

# *Discovery Science Library*

## *The Basics: Space Science Teacher's Edition*

### **Teacher's Guide**

**Grade Level:** K–8

**Curriculum Focus:** Space Science

This Space Science Library includes the following segments: Galaxies; Our Revolving Earth and Moon; The Solar System; The Sun; and Tools of Exploration.

#### **I. GALAXIES**

##### **A. Characteristics of Galaxies**

###### **Main Points**

- A galaxy is a large group of stars, dust, and gas held together by gravity.
- There are three kinds of galaxies – spiral, elliptical, and irregular. Our galaxy, the Milky Way, is a spiral galaxy.
- Telescopes magnify distant objects, and telescopes work in different ways. Optical telescopes collect visible light and use it to form an image; radio telescopes capture radio waves given off by objects. The Hubble Space Telescope operates from space.

###### **Discussion Questions**

Before showing this segment, ask students the following:

- What galaxy do we live in?
- Why are telescopes important tools?

After showing this segment, find out what students have learned:

- How do scientists measure celestial distances?
- What was Edwin Hubble's discovery, and why was it significant?

##### **B. Stars**

###### **Main Points**

- A star forms from a nebula, or a cloud of dust and gas, which gravity caused to shrink and start spinning.
- A star gives off heat and light through nuclear fusion, during which the star converts hydrogen into helium.

- A medium-size star like our sun goes from being a red giant to a white dwarf to a black dwarf, which marks the end of its life. A very massive star undergoes a tremendous explosion called a supernova, after which it becomes a neutron star or a black hole.

### **Discussion Questions**

Before showing this segment, ask students the following:

- What is a star?
- How does a star produce energy?

After showing this segment, find out what students have learned:

- How do scientists measure the mass and temperature of a star?
- What stages mark the end of life for a medium-size star, such as the sun?

## **II. OUR REVOLVING EARTH AND MOON**

### **A. Rotation and Revolution**

#### **Main Points**

- The Polish astronomer Nicolaus Copernicus put forth the idea that the sun is motionless at the center of the solar system and that all objects in the sky revolve around it.
- It takes Earth approximately 365 days to complete one revolution around the sun.
- It takes Earth 23 hours and 56 minutes to complete one full rotation on its axis, a time period called the sidereal day. The time it takes Earth to complete one rotation relative to the sun is called the solar day, which is what we use to measure the length of one day.

### **Discussion Questions**

Before showing this segment, ask students the following:

- What does rotation mean?
- How long does it take Earth to orbit the sun?

After showing this segment, find out what students have learned:

- What is the Copernican concept of the solar system?
- What is the difference between the sidereal day and the solar day?

## **B. Seasons**

### **Main Points**

- When a planet is closest to the sun, it is at perihelion; farthest from the sun, it is at aphelion.
- During the summer solstice, June 21, the Northern Hemisphere experiences the longest period of daylight for the year. On December 21, the Northern Hemisphere experiences winter solstice, the shortest period of daylight.
- An equinox is when the sun is directly above the equator. The vernal equinox, March 21, marks the beginning of spring in the Northern Hemisphere. The autumnal equinox, September 23, marks the beginning of fall.

Before showing this segment, ask students the following:

- What do you think causes the seasons?
- When does each season begin in the Northern Hemisphere?

After showing this segment, find out what students have learned:

- What do the terms "perihelion" and "aphelion" mean?
- What are the summer solstice and the winter solstice?

## **C. Tides, Lunar Phases, and Eclipses**

### **Main Points**

- Earth's pull on the moon results in tidal coupling, causing the moon's rotation and revolution to be synchronized.
- The moon's phases are the result of its orbit around Earth, which causes its appearance to change depending on its position relative to Earth and the sun.
- A lunar eclipse occurs when Earth comes between the sun and the full moon. A solar eclipse occurs when the moon moves between Earth and the sun, blocking some or all of the sun's light from reaching part of Earth.

Before showing this segment, ask students the following:

- What do you think is unique about Earth's relationship to the moon?
- What causes the moon's phases?

