

ScienceNews

EDUCATOR GUIDE



DESIREE STOVER/NASA

October 9, 2021 & October 23, 2021
The Origami Satellite



About this Guide

In this Guide, based on the online *Science News* article "[When James Webb launches, it will have a bigger to-do list than 1980s researchers suspected](#)," students will learn about NASA's James Webb Space Telescope and discuss how scientific advances have shaped the telescope's mission.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "[When James Webb launches, it will have a bigger to-do list than 1980s researchers suspected](#)," which details the long journey of NASA's James Webb Space Telescope to make it into space to explore other galaxies. A version of the story, "The origami satellite," appears in the October 9, 2021 & October 23, 2021 issue of *Science News*. Related standards include NGSS-DCI: HS-ESS1.

Student Comprehension Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will discuss the mission of the James Webb Space Telescope and explore how scientific discoveries over the last few decades have shaped the telescope's to-do list. Related standards include NGSS-DCI: HS-ESS1.

Student Discussion Worksheet — These questions are formatted so it's easy to print them out as a worksheet.

Article-based Comprehension, Q&A

Directions for teachers: Ask students to read the online *Science News* article "[When James Webb launches, it will have a bigger to-do list than 1980s researchers suspected](#)," which details the long journey of NASA's James Webb Space Telescope to make it into space to explore other galaxies, and answer the following questions. A version of the story, "The origami satellite," appears in the October 9, 2021 & October 23, 2021 issue of *Science News*.

1. What is the James Webb Space Telescope?

The James Webb Space Telescope is a telescope that scientists plan to launch into space to explore distant galaxies.

2. What makes the James Webb Space Telescope different from previous space telescopes?

The James Webb Space Telescope will be the largest, most complex telescope ever sent into orbit. Unlike most space telescopes, which house a single lens or mirror within a tube that blocks out sunlight, the James Webb Space Telescope's 6.5-meter-wide mirror and its scientific instruments are exposed to the vacuum of space.

3. Why is the telescope's mirror so large? What is the purpose of the telescope's shield?

The telescope's mirror is large so it can see further into space. The telescope's multilayered shield, which is the size of a tennis court, will block light from the sun, Earth and moon so the telescope can see the cosmos. The shield will also radiate heat to keep the telescope cool.

4. Who is the telescope named for, and why did scientists choose that name? Why is the choice potentially controversial?

The telescope is named for former NASA administrator James Webb in honor of his efforts to support research that improved our understanding of the universe during a time when most of the United States' focus was on human spaceflight. Naming the telescope after Webb may be controversial because of allegations that he persecuted gay and lesbian people during his career in government. NASA is investigating the claims.

5. Why did scientists nickname the James Webb Space Telescope the "origami telescope"?

The telescope is so large that it has to be launched folded up. Once the telescope is in space, it will unfold and assemble itself.

6. When did scientists first come up with plans for the telescope, and when will it launch?

Scientists first dreamed up the James Webb Space Telescope in 1989. The telescope is slated to launch in

December 2021.

7. List some reasons for the delay of the telescope's launch.

Budgetary and technical issues, human errors and the coronavirus pandemic all contributed to delays in the telescope's launch.

8. Where will the telescope launch from, and how is it getting to its launch site? What is the telescope's final destination?

The James Webb Space Telescope is on its way by boat through the Panama Canal to French Guiana, where it will launch into space on the Ariane 5 rocket. Its destination is a point in space called L2 that is 1.5 million kilometers from Earth.

9. How has science changed since the telescope's inception? How does the telescope that scientists built differ from their original idea for the telescope?

When scientists first thought up the James Webb Space Telescope, dark energy and exoplanets (planets orbiting stars outside our solar system) hadn't been discovered yet. Scientists imagined the telescope would have a 10-meter-wide mirror that was sensitive to infrared light. While the James Webb Space Telescope does detect infrared light, its primary mirror is just 6.5 meters wide.

10. Look at the section titled "What could go wrong?" in the *Science News* article. How long will it take for the telescope to reach its destination and start taking scientific measurements? Name at least two major milestones between the telescope's launch and when it begins its mission.

The telescope will reach its destination 29 days after launch. At 180 days after launch, the telescope will have finished calibrating its science instruments and can start its mission. The telescope will unfurl itself within the first 12 days after launch and communicate with scientists on Earth 28 days after launch.

11. How long is the telescope estimated to "live" once it reaches its final destination? Why does the telescope have a fixed lifetime, and what will happen when it retires?

The telescope is estimated to operate for five to 10 years. The telescope has a fixed lifetime because it will be too far from Earth for astronauts to refuel and repair it. Once the telescope runs out of fuel, its operators will position it in an out-of-the-way orbit around the sun.

