



Getting to the Core



5th Grade Mini-Unit of Study

Astronomy

Student Learning Journal

Lesson 1

Extended Anticipatory Guide



Statements	Opinion Agree	Opinion Disagree	Evidence and Source
1. Astronomers have always used telescopes to learn about the universe.			
2. Our understanding of the solar system has changed.			
3. Throughout time, people have always been recognized and rewarded for making new discoveries or advancements.			
4. The main purpose of a telescope is to magnify objects in the sky.			

Language for Agreeing	Language for Disagreeing
<ul style="list-style-type: none"> ● I agree with the statement that _____ because _____. ● I agree with you that _____ because _____. ● I have a similar opinion. I believe _____. 	<ul style="list-style-type: none"> ● I disagree with the statement _____ because _____. ● I respectfully disagree with you. I believe that _____ because _____. ● I have a different opinion. I believe _____.

Scan and Skim the Text

pages 114-117



<p>What do you predict this text will be about?</p>	
<p>What text features helped you to make your predictions?</p>	
<p>Quick Write: What else did you learn after reading the text?</p>	

Lesson 1



Telescopes Process Grid

Type of Telescope	History	Key Parts	Advantages	Disadvantages

Lesson 1

Reflection

Based upon our reading, what Essential Questions could be answered? How does our learning connect to the Big Idea?



Big Idea: Understanding our universe is an ongoing process.

Essential Question:

1. How do astronomers acquire information about the universe?
2. How has our understanding of the solar system changed?
3. How did different cultures relate to the universe?

Lesson 1

Telescopes

from *The Way Things Work*
by David Macaulay

Telescopes

A telescope gives a close-up view of a distant object, which, in the case of an astronomical telescope viewing a far-off planet or galaxy, is very distant indeed. Most telescopes work in the same basic way, which is to produce a real image of the object inside the telescope tube. The eyepiece lens then views this image in the same way as a magnifying glass. The viewer looks at a very close real image, which therefore appears large. The degree of magnification depends mainly on the power of the eyepiece lens.

Refracting Telescope

In a refracting telescope, an objective lens forms the real image that is viewed by the eyepiece lens. The image is upside down, but this is not important in astronomy.

Reflecting Telescope

In a reflecting telescope, a large concave primary mirror forms the real image that is then viewed by an eyepiece lens. Usually, a secondary mirror reflects the rays from the primary mirror so that the real image forms beneath the mirror or to the side. This is more convenient for viewing.

Reflecting telescopes are important in astronomy because the primary mirror can be very wide. This enables it to collect a lot of light, making faint objects visible. Collecting light from an object is often more important than magnifying it because distant stars do not appear bigger even when magnified.

Radio Telescope

Many objects in the universe send out radio waves, and a radio telescope can be used to detect them. A large curved metal dish collects the radio waves and reflects them to a focus point above the center of the dish, rather as the curved mirror of a reflecting telescope gathers light waves from space. At this point, an antenna intercepts the radio waves and turns them into a weak electric signal. The signal goes to a computer. Radio telescopes detect very weak waves, and can also communicate with spacecraft.

By detecting radio waves coming from galaxies and other objects in space, radio telescopes have discovered the existence of many previously unknown bodies. It is possible to make visible images of radio sources by scanning the telescope or a group of telescopes across the source. This yields a sequence of signals from different parts of the source, which the computer can process to form an image. Differences in frequency of the signals give information about the composition and motion of the radio source.

Space Telescope

The Hubble space telescope is part optical telescope and part satellite. It promises to revolutionize astronomy because it operates outside the atmosphere, which hampers any observations made from the ground. The space telescope orbits the earth, observing distant stars and galaxies in the total clarity of space. It can peer seven times further into the universe than we can see from the ground, and can also detect very faint objects. The telescope may be able to “see” far back in time by observing ancient light waves from the most distant galaxies. Among these may be light waves produced just after the big bang that blew the universe into existence some 15 billion years ago.



