# *Elements of Earth Science*
# *The Universe and the Solar System*
# Teacher's Guide

| **Grade Level:** 6–12 | **Curriculum Focus:** Earth Science | **Lesson Duration:** Two class periods |
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## Program Description

Explore scientific theories about the origin of the universe, the formation of stars, planets, and galaxies. Learn why Earth is the only planet in our solar system capable of supporting life, what effect comets and asteroids have on the planet, and how the moon influences the tides.

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## Onscreen Questions

How does modern science explain the origins and development of the universe?

What existed before the big bang?

Will the universe expand forever?

How are stars and galaxies formed?

What are the origins and forces that shaped our solar system?

How are the planets alike, and how are they different?

How are comets, asteroids, and meteorites alike, and how are they different?

How do the Earth's shape, orbit, and the tilt of its axis determine the seasons?

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## Lesson Plan

### *Student Objectives*

Understand the big bang and the origins of the universe.

Determine similarities and differences between the planets.

Explain why Earth is the only planet capable of supporting life.

## *Materials*

*The Universe and the Solar System* video

Computer with Internet access

Print research materials

Travel brochures to a wide variety of destinations, the more exotic and faraway the better

Desktop publishing program or paper and markers

## *Procedures*

1. Discuss what it might be like to be a space traveler.
2. Hand out the travel brochures. Ask students if the brochures make them feel excited about traveling to the places described. If students say yes, tell the students the travel brochures have done their job. Ask students to point out specific words and pictures in the brochures that make the places seem inviting.
3. Discuss the factors that make a place a good travel destination. Students can infer these factors from the brochures or from their own experiences.
4. Tell students that they will be creating travel brochures for some very exotic, faraway places—the other eight planets of the solar system.
5. Divide your class into eight groups, and assign each group a planet. The students should begin by researching their planet. They should list all of the scientific details they can find, including such things as the planet's size, composition, surface features, satellites, distance from the sun and Earth, and its relationship to other planets in the solar system.

   The following web sites have useful information about the planets and the solar system. They are a good starting point for exploring this topic:

   - http://amazing-space.stsci.edu/eds/astronomy-basics.php - solarsystem
   - http://www.nineplanets.org/
   - http://space.jpl.nasa.gov/
   - http://csep10.phys.utk.edu/astr161/lect/
   - http://www.windows.ucar.edu/tour/link=/our_solar_system/solar_system.html
6. Have students use their imaginations to invent details like those in the travel brochures they read. For example, their brochures might cover things like accommodations, restaurants, recreational activities, sites to tour, weather conditions, travel and dress requirements, and indigenous life forms, if any. Students should be sure to call attention to some authentic details about the planet in question. For example, students working with the planet Mars could plan a sightseeing expedition to Olympus Mons, an extraordinarily large and active volcano on Mars' surface.

7. Have students sketch out their brochure on a piece of paper. Remind them to use pictures, graphics, and words to "sell" their planet. Once they've designed the brochure have them create it on a computer or with paper.
8. Have the groups exchange and evaluate each other's brochures. Have them respond to these questions:
   - Does the brochure include information about the planet that is scientifically accurate?
   - Does the brochure do a good job of "selling" the proposed planetary trip?

## *Assessment*

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

**3 points:** Students were highly engaged in class discussions; conducted thorough research; created an attractive and informative brochure.

**2 points:** Students were somewhat engaged in class discussions; conducted adequate research; created an acceptable brochure.

**1 point:** Students were not engaged in class discussions; conducted inadequate research; did not complete an acceptable brochure.

## *Vocabulary*

**atmosphere**

*Definition:* The envelope of gases that surround a planet or celestial body

*Context:* Earth is the only planet with an atmosphere of oxygen and nitrogen.

**big bang**

*Definition:* The theory that the universe began with the explosion of a single infinitesimally small and dense point

*Context*: Scientists believe that at the instant of the big bang all the matter in the universe began to expand outward at tremendous speed.

**galaxy**

*Definition:* A very large groups of stars and associated matter

*Context:* A galaxy may contain hundreds of billions of stars.

**inner planets**

*Definition:* The four planets closest to the sun —Mercury, Venus, Earth, and Mars

*Context:* The inner planets are composed primarily of rock and metal, and are relatively small.

**meteorites**

*Definition:* A meteor that reaches the surface of the Earth

*Context:* Most meteorites are small, leaving little impact when they reach the ground, but some can create large craters, such as the Barringer Crater in Arizona.

**outer planets**

*Definition:* The five planets farthest from the sun—Jupiter, Saturn, Uranus, Neptune, and Pluto

*Context:* Except for Pluto, the outer planets are composed mainly of hydrogen and helium gas and liquid, and are also known as "gas giants."

