WORLD BOOK PRESENTS:

Innovations of Space & Time

FEATURING:

A Timeline Of
Explore the Solar System
Explore the Universe
Out of This World
Discovery Science Encyclopedia

WORLD BOOK STEM

Science, Technology, Engineering and Mathematics (STEM) are at the heart of a technological revolution which is transforming the way we live and the way we work.

Students naturally engage in early STEM exploration through hands-on multisensory and creative experiences. By engaging in these experiences, young children are developing curiosity, inquisitiveness, critical-thinking and problem-solving capacities which are built on through their primary and post-primary school experience.

A Timeline Of…

Look at major technological innovations from their first appearance in human history to its present-day development.

Explore the Solar System

Master solar system basics with topics ranging from early efforts in space exploration to some of the most recent discoveries.

Explore the Universe

Examine celestial wonders beyond the solar system, covering the most important objects in the universe and how scientists study them.

Out of This World

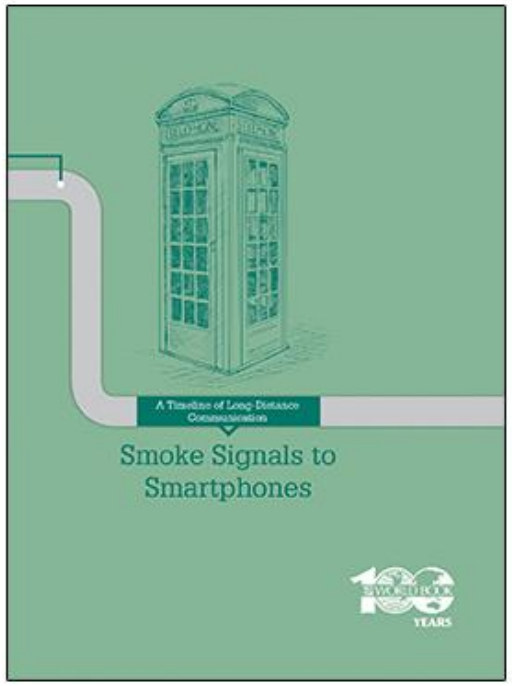
Explore the next frontiers of space with this exclusive series developed in collaboration with NASA.

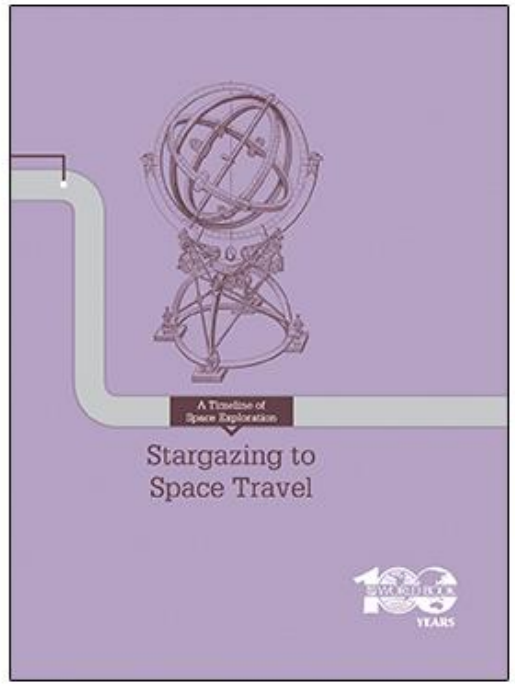
Discovery Science Encyclopedia

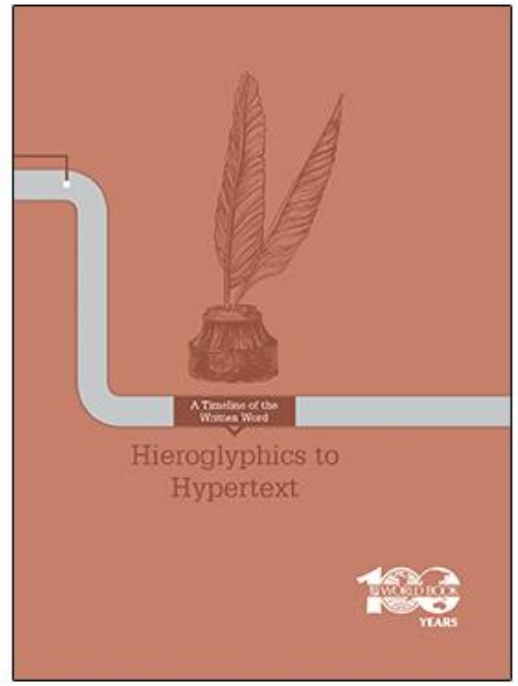
Enhance research skills and knowledge retention in this introduction to core science topics with extension activities and experiments.

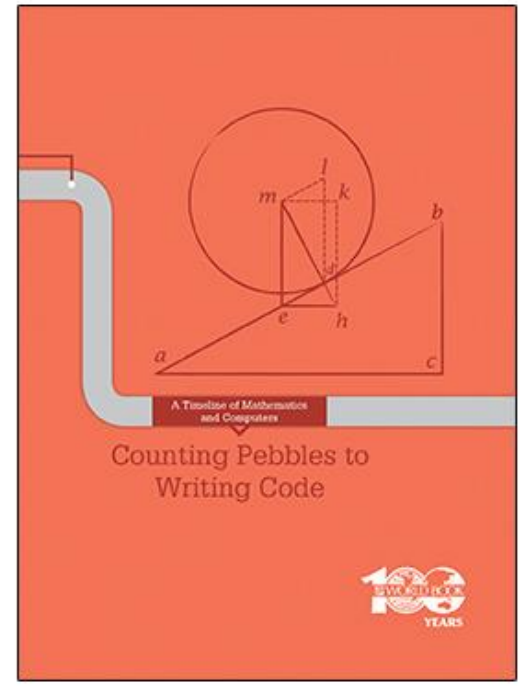
A TIMELINE OF…

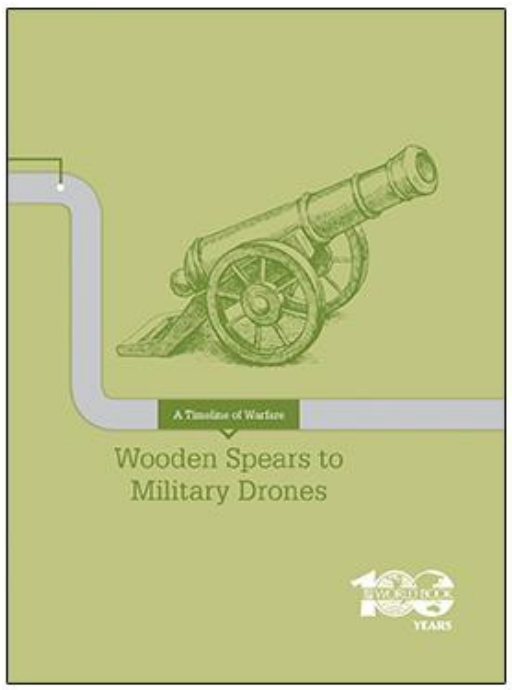
Recommended Age Rage: 7-11
Hard Cover, 8 volumes, 40 pages each

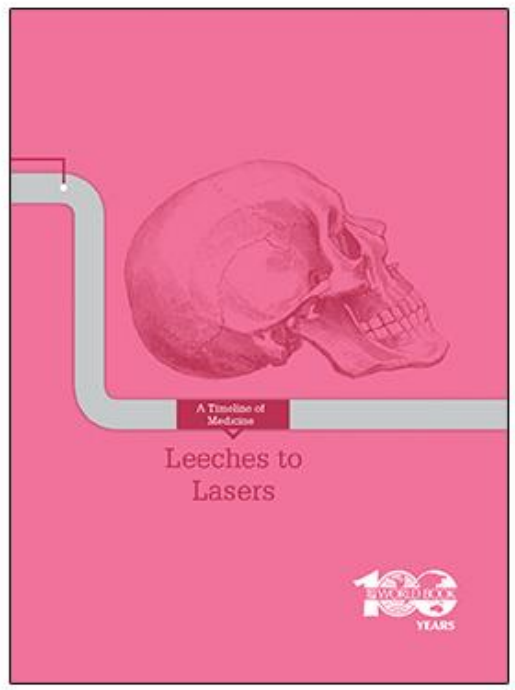


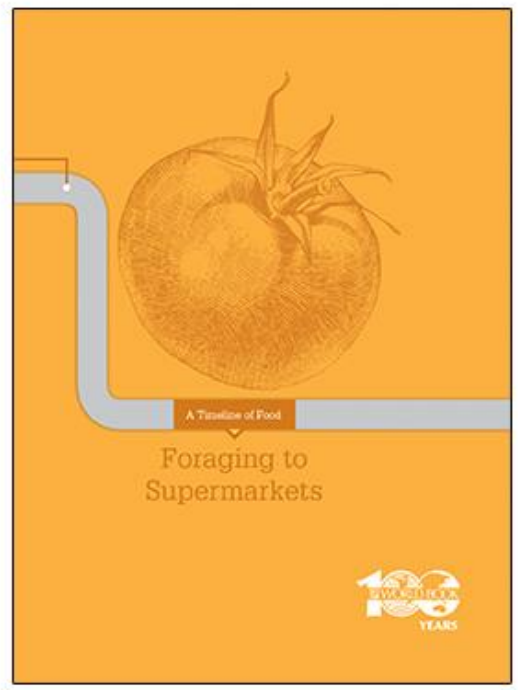


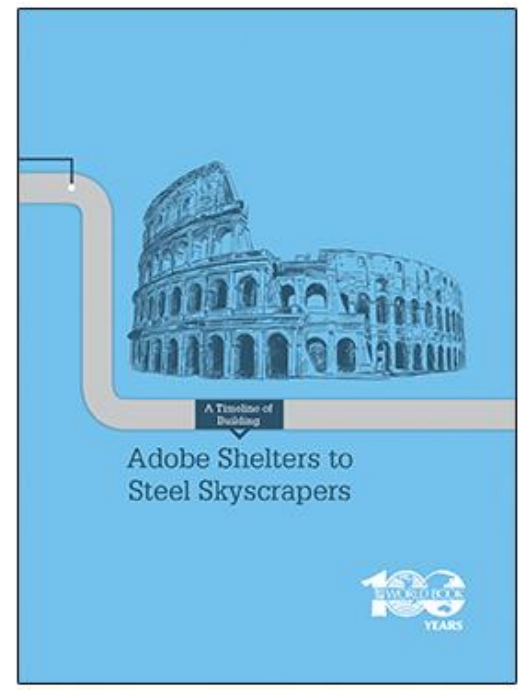












Provides a visual presentation of the topic to help reinforce information from textbooks and classroom lectures.