Lesson 1, Day 2: How Telescopes Work” Video Clip Annotation

<p>What are two of the most important points of a telescope?</p>	
<p>A refractive telescope uses two types of lenses. What does each one do?</p>	
<p>What does a reflective telescope use?</p>	
<p>What is one advantage of a reflective telescope?</p>	

Lesson 1 Day 2 Writing: Sentence Frames for Compare and Contrast

By comparison it is _____.

In comparison it is _____.

The things they have in common are _____.

They are similar because _____.

Both are the same because _____.

Their shared/common attributes are _____.

They are similar in that _____.

The differences between _____ and _____ are _____.

A distinction between _____ and _____ might be _____.

It is _____-er than _____.

It is the _____-est of all of them.

It is _____-er than _____, but _____-er than _____.

A _____ is _____-er than a _____.

**_____ and _____ are similar because they both
(are/have)_____.**

They are different because _____ is _____ and _____ is _____.

**The way they are alike is that they both are/have _____, but what's different is that _____
are/have _____.**

A notable difference (key distinction) between _____ and _____ is _____.

Neither _____ nor _____ have/contain/demonstrate/show _____.

_____ is/tends to be _____, whereas _____ is _____

20 Point Rubric

Paragraph 1= **Introduction:** 2 pts. Total__

- ___ 2-3 logically organized introductory sentences and thesis statement
- ___ 1 thesis or introductory sentence logically organized
- ___ 0 thesis or introductory sentence logically organized

Paragraph 2-4: **Body of the Report:** 4 pts. Total__

- ___ 2-3 paragraphs logically organized with proper evidence or examples from the various texts using the student's own words.
- ___ 2-3 paragraphs logically organized with proper evidence or examples from at least 2 sources using mostly the student's own words.
- ___ 1-2 paragraphs with little organization and 1 piece of evidence or an example from a source using some of the student's own words.
- ___ 1 paragraph, lacking organization, with little evidence from sources. The student copies information in a haphazard way.

Paragraph 5: **Conclusion:** 2 pts. Total

- ___ 3 to 5 well thought-out sentences that revisit or summarize the main points of the report or reflect the significance of the information learned or realized (revisiting the thesis or introduction).
- ___ 2 to 3 thought-out sentences that revisit or summarize the main points of the report or reflect the significance of the information learned or realized
- ___ 1 to 2 sentences summarizing some the main points of the report or reflect somewhat what was learned or realized.

Paragraph 5: **Conclusion:** 2 pts. Total

- ___ 3 to 5 well thought-out sentences that revisit or summarize the main points of the report or reflect the significance of the information learned or realized (revisiting the thesis or introduction).
- ___ 2 to 3 thought-out sentences that revisit or summarize the main points of the report or reflect the significance of the information learned or realized (revisiting the thesis or introduction).
- ___ 1 to 2 sentences summarizing some of the main points of the report or reflect somewhat what was learned or realized

Conventions 2 pts.

- ___ The student follows conventions of capitalization, punctuation, and spelling and any errors do not interfere with the smooth readability of the piece.
- ___ Capitalization, punctuation, and spelling errors interfere somewhat with the smooth readability of the piece.
- ___ Capitalization, punctuation, and spelling errors interfere significantly with the smooth readability of the piece.

Clear Explanations and examples: 5 pts.

- ___ 3 middle paragraphs, each consisting of a topic/introductory sentence and at least four additional sentences that provide support with examples, explanations, or facts.
- ___ 2 middle paragraphs, each consisting of a topic/introductory sentence and at least three additional sentences that provide support with examples, explanations, or facts.
- ___ 1 middle paragraph, consisting of a topic/introductory sentence and two additional sentences that provide support with examples, explanations, and/or facts.

____ The middle portion of the written piece lacks either a topic/introductory sentence or has less than two sentences that provide support with examples, explanations, and/or facts.

Clear, Precise Language: 2 pts. Total

2____ The student uses at least 6 examples of his own clear, precise and deliberate language to help the reader more clearly visualize the explanation, examples or facts.

