma rays are absorbed by the Earth’s atmosphere, this causes showers of sub-atomic particles which create Cherenkov radiation. This can be detected at the Earth’s surface as explained in the short video (2:42) at this link:

https://www.cta-observatory.org/about/how-cta-works/

13.32 Understand the advantages and disadvantages of space telescopes and detectors, including orbital observing platforms

By now you should be aware of the advantages of space based observation, unaffected by the annoying effects of Earth's protective atmosphere. However, it's not all good news - go to this link and make a note of the advantages and disadvantages of space telescopes listed there:

https://www.space.fm/astronomy/planetarysystems/spacetelescopes.html

If you want to take things a bit further read this very interesting information about adaptive optics which can make ground based observations as good, if not better, than those from space telescopes:

https://research.arizona.edu/stories/space-versus-ground-telescopes

13.33 Understand how gamma ray, x-ray and ultraviolet astronomy have been important in the discovery of gamma ray bursts, black hole accretion discs and the corona and chromosphere structure of young stars

Gamma ray bursts - go to this link and watch the short animation (1:03) of 500 GRB's detected by NASA's SWIFT satellite, then make notes on the causes of GRB's:
https://imagine.gsfc.nasa.gov/science/objects/bursts1.html

Black hole accretion discs - answer the following questions by reading this link
http://stronggravity.eu/public-outreach-tmp/accretion-disks/

- Why can't we study black holes directly?
- What is an accretion disk?
- What types of EM radiation are given out by accretion disks around (i) stellar mass black holes (ii) supermassive black holes?
- Extension question - why are longer wavelengths emitted by the supermassive black hole accretion disks?

Here's a good summary of how shorter wavelength astronomy helps with understanding hotter and more energetic objects and events https://www.space.fm/astronomy/planetarysystems/uvxraygamma.html including UV for investigating the corona and chromosphere structure of young stars

13.34 Understand how a telescope alters the appearance of:

a stars - watch this enthusiastic description https://www.youtube.com/watch?v=msBmWKIHQCQ (3:07)
b double stars and c binary stars - image resolution is the key to seeing double stars. This link explains the difference and shows some lovely examples: https://www.skyatnightmagazine.com/advice/double-binary-stars-guide/
d open clusters and e globular clusters - find out and learn the difference here: https://www.atnf.csiro.au/outreach/education/senior/astrophysics/stellarevolution_clusters.html
f nebulae - have a look at this site which explains what nebulae are, what the different types are and shows some images of what they look like through small telescopes (write or sketch a description in your notes): https://earthsky.org/space/deep-sky-objects-galaxies-nebulae-star-clusters/
g galaxies - Andromeda (M31) is the only other galaxy you will ever be able to see with your naked eye. This site compares a VERY good, dark sky view with a telescopic image - make some notes on the very obvious differences! https://earthsky.org/astronomy-essentials/2-ways-to-find-the-andromeda-galaxy/