

Hubble Telescope: Exploring Our Solar System



Lesson Overview:

This lesson looks at the Hubble telescope's missions. Students will explore data and information gathered by the Hubble telescope in order to describe how we can explore the solar system, galaxy and the universe. Students will start with exploring Hubble's current observations and work through an interactive timeline to observe Hubble's discoveries. Students will create a star chart to observe constellations as a STEM component.

Lesson Objectives:

Students will be able to understand the scale of objects in the universe. They also will be able to analyze pictures and data using the Hubble telescope data to understand how we can determine how our galaxy has formed. Students will be able to understand gravity's role in creating and maintaining our solar system. Students will develop a booklet showing Hubble's discoveries and what they mean to science. They will investigate the technologies on Hubble that allow it to explore our universe. They also have the opportunity to observe constellations in their own night sky and discuss their importance.

NGSS Standards:

ESS1.A: The Universe and Its Stars

- Patterns of the apparent motion of the sun, the moon, and stars in the sky can be observed, described, predicted, and explained with models. (MS-ESS1-1)
- Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe. (MS-ESS1-2)

ESS1.B: Earth and the Solar System

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them. (MS-ESS1-2),(MS-ESS1-3)
- The solar system appears to have formed from a disk of dust and gas, drawn together by gravity. (MS-ESS1-2)

Background Information:

Hubble "is the first major optical telescope to be placed in space" (About the Hubble Space Telescope, 2018). Scientists use Hubble to observe objects within our own solar system, and far

away galaxies. Multiple instruments and cameras were designed to fit into the telescope housing. The concept of conducting servicing missions to the satellite while in orbit was also a new idea. After the loss of the Challenger in 1986, upgrades were made to Hubble to ensure safety and longevity of the equipment. On April 24, 1990, the Hubble Space Telescope was launched into space aboard the Discovery, and released the next day into orbit. Hubble has been instrumental in broadening our view of the universe, and our place within it.

Materials:

Computers with internet for interactive timeline (There is a print version if needed here:

<https://www.nasa.gov/content/goddard/hubble-timeline-full-text>)

Paper or computers to complete student booklets.

Recommended sticky notes for Notice/Wonder or KWL charts

PDF printout of the Hubble Space Telescope's diagram. (A digital version could be created)

Rulers to measure the diagram.

Computers for 3D exploration of Hubble Space Telescope

Constellation Maps-printed copy

Extension:

Computer for web page or printout of Charles Messier

Paper for report/Social Media fake page

Computers to compare constellations

Craft supplies for STEM satellite design and build

Time Requirement: 8-15 days (dependant upon STEM builds and time for booklets)

Engage: 1 day

Explore: 4-7 days (dependant upon Booklet building time)

- Interactive Timeline
- Creation of booklets
- Exploring Hubble/ratios
- Constellations

Extend: 3-5 days (dependant upon STEM build)

Vocabulary/Key Words:

Satellite	Moon
Telescope	Sun
Galaxy	Universe
Solar System	Asteroid
Planet	Constellation
Orbit	Gravity

Engage:

Show students the "What is Hubble Looking at now?" link

<http://www.waterandclimatechange.eu/rainfall/average-monthly-1985-1999>

Have students fill out a KWL or Notice/Wonder chart. What do students notice about this

picture? (If filling out a KWL, they may have some background knowledge of what Hubble is) What do they wonder about the image? (Teacher's may guide wonders towards "How do they know this?" questions; but the goal is completely student led questioning). (A good way of recording these discussions are to have a board at the front and have students all add to each section with mini sticky notes.)

Explore:

Interactive Timeline: Students will observe Hubble discoveries through its interactive timeline. This timeline shows discoveries made by Hubble and important events, such as servicing, that keep Hubble productive today. Find the timeline here:

<https://www.nasa.gov/content/goddard/hubble-timeline-full-text>

Booklet Creation: Students will use the interactive timeline to create a "Highlights" booklet showing important discoveries and moments in Hubble's history. Emphasis is on our solar system to match with DCIs, but may include other exciting events. NASA has developed a booklet here:

https://www.nasa.gov/sites/default/files/atoms/files/highlights_of_hubbles_exploration_of_the_universe_0.pdf that students can reference. NASA also released an eBook called "Hubble Focus: Our Amazing Solar System" (http://hubblesite.org/video/1205/tonights_sky). Chapter 1 (pg 6-14) is all about Hubble's work investigating our solar system.

This would be a great literature component, as well as evidence for student observations in their booklets.