Ancient World Mathematics

Before 20,000 B.C.—c. 200 B.C.

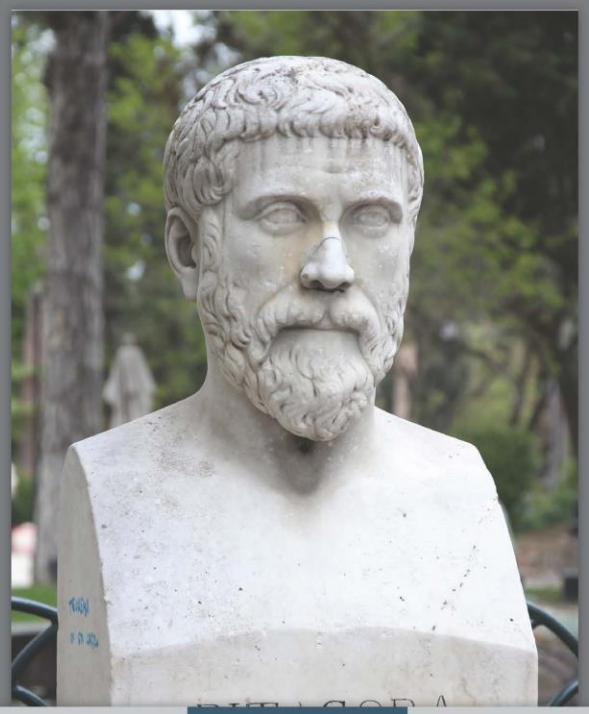
Across the Mediterranean Sea from Egypt, people in another large civilization became masters of mathematics. Philosophers, or thinkers, of Ancient Greece were fascinated by the shapes in **geometry.** The word "geometry" comes from the Greek words for "Earth" and "to measure." Philosophers proved many new facts about shapes and numbers. They used **logic**—step-by-step thinking—to show how new facts followed from older ones.

For example, the Ancient Egyptians discovered that a "3-4-5" triangle has one **square angle.** Later, the Babylonians, who also lived in Mesopotamia, studied the "3-4-5" triangle. They discovered another interesting pattern about this triangle. If the triangle's sides are turned into squares, then the "3" and "4" squares, added together, have the same area, or surface space, as the "5" square. Using the work of the Egyptians and Babylonians, Greek philosophers used logic to prove that this fact is true for any triangle with a square angle. Their proof became known as the *Pythagorean theorem*. It is named after the philosopher Pythagoras.

The Greeks also used facts about triangles and angles to prove other ideas true. One Greek philosopher, Eratosthenes, used geometry to measure the size of Earth. He did this without leaving his home in northern Africa. He studied the angles of shadows and used logic to learn more about Earth.

Thales, a Greek philosopher, is thought to have been born around 625 B.C. According to tradition, Thales was the first to prove a geometric idea with step-by-step logic.

c. 625 B.C.



c. 580 B.C.

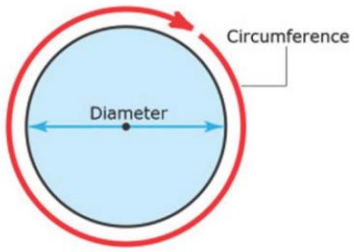
Greek philosopher Pythagoras (580?-? B.C.) is thought to have been born around 580 B.C. He taught geometry and explored numbers.

Alexander the Great (356-323 B.C.) founded the Greek city of Alexandria in Egypt. The city became a great center of learning.

331 B.C.

Greek mathematician Euclid is thought to have been born around 330 B.C. Euclid wrote a geometry book called *Elements*. This book gathered all of the Greeks' knowledge about geometry into one place. Euclid also explored **prime numbers.** A prime number can be divided evenly by 1 and itself. He proved there must be an unlimited amount of prime numbers.

c. 330 B.C.



Greek mathematician and inventor Archimedes is thought to have been born around 287 B.C. He explored one of the most important numbers in mathematics—**pi.** Pi—sometimes written with the Greek letter π—has to do with circles. A circle's *circumference* (outer boundary line) divided by its *diameter* (line that crosses through the center) always equals pi. Pi is not exactly equal to any fraction or decimal number.

c. 287 B.C.

Dynamic layout enables the reader to follow the narrative or browse from fact to fact.

Chapter 8

Computers Everywhere

Mid-1970's—today

In the early 1970's, most computers were used in businesses and government operations. They were too bulky and complicated for people to use at home. In 1975, the first small home computer, the Altair, went on sale to the public. The computer was sold as a kit for people to assemble, or build, at home. Two Americans named Bill Gates and Paul Allen founded a company called Microsoft Corporation. They wrote **programs** for the Altair. They use advanced mathematical concepts to write the computer programs

Americans Steven Jobs and Stephen Wozniak founded Apple Computer, Inc. in 1976. They sold a home computer that needed no assembly. In 1981, International Business Machines Corporation (IBM) offered its first personal computer (PC) to the public. Soon, small computers became common in homes, schools, and offices.

By the early 1990's, some computers were connected to the Internet. But the Internet's main users were computer scientists and military staff. In 1991, British scientist Tim Berners-Lee developed the World Wide Web. The Web made it easy to use the Internet from a personal computer. Soon, the amount of information available on the Web greatly increased. Companies developed computer programs called *search engines*. The search engines helped people enter a keyword to more easily find information.

1975

The first personal computer, the Altair, was released.

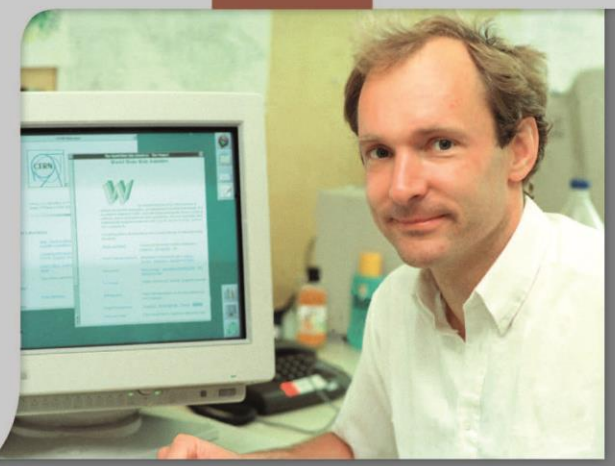
Apple Computer, Inc. (now Apple Inc.) was founded by Americans Steve Jobs (1955-2011) and Steve Wozniak (1950-...). The Apple II personal computer, released the following year, cost less than the big, powerful computers used by businesses. The Apple II computer was sold as an assembled unit, so people did not need to be experts to build or use it.

American inventors Bill Gates (1955-...) and Paul Allen (1953-...) founded Microsoft Corporation.

1975 **1976**

British scientist Tim Berners-Lee (1955-...) introduced the World Wide Web. Berners-Lee was working at the European Organization for Nuclear Research (CERN) near Geneva, Switzerland, when he had the idea for the World Wide Web. He thought the Web would help other scientists link to CERN's computer files. Today, people can use the Web to search for information about almost anything.

1991



1998

Google, Inc. launched its search engine. It helped people find information on the vast World Wide Web. Google's search engine works by counting *links* to websites. If many links lead to a given website, the search engine gives the website a higher rank, or level, in the results.

2002

The BlackBerry was the first popular smartphone, a phone that works like a small computer. A modern smartphone has more computing power than the NASA computers used on the Apollo moon-landing mission in 1969.

Breaks down complicated developments into manageable pieces while graphically showing interdependencies and continuity.

Chapter 1

The Ancient World

c. 3000 B.C.—c. A.D. 200

In ancient Egypt, India, China, Greece, and Rome, many people believed that good health depended on a person's lifestyle, environment, and the flow of *humors*, or energy, through *channels* that moved through the body. To treat the sick, healers used medicines, traditional cures, simple methods, and prayer. Early healers were not professionally trained. They learned medical practices by following tradition and from their own observations and experiences over time.

Ancient Egyptians thought that illness was the result of evil spirits entering the body and blocking its channels. Magic was used to cure the illness. Early medicines were made from foods, plants, shells, herbs, minerals, and animal parts. The Egyptians put honey on wounds to help them heal. Although the Egyptians did not understand how this process worked, scientists now know that honey kills **bacteria** living on a surface. Other ancient medical treatments, however, probably made the illness worse. Egyptian doctors sometimes put soil into a part of the body as a remedy. Rather than help, this method likely hurt the body's natural healing process. But the Egyptians were skilled at setting broken bones. They carried out such basic surgery as stitching serious skin wounds closed.

c. 3000 B.C.

Ancient Egyptians developed the first formal system of medicine.

c. 3000 B.C.–1000 B.C.

Ayurvedic medicine started in what is now the nation of India. Ayurvedic medicine is a system of care that focuses on a state of overall well-being and balance between physical, emotional, and spiritual parts of a person's life. The ancient Ayurvedic god of medicine was named Lord Dhanvantari.

c. 2500 B.C.

Evidence shows that acupuncture was widely used in areas of what is now the country of China. Acupuncture is the ancient practice of inserting needles into the body to relieve pain and illness.

c. 1550 B.C.

The Ebers Papyrus, an ancient Egyptian medical text, was written around 1550 B.C. It is one of the oldest medical documents ever discovered. It describes blood vessels in the human body and lists over 700 home remedies and magic formulas to cure sickness.

c. 1000 B.C.

Ayurvedic doctors in what is now India developed surgical techniques to treat many injuries and conditions. They used about 125 surgical instruments. They invented plastic surgery techniques to replace damaged noses and ears.

A TIMELINE OF...

