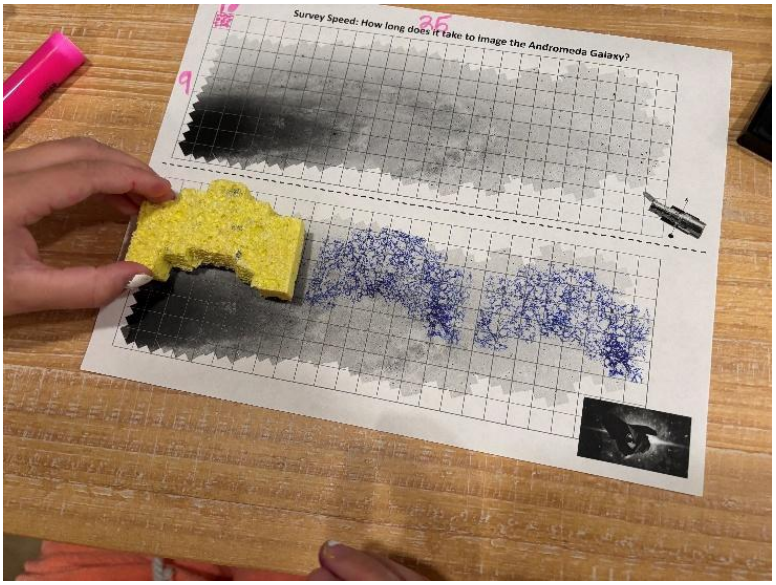
Activity Guide

Fields of View: Flip and Stamping

OVERVIEW

In this activity, participants investigate how a telescope's field of view (FOV) affects its efficiency and the science it can perform. This is meant to be a quick introduction to the Roman Space Telescope and its ability to collect large amounts of data relative to telescopes like Hubble and Webb, which are not designed for large surveys of the sky.



A participant uses a sponge to stamp Roman's field of view onto an image of the Andromeda Galaxy.

LEARNING CONCEPTS

Participants will learn that:

- Telescopes have different fields of view
- Different fields of view allow telescopes to collect data in different ways
- Some telescopes can see only a very small area of sky

PARTICIPANTS

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

ACTIVITY TYPE

Facilitated Activity

PREPARATION TIME

10 to 20 minutes

ACTIVITY TIME

10 to 20 minutes

MATERIALS COST

$40

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
Flip Activity		
1 set	Field of view Comparison Images	To print out on plain paper in order to compare fields of view
5 per set	Sheet protector	To hold the images being shown in different fields of view
1 per set	Binder ring	To hold the set of images in sheet protectors together
Stamping Activity		
1	Roman field of view Template	To print out on card stock and then cut out to use as a template for cutting the sponges
1 sheet	Card stock	To create templates for cutting Roman fields of view
1	Scissors and/or craft knife	To cut Roman Space Telescope field of view template from the card stock and to cut fields of view from the sponges (Facilitator use only)
1	Marker	To trace the Roman field of view onto the sponge
1 per person	Sponge	To cut into a stamp of the Roman field of view

MATERIALS (CONTINUED)

Amount	Material	Notes
1 per person or pair	Stamp pad	To cover the field of view sponge with ink • Other options include finger paint or markers. • Stamp pads are suggested here to limit the mess.
1 per person	Thick-tip highlighter or marker	To use as the Hubble Space Telescope field of view. • Any color can be used, but lighter colors or highlighters allow participants to see the image and what they are doing more easily.
1 set per person or pair	Roman field of view Worksheets (3)	To stamp with the sponge and highlighter
1 per table	Plastic tablecloth	Optional: To contain stamping mess

PREPARATION

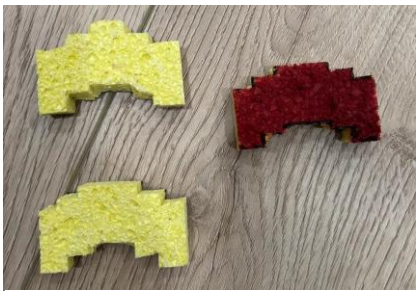
TO CREATE THE FIELD-OF-VIEW FLIP

1. Print the field of view Comparison Images with one image per page. You should have five sets of images, each set containing a small field of view and a 100× field of view.
2. Place one set of images in each sheet protector so that one side shows "field of view" and the other side shows "100× field of view."
3. Clip the sheet protectors together with the ring.