After showing this segment, find out what students have learned:

- What is tidal coupling?
- What is the difference between a lunar eclipse and a solar eclipse?



### III. THE SOLAR SYSTEM

#### A. How the Solar System Formed

##### Main Points

- The solar system formed about 10 to 15 billion years ago, when matter in the universe condensed and then exploded, expanding equally in all directions.
- The sun began as a nebula. Gravity pulled gas and dust to the center of the nebula until there was enough energy for nuclear fusion to begin.
- Many scientists believe that Pluto is the outermost edge of the solar system, but others think that the solar system extends another 50 miles to the Oort Cloud, comets that surround the sun.

##### Discussion Questions

Before showing this segment, ask students the following:

- How do you think the solar system formed?
- How big do you think the solar system is?

After showing this segment, find out what students have learned:

- How did the sun form?
- What are two models of the solar system?

#### B. The Planets

##### Main Points

- The inner planets are Earth, Mercury, Venus, and Mars. The outer planets are Jupiter, Saturn, Uranus, Neptune, and Pluto.
- Some scientists think that Pluto is a planet, but others think that it is an exceptionally large comet.
- Voyager and Galileo spacecraft have sent images to Earth showing storms and cloud formations on Jupiter.

##### Discussion Questions

Before showing this segment, ask students the following:

- What do you know about the planets?
- How do scientists study planets?



After showing this segment, find out what students have learned:

- What is the difference between the inner and outer planets?
- Why are scientists debating whether Pluto is really a planet?

### **C. Comets and Asteroids**

#### **Main Points**

- The three parts of a comet are the tail; nucleus, made of ice and dust; and coma, gas particles surrounding the nucleus.
- Asteroids are made of the same materials as planets, but they are much smaller.
- Meteoroids are space rocks that can enter Earth's atmosphere. When a meteoroid burns, it becomes a meteor, or a streak of light. The part that doesn't burn and falls to Earth is a meteorite.

#### **Discussion Questions**

Before showing this segment, ask students the following:

- What do you know about comets and asteroids?
- What is the difference between a meteoroid and a meteorite?

After showing this segment, find out what students have learned:

- What are the three parts of a comet?
- What evidence do scientists have that comets and asteroids have collided with Earth?

## **IV. THE SUN**

### **A. Characteristics of Stars and the Sun**

#### **Main Points**

- Our star nearest is the sun, which produces the energy that sustains life on Earth.
- Stars vary in size, mass, luminosity, and magnitude.
- Our sun is a medium-size star with surface temperatures between 4,900 and 6,000 degrees Celsius.

#### **Discussion Questions**

Before showing this segment, ask students the following:

- What do you know about stars?



- What do you know about the sun?

After showing this segment, find out what students have learned:

- Why is the sun essential to life on Earth?
- How do yellow stars, like our sun, compare to red and blue stars?

## **B. Structure of the Sun**

### **Main Points**

- The sun's atmosphere has three layers: photosphere, chromosphere, and corona.
- The photosphere is the lowest and densest region of the sun and the source of sunlight.
- The chromosphere, a reddish rim of gas, surrounds the photosphere. The corona is the outermost region of the solar atmosphere.

### **Discussion Questions**

Before showing this segment, ask students the following:

- How does the sun affect daily life on Earth?
- What do you know about the sun's structure?

After showing this segment, find out what students have learned:

- What are the sun's three layers?
- What are sunspots?

## **C. The Sun's Energy and the Solar Wind**

### **Main Points**

- An erupting solar flare is equal in power to one billion hydrogen bombs.
- Solar wind is the emission of charged particles – electrons and protons – from the sun. Earth's magnetosphere offers some protection against solar wind, but it can enter the upper atmosphere.
- Solar storms can cause power outages and disruptions in communication.

### **Discussion Questions**

Before showing this segment, ask students the following:

- What do you know about solar flares?



- What do you know about solar wind?

After showing this segment, find out what students have learned:

- What is solar wind?
- What took place in Canada after the solar storm on March 13, 1989?