Focus on Curriculum

English/Language Arts
Reading Informational Text

- Use text features and search tools (e.g., key words, sidebars, Table of Contents, captions) to locate information relevant to a given topic efficiently.
- Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.
- Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

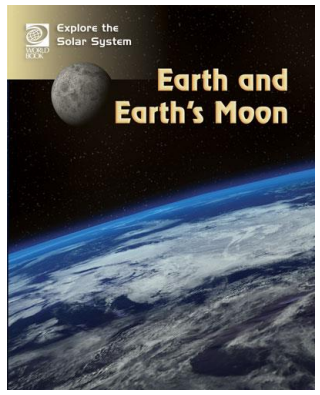
History/Social Studies/Science

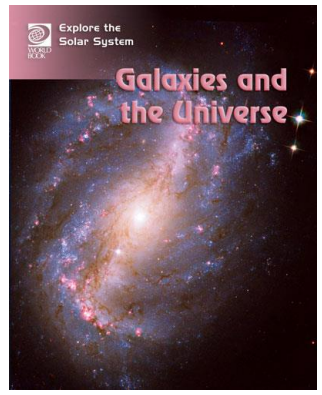
- Understand key features of ancient societies (farming, trade, social classes, religion, rule of law)
- Sequence information about events, developments, periods and phenomena using a timeline
- Describe how a text presents information (e.g., sequentially, comparatively, causally) and analyze how it uses structure to emphasize key points.
- Identify key steps in a text's description of a process related to history/social studies.
- Analyze in detail a series of events described in a text; determine whether earlier events caused later ones or simply preceded them.
- Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain
- Integrate visual information (e.g., in research data, charts, graphs, flowcharts, timelines, photographs, videos, or maps) with other information in print and digital texts.

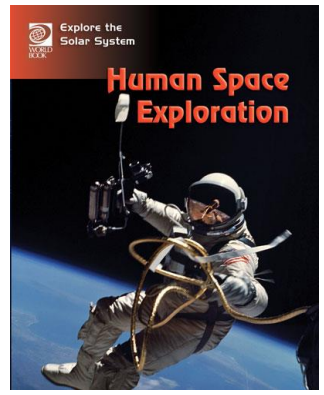
EXPLORE THE SOLAR SYSTEM & EXPLORE THE UNIVERSE

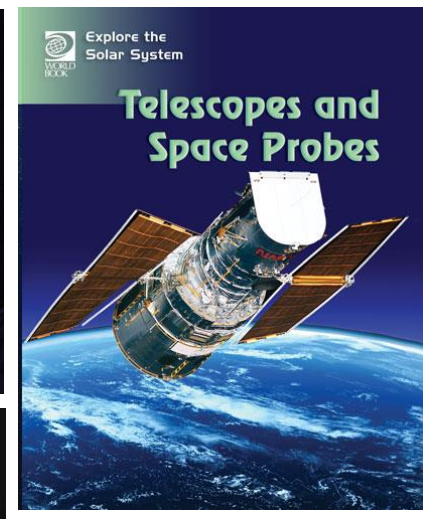
COMPANION SETS

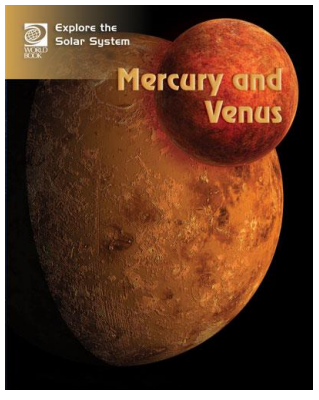
Recommended Age Rage: 8-14
Hard Cover, 10 volumes, 64 pages each

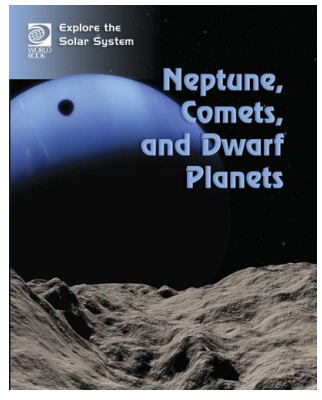


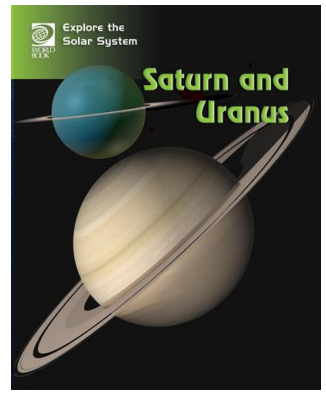


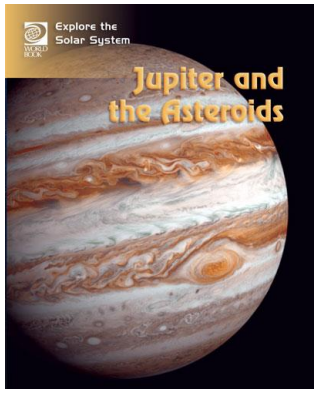


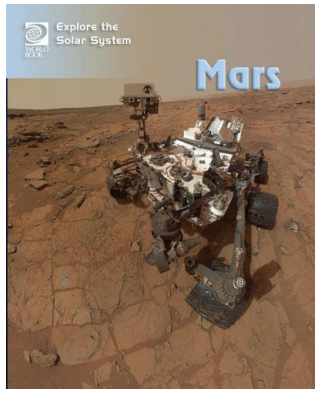


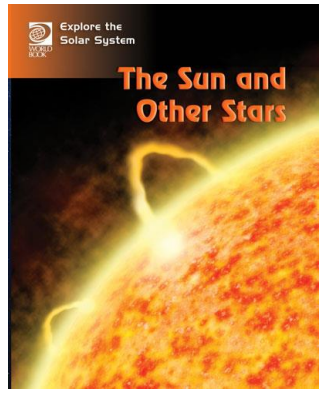


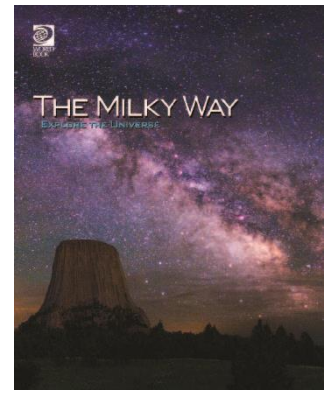


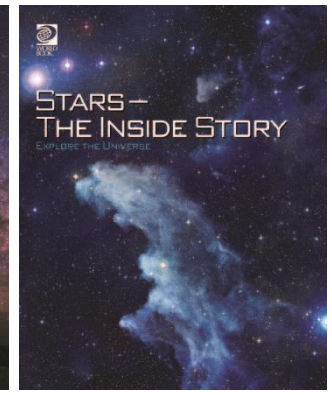


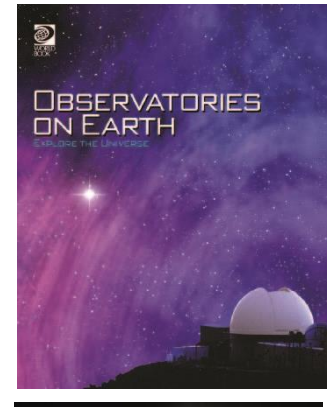


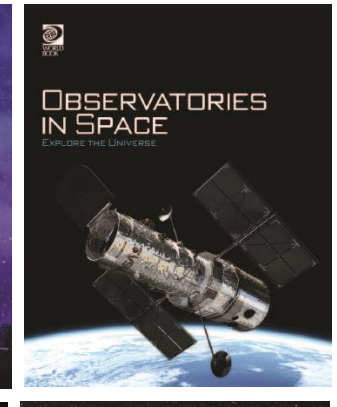


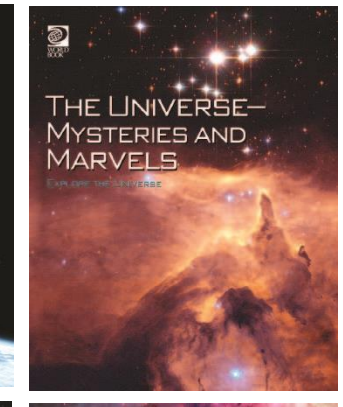


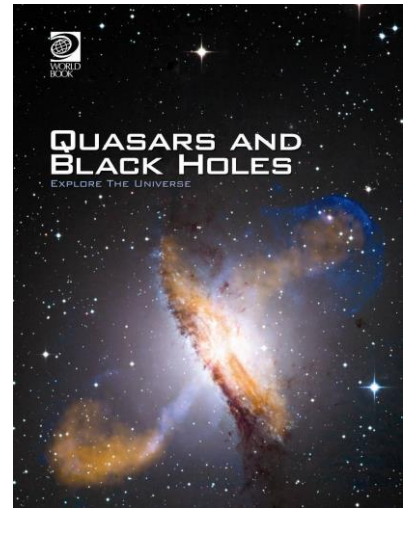


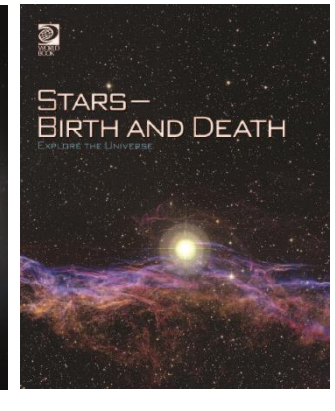


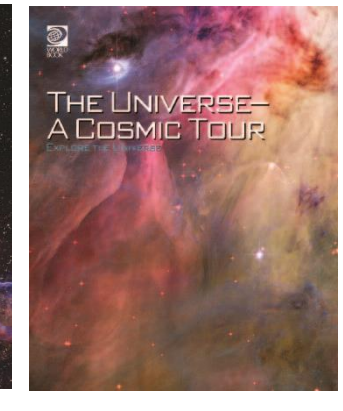












Together, the two sets cover astronomy curriculums from early primary through to high school.

What Is Earth Made Of?