1____ The student uses at least 4 examples of his own clear, precise and deliberate language to help the reader more clearly visualize the explanation, examples or facts.

0____ There are less than 4 examples of his own clear, precise and deliberate language to help the reader more clearly visualize the explanation, examples or facts.

Transitional words or phrases 3 pts. Total____

at least 7 varied and appropriate transitional words or phrases that “move” the writing logically

2____ The student uses at least 5 varied and appropriate transitional words or phrases that “move” the writing logically

1____ There are at least 3 appropriate transitional words or phrases that “move” the writing logically

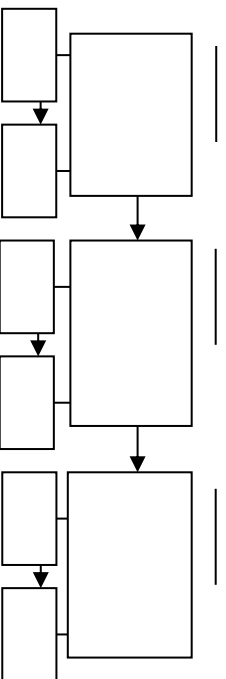
0____ There are less than 3 appropriate transitional words that “move” the writing logically

3____ The student uses

Compare and Contrast the Two Telescopes Using a Thinking Map

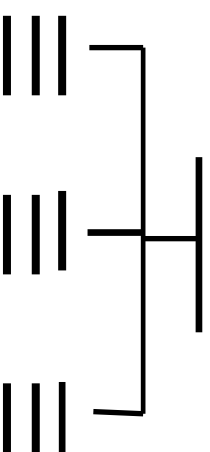
Which Thinking Map matches the structure of the text that the author used?

Flow Map: “How To”, Sequence, Chronological order (time)



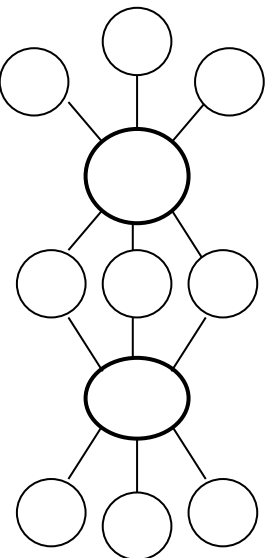
Words you might see: first, second, third, then, next, after, later, finally, at last, before, in the end, earlier

Tree Map: Main Idea and Details, Classifying and Categorizing



Words you might see: all about, types, kinds; (there is a main statement and then details that support the main idea that informs.)

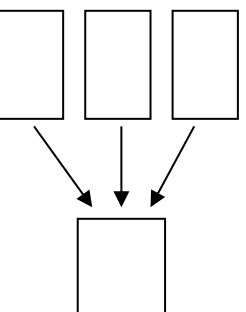
Double Bubble Map: Compare and Contrast



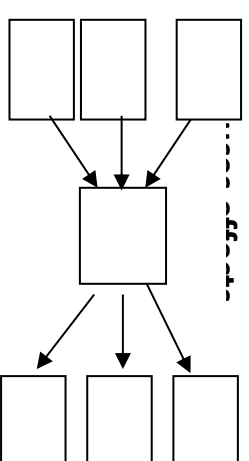
Words you might see: **Same:** also, as well, similarly, so, too, as well

Multi-Flow Map: Cause/Effect or “To Explain Why”

Many causes lead to one effect



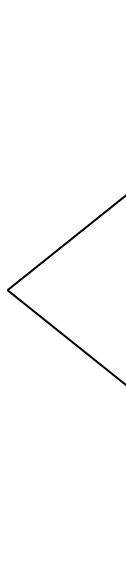
causes leads an event that



Words: because, one reason, another reason, for instance, in fact, for example, since, such as, of course, that is, actually

