

Greatest Discoveries With Bill Nye: Astronomy

Teacher's Guide

Grade Level: 6–8

Curriculum Focus: Earth and Space

Lesson Duration: 1–2 class periods

Program Description

The Structure of Our Solar System – Explore how we came to understand that we live in a sun-centered solar system. *Observing Movement in Space* – Learn about the theory of general relativity and see how the Hubble Space Telescope changed the way we can view outer space. *Measuring Cosmic Radiation* – Examine the big bang theory and the discovery that provided evidence to support it. *The Golden Age of Astronomy* – Explore the golden age of astronomy and the mystery of our accelerating universe.

Discussion Questions

- What are some important discoveries in astronomy?
 - How do we know that our solar system is sun-centered?
 - Why do we study outer space? What can we learn from astronomy?
 - What do we know about our galaxy?
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Video Index

Segment 1: Solar System Structure (11 min.)

Description

Galileo's invention of the telescope gave people a way to begin to see our solar system and its complexities. Discover how Nicholas Copernicus, Johannes Kepler, and Galileo revolutionized astronomy.

Pre-viewing question

Q: How can you tell that the Earth is in constant motion?

A: Answers will vary.

Post-viewing question

Q: What did Galileo do that revolutionized our understanding of the solar system?

A: In making his telescope, Galileo essentially converted a toy into a scientific instrument. He was the first to see the mountains on the moon and the star clusters of the Milky Way, and he

observed a group of small, bright stars around Jupiter, which he later could determine were four moons orbiting the planet. With this information, he could prove that Copernicus was correct about the structure of the sun-centered solar system.

Segment 2: Observing Movement in Space (9 min.)

Description

Albert Einstein's theory of general relativity revealed that space is even stranger than previously thought. Learn how discoveries by Einstein and other scientists changed the way we see outer space.

Pre-viewing question

Q: What have you observed in the night sky?

A: Answers will vary.

Post-viewing question

Q: What was William Herschel's great discovery?

A: William Herschel identified Uranus; it was the first discovery of a planet in more than 3,500 years. He also built a powerful telescope to systematically count the stars; he showed that the Milky Way was a gigantic disk of stars, and his star count revealed that our galaxy was much larger than previously believed. His discoveries helped scientists see that solar system was just a small part of a deep and expansive universe.

Segment 3: Measuring Cosmic Radiation (7 min.)

Description

See how radio astronomy helped define the beginnings of our universe, and learn how physicists Arno Penzias and Robert Wilson proved the big bang theory with their cosmic radiation data.

Pre-viewing question

Q: What do you know about the big bang theory?

A: Answers will vary.

Post-viewing question

Q: Why is the steady-state theory no longer generally accepted?

A: The steady-state theory proposed that the universe is timeless, expanding forever with no beginning or end. When physicists Arno Penzias and Robert Wilson set out to measure the temperature of the gas halo surrounding the Milky Way galaxy, they found that their measurements were consistently off by several degrees. They brought their information to Princeton University, where it was determined that the static detected was evidence of a faint thermal afterglow in the universe – and such traces of heat were consistent with the big bang theory. By measuring the radiation that proved the big bang theory, Penzias and Wilson negated the steady-state theory.



Segment 4: The Golden Age of Astronomy (12 min.)

Description

Monumental discoveries mark the current golden age of astronomy. Learn about gamma ray bursts, the possibilities of extrasolar planetary systems, and the mysterious acceleration of the universe.

Pre-viewing question

Q: Do you think other planetary systems exist?

A: Answers will vary.

Post-viewing question

Q: Why do you think the universe is accelerating?

A: Answers will vary.

Lesson Plan

Student Objectives

- Investigate important discoveries in astronomy.
- Understand how we know what we know about our solar system and universe.
- Write news articles detailing an important discovery in astronomy

Materials

- *Greatest Discoveries With Bill Nye: Astronomy* program
- Encyclopedias and science texts
- Pencils and erasers
- Paper
- Newspapers (to share news stories with the class)
- Computer with Internet access (optional)

Procedures

1. Talk about important discoveries in astronomy. Introduce this topic by showing *Greatest Discoveries With Bill Nye: Astronomy*. Beforehand, tell students to take notes on the discoveries they find most interesting.
2. After viewing the program, talk about the discoveries that have changed the way we see our solar system and universe. What do you think was the most important discovery in astronomy?



How did it come to be? What did it tell us? How did it change the future of astronomy and how we see the universe?

