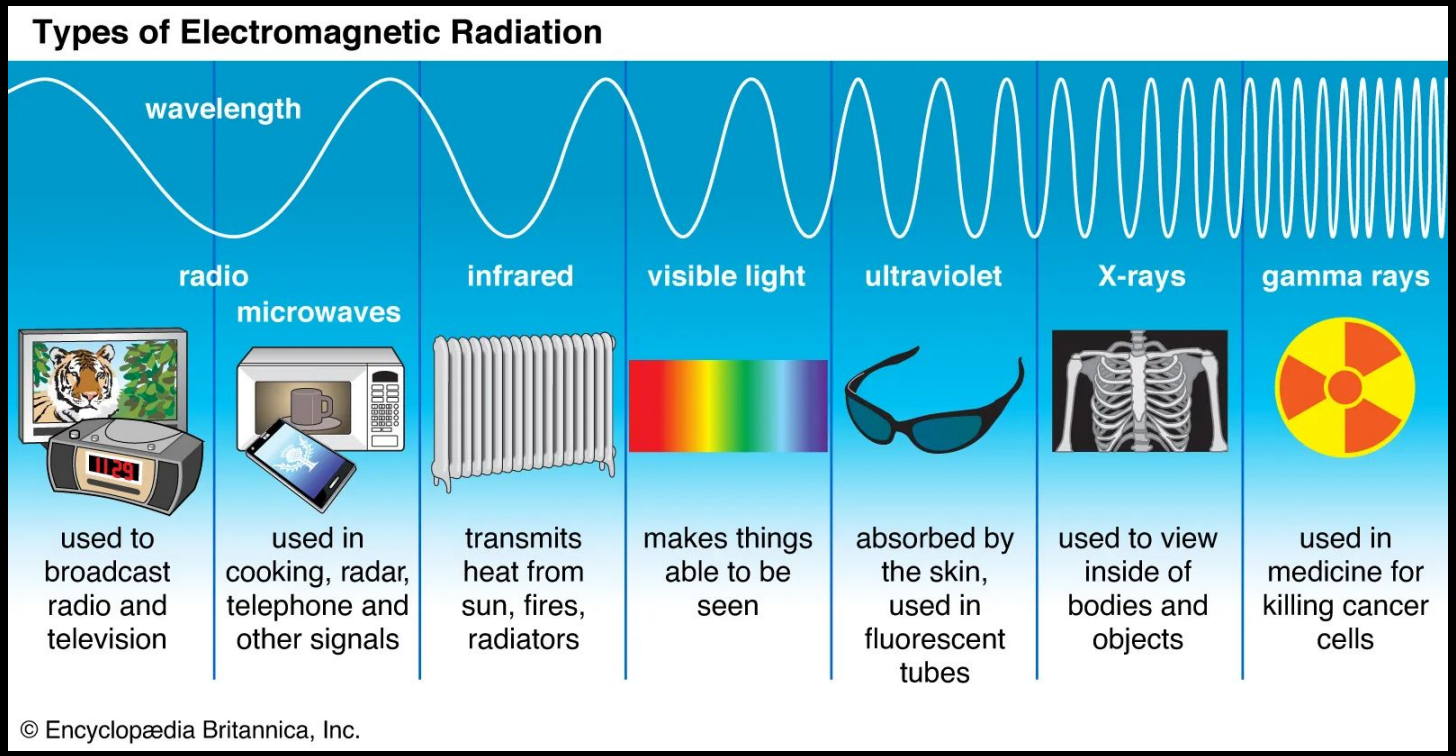
Telescopes

Let There Be Electromagnetic Radiation…

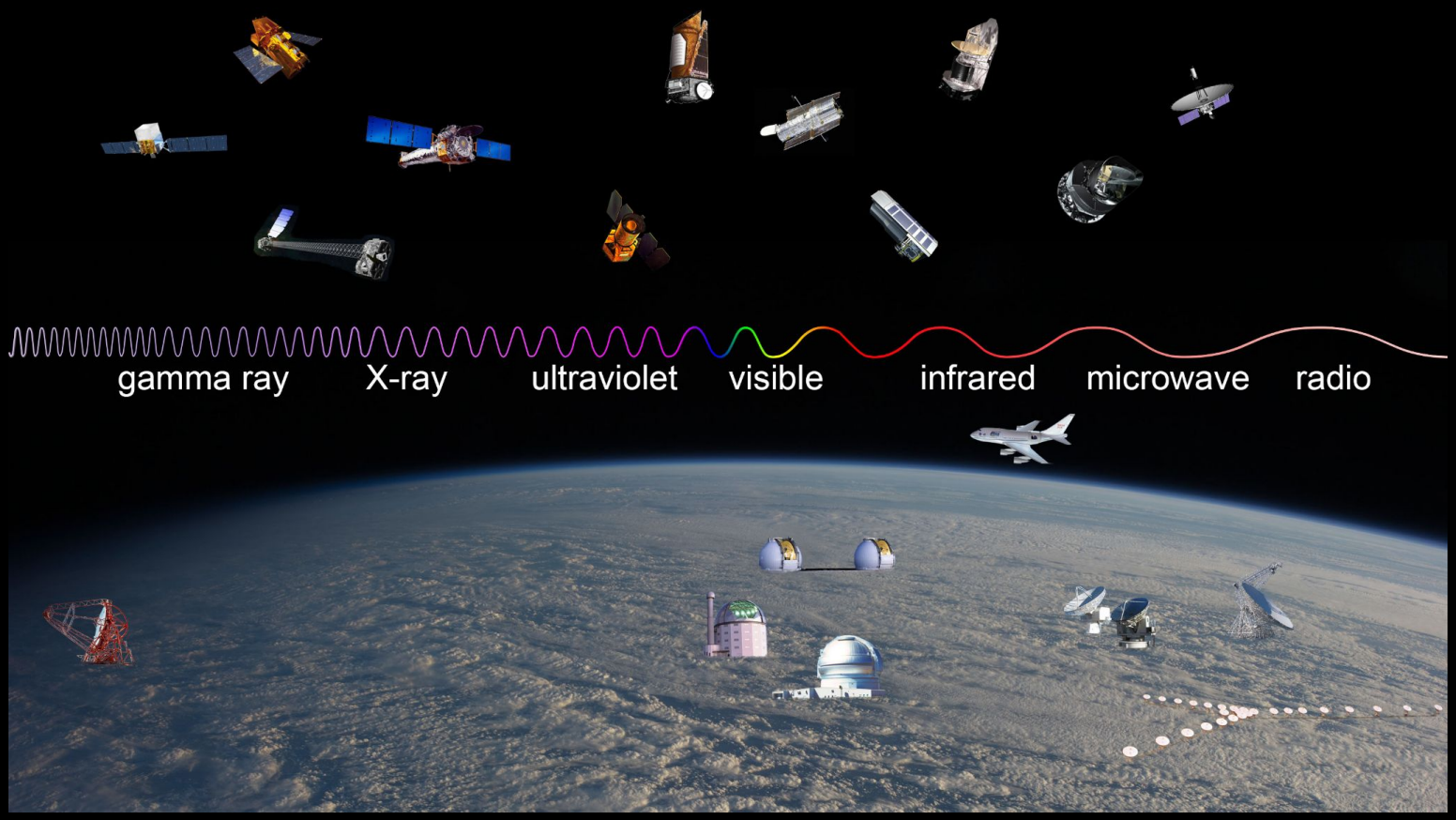
Light is one form of electromagnetic radiation. Scientists refer to the light we see with our eyes “visible light.” The range is known as a spectrum. The electromagnetic spectrum includes the entire range of radio waves, microwaves infrared, visible light, ultraviolet radiation, X-rays, and gamma rays.



