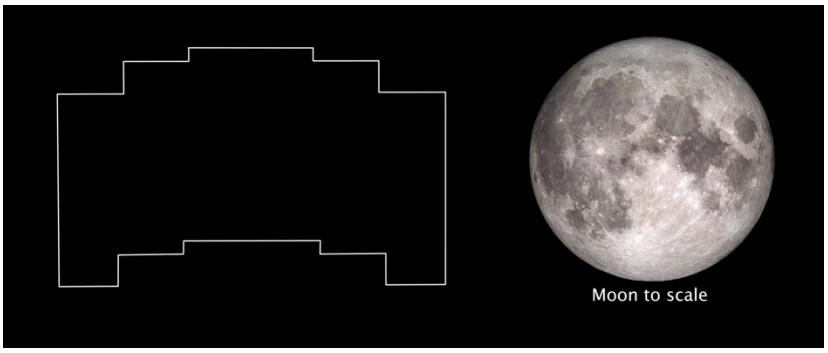
ROMAN SPACE TELESCOPE

Activity Guide

Fields of View: Tube “Telescopes”

OVERVIEW

In this activity, participants compare and contrast the fields of view of the Hubble Space Telescope and the Roman Space Telescope, using the apparent size of the Moon in the sky for comparison. This is meant to be a visual, interactive way for learners to experience the differences for themselves.



Field of view of the Roman Space Telescope compared to the apparent size of the Moon on the sky.

LEARNING CONCEPTS

Participants will learn that:

- Telescopes have different fields of view
- Different telescopes collect data in different ways
- Telescopes can see only a small portion of the night sky

PARTICIPANTS

- Families and other mixed-age groups
- Children with fine motor skills

ACTIVITY TYPE

10 to 20 minutes

PREPARATION TIME

10 to 20 minutes

ACTIVITY TIME

5 to 10 minutes

MATERIALS COST

$5 to $30

The Nancy Grace Roman Space Telescope is managed at NASA’s Goddard Space Flight Center in Greenbelt, Maryland, with participation by NASA’s Jet Propulsion Laboratory in Southern California; Caltech/IPAC in Pasadena, California; the Space Telescope Science Institute in Baltimore, Maryland; and a science team comprising scientists from various research institutions. The primary industrial partners are BAE Systems, Inc. in Boulder, Colorado; L3Harris Technologies in Melbourne, Florida; and Teledyne Scientific & Imaging in Thousand Oaks, California.

Activity developed by the Space Telescope Science Institute's Office of Public Outreach

MATERIALS

Amount	Material	Notes
3	Paper towel tubes	“Telescopes” to look through in order to compare fields of view
1	Tube Ends page	To print on clear label paper, or to print on regular paper if using plastic wrap instead of labels
1 sheet (8½ × 11)	Clear label or plain paper	To print tube ends on, cut up, and then stick to the end of the paper towel tubes
1 pair	Scissors	To cut out tube ends from label or paper
1 roll	Clear plastic wrap	To use as an alternative to the clear labels, to hold the tube ends to the paper towel tubes.
1 roll	Tape	To secure labels or plastic to the ends of the tubes

PREPARATION

To prepare the tubes for viewing, two options are described below: Using Clear Labels and Using Plastic Wrap.

USING CLEAR LABELS

1. Print the Tube Ends on one clear label sheet.
2. Cut out each of the three tube ends (Moon, Hubble Space Telescope, and Roman Space Telescope) so that you have one for each tube.
3. Place a label over the end of each tube, pressing the tabs down on the sides to secure it.
4. Using the tape, further secure each tube end to the paper towel tube. Be sure not to tape over the end of the tube.
5. Label each tube with the appropriate field of view: Moon, Hubble Space Telescope, or Roman Space Telescope.

Example of the finished ends of the tubes. From left to right: Moon, Hubble Space Telescope field of view, Roman Space Telescope field of view.

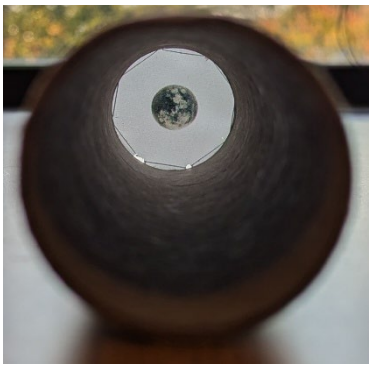
USING PLASTIC WRAP

1. Cut three squares of plastic wrap, each 3 inches by 3 inches.
2. Print the Tube Ends on a sheet of regular paper.
3. From each Tube End, cut out:
   - The Moon
   - The small white square of the Hubble Space Telescope field of view
   - The detector shape of the Roman Space Telescope field of view
4. In the center of each piece of plastic wrap, place one of the cut-out pieces. Press down or use a small amount of clear tape if the paper will not stick to the plastic wrap.
5. Place the plastic wrap with the paper facing into the tube over the end of the tube. Press the plastic wrap around the side of the tube to make the end taught.
6. Tape the plastic wrap down on to the tube as needed.
7. Label each tube with the appropriate field of view: Moon, Hubble Space Telescope, or Roman Space Telescope