Five sets of small and large fields of view in sheet protectors

TO PREPARE STAMPING ACTIVITY

1. Print out the Roman field of view Template on card stock.
2. Cut out the template and then trace it onto a sponge using a marker.
3. Using the craft knife or scissors, cut out the shape of the Roman field of view.
4. Prepare a work area for the stamping. A table with a plastic tablecloth works well to contain the mess.
5. Print enough Roman field of view Worksheets for each participant to have one set.
6. Prepare stamp pads (or paint or markers) for use with the sponges.



Roman Space Telescope field of view cut out from sponges

ACTIVITY GUIDELINES

FIELD OF VIEW FLIP ENGAGEMENT ACTIVITY

This activity will help the audience understand the purpose of a field of view and the power of the Roman Space Telescope.

1. Start the activity by showing one of the small square pictures from the field of view Comparison Images that are labeled “Field of View.” Ask questions to encourage participants to think about what they can and can't see with this field of view.
   - What do you see here?
   - How do you know?
   - Where do you think this is?
   - What is going on around this picture?
   - What do you need in order to understand more? (See more of the image, larger field of view)
2. Flip the page over from “field of view” to the larger “100× field of view.” Ask the same questions as before, now with the learners seeing more of the image.
3. Repeat the same steps with the other images in the Image Set as appropriate.
4. Share with the learners in an appropriate way that:
   - Different telescopes have different fields of view
   - The size of the field of view determines the kind of science that can be done