Source: https://www.britannica.com/science/electromagnetic-spectrum

What ARE telescopes?

Telescopes are instruments that collect and focus forms of electromagnetic radiation.

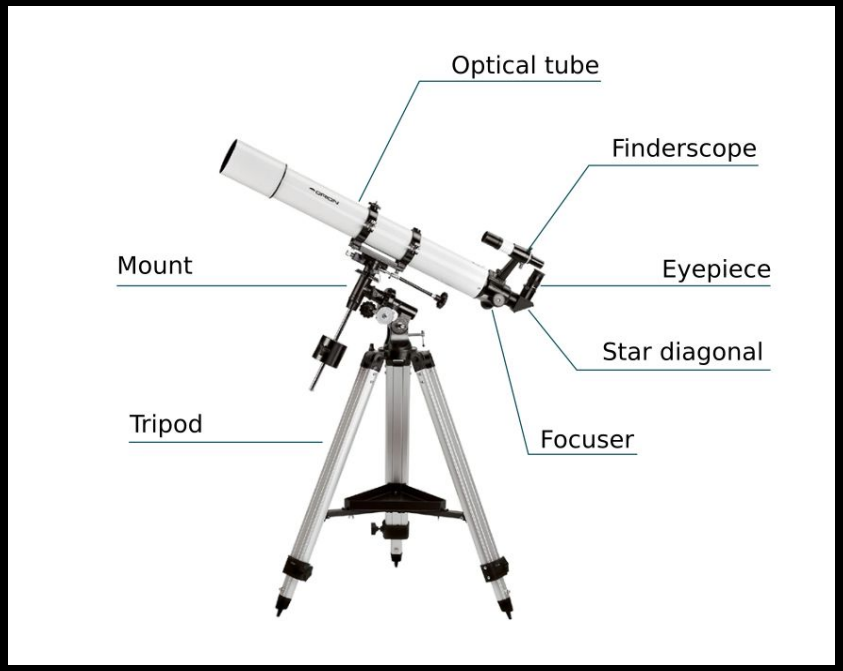


Source: https://imagine.gsfc.nasa.gov/Images/science/observatories_across_spectrum_full.jpg?fbclid=IwAR0PuUBZ2OUG55kg1TEBocZ0TwN5hUbj7GvOWLd-LqHH0CeDkWFxS2qIsz0