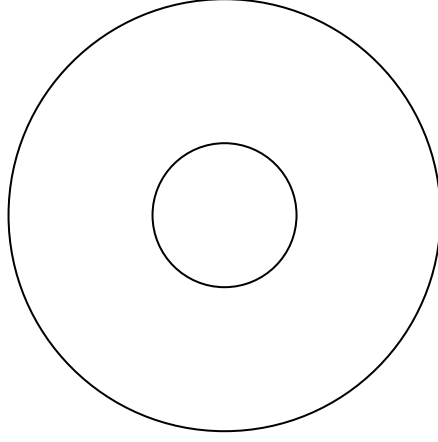
Words: so, as a result, because of this, hence, then, therefore, thus, accordingly, because of _____, we have _____.

Bridge Map: Seeing Relationships – how things remind you of something else



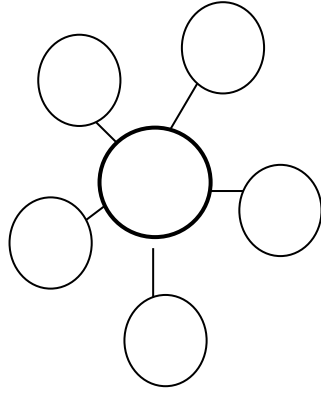
Words you might see: just like, as ___ as, same as, looks like, reminds,

Circle Map: Defining



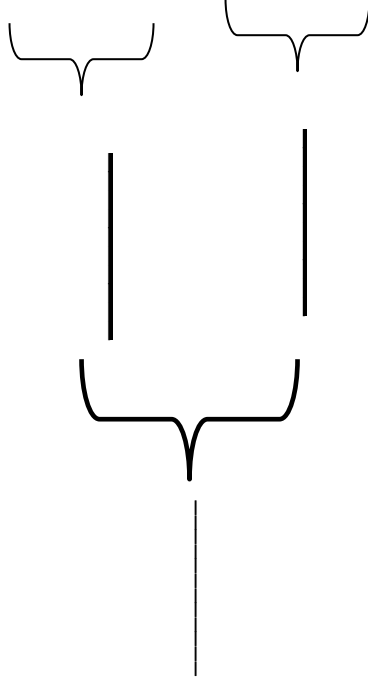
Words you might see: can be defined, is a, has, definition

Bubble Map: Describing a person or place



Words you might see: can be describes, is, has, (lots of adjectives!)

Brace Map: Whole to Parts



Words you might see: parts of, has the following, has (must be physical things that are parts of a whole)

FLIEE Map for Comparing and Contrasting Telescopes



Read with a Pencil “Galileo” Text

<p>Key Words</p>	<p>Difficult Words</p>
<p>Questions</p>	<p>Comments/Thoughts</p>

Galileo's Telescope" Video Note-Taking Guide



<p>First Viewing: Jot down notes that explain the importance of his invention</p>	
<p>Second Viewing: For what purpose was the telescope first invented?</p>	
<p>Galileo decided to use the telescope for a different purpose.</p> <p>What did he learn about the moon?</p> <p>What did he learn about Jupiter?</p>	
<p>What did the Church believe about the universe in 1600?</p> <p>What happened when Galileo shared his ideas that were different?</p>	
<p>How is Galileo honored?</p>	
<p>“Galileo took a weapon of war and turned it into an instrument of science?</p> <p>What does that mean?</p>	



“Galileo” Text: Thinking Map

Directions: Create a Thinking Map for the events in the “Galileo” text.

Lesson Closure

Group Quick Write

What is the author's position on the conflict between Galileo and the Roman Catholic Church? What evidence from the text leads you to believe that? (Scaffold: Look for where the author's emotion is revealed. These could be adjectives or strong verbs.)

Definition

Characteristics

Vocabulary
Word

Examples

Non-Examples

What is a moon?

A moon is an object that circles around a planet. Different planets have different numbers and sizes of moons. Mercury and Venus do not have moons. Earth has one moon, Mars has two, and Jupiter has at least 63 moons. Saturn has 49 moons. Astronomers have discovered at least 27 moons around Uranus and 13 moons orbiting Neptune.