12. Give an example of a literary device that is used in the article. What type of literary device is it?

The article relates the time and process of building the telescope to building a pyramid. This is an example of a metaphor.

Student Comprehension Worksheet

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Cross-curricular Discussion, Q&A

Directions for teachers:

Ask students to read the online *Science News* "[When James Webb launches, it will have a bigger to-do list than 1980s researchers suspected](#)," and answer the following prompts with a partner. A version of the article, "The origami satellite," appears in the October 9, 2021 & October 23, 2021 issue of *Science News*.

Want to make it a virtual lesson? Post the online *Science News* article to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

Making a scientific to-do list

1. List the main questions that scientists hope to answer with help from the James Webb Space Telescope.

How old is the universe and how has it evolved over time? Why is there a mismatch in measurements of the Hubble constant (the rate at which the universe is expanding)? Is the mismatch real or the result of some error in the measurements? Could planets around other stars host life?

2. Explain how the James Webb Space Telescope could be used to help answer one of the scientific questions. What type of data is needed to answer the question, and how will the telescope collect the data?

Student answers will vary. For example, a student might say that the James Webb Space Telescope will be used to verify that certain types of exoplanets (planets around other stars) have atmospheres and look for carbon-bearing molecules in those exoplanet atmospheres using starlight in the infrared range. The telescope will set its sights on several exoplanets, looking at how the exoplanets' atmospheres filter starlight as the planets pass in front of their parent stars. Atoms and molecules in an exoplanet's atmosphere absorb certain wavelengths of starlight as the exoplanet transits its parent star, which leave unique fingerprints in the spectrum of light that the telescope picks up. If the James Webb Space Telescope detects carbon-bearing molecules in an exoplanet's atmosphere, that could be a sign of possible life.

3. Choose one scientific discovery that was made during the development of the James Webb Space Telescope and explain how that discovery shaped the telescope's mission.

Student answers will vary. For example, a student might say that the discovery of thousands of exoplanets has led to an entirely new field of science that will help the James Webb Space Telescope achieve one of its initial goals: looking for signs of life on Earthlike planets around other stars. In the early days of the telescope's development, scientists knew of just a handful of exoplanets, and none of them were anything like Earth. Now, James Webb has many exoplanets to choose from that are close enough to see. Some are rocky and have just the right temperatures to support liquid water and perhaps life.

Discussing diagrams

Study one of the following diagrams that appears in the *Science News* article: “Mixed views,” “A novel design,” “Getting there” and “Transit advantages.” After answering the questions below on your own, explain the diagram to a partner and have your partner explain their chosen diagram to you. Make sure you and your partner choose different diagrams.

1. What diagram did you choose and what does the diagram depict? Be sure to indicate units as appropriate.

Student answers will vary. As an example, a student might say that the “Mixed views” diagram depicts the electromagnetic spectrum and the range of wavelengths that the Hubble Space Telescope, the James Webb Space Telescope and the Spitzer Space Telescope can observe. Units of wavelength are given in micrometers.

2. How does the diagram help your understanding of the James Webb Space Telescope and its importance?

Student answers will vary. As an example, a student might say that the “Mixed views” highlights the fact that the James Webb Space Telescope will fill a gap in the type of light data collected by current and past space telescopes.

3. What is one science concept that is covered in the diagram that relates to something you’ve studied in science class? How does understanding that science concept affect your understanding of the *Science News* article?

Student answers will vary. As an example, a student might say that “Mixed views” shows the electromagnetic spectrum and indicates the different types of electromagnetic radiation and their wavelength ranges. In order to understand why the James Web Space Telescope is important to furthering our knowledge of the universe, I need to know the different wavelengths of light, or electromagnetic radiation, that space telescopes collect and what information the light can provide about the universe.

Student Discussion Worksheet

Directions: Read the online *Science News* article "[When James Webb launches, it will have a bigger to-do list than 1980s researchers suspected.](#)" Then discuss and answer the following prompts with a partner. A version of the article, "The origami satellite," appears in the October 9, 2021 & October 23, 2021 issue of *Science News*.

Making a scientific to-do list

1. List the main questions that scientists hope to answer with help from the James Webb Space Telescope.
2. Explain how the James Webb Space Telescope could be used to help answer one of the scientific questions. What type of data is needed to answer the question, and how will the telescope collect the data?
3. Choose one scientific discovery that was made during the development of the James Webb Space Telescope and explain how that discovery shaped the telescope's mission.

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1. What diagram did you choose and what does the diagram depict? Be sure to indicate units as appropriate.
2. How does the diagram help your understanding of the James Webb Space Telescope and its importance?
3. What is one science concept that is covered in the diagram that relates to something you've studied in science class? How does understanding that science concept affect your understanding of the *Science News* article?



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