Optical Telescopes

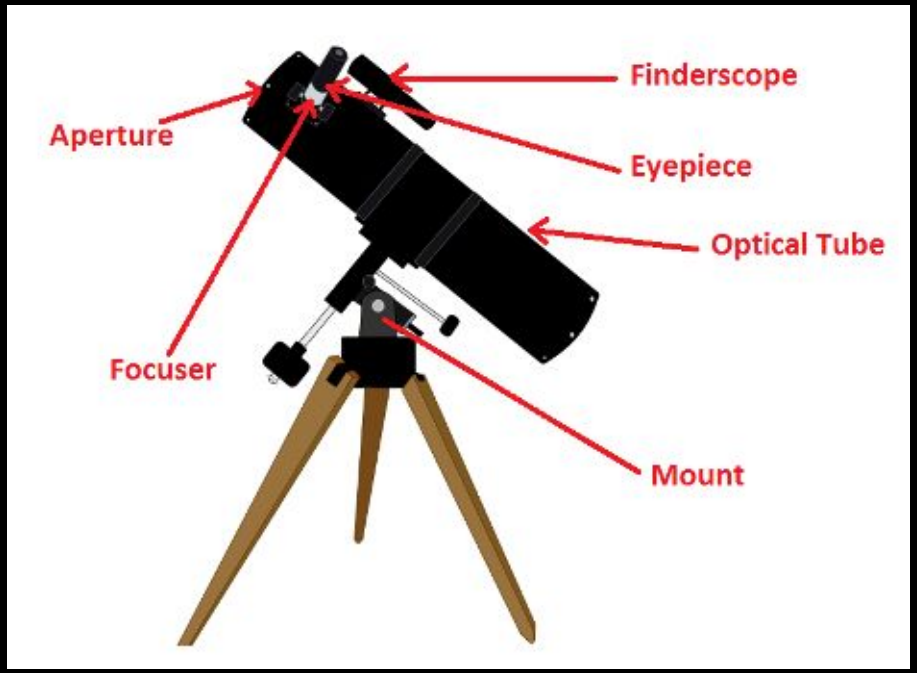
A telescope that uses lenses or mirrors to collect and focus visible light is called an optical telescope.

The two major types of optical telescopes are refracting telescopes and reflecting telescopes.



Refractor Telescope

Source: https://nightskygazing.com/parts-of-telescope



Reflector Telescope

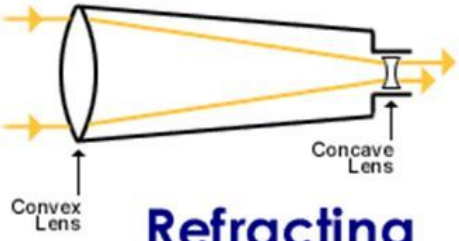
Source: https://study.com/academy/lesson/refracting-telescope-definition-parts-facts.html

Optical Telescopes (Cont'd)

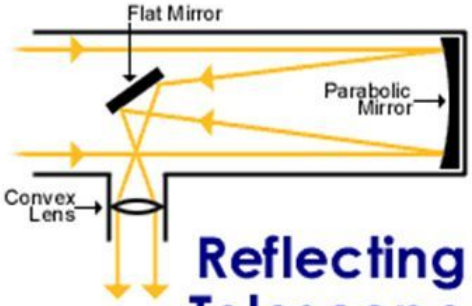
Two Basic Telescope Designs

- Refractors
  - Use lenses to concentrate incoming light at a focus.
- Reflectors
  - Use mirrors to concentrate incoming light at a focus.

The goal is always the same – gather as much light as possible and concentrate it at a focus.