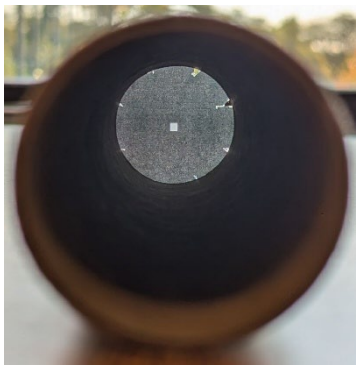
Note: The sizes of the Hubble and Roman fields of view relative to the Moon are roughly, but not precisely, to scale.

ACTIVITY GUIDELINES

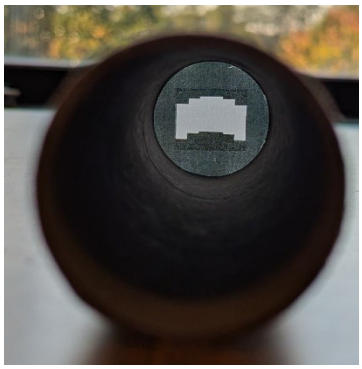
1. Allow time for learners to explore and look through each of the three tubes. Learners can look through the tubes in any order.
2. Ask the learners:
   - What are they seeing?
   - What ideas do they have?
   - What questions do they have?



View looking through the Moon tube



View through the Hubble Space Telescope field of view tube



View looking through the Roman Space Telescope field of view tube

3. Have the learners look through the "Moon" tube. Share with them that the size of Moon they are seeing through the tube is roughly the same size that the Moon appears to be on the night sky. If the Moon is visible, have learners compare the size of the Moon in the tube with the actual Moon.
   Keep the Moon tube close by so that learners can return to it as they are comparing the Hubble and Roman fields of view to the apparent size of the Moon on the sky.

4. Have learners look through the Hubble Space Telescope field of view tube. When looking through this tube, ask them what they are seeing and what they are thinking. Some ideas may be:
   - This is a very small field of view.
   - It is much smaller than the Moon looks.
   - There is a lot that we cannot see in this field of view.
   - Why would it be so small? Why not make it bigger?
   - I can't see anything!

5. Have learners look through the Roman Space Telescope field of view tube. Ask what they are seeing and thinking. Some ideas may be:
   - This is much larger than the Hubble field of view.
   - This is about the same size as the Moon is on the sky.
   - Could we use Roman to take a picture of the whole Moon? (No. Although the Roman's field of view is big enough, the Moon is too bright for Roman's detectors.)

6. After looking through all three tubes, discuss the differences between the two fields of view:
    - You can see the big picture with the Roman field of view. Roman allows scientists to collect a lot of data at once and come back and do the same observation again over time to see how the universe is changing.
    - Hubble's field of view is much smaller. It is designed to focus on very specific spots in space. Although Hubble can't capture as much of the sky in one image, it has other advantages. For example, Hubble can detect ultraviolet light, visible light, and near-infrared light. It can also track objects as they move across the sky. This is very important when observing planets in our solar system.
    - Roman and Hubble work together to gain a full understanding of the universe through time and multiple wavelengths (different types of light).

FAQs

1. Why do different telescopes have different fields of view?
    - Each telescope has been built for specific scientific purposes, using the latest technology available. The field of view determines how much of an object or region of space the telescope can view at one time.
    - The Roman Space Telescope has a large field of view because it is a survey telescope. It is designed to collect data from large areas of the sky very quickly. This allows scientists to study many examples of stars, galaxies, and planets, and see how they relate to each other and their surroundings. A large field of view also makes it possible to survey the same areas of sky over and over to see how things change over time.
    - The unique shape of Roman's field of view has to do with its camera, the Wide Field Instrument (WFI). The WFI is made of 18 detectors that are arranged in an arch-shaped mosaic.
2. Will Roman look at the Moon or other objects in the solar system?
    - Roman will not look at the Moon, the Sun, or Earth because they are too bright. Roman's detectors are designed to map the fainter objects in the universe with the most sensitive near-infrared detectors ever put on a space telescope.
    - The field of view of Roman's WFI (its camera) is large enough to image an area the size of the full Moon. However, in a single shot there would be gaps in the image. This is because there are spaces (called chip gaps) between the 18 detectors that make up the WFI.
    - Roman is not designed to study planets and moons in our solar system, but it will be able to help us measure the sizes, shapes, and orbits of smaller objects like asteroids and comets.