Much of Earth is made of solid rock. Earth has three layers: the **crust, mantle,** and **core.**

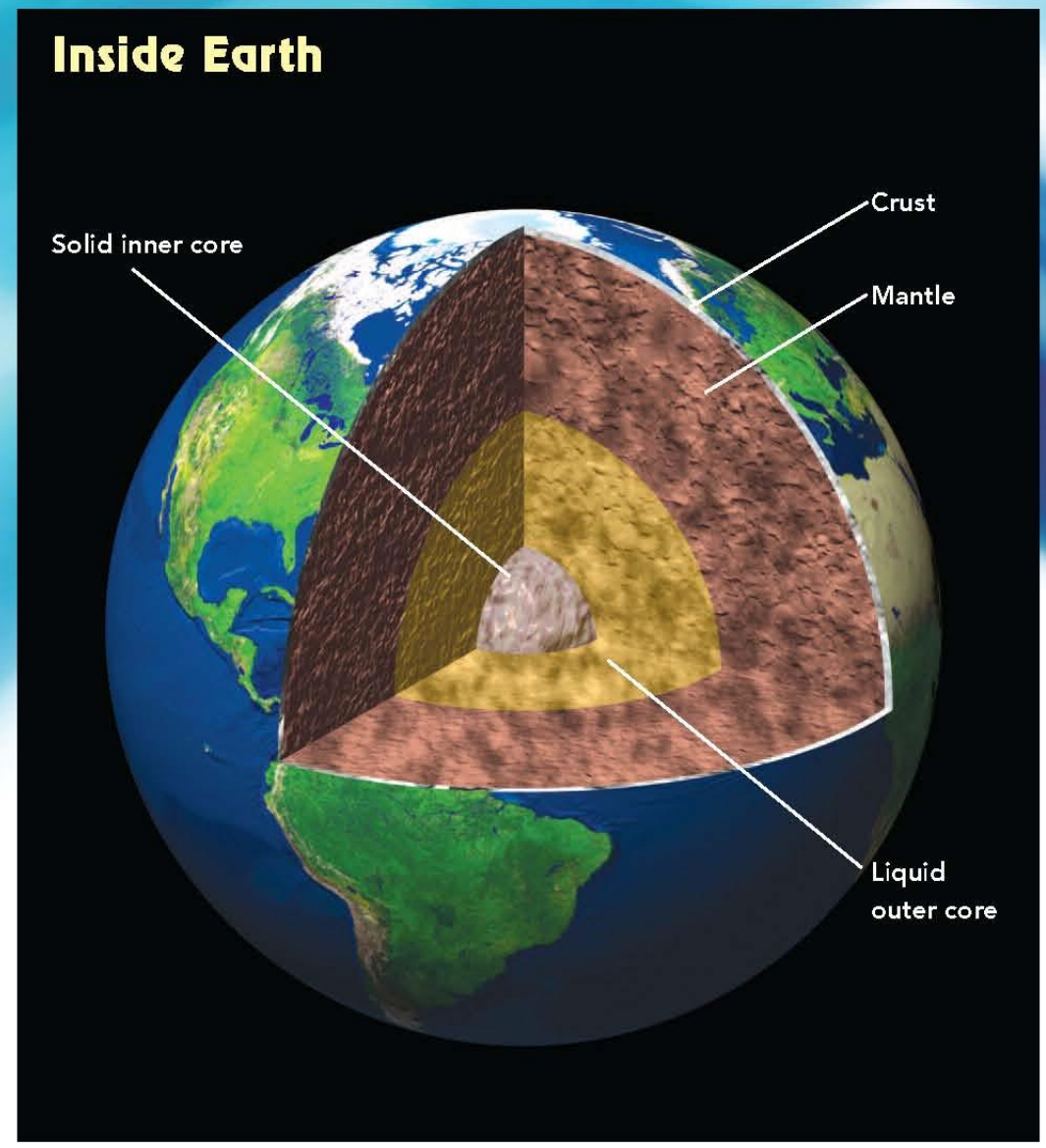
The crust is Earth's thin, cool, outer layer. The crust under the continents is mostly **granite** and similar rock. The crust under the oceans is much thinner. It is mostly **basalt** (*buh SAWLT* or *BAS awlt*), which is a dense and dark volcanic rock. Oxygen is the **most common chemical element** in Earth's crust.

Beneath the crust is the mantle, a thick, hot layer that flows slowly. The crust floats on the mantle like a board on water. Most of the mantle is made up of a group of minerals called **silicates.** They consist of silicon, oxygen, and one or more metallic elements.

The core lies at the center of Earth. The core, which is about the same size as Mars, is made mostly of iron and nickel. Scientists think that the outer part of the core is liquid and that the inner core is solid.

Highlights

- Much of Earth is made of rock, just like the other inner planets.
- Earth's crust under the continents is made mostly of granite. Its crust under the oceans is made mostly of basalt.
- The mantle is made mostly of minerals called silicates, and the core is mostly iron and nickel.



Easy-to-follow Question & Answer format effectively draws readers into the material.

How Big Is the Milky Way?

The Milky Way is enormous. If you could travel at the **speed of light,** it would take you 100,000 years to get from one end of the **galaxy** to the other! Light travels about 5.88 trillion miles (9.46 trillion kilometers)—in one year.

The central bulge of the Milky Way is about 10,000 **light-years** thick and about 27,000 light-years long. Toward the edges, the Milky Way is about 1,000 light-years thick. Scientists think that the galaxy contains about 200 billion **stars.** The Milky Way is so massive that there are many smaller **galaxies** in **orbit** around it, much like **moons** orbiting a **planet.**

Fun Fact

The Milky Way's central bulge is made up of a thick bar of stars that stretches for about 27,000 light-years. That is why astronomers call the Milky Way a barred spiral galaxy.

Although the Milky Way is vast, other galaxies are even larger. The most massive galaxies can have 100 times as much **mass**—in the form of stars, hot gas, and other **matter**—as the Milky Way.

The central bulge of the Milky Way appears in a photo taken from the side by a satellite recording *infrared light* (light in the form of heat).

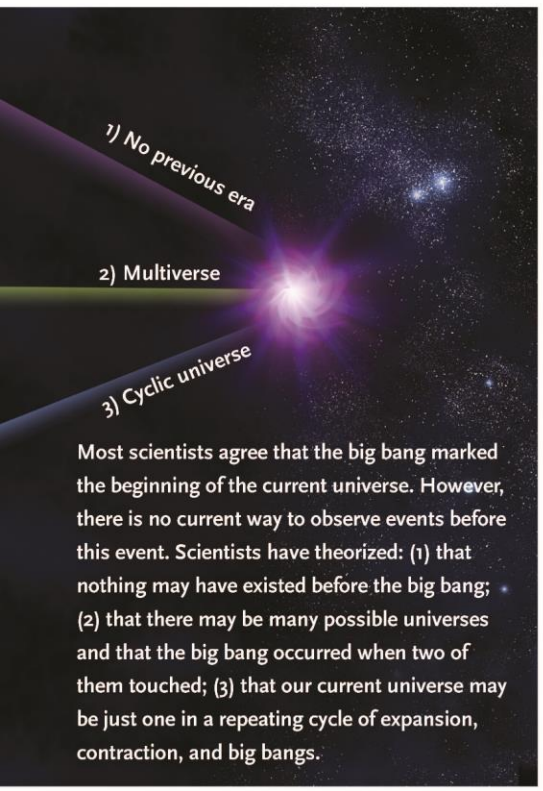
Highlights

- **The Milky Way is so large, it would take someone traveling at the speed of light 100,000 years to travel from one end of the galaxy to the other.**
- **The Milky Way contains about 200 billion stars.**
- **Some galaxies are even larger than the Milky Way.**

Information is presented in brief sections to facilitate comprehension of deep-space science themes.

WHERE DID THE UNIVERSE COME FROM?

Most scientists accept the theory that the universe began to expand and evolve with an event that they call the big bang.



Most scientists agree that the big bang marked the beginning of the current universe. However, there is no current way to observe events before this event. Scientists have theorized: (1) that nothing may have existed before the big bang; (2) that there may be many possible universes and that the big bang occurred when two of them touched; (3) that our current universe may be just one in a repeating cycle of expansion, contraction, and big bangs.

TINY FIREBALL

It is hard to imagine what things were like at the moment of the **big bang.** For the tiniest fraction of a second, the entire universe was unimaginably hot and dense. Some scientists describe the universe of this time as a tiny, primordial fireball. It was thousands of times smaller than the head of a pin. Space and time as we think of them did not even exist.