Refracting Telescope



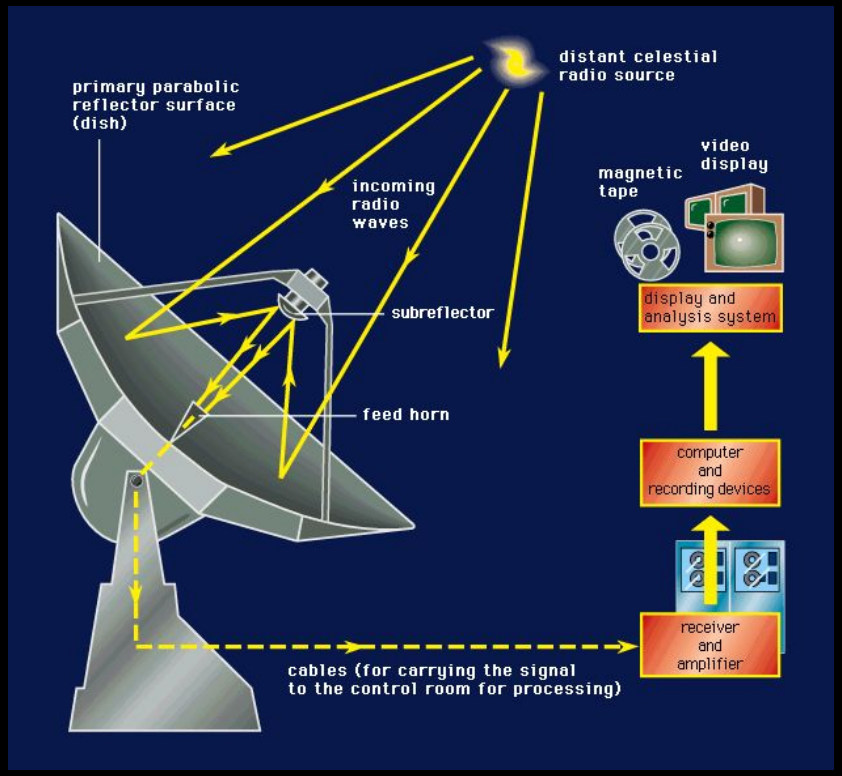
Reflecting Telescope

Source: https://images.slideplayer.com/24/7484189/slides/slide_3.jpg

Radio Telescopes

Telescopes that detect radio waves from space are called **radio** telescopes. Typical radio telescopes have a parabolic reflecting surface commonly referred to as a “dish.” Unlike most optical telescopes, radio telescopes may be used during the day or night. They may also be used when the sky is cloudy because radio waves pass through clouds.

Source: https://www.collinsdictionary.com/dictionary/english/radio-telescope



Source: http://abyss.uoregon.edu/~js/glossary/radio_telescope.html

Shared/Remote Telescopes

https://www.sierra-remote.com/

Sierra Remote Observatories

Telescope Hosting for Remote Astronomical Imaging, Data Acquisition, Satellite Tracking and Space Communications

Site Updates:

January 2022: SRO Newsletter

SRO Virtual Astrophotographer

Introductory Video of SRO

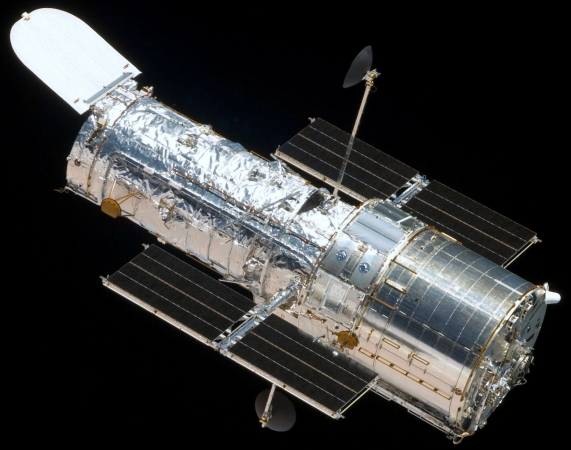
Buildings 13 & 14

Break Room Construction

Space Telescopes

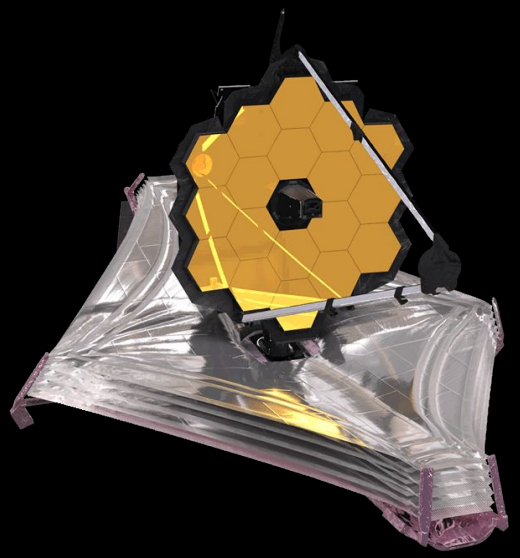
A majority of ultraviolet radiation, x-rays, and gamma rays are blocked by Earth's atmosphere. To detect electromagnetic radiation in these wavelengths, astronomers use spaceborne telescopes like the Hubble Space Telescope (HST), and the James Webb Space Telescope (JWST).

By placing telescopes in space, astronomers get a more clear picture of the universe.



Hubble Space Telescope (HST)

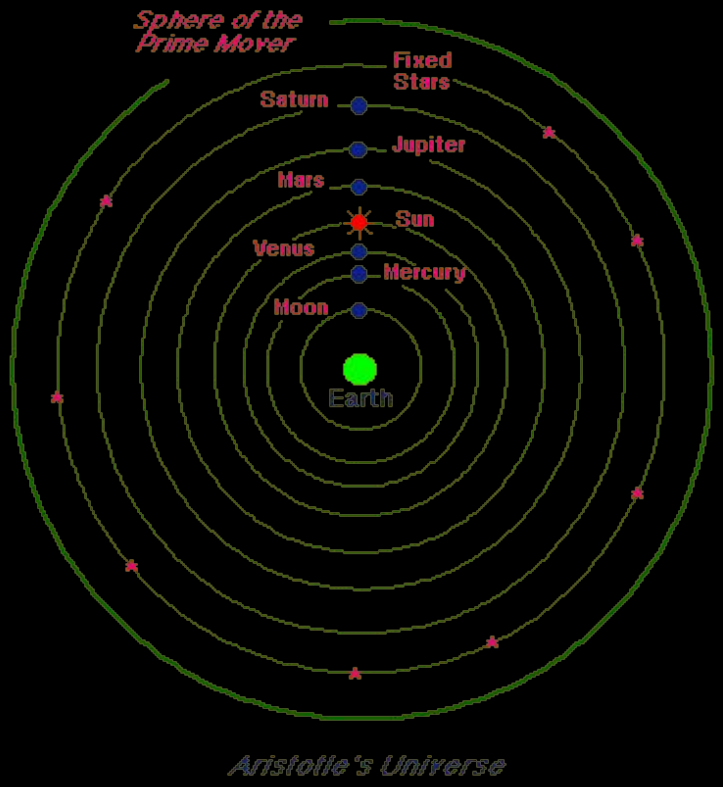
Source: https://en.wikipedia.org/wiki/Hubble_Space_Telescope