BACKGROUND RESOURCES

Website: Roman Space Telescope at NASA Science

Presentation: Nancy Grace Roman Space Telescope, Expanding Our View

KEY VOCABULARY

Field of View

The area and shape of sky that a telescope can "see" at one time. Field of view is measured in square degrees, arcminutes, or arcseconds. To see an area the size and shape of the full Moon at once, a telescope would have to have a circular field of view about ½ degree across (an area of 0.2 square degrees).

Hubble Space Telescope

An orbiting telescope that collects visible, near-ultraviolet, and near-infrared light from celestial objects. The telescope's primary mirror is 7.9 feet (2.4 meters) wide. It completes one orbit around Earth about every 96 minutes and is powered by sunlight collected with its two solar arrays.

Roman Space Telescope

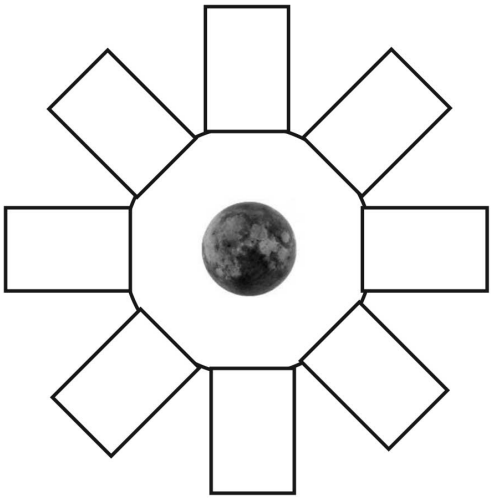
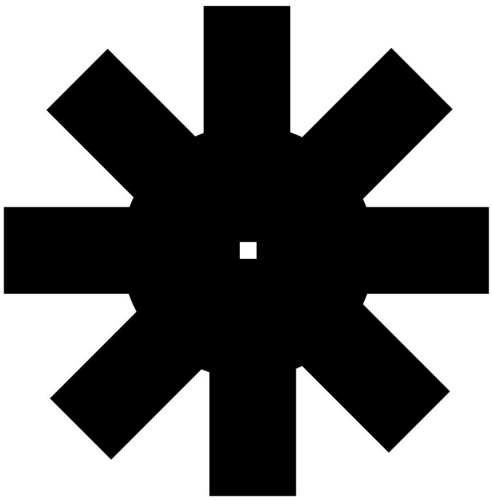
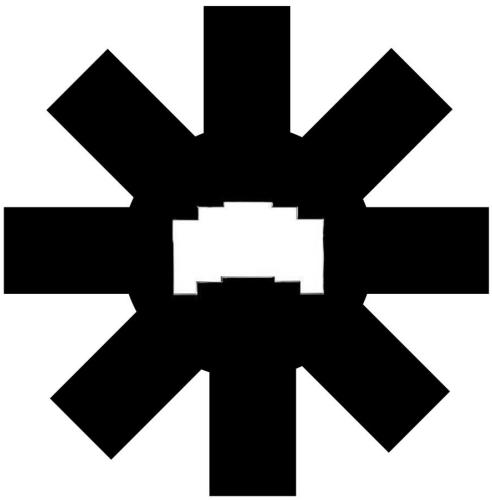
The Nancy Grace Roman Space Telescope is a near-infrared telescope with a 7.9-foot (2.4-meter) primary mirror. It will have the same infrared sensitivity and resolution as Hubble, but with a field of view 100 times greater than either Hubble or Webb. Slated to launch by May 2027, Roman is designed to revolutionize our understanding of dark energy, exoplanets, and general astrophysics by combining planned community surveys with additional surveys and archival research programs.

Originally called the Wide Field Infrared Survey Telescope (WFIRST), NASA renamed the telescope in honor of Dr. Nancy Grace Roman, NASA's first Chief of Astronomy, who paved the way for space telescopes focused on the broader universe.

Telescope

An instrument used to observe distant objects by collecting and focusing light (electromagnetic radiation) coming from them. Telescopes are typically designed to collect a specific type of light (light in a certain wavelength range). Examples include optical telescopes, which observe visible light (light that human eyes can detect), and radio telescopes, which detect radio waves.

TUBE ENDS

	The Moon
	The Hubble Space Telescope Field of View
	Roman Space Telescope Field of View