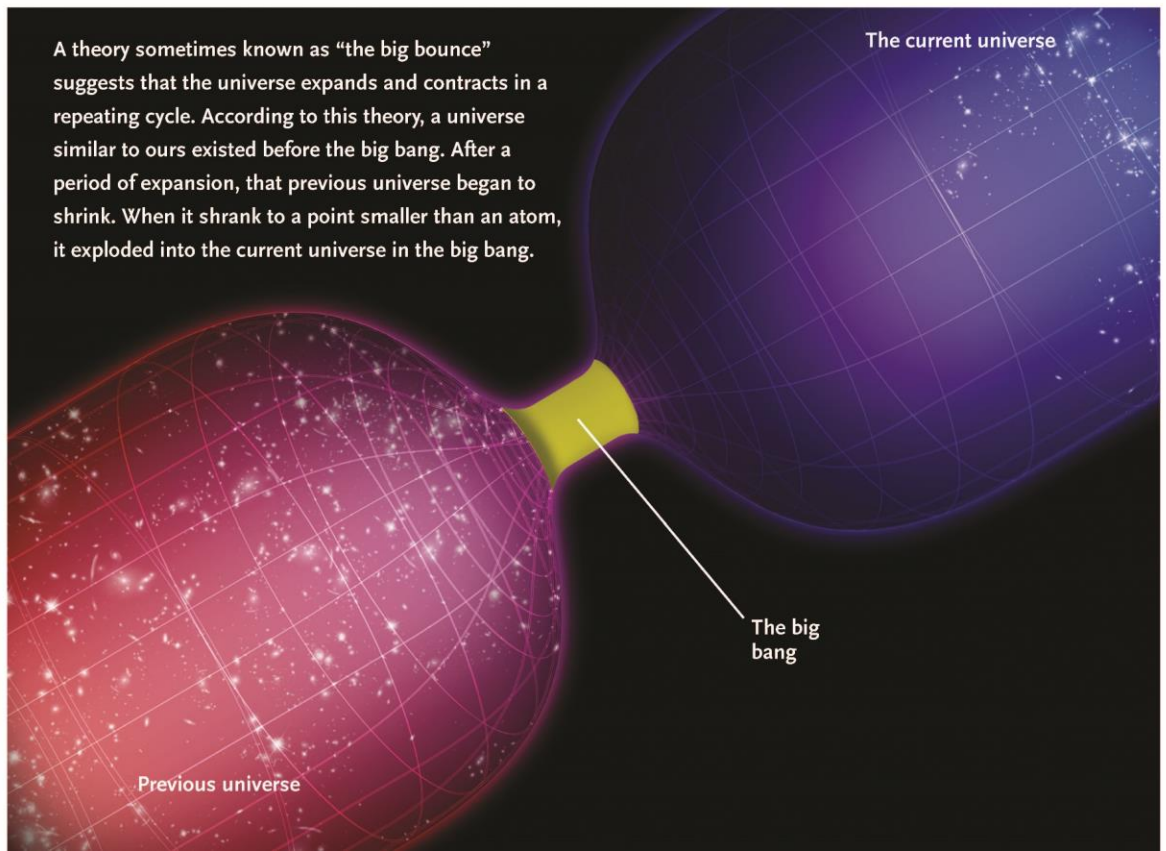
RAPID INFLATION

A theory called **inflation theory** explains what happened right after the **big bang.** According to inflation theory, the universe expanded very rapidly in the first few seconds. Imagine the early universe as a balloon. Suppose you attach the balloon to a tank of gas and open the nozzle all the way. The balloon will inflate, or blow up, very quickly. According to inflation theory, the universe grew from less than the size of a pinpoint to the size of a **galaxy** in just a fraction of a second. Inflation stopped when the universe cooled down and matter as we know it began to form.

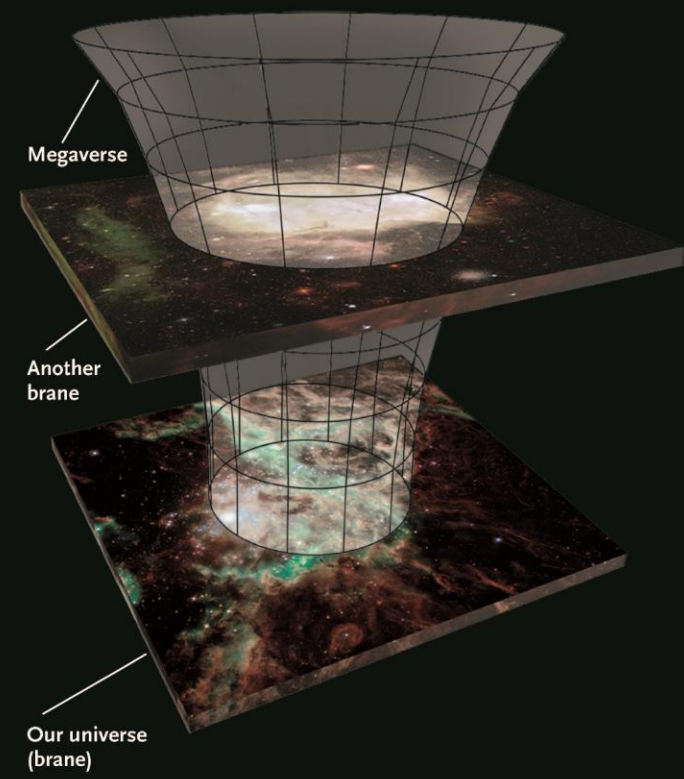
STILL EXPANDING

Astronomers have found that the universe is still expanding. They see galaxies moving farther away from Earth as well as from one another. **Cosmologists** say the galaxies appear to be moving because space itself is continuing to expand.

A theory sometimes known as "the big bounce" suggests that the universe expands and contracts in a repeating cycle. According to this theory, a universe similar to ours existed before the big bang. After a period of expansion, that previous universe began to shrink. When it shrank to a point smaller than an atom, it exploded into the current universe in the big bang.



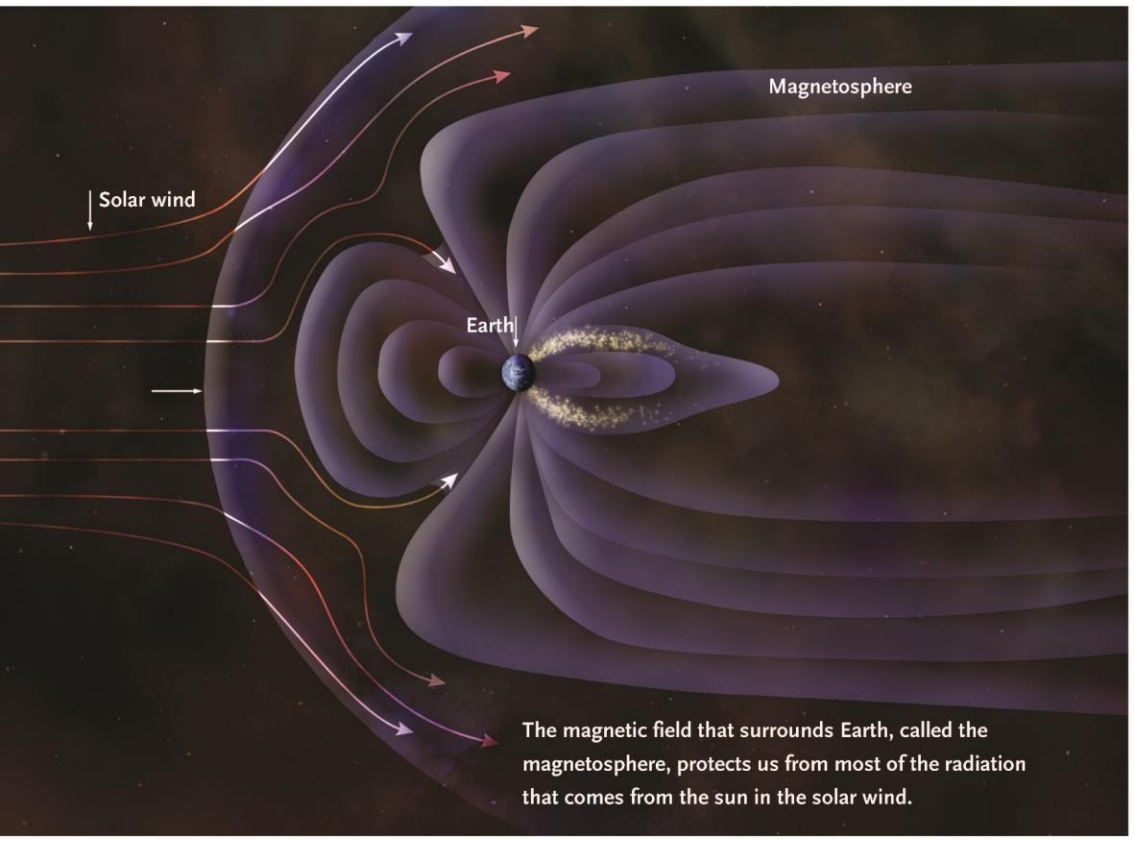
Some scientists theorize that the universe we live in exists on a membrane-like surface called a brane, or a "braneworld" (below). This brane is only a thin slice of the entire "megaverse," which consists of extra dimensions we cannot detect. According to this idea, other universes on other branes also make thin slices through the multidimensional megaverse.



Many spreads include a “Did You Know” feature that offers an interesting and little-known fact about some element of the topic.

WHAT ARE MAGNETIC FIELDS?

Magnetic fields are lines of magnetic force around a magnet. The sun and other stars, Earth and some other planets, as well as entire galaxies are surrounded by magnetic fields.



The magnetic field that surrounds Earth, called the magnetosphere, protects us from most of the radiation that comes from the sun in the solar wind.

SIMPLE MAGNETIC FIELD

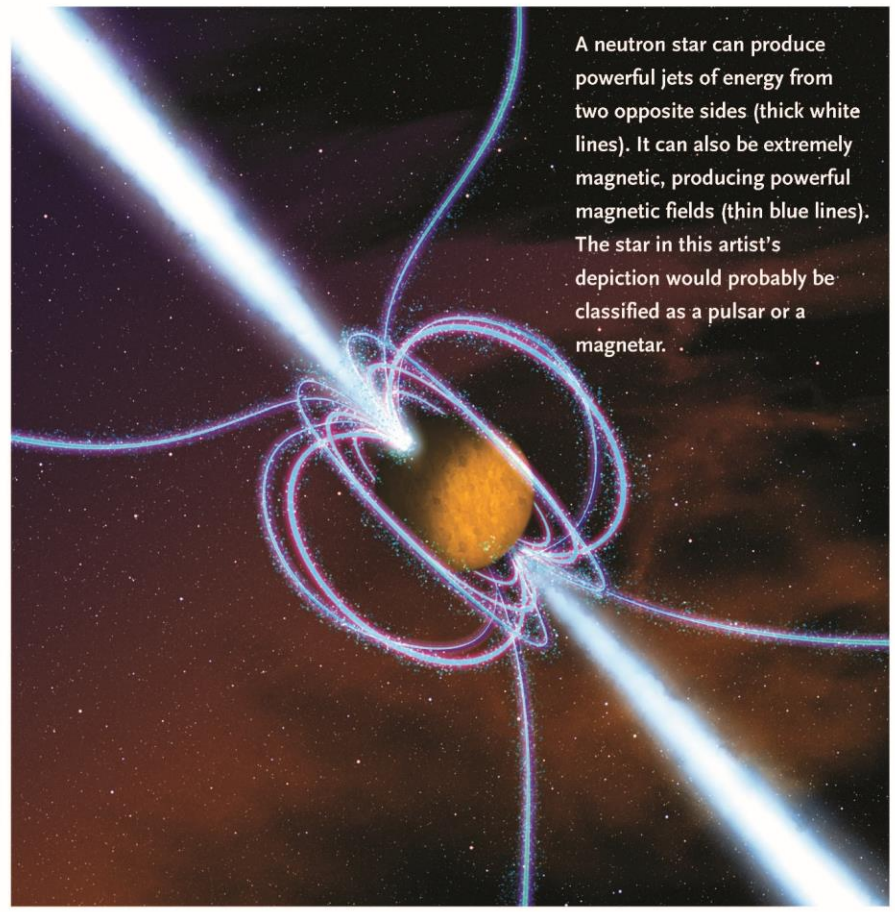
Magnetism is related to electricity. Magnetism can be caused by the spinning movement of *electrons* (negatively charged particles) in certain atoms. Not all materials are attracted to magnetic fields. Magnets affect only certain metals, such as iron, nickel, and cobalt, and only these elements can become magnets.