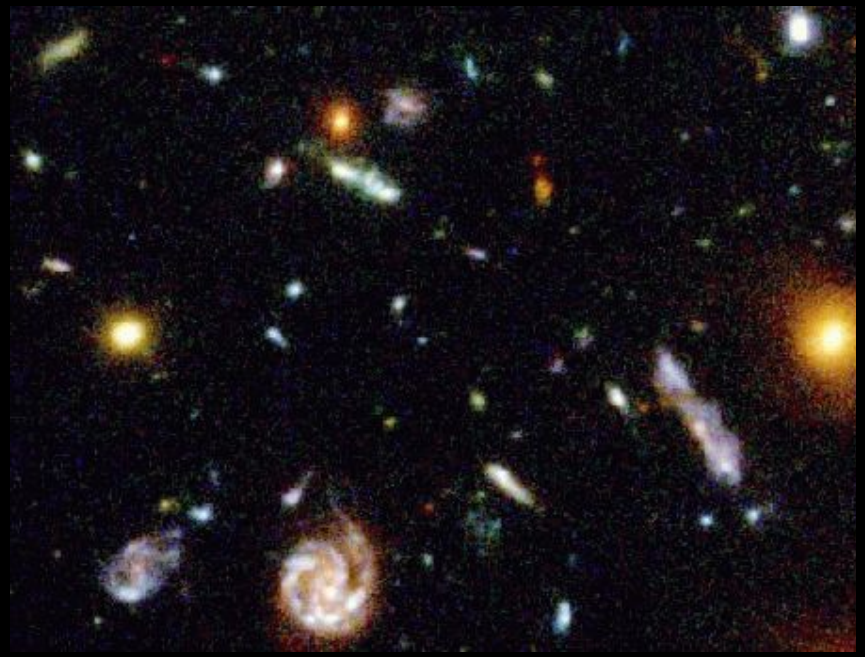


James Webb Space Telescope (JWST)

Source: https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

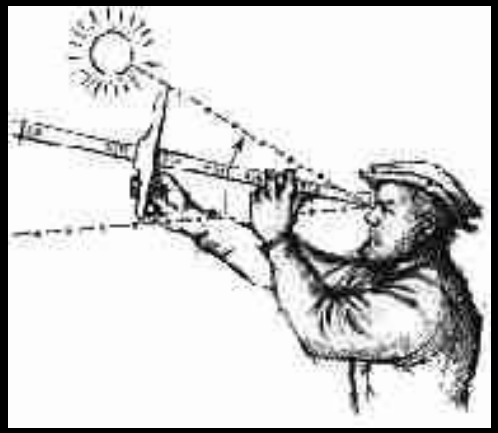
Telescopes Changed Our Understanding of the Universe…





STScI and NASA

Before Telescopes…



… We only had our eyes . . .

and a variety of measuring instruments.

We also had many questions…

Is Earth the center of the universe?

How far away are the stars?

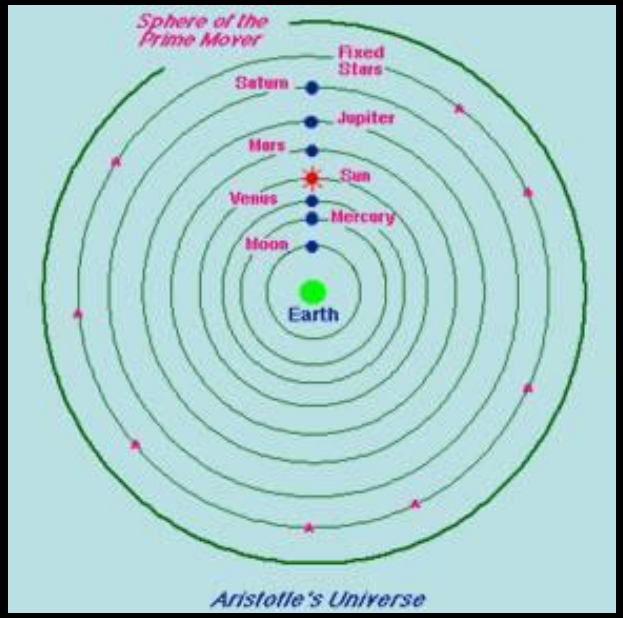
Is there more than one galaxy?

