SCIENCE CONTENT/ CURRICULUM LINK

PHYSICAL WORLD: PHYSICAL ENQUIRY & PHYSICS CONCEPTS / USING PHYSICS. NATURE OF SCIENCE: UNDERSTANDING / INVESTIGATING / COMMUNICATING

STARDOME OBSERVATORY & PLANETARIUM

FACTS, RESOURCES AND ACTIVITIES ON...

THE INVISIBLE SKY

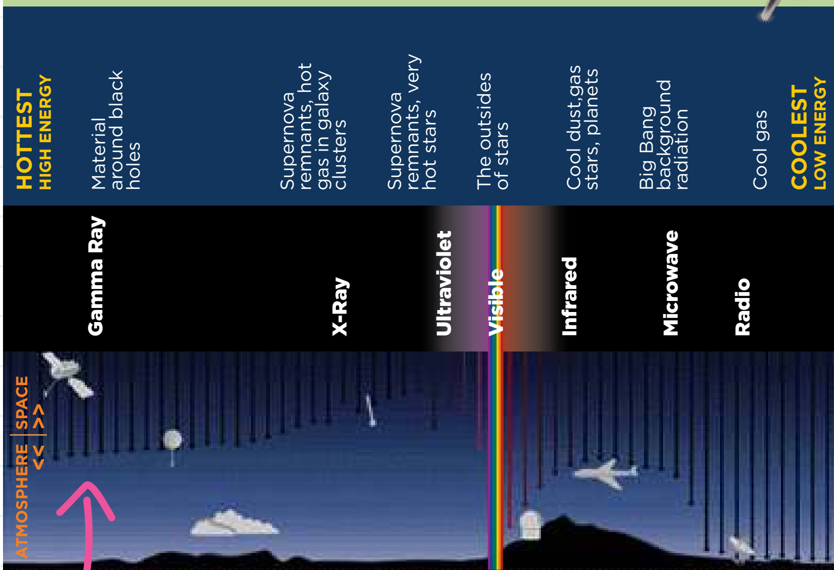
MULTI-WAVELENGTH ASTRONOMY

Almost everything we know about the Universe comes to us riding on beams of light. The entire range of energies of light is called the electromagnetic (EM) spectrum. The image shows the spread of the spectrum from high energy gamma rays on the left to low energy radio waves on the right. Note how narrow the visible band of light and how little our eyes can see!

Unfortunately for observing (but fortunately for our survival) our atmosphere is **opaque** to most of the EM spectrum. With the notable exceptions of radio frequencies and visible light, most of the other wavelengths never reach the ground.

> Observing the infrared, we can peer through interstellar clouds that block visible light

TYPICAL SPACE OBJECTS OBSERVED



Rocketry has enabled us to get new instruments above Earth's opaque atmosphere. Today, these 'space-borne' technologies, air-borne observatories such as SOFIA, and ground-based telescopes, enable us to 'see' a vast array of objects that radiate in all the wavelengths that our eyes cannot see.

In truth, most objects in space give off several types of EM radiation at the same time. The type depends on multiple things, such as their temperature and what they are made of. When our eyes view a clear night we find that stars dominate the sky. This is because visible light is the predominant EM radiation emitted by objects with star-like temperatures (ie. between 2,000 and 10,000 degrees C). While still radiating visible light, objects cooler than stars such as planets radiate more in the infrared.

As seen in the image above, we can learn more about an object when we observe it in the wavelengths that it radiates the most. Many Space Observatories have been deployed and dedicated to specific bands of the spectrum to do just that.

As we put these separate observations together (AKA multi-wavelength astronomy) we find that they can complement one another, greatly extending our understanding of the dynamic Universe around us.

> Objects can look vastly different when observed in different wavelengths

Check out these other resources...