The simplest magnetic field is one around a bar magnet. One end of the magnet is the north pole and the other is the south pole. Invisible magnetic field lines loop out of one pole and back to the magnet's other pole.

Magnets can attract or repel one another. The north end of one magnet will attract the south end of another. But the same poles of two magnets will repel each other.

DID YOU KNOW?

Like Earth, Jupiter, Saturn, Uranus, and Neptune are surrounded by a magnetic field. Mercury has an extremely weak magnetic field. Venus and Mars apparently have no magnetic field.



A neutron star can produce powerful jets of energy from two opposite sides (thick white lines). It can also be extremely magnetic, producing powerful magnetic fields (thin blue lines). The star in this artist's depiction would probably be classified as a pulsar or a magnetar.

MAGNETIC FIELDS IN SPACE

Earth has a magnetic field. It is produced by the motion of currents in the liquid outer core. Earth's magnetic field protects the **planet** from the **solar wind** of the sun. The solar wind is a stream of electrically charged particles coming from the sun.

The sun is surrounded by a magnetic field. Eruptions of this field cause disturbances on the sun's surface. Huge prominences, loops of fiery gas, sometimes rise up from the sun's surface along a magnetic field. Sunspots—darker, cooler, areas on the surface of the sun—form from looping magnetic fields.

Other stars also have magnetic fields. Some are far more powerful than those of the sun. Collapsed stars called **neutron stars** have magnetic fields a thousand times as powerful as the sun's. Physicists measure magnetism with a unit called a gauss. The sun's magnetic field is 1 or 2 gauss. Some neutron stars have a magnetic field of 10 trillion gauss.

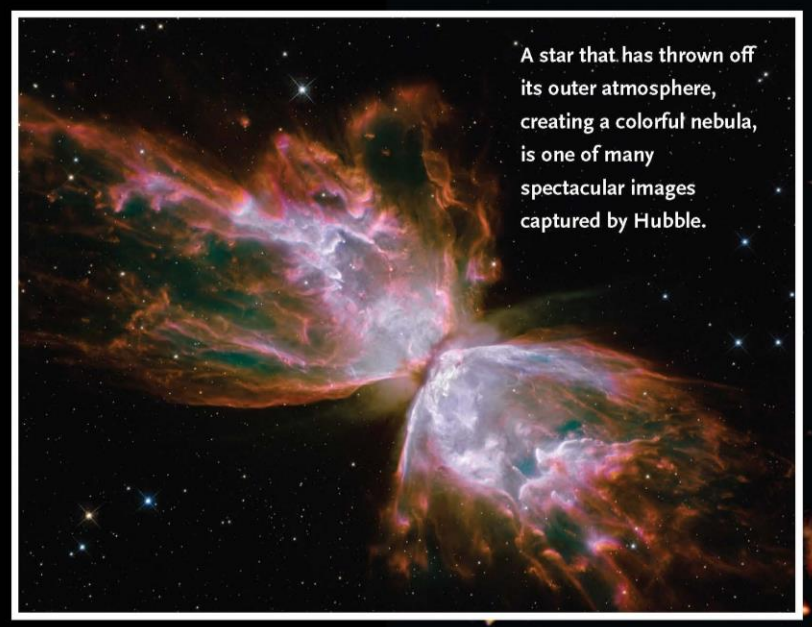
Astronomers have also detected magnetic fields in the Milky Way and other **galaxies.** They think that slowly rotating galaxies could have created these fields. They believe that such magnetic fields could affect the rate at which **stars** form.

Four “Focus On” special features per volume that offer in-depth looks at amazing phenomena, explain scientific processes, and offer side trips to exotic locations.

FOCUS ON

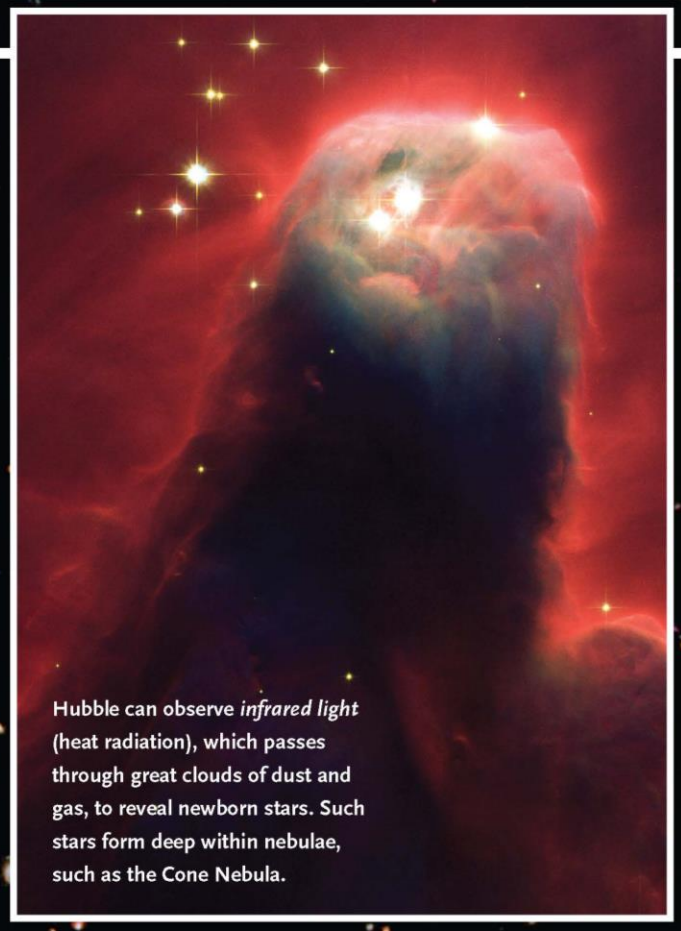
HUBBLE'S VIEW OF THE UNIVERSE

The Hubble Space Telescope has provided unprecedented views of the universe, forever changing our understanding of the planets of the solar system, how stars are born and die, and the overall structure of the universe.



A star that has thrown off its outer atmosphere, creating a colorful nebula, is one of many spectacular images captured by Hubble.

The Hubble Deep Field (background photograph) is a revolutionary image that stretches to the edge of the visible universe. The Deep Field shows only a tiny part of the sky, equivalent to the size of a tennis ball seen at 330 feet (100 meters). Yet even such a small part of the sky is filled with galaxies, some billions of light-years away. The Hubble Deep Field emphasizes the vast, complex nature of the universe.



Hubble can observe *infrared light* (heat radiation), which passes through great clouds of dust and gas, to reveal newborn stars. Such stars form deep within nebulae, such as the Cone Nebula.

A false-color ultraviolet image of Saturn taken by Hubble reveals the bands of rotating gas that make up the planet's atmosphere.

EXPLOLRE THE SOLAR SYSTEM & UNIVERSE

Focus on Curriculum

English/Language Arts

Reading Informational Text

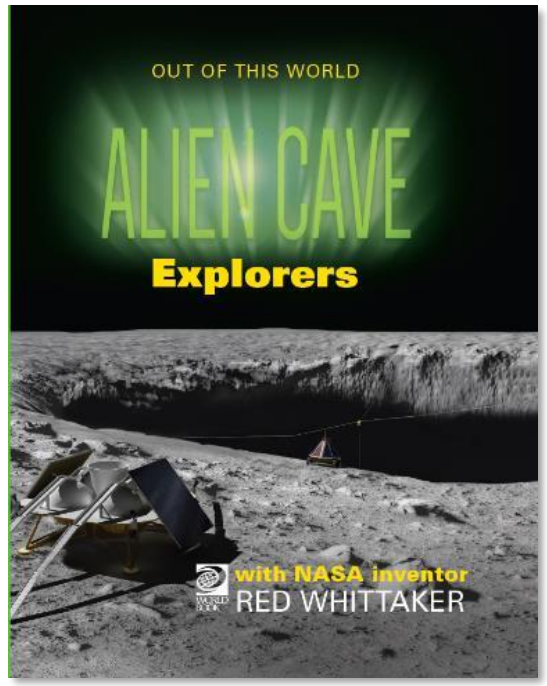
- Use text features and search tools (e.g., key words, sidebars, Table of Contents, captions) to locate information relevant to a given topic efficiently.
- Describe the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in a text or part of a text.
- Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