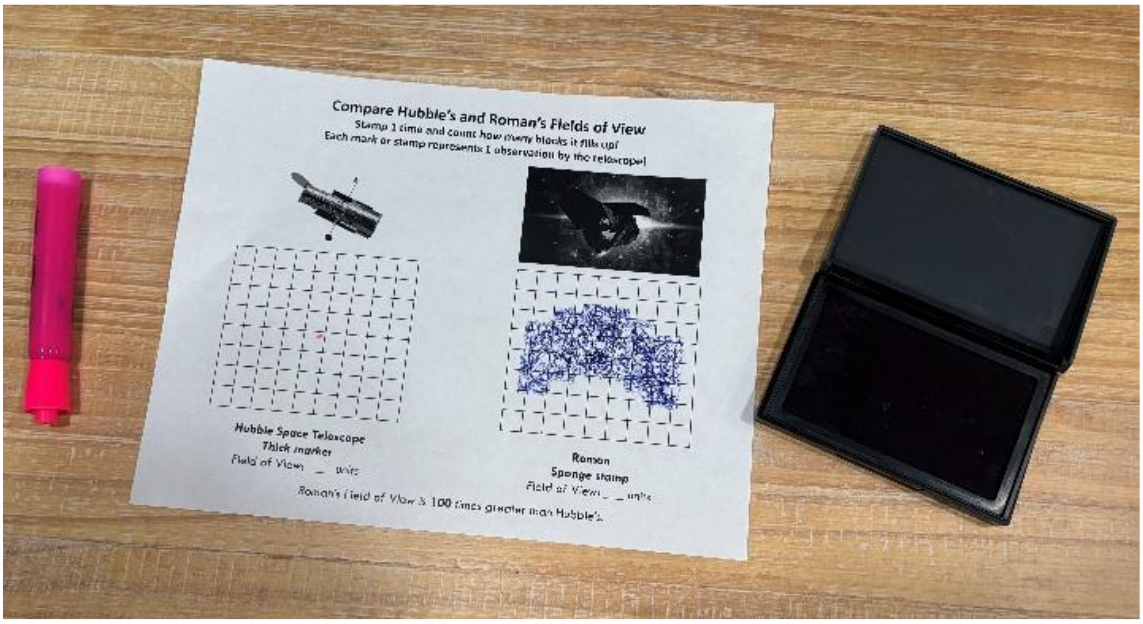
Field of View side of the Flip Pages

100× Field of View side of the Flip Pages

STAMPING ACTIVITY

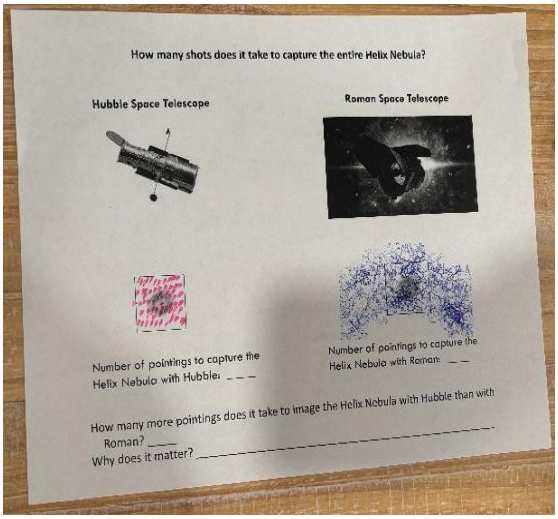
This activity is designed to help the audience understand how the Roman Space Telescope is a more efficient telescope than Hubble when it comes to surveying large areas of the sky.

1. Pass out Page 1 of the Roman field of view worksheets. Have participants use a highlighter to put one dot in the grid under "Hubble." Discuss with the audience:
   - Did the dot fill a whole square?
   - If not, how much do you estimate it filled? (The exact answer here is not essential; participants should just understand that it is a very small portion.)
2. Next, have participants use the Roman field of view sponge to stamp under the Roman grid.
   - About how many blocks did the stamp fill?
   - How does this field of view compare to Hubble's? (Roman covers a much larger area than Hubble.)



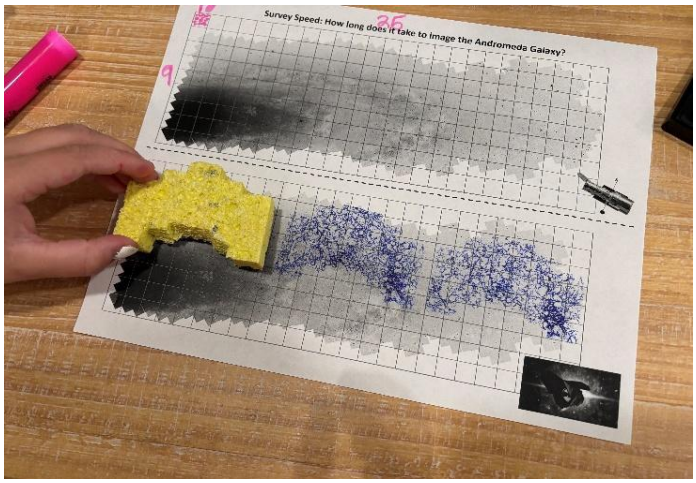
Roman Field-of-View Worksheet 1, demonstrating Steps 1 and 2. The pink dot represents Hubble's field of view. The blue shape is Roman's field of view.

3. Note that this is not a scientifically precise comparison. Make sure participants understand that Roman's field of view much larger (about 100 times) than Hubble's.
4. Pass out Roman Field-of-View Worksheet 2. Explain that on this page are two images of the Helix Nebula. Hubble has imaged this nebula, but needed multiple pointings (it needed to capture many separate images) to cover the full extent of the nebula.
5. Have participants use the highlighter to cover the whole Helix Nebula under Hubble with dots, counting as they go.
6. Have the participants use the sponge to cover the Helix Nebula under Roman.
   - How many more pointings does it take Hubble to cover the Helix Nebula than Roman?
   - Why does this matter? Why is this important for exploration?
7. Pass out Page 3 of the Roman field of view worksheet. Explain that the sheet shows two images of the Andromeda Galaxy.



Roman field of view worksheet 2 showing Steps 4-6, counting the number of pointings needed by each telescope to cover the entire Helix Nebula.