The sizes of the moon vary. Some of the moons are very small. Seven of the moons in the solar system are actually bigger than Pluto! These include Jupiter’s Ganymede, which is the largest moon, and Earth’s moon.

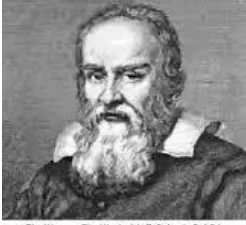
Moons are also called satellites (SAT-uh-lights). A satellite is an object in space that circles around another object. The moons of the planets are natural satellites. Man-made satellites circle around Earth. These provide weather information and are part of communications systems.

Forming Craters

When objects in space collide, the impact forms a crater, or hole. The surface of Earth’s Moon has millions of these craters. The craters are easy to see because the impact knocks the surface material away so the darker rock underneath shows through.



Most objects that fall toward Earth burn up in Earth’s atmosphere. Since the moon has no atmosphere, the objects that fall toward Earth burn up in Earth’s atmosphere. Since the moon has no atmosphere, the objects that fall toward it do not burn up. As a result, the Moon has more craters than Earth.



Galileo Galilei (1564-1642)

Create a Thinking Map

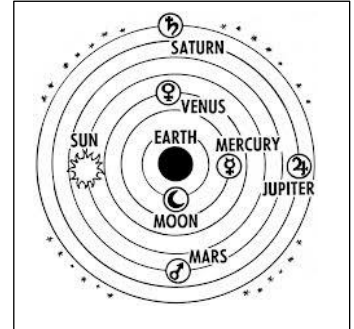
**Compare “Galileo” text pages 105-108 and
Science Text pages 310-311**



The Making of the Hubble Telescope

In the Beginning

Since the early days of astronomy, man and his understanding of the universe was limited by his vision. Since the time of Galileo, astronomers have had one goal-to see more, to see farther, and see deeper. The invention of the telescope allowed astronomers of the 16th and 17th centuries like Copernicus, Galileo, and Kepler to disprove the centuries' old belief that Earth was the center of our universe. This was the beginning of the Scientific Revolution.

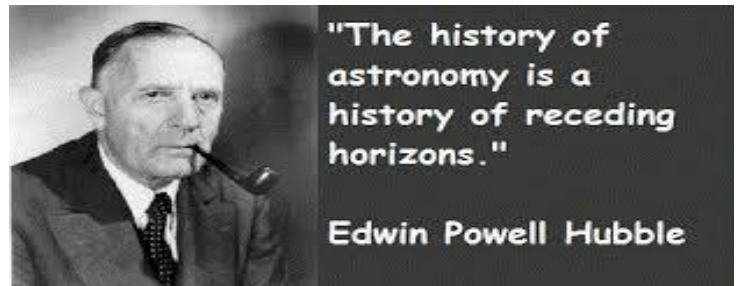


By the 18th century, the telescope would become the indispensable instrument for the investigation of our universe. Bigger and better telescopes were being built all over the world. Celestial bodies like planets, stars, and nebulae, which could not be seen with the naked eye, were being routinely noted and documented.

By the turn of the 20th century, most astronomers believed that the universe that could be observed consisted of one galaxy, our Milky Way Galaxy and an oasis of stars, dust, and gas in the vastness of space. A major obstacle that stood between the astronomers and a clear view of the universe was the Earth's atmosphere, which is a fluid, chaotic soup of gas and dust. Throughout the world, observatories with the largest telescopes were built upon high mountaintops, far away from distracting city lights. These had varying degrees of success.

Edwin Hubble

Edwin Hubble, who is often lauded as the father of modern cosmology, made several important discoveries that changed how scientists viewed the universe. Born in 1889, Hubble began his professional life as a lawyer. After only a few years, he returned to school to obtain a doctorate in astronomy.