3. Tell students to imagine that they are reporters for a newspaper. Each student should write a news story about the discovery they found the most interesting or significant in *Greatest Discoveries With Bill Nye: Astronomy*. Have students write the news stories as if they were taking place at the time the discovery was proved. The stories should be exciting and creative and include the following facts:
 - What is the discovery? (name and a brief explanation)
 - Who made the discovery?
 - Where and when did it happen?
 - How did it come about?
 - What does it tell us about the solar system or universe?
 - How was it proved?
 - Did it change any current theories or beliefs? If so, what and how?
 - Predictions for what it could mean for the future
4. Share some examples of news stories with the class and discuss common the features. Student stories should also include an attention-grabbing headline and a dateline and byline.
5. Give students time in class to work on their news stories or assign as homework. The following Web sites may be helpful to students:
 - http://www.cv.nrao.edu/fits/www/yp_history.html
 - <http://www.geocities.com/CapeCanaveral/Launchpad/4515/HISTORY.html>
 - <http://www.physlink.com/Education/History.cfm#astro>
 - <http://antwrp.gsfc.nasa.gov/htmltest/jbonnell/www/grbhist.html>
 - <http://csep10.phys.utk.edu/astr161/lect/>
6. Have all students type their stories on the computer to create a class newspaper for each student. Allow time in class for to read the stories and talk about the discoveries in astronomy.

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- **3 points:** Students were highly engaged in class discussions; wrote creative and coherent news stories about a particular discovery in astronomy that correctly addressed the stated criteria; and demonstrated a good understanding of how discoveries in astronomy changed the way we see our solar system and universe.



- **2 points:** Students were engaged in class discussions; wrote somewhat creative and coherent news stories about a particular discovery in astronomy that correctly addressed most of the stated criteria; and demonstrated a basic understanding of how different discoveries in astronomy changed the way we see our solar system and universe.
- **1 point:** Students participated minimally in class discussions; wrote incomplete or incoherent news stories about a particular discovery in astronomy that correctly addressed little to none of the stated criteria; and were unable to demonstrate a basic understanding of how different discoveries in astronomy changed the way we see our solar system and universe.

Vocabulary

cosmos

Definition: A complex and orderly system such as our universe

Context: According to Bill Nye, a blueprint is necessary to march ahead to the physics of the cosmos.

galaxy

Definition: Any of the very large groups of stars, gas, and dust that are found throughout the universe, containing an average of 100 billion solar masses and ranging in diameter from 1,500 to 300,000 light-years

Context: Astronomer Edwin Hubble estimated that galaxies were usually many hundreds of thousands, even millions, of light-years away.

orbit

Definition: The path of a celestial body or an artificial satellite as it revolves around another body

Context: Albert Einstein believed that his concept of curved space was responsible for shifting Mercury's orbit.

paradigm

Definition: An outstandingly clear or typical example pattern, or model

Context: A paradigm shift in science may take generation for people to accept it.

telescope

Definition: An arrangement of lenses, mirrors, or both that gathers visible light, permitting direct observation or photographic recording of distant objects

Context: Turning his telescope skyward, Galileo was the first to see the mountains on the moon.

theory

Definition: A set of statements or principles devised to explain a group of facts or phenomena, especially one that has been repeatedly tested or is widely accepted and can be used to make predictions about natural phenomena



Context: Science required a theory that could explain gravity.

radiation

Definition: Energy that comes from a source and travels through some material or through space

Context: In our universe, we're seeing big bang radiation some 300,000 years after it occurred.

universe

Definition: The whole cosmic system of matter and energy of which the Earth is a part

Context: Herschel's discovery revealed that our solar system was an island in a deep and expansive universe.

Academic Standards

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K-12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>.

This lesson plan addresses the following science standards:

- Science as Inquiry: Understanding about scientific inquiry
- Physical Science: Properties and changes of properties in matter; interactions of energy and matter
- Earth and Space Science: Objects in the sky; Earth in the solar system; Origin and evolution of the universe
- Science and Technology: Understanding about science and technology
- Science in Personal and Social Perspectives: Science and technology in local, national, and global challenges
- History and Nature of Science: History of science; Historical perspectives; Science as a human endeavor

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit

<http://www.mcrel.org/compendium/browse.asp>

This lesson plan addresses the following national standards:

- Science—Earth and Space Science: Understands the composition and structure of the universe and the Earth's place in it



- Physical Science: Understands the sources and properties of energy
 - Science – Nature of Science: Understands the nature of scientific knowledge; Understands the nature of scientific inquiry
 - Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media; Writing: Gathers and uses information for research purposes; Reading: Uses reading skills and strategies to understand and interpret a variety of informational texts
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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