## V. TOOLS OF EXPLORATION

### A. Solving Problems through Technology

#### Main Points

- Always been curious about the universe, people have sought ways to explore it.
- Different telescopes provide information about the universe: Optical telescopes collect light to produce an image, and the Very Large Array in New Mexico uses radio signals.
- Orbiting spacecraft send pictures from space, showing volcanoes on Jupiter's moons and winds on Saturn.

#### Discussion Questions

Before showing this segment, ask students the following:

- Why do you think people are interested in learning about the universe?
- What questions do you have about space?

After showing this segment, find out what students have learned:

- What is the difference between a refracting and a reflecting telescope?
- What have we learned from the Hubble Space Telescope?

### B. Supporting Science with Technology

#### Main Points

- Science asks how and why things happen; technology uses science to design devices that can change the world.
- The space program is a good example of science and technology working together.
- Bulletproof vests, shock absorbers in shoes, and other spin-off products came about by applying technology developed for the space program to life on Earth.

#### Discussion Questions

Before showing this segment, ask students the following:

- What is the relationship between science and technology?



- How does technology affect your daily life?

After showing this segment, find out what students have learned:

- Why is the space program a good example of science and technology working together?
  - What are two examples of spin-offs?
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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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## 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 (see below), 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.

**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. GALAXIES**

#### **Characteristics of Galaxies**

Explore the sky and learn about the three kinds of galaxies—spiral, elliptical, and irregular. Observe different telescopes and find out what each reveals about the universe.

#### **Stars**

Observe stars and discover what they are made of. Find out how astronomers measure a star's mass and temperature, and learn about a star's life cycle.

### **II. OUR REVOLVING EARTH AND MOON**

#### **Rotation and Revolution**

Learn about Earth's relationship to the sun and the difference between sidereal and solar time. Discover what causes day and night.

#### **Seasons**

Discover how Earth's tilt affects the seasons. Find out the summer and winter solstice in each hemisphere and all about the vernal and autumnal equinoxes.

#### **Tides, Lunar Phases, and Eclipses**

Explore the moon's relationship to Earth, and find out why its rotation and revolution are synchronized. Observe the moon's phases, and learn about different kinds of eclipses.

### **III. THE SOLAR SYSTEM**

#### **How the Solar System Formed**

Find out how the solar system formed and observe a model illustrating its vast distances.

#### **The Planets**

Discover the differences between the inner and outer planets. Listen to scientists debate Pluto's status as a planet, and observe photographs of Jupiter from spacecraft.

#### **Comets and Asteroid**

Check out Comet Hale-Bopp, discovered by amateur astronomers. Identify a comet's parts and observe asteroids. Discover what scientists learn from meteorites.

### **IV. THE SUN**

#### **Characteristics of Stars and the Sun**

Learn about the sun, our closest star. Find out why it is essential to life on Earth. Compare the sun's size and temperature to other stars.

#### **Structure of the Sun**

Explore the three layers of the sun's atmosphere: photosphere, chromosphere, and corona. Learn about sunspots and prominences, and observe vivid images.



### **The Sun's Energy and the Solar Wind**

Observe solar flares, solar wind, and solar storms, beautiful but disruptive phenomena. See how these events affect Earth.

## **V. TOOLS OF EXPLORATION**

### **Solving Problems Through Technology**

Find out how technology has led to some wondrous discoveries. Learn about tools built to explore the universe, from optical telescopes to orbiting telescopes to spacecraft.

### **Supporting Science With Technology**

See how the space program evolved from a combination of scientific curiosity and technological knowledge. Find common examples of spin-off products.

### *Academic Standards*

This library addresses the following national standards.

#### *National Academy of Sciences*

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

Grades K-4: Space Science: Objects in the sky; Changes in earth and sky

Grades 5-8: Space Science: Structure of the earth system; Earth in the solar system

#### *Mid-continent Research for Education and Learning*

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

Understands the composition and structure of the universe and Earth's place in it.