8. Have the participants estimate how many Hubble pointings it would take to cover the entire image.
    a. Count the number of squares along the top. (25)
    b. Count the number of squares along one side. (9)
    c. Multiply those two numbers together to get the total number of squares. (225)
    d. Have the participants cover one square with dots, counting as they go.
    e. Multiply that number by 225 to estimate how many Hubble pointings would be needed.
9. Have the participants use the sponge to estimate how many Roman pointings it would take to cover the entire image.
    - Participants may have questions such as: Can they overlap? What if I have places I didn't cover?



Roman field of view Worksheet 3 showing Steps 9, covering the Andromeda Galaxy with Roman fields of view.

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.
2. Why does Roman's field of view have that shape?
    - 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.

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 the entire 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 or Astronomy, who paved the way for space telescopes focused on the broader universe.

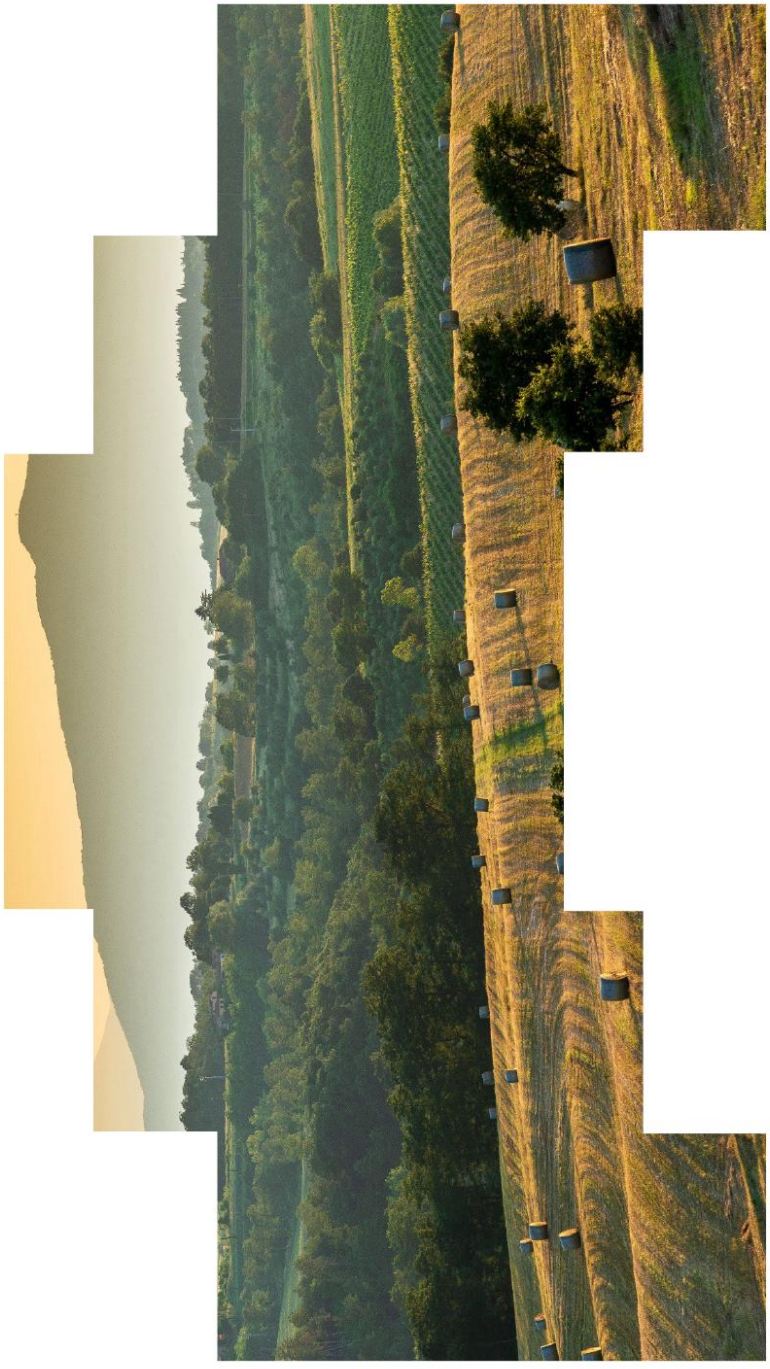
Telescope

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 that observe visible light (light that human eyes can detect) and radio telescopes, which detect radio waves.