After graduation, Hubble was invited to work at the Mount Wilson Observatory in California, but he had to delay his work there while he served as a soldier in World War I. Once he returned to civilian life, he started his work there, where he was able to work with the two largest telescopes in the world. These were 60 inch and 100 inch reflector telescopes. In 1924, he observed billions of other galaxies which were all moving away from each other. This suggested that the universe was expanding.

A Telescope in Space?

In 1923, German scientist Hermann Oberth, one of the three fathers of modern rocketry, published an article about sending rockets into space. He mentioned how a telescope could be propelled into Earth's orbit by a rocket. In 1946, Lyman Spitzer wrote about the scientific benefits of a telescope in space, far above the Earth's turbulent atmosphere. He knew that this would take a while because at that time, the most powerful rocket of the day, the V-2, could only send instruments into space for only a few minutes.



Lyman Spitzer

The invention of a space telescope became his life mission, and Spitzer worked for 44 years for the space telescope that he invented to make it into orbit. He was a determined visionary who would not take “no” for an answer. In 1965, he was named head of a committee whose job it was to define the space observatory's scientific goals. NASA, the National Aeronautics and Space Administration, approved the plans for the telescope in 1968. The launch date aboard the new space shuttle was planned for 1979.

They named the observatory after the famous astronomer, Edwin Hubble. Both the observatory and the space shuttle ran into some technical problems, budget overruns, and delays. Spitzer and other astronomers worked hard to keep the Hubble alive. They met with Congress and organized letter writing campaigns. Their effort paid off. The telescope was completed and a launch set for October 1986.



Next, tragedy struck! The Space Shuttle Challenger exploded after liftoff in January of that year. The nation mourned as NASA fixed the problem, and the telescope sat in storage. It was not until April 25, 1990, that the Space Shuttle Discovery lifted off from earth with the Hubble Space Telescope carried securely in its bay. The following day, Hubble was released into space, ready to peer into the vast unknown of space.

Then NASA discovered a final obstacle. The pictures being sent from the Hubble were blurry. The telescope's mirrors had been ground incorrectly. It wasn't until December 1993, that another crew of astronauts was able to install the correct optics that the telescope was able to focus properly. Then the Hubble began to return extraordinary results, making the nearly 50 years of Spitzer's work worthwhile and making him the father of the space telescope.

Even as Spitzer turned 80, he continued to analyze the images sent from the Hubble. After a full day of working at his life's work, on March 31, 1997, Spitzer collapsed at home and passed away. He was 82 years old. To honor his great work, NASA renamed the Space Infrared Telescope Facility the Spitzer Space Telescope.

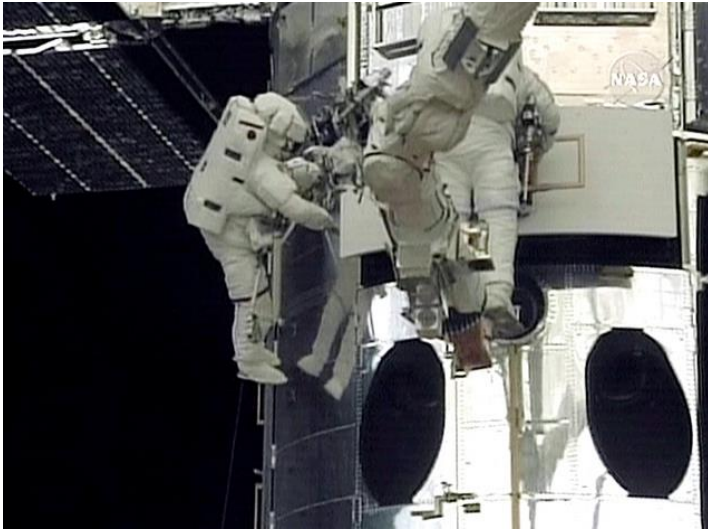
The Hubble Telescope Today



Today, the Hubble is a project of international cooperation between NASA and the European Space Agency. It completes one full orbit of the Earth every 96 minutes, moving at a speed of 17,500 miles per hour. At that speed, a trip from Los Angeles to New York would take about ten minutes. It has traveled more than three billion miles in its orbit 350 miles above Earth. As it orbits, it collects light and directs it to scientific instruments that work together or individually to provide the observations. It does not travel to stars, planets, or galaxies, but takes pictures of them. In fact, it has made more than one million observations since it began its mission. These observations help give direction to future space missions. It can sometimes be spotted on a very dark, clear night with naked eye when it passes closely enough overhead. It will appear as a fast moving speck of light.