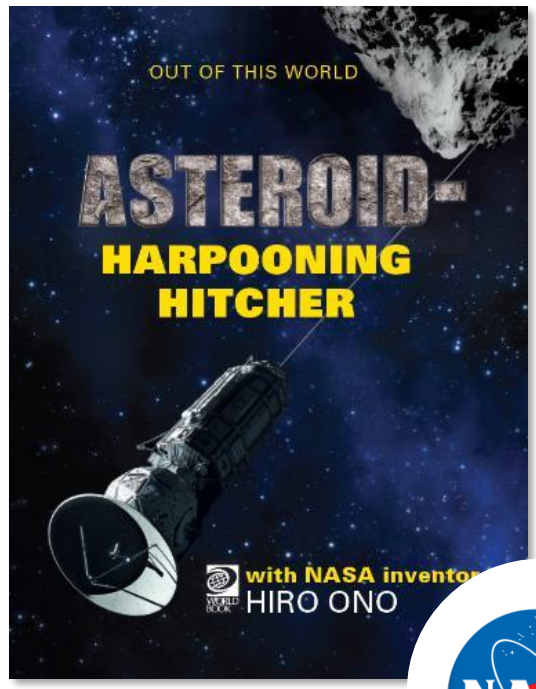
STEM/NGSS

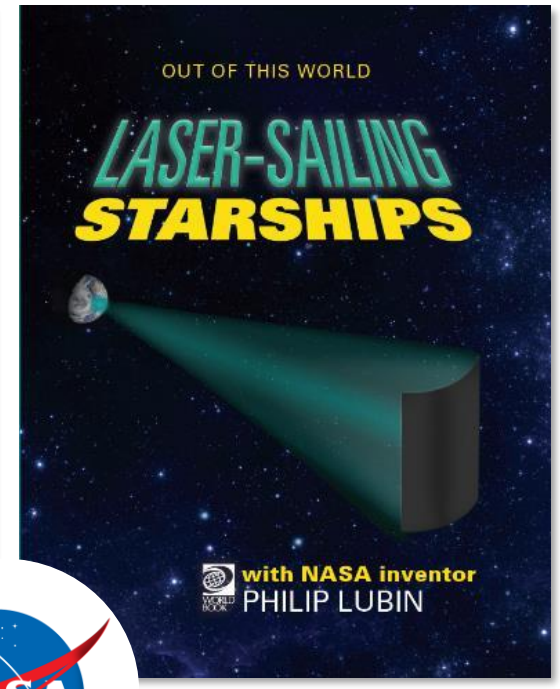
- Identify planets of the Solar System
- Model the relative size of and distance between Earth, other planets in the solar system, and the sun
- Research how scientists were able to develop ideas about the solar system through the gathering of evidence through space exploration
- Describe how the evolution of the universe, including the formation of galaxies and stars, has continued since the Big Bang

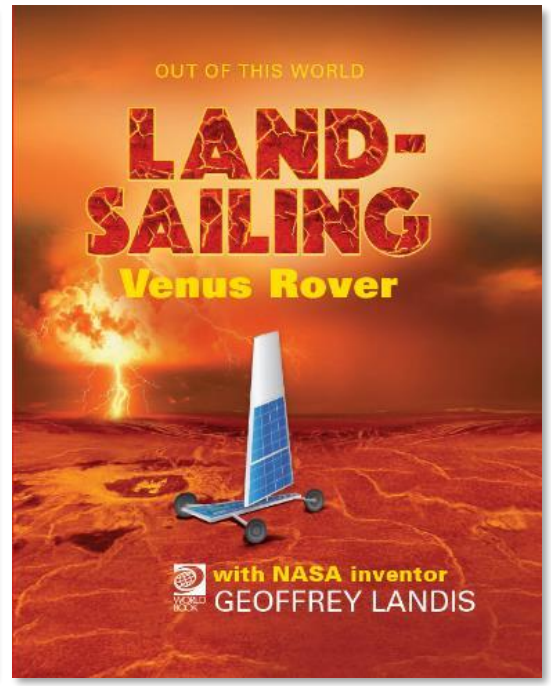
OUT OF THIS WORLD

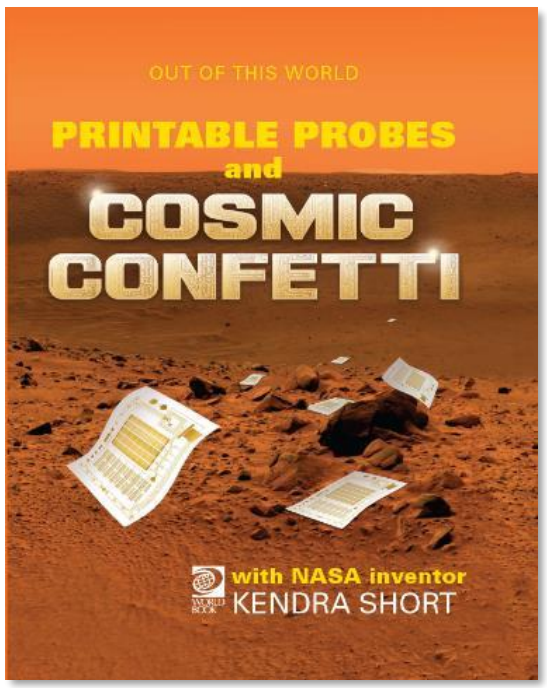
Recommended Age Rage: 8-12
Hard Cover, 8 volumes, 48 pages each

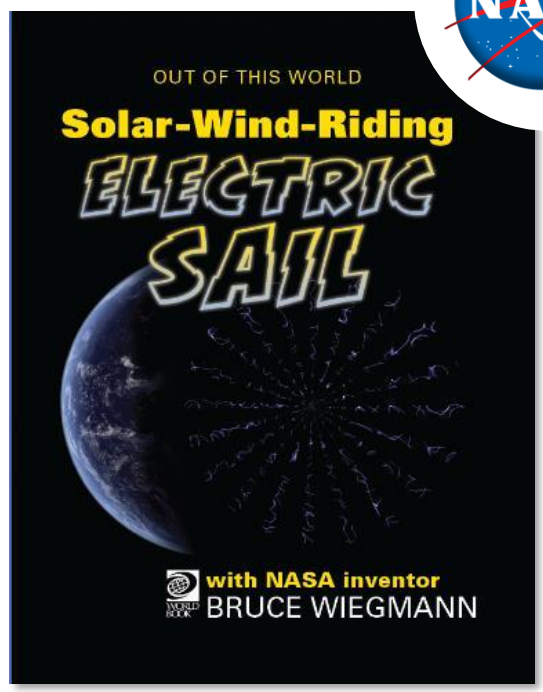


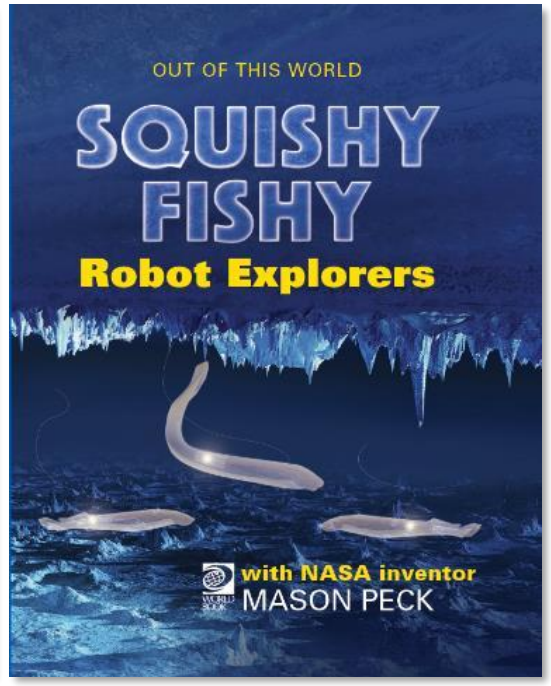












Features projects that have won grants from the NASA Innovative Advanced Concepts program, which provides funding to teams working to develop bold new advances in space technology.

Big idea: Additive manufacturing

Hoyt's Trusselator is an example of **additive manufacturing.** Additive manufacturing means using a mechanical device to build up a three-dimensional structure piece by piece. Additive manufacturing more typically makes use of a device called a **three-dimensional (3-D) printer.**

"A number of years ago, we were looking at ways to set up large antennas in space. We tested a number of unconventional ways of folding or packing them. Then about 10 years ago, 3-D printing technology really started to take off. I became intrigued with the idea of printing satellite components in orbit." —Robert

A 3-D printer can turn a computer model into a real-life object. A computer begins the process by "slicing" the model into thin cross sections. These cross sections are sent to the 3-D printer as a series of flat images. But instead of printing the images on multiple sheets of paper, the 3-D printer prints each layer on top of the previous layer, building up a three-dimensional form.

A three-dimensional (3-D) printer produces a plastic model of the character Yoda from the *Star Wars* films, building up the form layer by layer.

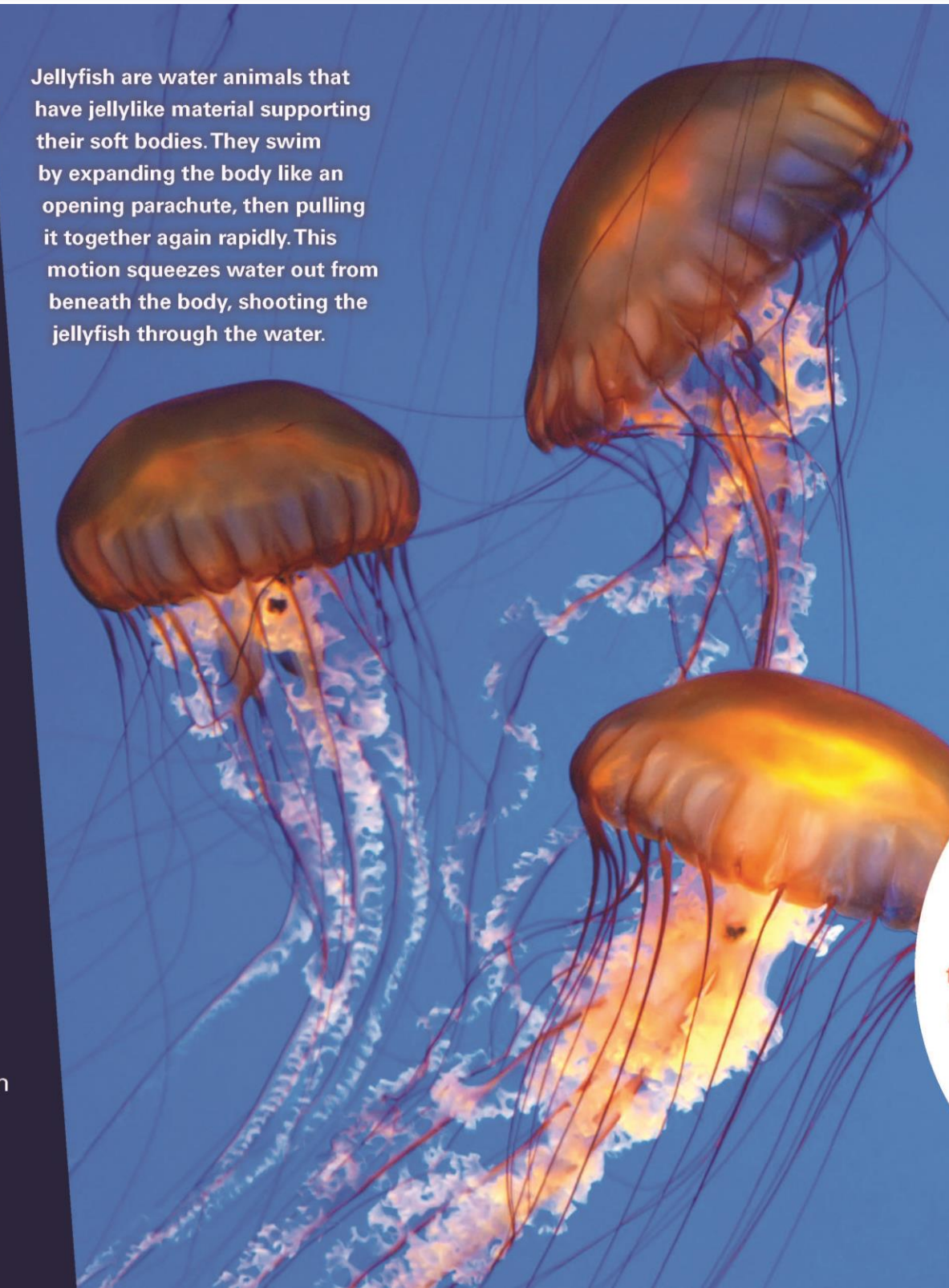
Easy-to-read text explains complex space science concepts.