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 1A

Field of View

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 1B



100× Field of View

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 2A

Field of View

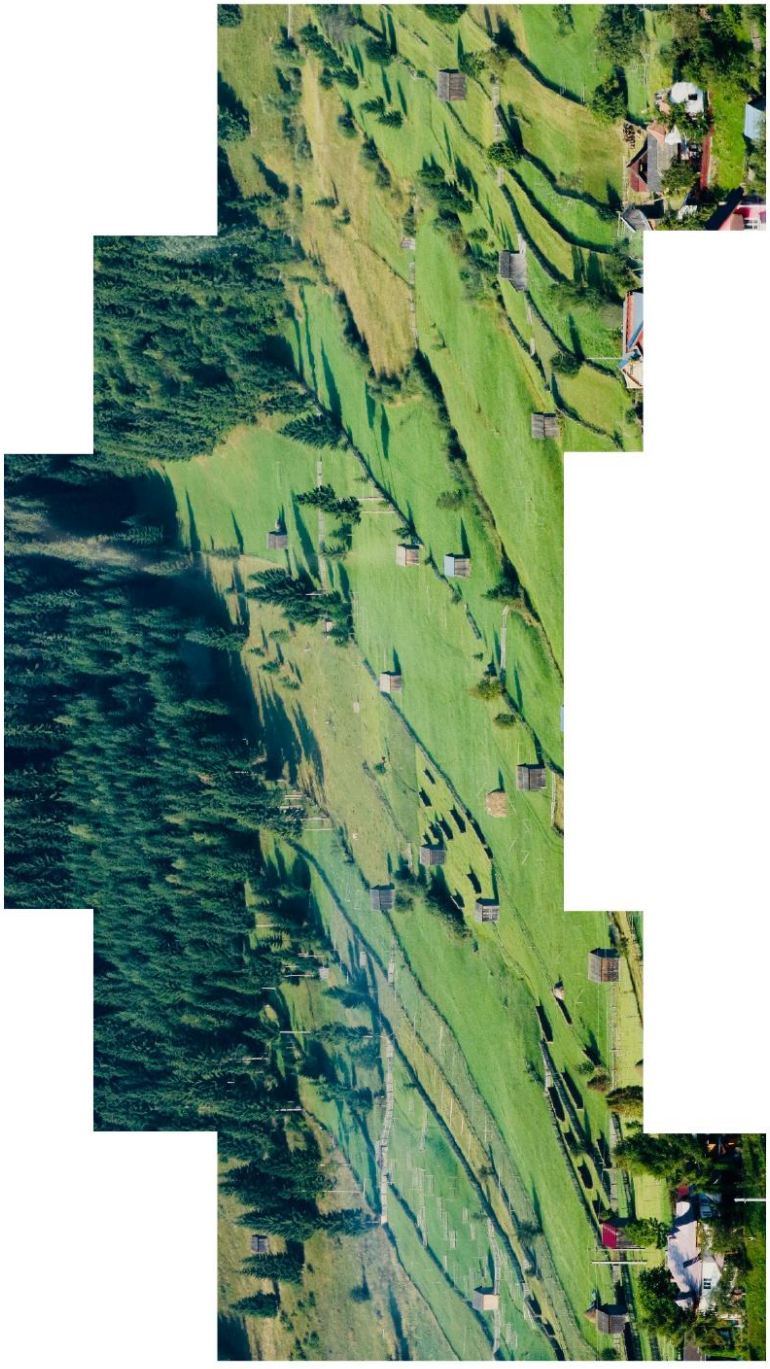
FIELDS OF VIEW: FLIP ACTIVITY IMAGE 2B

100× Field of View

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 3A

Field of View

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 3B



100× Field of View

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 4A

Field of View

FIELDS OF VIEW: FLIP ACTIVITY IMAGE 4B

100× Field of View

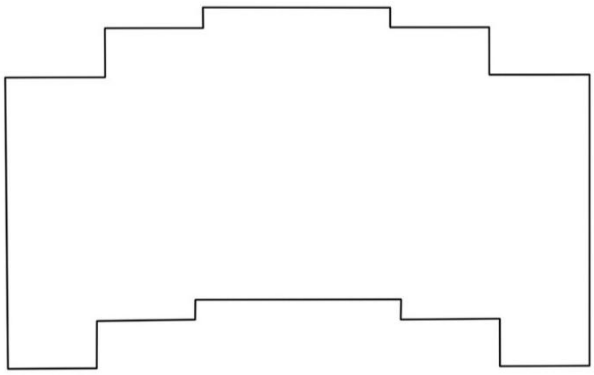