The Hubble celebrated its 24th anniversary on April 24, 2014. To celebrate, NASA looked at some of the amazing statistics generated by this world famous telescope.

- It is a part of the entire astronomical community and more than 4,000 astronomers from all over the world have used the Hubble to probe the universe.
- More than 11,000 scientific papers have been published using data from the Hubble, making it one of the most productive instruments ever built.
- It has transformed the way that scientist look at the universe, proving some theories to be truths while disproving others and sparking new theories to be formed.
- It has shown galaxies in all stages of evolution, including toddler, helping them to understand how they formed.
- It revealed the age of the universe to be about 13-14 billion years old which is more accurate than the previous range of 10-20 billion years old.
- It has observed more than 38,000 celestial bodies.

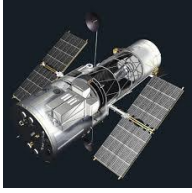


Astronauts, John Grunsfeld and Drew Feustel, during the first spacewalk to repair the Hubble.

Hubble's Future

Eventually, the Hubble Space Telescope's time will end. The parts will slowly degrade to the point where the telescope stops working. When that happens, it will continue to orbit the Earth until its orbit decays. Then it will spiral toward Earth. Originally, NASA had planned to bring the Hubble back to Earth for display at a museum. A space shuttle would have brought it back because it was specifically designed to work with the shuttle. The Hubble's prolonged life span has made this impossible because it will continue to work after the space shuttle program has retired. When its orbit decays, a robotic mission will de-orbit the telescope, guiding its remains through Earth's atmosphere and into the ocean.

Long after the Hubble stops working, its legacy will live. Its many discoveries and trailblazing designs have forever changed the way we look at the universe.



The Making of the Hubble Telescope

Double Entry Journal

Main Points from the Text	Supporting Evidence

Lesson 3

Reflection

Based upon our reading, what Essential Questions could be answered? How does our learning connect to the Big Idea?



Big Idea: Understanding our universe is an ongoing process.

Essential Question:

1. How do astronomers acquire information about the universe?
2. How has our understanding of the solar system changed?
3. How did different cultures relate to the universe?

Brochure Rubric

Category	4 Excellent	3 Good	2 Almost	1 Not yet
Attractiveness & Organization	The brochure has exceptionally attractive formatting and well-organized information.	The brochure has attractive formatting and well-organized information.	The brochure has well-organized information.	The brochure's format and organization of material are confusing to the reader.
Content Accuracy	The brochure has all of the required information and some additional information.	The brochure has all of the required information.	The brochure has most of the required information.	The brochure has little of the required information.
Writing Mechanics	All of the writing is done in complete sentences. Capitalization and punctuation are correct throughout the brochure.	Most of the writing is done in complete sentences. Most of the capitalization and punctuation are correct throughout the brochure.	Some of the writing is done in complete sentences. Some of the capitalization and punctuation are correct throughout the brochure.	Most of the writing is not done in complete sentences. Most of the capitalization and punctuation are not correct throughout the brochure.
Graphics/Pictures	The graphics go well with the text and there is a good mix of text and graphics.	The graphics go well with the text, but there are so many that they distract from the text.	The graphics go well with the text, but there are too few.	The graphics do not go with the accompanying text or appear to be randomly chosen.
Sources	Many citations from a variety of sources are accurately listed on the brochure.	Some citations from a variety of sources are accurately listed on the brochure.	A few citations are accurately listed on the brochure.	Incomplete or inaccurate citations are listed on the brochure.