With the Webb telescope, we will explore the evolution of these galaxies.

Today we see hints of structure in distant galaxies.

With the Webb telescope, we will explore the evolution of these galaxies.
Science on the edge

The James Webb Space Telescope promises to open up new horizons as we gaze to the edges of the visible universe. Webb is an infrared telescope, seeing in a wavelength of light difficult to observe from Earth and invisible to the human eye. Scanning the universe for infrared light, Webb will have to be larger than any space telescope yet placed in orbit. It will function at temperatures just tens of degrees above absolute zero — the temperature at which even atoms are so cold they cannot move. The telescope’s launch in 2018 will make the invisible visible and will help astronomers answer some of the most pressing questions of astronomy.

**How did the universe form?** Orbiting nearly 1 million miles from Earth, the Webb telescope will witness the flicker of the first galaxies popping into existence in the early universe. Webb will chart the growth of galaxies from shapeless masses to the giant spiral shapes we see today.

**The birth of stars and planets:** Webb will see through clouds of dust to the warm, infrared-emitting objects hidden within. It will uncover the swirling disks that surround newly forming stars, and study new planets in the making.

**Are we alone?** Does life exist around other stars? We suspect that Earth-sized planets are abundant in the universe, but are they Earth-like, too? Webb will study the atmospheres of extrasolar planets of all types, sizes, and temperatures, analyzing their composition and climate.

**Telescope statistics**

**Mirror Type:** Segmented parabolic reflector

**Number of Mirror Segments:** 18, made of beryllium and coated with a thin layer of gold

**Mirror Width:** 21.6 feet (6.5 m) at its widest point

**Sunshield:** Tennis-court-sized, protects Webb from light and heat from the sun and Earth

**Instruments:** Webb will have several science instruments. The Near-Infrared Camera (NIRCam) and the Near-Infrared Spectrograph (NIRSpec) are two instruments that will detect near-infrared light. The Mid-Infrared Instrument (MIRI) will observe mid-infrared light. The Fine Guidance Sensor/Near-Infrared Imager and Slitless Spectrograph (FGS and NIRISS) will help point the telescope and will detect near-infrared light.

National Aeronautics and Space Administration

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Vocabulary

**Spectrograph:** An instrument that spreads light into its component colors for detailed study.

**Infrared light:** The part of the electromagnetic spectrum that has slightly lower energy than visible light but is not visible to the human eye. Just as there are low-pitched sounds that cannot be heard, there is low-energy light that cannot be seen. Infrared light can be detected as the heat from warm-blooded animals.

The corresponding classroom activity for this lithograph can be found at:
http://amazingspace.org/resource/resource_index/lithographs/type or may be obtained by contacting the Office of Public Outreach at the Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218.
In Search of … the James Webb Space Telescope

Description
The “James Webb Space Telescope” lithograph serves as the initial source of information to engage students in a Level One Inquiry Activity. In this activity, educators will use the lithograph to help students formulate questions about some aspect of the James Webb Space Telescope (JWST). Educators will suggest selected resources about JWST to help students answer their questions. Students will then conduct research and provide supporting evidence for their conclusions. This curriculum support tool is designed to be used as an introductory activity in a unit that incorporates scientific inquiry or that has an engineering theme.

About Inquiry-based Learning
The inquiry process is driven by a student’s own curiosity, wonder, interest, or passion to understand an observation or to solve a problem. It involves a process of exploring the natural or material world. This exploration prompts students to ask questions and to make discoveries in the search for new insights. A Level One Inquiry Activity uses questions and problem-solving methods directed by an educator. The process of inquiry-based learning can help prepare students to become more independent thinkers.

Grade Level
Grades 6-12

Prerequisites
Students should know that infrared light is part of the electromagnetic spectrum, which is made up of light in many different wavelengths, most of which is invisible to the human eye.

Misconceptions
Educators should be aware of the following common misconceptions about telescopes and determine whether their students harbor them. Students may think that all telescopes have the same design. They also may think that telescopes are judged by their ability to magnify objects, or that astronomers make observations by looking through a telescope.

Vocabulary
Terms students may encounter while doing further research on telescopes include:

Multi-mirror telescope: A telescope constructed of more than one primary mirror that all work together to form an image.
Sunshield: The sunshield protects the Webb telescope from the heat and light of the sun, moon, and Earth. It is made up of five huge layers of Kapton.

Purpose
The purpose of this activity is to engage students in a Level One Inquiry Activity with astronomical images and information. Students will gain experience using the Internet to search for information. They will practice the process skills of observing and analyzing. Students also will organize their material, present their findings, and reflect on what they have learned.

Materials
• “James Webb Space Telescope” lithograph
• Computer with Internet connection for conducting research

Instructions for Educators
Preparation
• Obtain copies of the lithograph for each student. The “James Webb Space Telescope” lithograph can be found at: http://amazingspace.org/resource_page/518/space_telescopes/type
• Preview the Overview page at: http://amazingspace.org/resource_page/518/space_telescopes/type#educator_tab
• Bookmark or identify as favorites the following suggested websites:
In Search of … the James Webb Space Telescope (cont’d)

Procedure

Identify your students’ misconceptions about telescopes by having them write down anything they know and understand about this topic. Have students volunteer their ideas about telescopes. From those ideas, identify their misconceptions and discuss them with the class. An alternative method is to collect your students’ written ideas about telescopes. From those ideas, compile a list of their misconceptions and discuss them with the class.

Ask students to study the illustration of the James Webb Space Telescope on the front and the diagram of the Webb telescope on the back of the lithograph. Ask them what features of the telescope are most prominent. Then have students write as many questions as they can about one of the telescope’s features. Collect the questions and group them by common themes. Ask students to read the information on the back of the lithograph. Then ask them if they found the answers to any of their questions. Have students use the Internet to research their questions. The Internet sites listed in the “Preparation” section provide a starting point for their research. Tell students how to access other websites.

Have students prepare presentations or written reports that include the answers to their questions. Their presentations also should address their selected feature and explain how it is unique to the James Webb Space Telescope. The presentation can be in the form of a skit, a story, a graphic organizer, or a PowerPoint show – any method that conveys the information they learned about the James Webb Space Telescope. Your teacher will direct you to work individually or in small groups. You may be instructed to make your presentation to another student, to a group of students, or to the entire class.

Education Standards

AAAS Benchmarks: Project 2061
http://www.project2061.org/publications/bsl/online/index.php
3. The Nature of Technology
A. Technology and Science
By the end of the 8th grade, students should know that:
• Technology is essential to science for such purposes as access to outer space and other remote locations, sample collection and treatment, measurement, data collection and storage, computation, and communication of information.

4. The Physical Setting
A. The Universe
By the end of the 12th grade, students should know that:
• Increasingly sophisticated technology is used to learn about the universe. Visual, radio, and X-ray telescopes collect information from across the entire spectrum of electromagnetic waves; computers handle data and complicated computations to interpret them; space probes send back data and materials from remote parts of the solar system; and accelerators give subatomic particles energies that simulate conditions in the stars and in the early history of the universe before stars formed.

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Educational Product
Educators & Students | Grades 6 –12