FIELDS OF VIEW: FLIP ACTIVITY IMAGE 5A

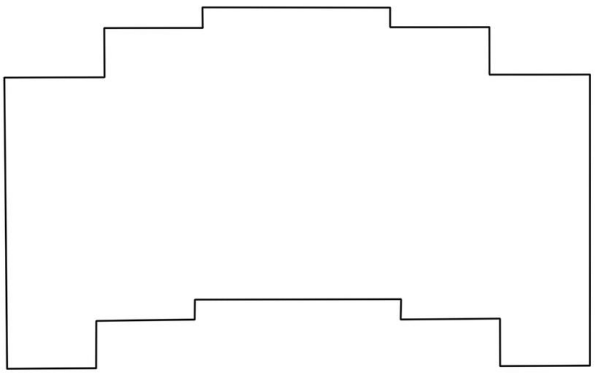
Field of View

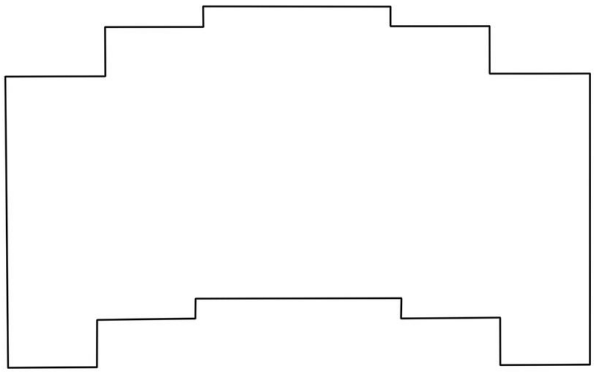
FIELDS OF VIEW: FLIP ACTIVITY IMAGE 5B

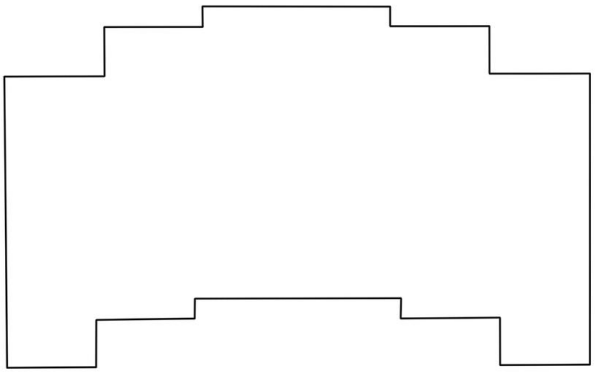
100× Field of View

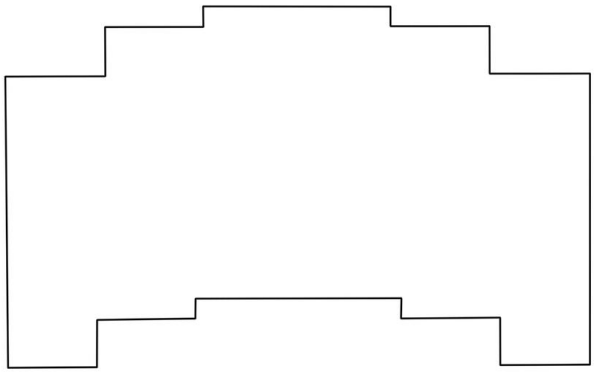
ROMAN FIELD OF VIEW STAMPING TEMPLATE

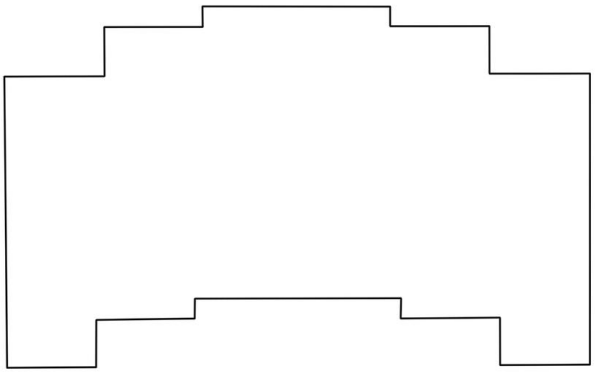






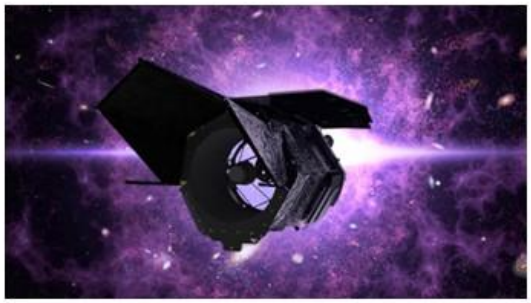


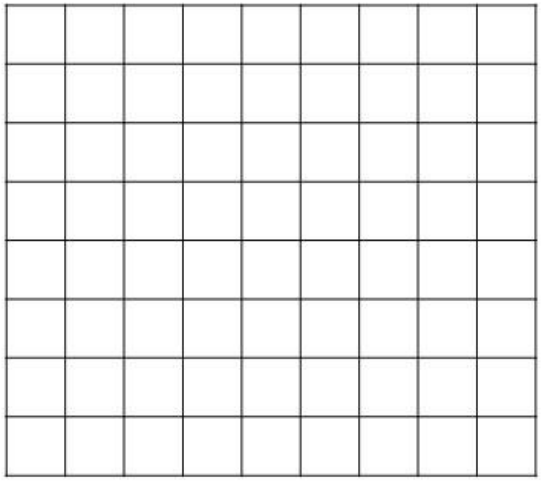


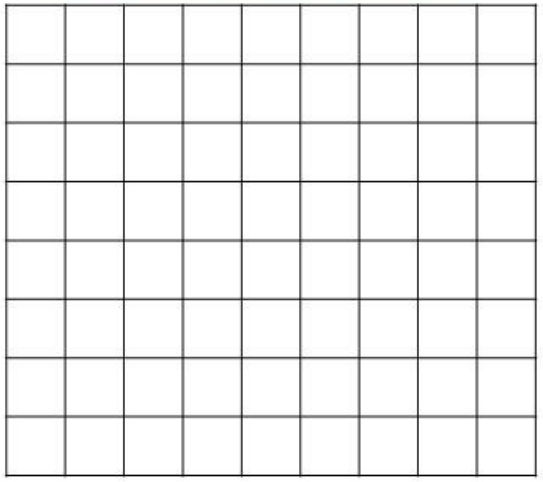


Compare Hubble's and Roman's Fields of View

Stamp 1 time and count how many blocks it fills up!
Each mark or stamp represents 1 observation by the telescope!







Hubble Space Telescope
Thick marker
Field of View: ____ units

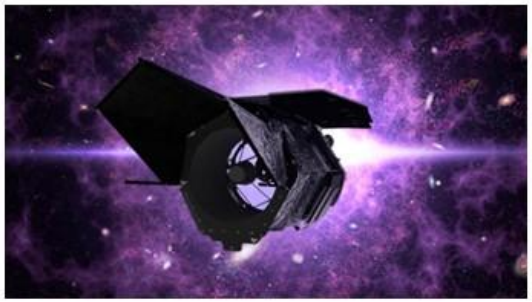
Roman
Sponge stamp
Field of View: ____ units

Roman's Field of View is **100** times greater than Hubble's.

How many shots does it take to capture the entire Helix Nebula?

Hubble Space Telescope

Roman Space Telescope



Number of pointings to capture the Helix Nebula with Hubble: _____

Number of pointings to capture the Helix Nebula with Roman: _____

How many more pointings does it take to image the Helix Nebula with Hubble than with Roman? _____

Why does it matter? _____

ROMAN FIELD OF VIEW WORKSHEET 3