Are there other planets outside of our solar system?

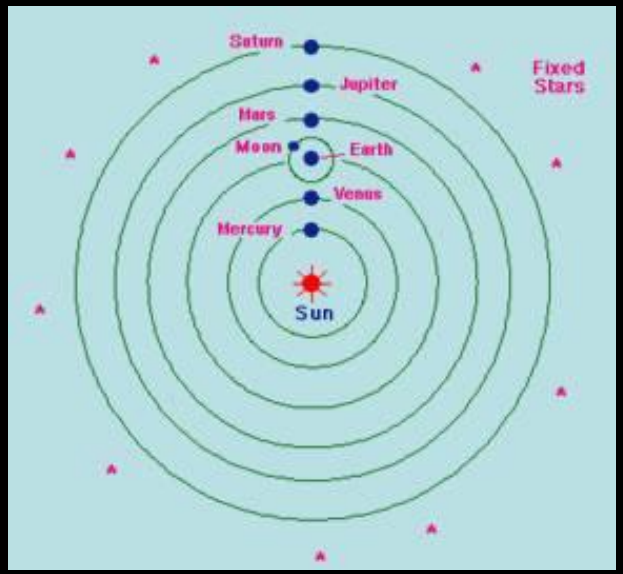
Question 1: Is Earth or Sun at the center?

Is Earth the center of the universe?

Aristotle said "Earth"



Copernicus said "Sun"



Question 2: How far away are the stars?

How far away are the stars?

M34 image courtesy of Glenn Spielgelman

Light Years!

Light minute: a unit of astronomical distance equivalent to the distance that light travels in one minute, which is 1.799×107 km (11,187,000 miles)

Light year: a unit of astronomical distance equivalent to the distance that light travels in one year, which is 9.4607 × 1012 km (nearly 6 trillion miles)

Moon: about 1.3 light-seconds from Earth (avg 238,855 miles)

Sun (Our Star): a little more than 8 light-minutes from Earth (93 million miles)

Polaris (North Star): 443 light-years from Earth (2,545,444,786,588,502 miles)

M51 courtesy of M. Harms

M31 - Andromeda courtesy of G. Spielgelman

Question 3: One Galaxy or Many?

Is there more than one galaxy?

NGC 1232 courtesy of M. Harms

Hubble Ultra-Deep Field

Source: https://en.wikipedia.org/wiki/Hubble_Ultra-Deep_Field

Question 4: Are there other planets?

In our own solar system, telescopes found planets our eyes could not see.

Are there other planets outside of our solar system?

Herschel's telescope -- used to discover Uranus in 1781

William Herschel

90377 Sedna

90377 Sedna (via HST)

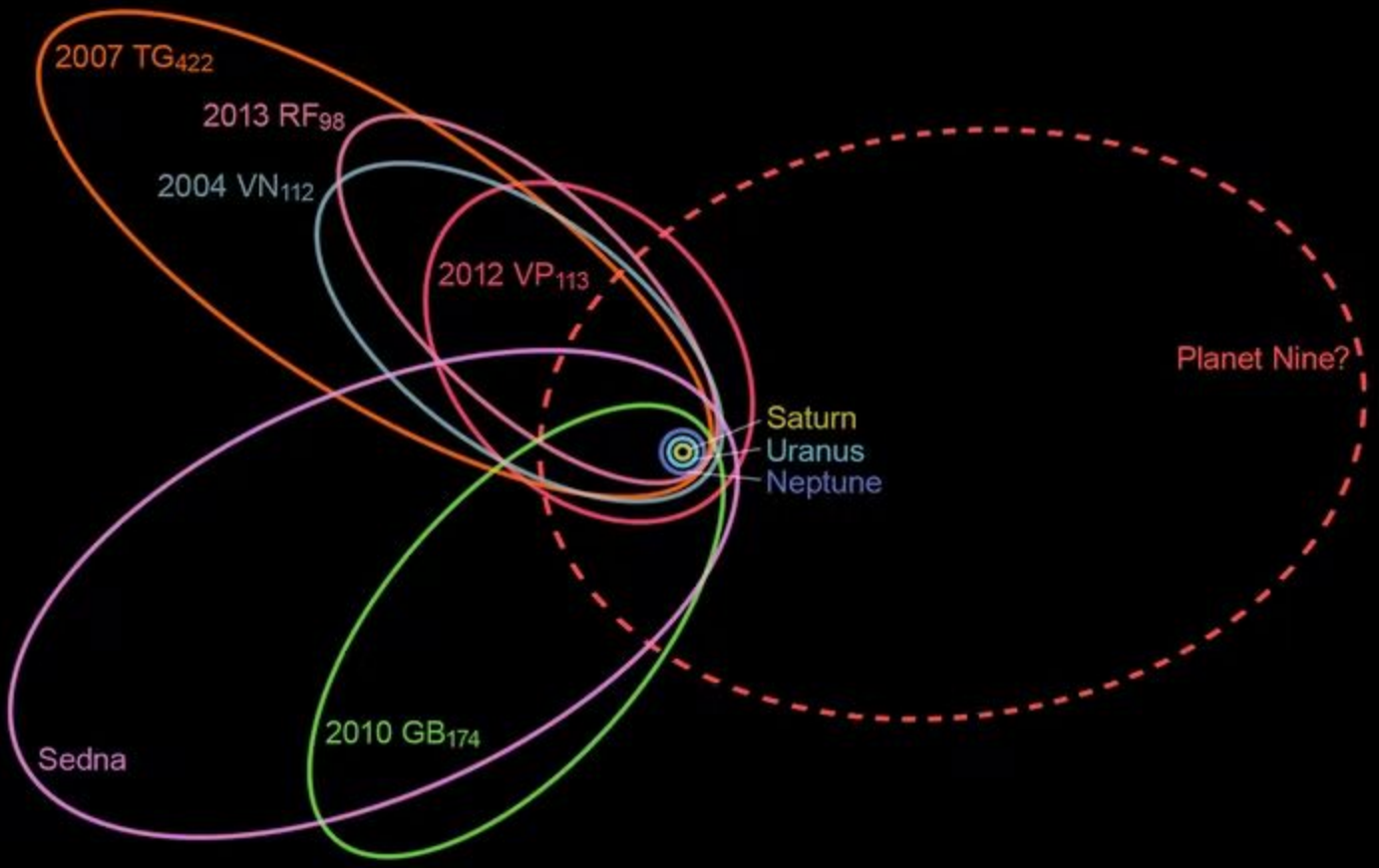
Source: https://en.wikipedia.org/wiki/90377_Sedna