Students can use pictures from Hubble missions in the gallery

(https://www.nasa.gov/mission_pages/hubble/multimedia/index.html). (A digital version could be made by students who have access to computers.) **This component also meets the**

suggested ELA Connection:

- **SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ESS1-1), (MS-ESS1-2)**
- **RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS1-3)**

Exploring Hubble: After discovering some of the important work of the Hubble telescope, students could take a day to study how the Hubble works. A PDF diagram

(https://www.nasa.gov/mission_pages/hubble/spacecraft/index.html) is available as well as a list of fun facts that students could label

(https://www.nasa.gov/mission_pages/hubble/story/index.html). (A math component would be to measure the image and compare it to the measurement of the actual telescope, using ratios, to understand the scale of the telescope.

- **MP.2 Reason abstractly and quantitatively. (MS-ESS1-3)**
- **MP.4 Model with mathematics. (MS-ESS1-1),(MS-ESS1-2)**
- **6.RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS1-1), (MS-ESS1-2).(MS-ESS1-3)**
- **(ELA connection to RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed**

visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS1-3)

A 3D model that students can explore is located here:

https://www.spacetelescope.org/products/models3d/3dmodel_006/. This would be a great way to involve technology (they have a virtual reality version if there is a classroom with that technology).

Discussion about the technologies that the Hubble has in order to observe objects in our solar system as well as far away.

1. How do objects, such as Hubble, stay the perfect distance from Earth (orbit)? (Emphasis on Hubble staying in orbit due to gravity). Students could create a Claim-Evidence-Reasoning answer. (Citing textual evidence is an ELA standard)

Constellations STEM: After observing what Hubble discovered, as well as how it discovered these objects, students can create their own constellation map and see what constellations they can find at night (**Requires observation of the weather**). A downloadable map can be found here: <https://mrprintables.com/printable-constellation-map-summer.html>. A video provided from NASA called "Tonight's Sky" explains what constellations they should be able to see this month in the sky. http://hubblesite.org/video/1205/tonights_sky

Discussion over constellation importance. (CER format would meet SEPs as well as ELA citing evidence from text components). A resource students can use for importance is here <http://curious.astro.cornell.edu/about-us/117-the-universe/stars-and-star-clusters/constellations/375-what-are-constellations-used-for-intermediate>

Explain:

After completion of the activities, students should be able to explain the important events in their booklets. They should be able to understand how the Hubble has helped us understand our solar system, and universe, more extensively.

Mastery of content:

- Understand that we use these images to make predictions of future events.
- Understand that there are billions of galaxies in our universe, and the importance of understanding their structure and life cycle.
- Understand what our solar system consists of.
- Understand that by evaluating other similar galaxies, we can determine how our own was formed.
- Understand that gravity is required for creation of our universe, and allowing Hubble to stay in orbit.
- Understand how we've used maps and constellations and star charts throughout history to navigate, monitor time, and referenced for finding new stars.

Evaluate:

Formative Assessments:

Teachers can check throughout the lesson that students are understanding the goal for each step:

- Interactive Timeline: Students will be able to explain Hubble's role in space exploration.
- Booklet: Students will accurately explain important events in Hubble's missions.
- Observatory: Students will be able to explain how technologies on Hubble were used to explore unknown galaxies and universes, as well as our own.

- Constellation Map: Students will be able to explain that we can map stars in the sky and use these maps for many purposes (navigation and comparison to new objects).

Summative Assessment:

Students will understand the importance of being able to model our solar system, and what technologies we use to do complete this. Students will be understand that by observing other galaxies scientists can understand ours better. A series of quiz questions could be determined to evaluate student understanding. The Mastery concepts in the Explain section can be a foundation for questions.

Elaborate/Extend:

Students can learn about Charles Messier, a famous astronomer who catalogued more than 100 objects in the night sky. A short biography is found here:

<https://www.nasa.gov/content/goddard/hubble-s-messier-catalog>. They can create a fake social media page, or write a short biography about his works and importance to astronomy today.

Constellations: On Sea and Sky (<http://www.seasky.org/constellations/constellations.html>), students can explore the names and histories behind constellations in their night sky and compare those they should see at the current time, to other months of the year. Students can also watch the “Tonight’s Sky” video (http://hubblesite.org/videos/tonights_sky) from other months to compare what constellations they might see at another time of year.

STEM: Students can design their own satellite telescope, citing important technologies that are needed, power sources, propulsion, data collection and a goal for the project. If supplies are available, they could build a model.

Students can explore Hubble’s Command Center with a 360 degree exploration found here <https://www.nasa.gov/content/hubble-mission-operations>.

Resources:

The Constellations. (1998). Sea and Sky. Retrieved from <http://www.seasky.org/constellations/constellations.html>

Summer Constellation Map (Northern Hemisphere). (n.d.). Geography. Retrieved from <https://mrprintables.com/printable-constellation-map-summer.html>

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<http://curious.astro.cornell.edu/about-us/117-the-universe/stars-and-star-clusters/constellations/375-what-are-constellations-used-for-intermediate>