**singularity**

*Definition:* A point or region of infinite mass at which space and time are infinitely distorted by gravitational forces and which is held to be the final state of matter falling into a black hole

*Context:* Scientists believe that 14 or 15 billion years ago, all the matter in the universe was contracted to a singularity.

## *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 national standards:

- Earth and Space Science: Origin and evolution of the universe; Earth in the solar system

**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 Sciences—Understands the composition and structure of the universe and the Earth's place in it
- Science: Physical Sciences—Understands the structure and properties of matter

## 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

## DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

### *How To Use the DVD*

The DVD starting screen has the following options:

***Play Video***—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

***Video Index***—Here the video is divided into sections indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

***Curriculum Units***—These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

***Standards Link***—Selecting this option displays a single screen that lists the national academic standards the video addresses.

***Teacher Resources***—This screen gives the technical support number and Web site address.

### *Video Index*

**I. The Big Bang and the Origin of the Universe (4 min.)**

Scientists believe that all the matter in the universe was once condensed into a single, infinitesimal point, and then, in an instant, everything began to expand.

*Pre-viewing question:*

Q: How does modern science explain the origins and development of the universe?
A: Answers will vary.

*Post-viewing question:*

Q: What existed before the big bang? Will the universe expand forever?
A: No one knows for sure, but scientists believe that an infinitesimally small point, called a singularity, held all the matter of the universe. The universe expanded outward at tremendous speed, forming everything that exists, including galaxies, planets, rocks, and living things. One theory says the universe will expand forever. Another holds that at a certain point, gravity will pull all matter back together until there is a new singularity.

**II. Stars, Galaxies and the Milky Way (5 min.)**

Stars and galaxies form in the interstellar gas and dust leftover from the big bang.

*Pre-viewing question:*

Q: How are stars and galaxies formed?
A: Answers will vary.

*Post-viewing question:*

Q: What shapes and features do galaxies have?

A: Galaxies can be spiral, such as our Milky Way, containing dust and stars surrounding a central bulge. New stars form in the spiral arms. Irregular galaxies have no particular shape, but are the location of new star formation. Elliptical galaxies are rounder or more oval-shaped. They have converted almost all of their gaseous material and are not creating new stars.

**III. The Origin of the Solar System (6 min.)**

Gravity caused gas and dust to collapse and condense billions of years ago to form the sun and the planets in the solar system.

*Pre-viewing question:*

Q: What are the origins and forces that shaped our solar system?
A: Answers will vary.

*Post-viewing question:*

Q: How did the sun impact the formation of our solar system's planets?
A: Closer to the sun, planets formed from heavier atoms, and are primarily composed of rock and metal. In the colder regions farther from the sun, the planets are mostly composed of gases like

hydrogen and helium. The sun's mass creates a strong gravitational field that holds the planets and other materials in orbit around it.

**IV. The Inner and Outer Planets (5 min.)**

The planets in our solar system have similarities and differences, but only Earth supports life.

*Pre-viewing question:*

Q: How are the planets alike and how are they different?
A: Answers will vary.

*Post-viewing question:*

Q: What are some of the unique features of the inner planets?
A: Earth and Venus still retain heat in their cores. Earth is the only planet with an atmosphere of oxygen and nitrogen, capable of supporting life. Seventy-one percent of Earth is also covered with water, while other planets only have small amounts. Mercury and Venus are the only planets without a moon.

**V. Comets, Asteroids, and Meteorites (5 min.)**

Comets, asteroids and meteors may be leftover debris from the big bang and some have impacted Earth.

*Pre-viewing question:*

Q: How are comets, asteroids, and meteorites alike and how are they different?
A: Answers will vary.

*Post-viewing question:*

Q: How have asteroids or meteorites left their mark on the Earth?

A: Most meteorites leave little impact, but larger asteroids can strike the ground and create large craters, like the Barringer Crater in Arizona. It is now thought that a huge asteroid struck Earth about 65 million years ago, leading to the extinction of the dinosaurs.

**VI. The Earth's Orbit (5 min.)**

The orbit, rotation and tilt of Earth affect seasons, temperature, and climate.

*Pre-viewing question:*

Q: How do Earth's shape, orbit and the tilt of its axis determine the seasons?
A: Answers will vary.

*Post-viewing question:*

Q: What may be responsible for periods of warmer and cooler temperatures on the Earth?
A: When the sun has fewer sunspots, it gives off less energy; this is thought to be responsible for periods of cooler Earth temperatures. Changes in Earth's orbit and tilt may also cause periods of significant temperature change.