Sedna *(minor-planet designation 90377 Sedna)* is a dwarf planet in the outer reaches of the Solar System that is currently in the innermost part of its orbit; as of 2021 it is 84 astronomical units (1.26 ×10^10 km) from the Sun, almost three times farther than Neptune.

Sedna's orbital period is 11,408 years

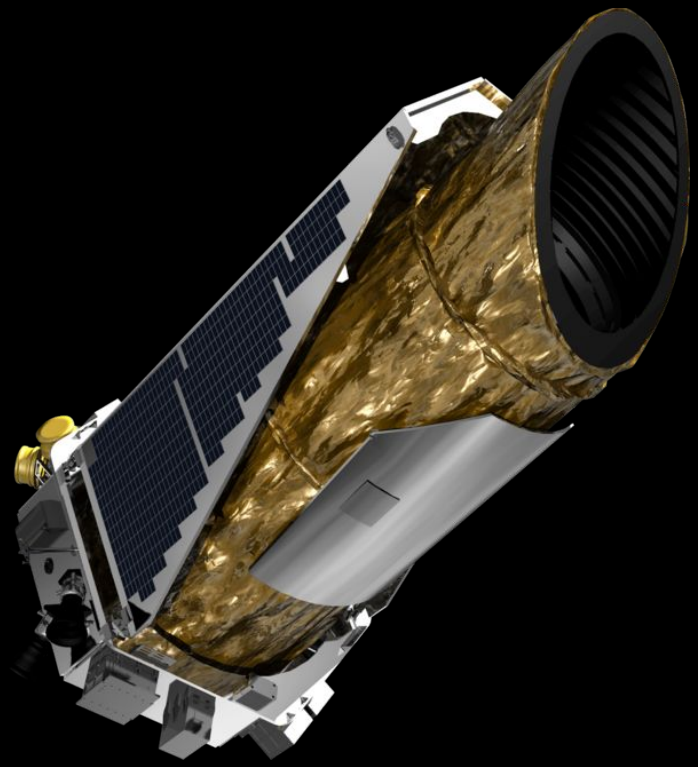
Planet Nine

Scientists believe that Planet Nine is comparable in mass to Neptune, moving on a highly eccentric orbit, with a period of around 15,000 years. Batygin and Brown are using the Subaru Telescope in Hawaii's Mauna Kea Observatory to find it.



Source: https://images.theconversation.com/files/239129/original/file-20181003-52688-mby0m1.png

Kepler Space Telescope

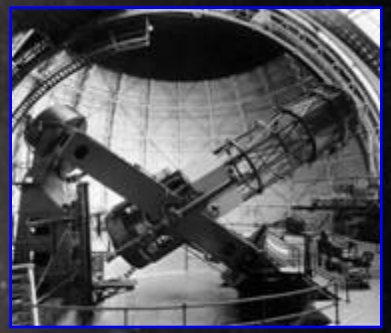


Kepler Space Telescope (KST)