- sciencelearn.org.nz/videos/919-detecting-light-in-space
- imagine.gsfc.nasa.gov/science/toolbox/multiwavelength1.html
- imagine.gsfc.nasa.gov/science/toolbox/emspectrum_observatories1.html
- nasa.gov/audience/forstudents/postsecondary/features/F_NASA_Great_Observatories_PS.html

DISCUSSION POINTS

- What are some scientific benefits and drawbacks of placing telescopes in space?
- Thousands of exo-planets have been discovered. What types of telescopes could be used to further our knowledge of these and why?
- Discuss why it's possible to see through vast volumes of dust and gas in space and yet Earth's atmosphere is opaque to most EM radiation

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ACTIVITY

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THE INVISIBLE SKY

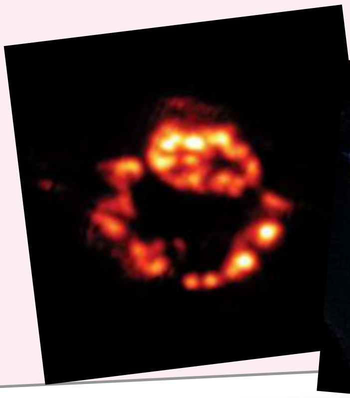
ACTIVITY ONE

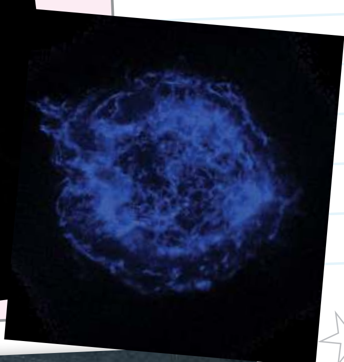
MULTI-WAVELENGTH BINGO

Played like real Bingo this game is designed for six players (or pairs of players) plus one caller. Lots of fun, the game utilises flash cards showing four images each of six well known deep space objects. Students will note how different each object's four images look from one another having been taken in different bands of the EM spectrum! Information about each object is also displayed in the flashcards.

Access the full Bingo instructions, calling cards, flash cards and multiple bingo boards here – chandra.harvard.edu/resources/handouts/constellations/activities/bingo.pdf

The images are courtesy of NASA's great observatories CGRO, Chandra, Hubble Space Telescope, Spitzer and more!





Cassiopeia A. ABOVE: Composite, RIGHT: Infrared, FAR RIGHT: Xray. Students will get familiar with how objects can look very different dependant on which band of the EM spectrum they were taken in.

ACTIVITY TWO ADVANCED

BUILD A SATELLITE MISSION

WHAT YOU'LL NEED:

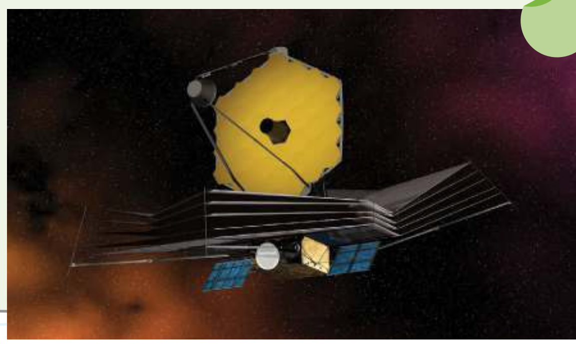
- Access to an online device and Flash 9 or higher.

WHAT TO DO:

Students choose what science their satellite will study then decide what wavelengths, instruments, and optics will help them achieve the best outcomes. In the process, they'll learn about real missions including those that might have collected similar data to their own.

They can then report on their decisions and findings.

https://www.jwst.nasa.gov/build.html



Credit: ESA

ACTIVITY THREE

If you've ever wanted X-ray spec's or super-human vision Chromoscope can get you there! This is a fun online activity.

http://www.chromoscope.net

TAKE A PHOTO OF YOUR ACTIVITY AND SEND IT TO US. WE'D LOVE TO SEE IT! EDUCATION@STARDOME.ORG.NZ

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