Source: https://en.wikipedia.org/wiki/Kepler_space_telescope

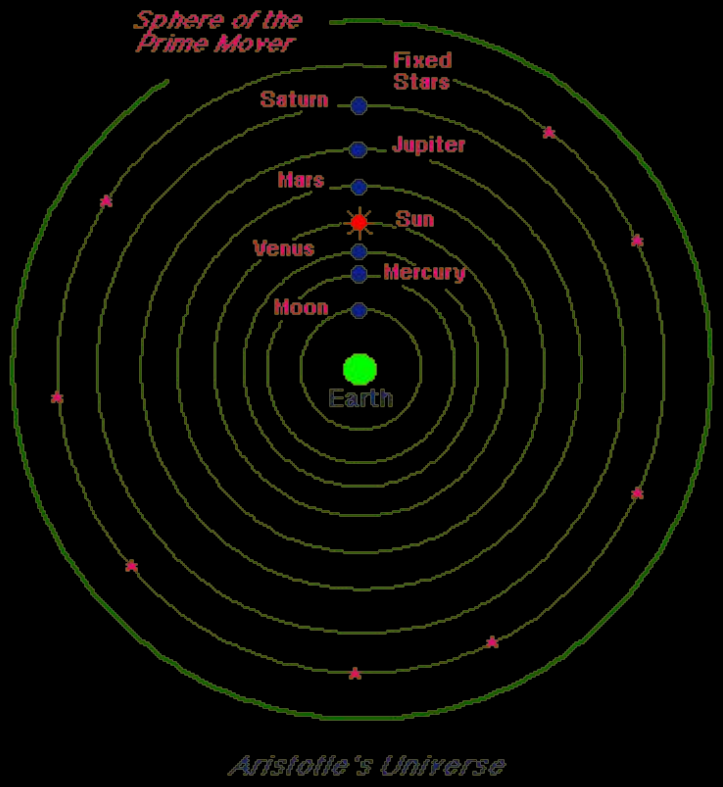
The Kepler space telescope is a retired space telescope launched by NASA in 2009 to discover Earth-size planets orbiting other stars. Named after astronomer Johannes Kepler, the spacecraft was launched into an Earth-trailing heliocentric orbit. The principal investigator was William J. Borucki.

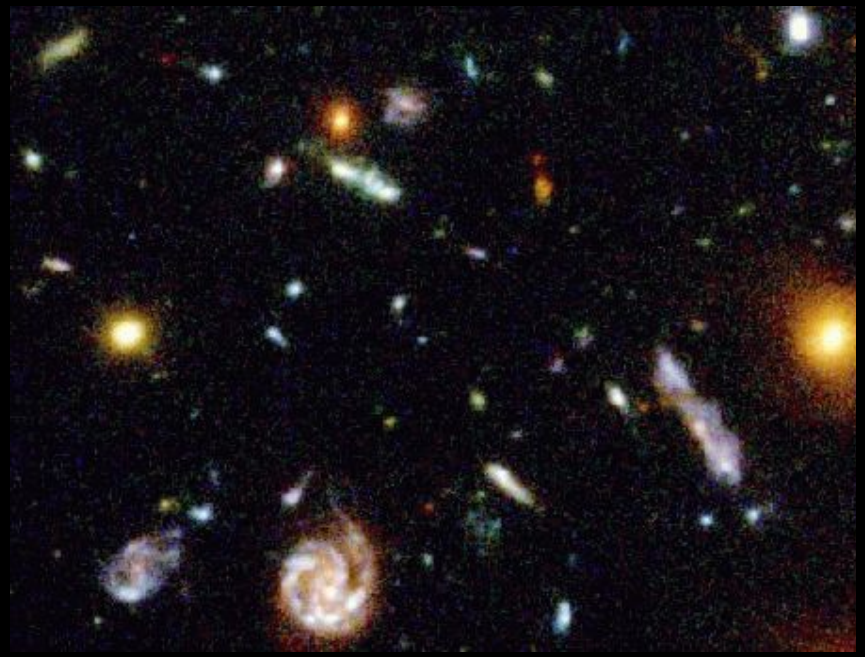
Telescopes have changed our understanding of the universe …



… and they are still changing our understanding of our place in the universe!

From the center of the universe…





… to a very small planet in an immense expanding universe

And the more we learn, the more questions emerge!

What is beyond Pluto in our Solar System?

How do stars and planets form?

Why are there black holes in the center of galaxies?

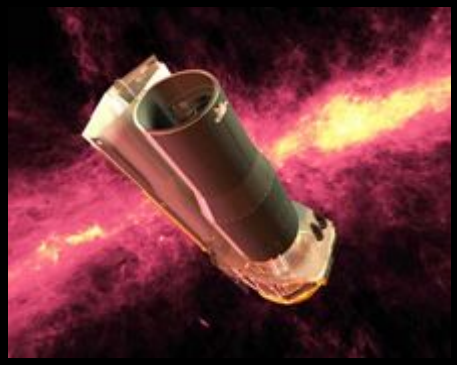
How did galaxies form?

Why is space expanding?

Do other planets harbor life ?

Telescopes will continue to expand our understanding of our universe.

Chandra Illustration: CXC/NGST



Spitzer Credit: NASA/JPL-Caltech

Arecibo Image Courtesy of the NAIC

Keck Image courtesy of NASA/JPL/Caltech

GLAST Credit: General Dynamics C4 Systems

Tomorrow Morning…

Not since 1864, and not again until 2040!

Source: https://www.space.com/rare-planetary-alignment-moon-joins-June-2022