A sea full of life?

Could Europa's huge ocean under the ice be filled with life? To find out, we may have to go there. Sending astronauts to such a far distant place is not yet possible. So, we would have to send robots. But usual robots—all metal parts and spinning motors—may be too clumsy, too heavy, and too expensive to do the job.

To search for sea creatures, we may have to design robots that work like sea creatures. A team of inventors led by an American professor named Mason Peck is doing just that. Their dream is to send robot explorers to search for life in Europa's oceans. And the squishy robots they are designing may have more in common with jellyfish or squid than with the clunky machines of yesteryear.

Jellyfish are water animals that have jellylike material supporting their soft bodies. They swim by expanding the body like an opening parachute, then pulling it together again rapidly. This motion squeezes water out from beneath the body, shooting the jellyfish through the water.



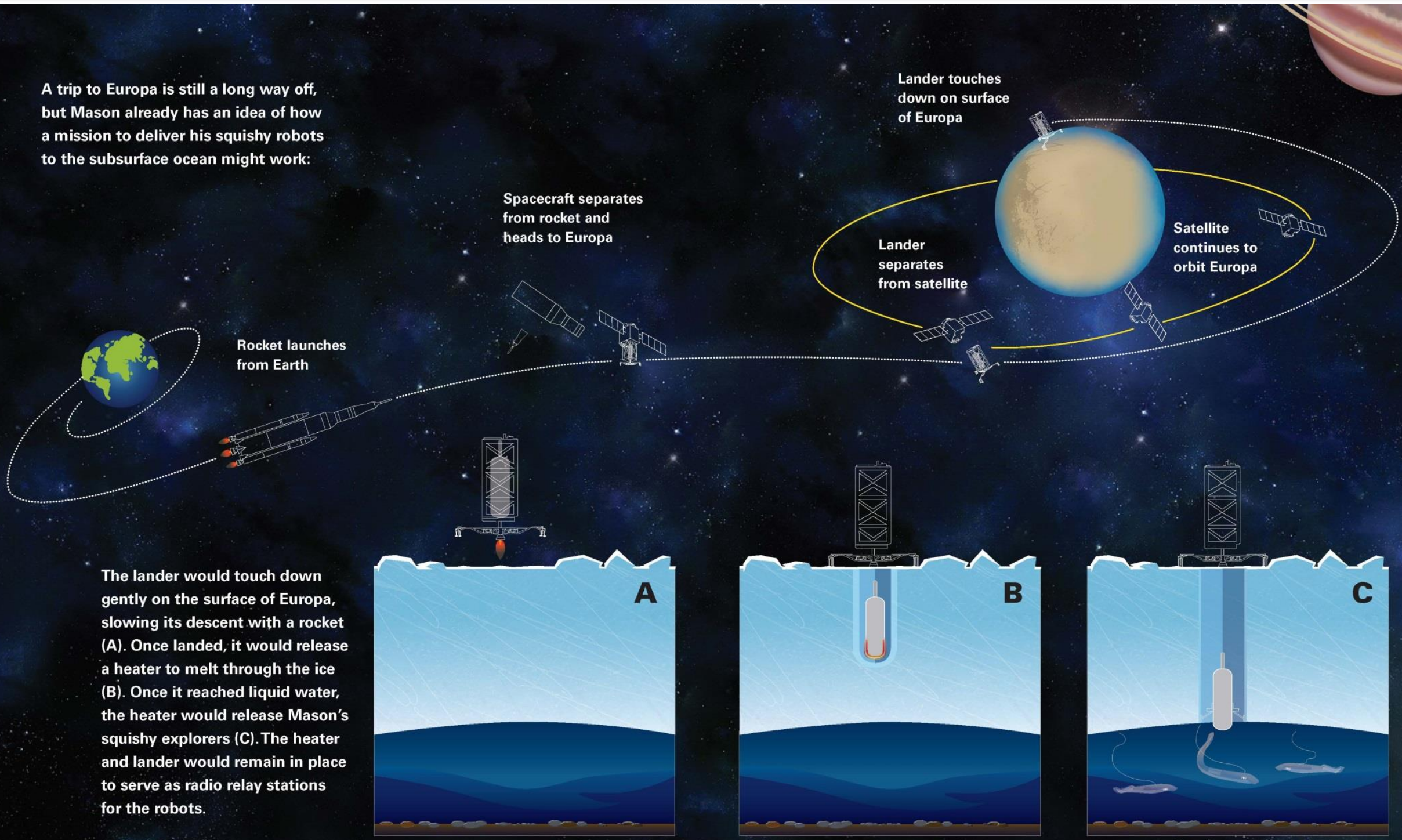
The NASA Innovative Advanced Concepts program. The titles in the *Out of This World* series feature projects that have won grant money from a group formed by the United States National Aeronautics and Space Administration, or NASA. The NASA Innovative Advanced Concepts program (NIAC) provides funding to teams working to develop bold new advances in space technology. You can visit NIAC's website at www.nasa.gov/niac.

Meet Mason Peck.

"I'm a professor of engineering at Cornell University in Ithaca, New York. From a young age, I wanted to build something that nobody had ever built before. Now I'm leading a team of inventors working to develop squishy robots for a future mission to Europa."

Stunning imagery and futuristic renderings bring innovations to life.

A trip to Europa is still a long way off, but Mason already has an idea of how a mission to deliver his squishy robots to the subsurface ocean might work:



The lander would touch down gently on the surface of Europa, slowing its descent with a rocket (A). Once landed, it would release a heater to melt through the ice (B). Once it reached liquid water, the heater would release Mason's squishy explorers (C). The heater and lander would remain in place to serve as radio relay stations for the robots.

OUT OF THIS WORLD

Focus on Curriculum

English/Language Arts
Reading Informational Text

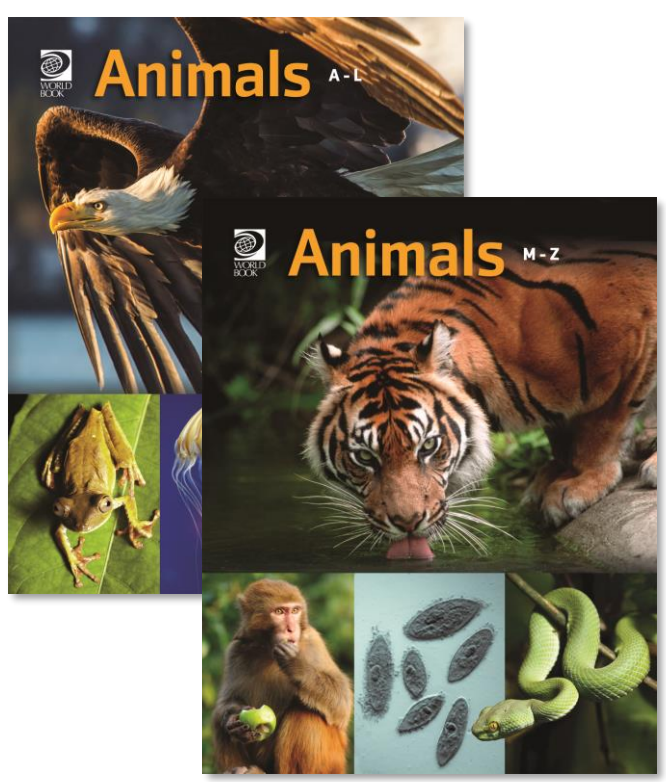
- Use text features and search tools (e.g., key words, sidebars, Table of Contents, captions) to locate information relevant to a given topic efficiently.
- Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.
- Determine an author's point of view or purpose in a text and explain how it is conveyed in the text.

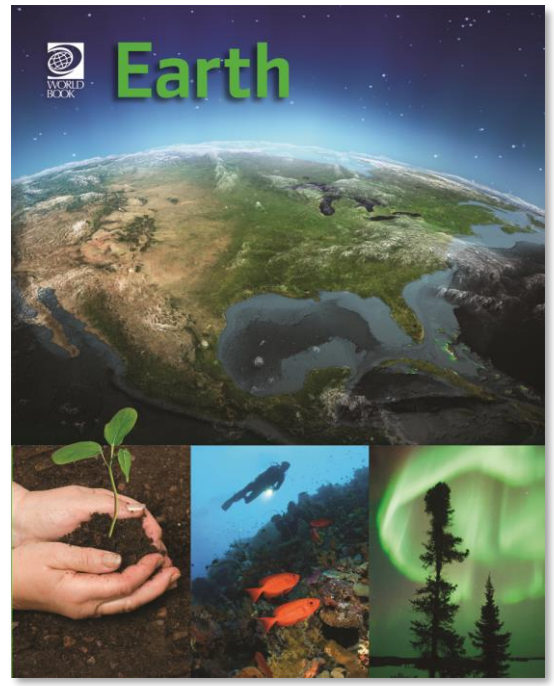
STEM/NGSS:

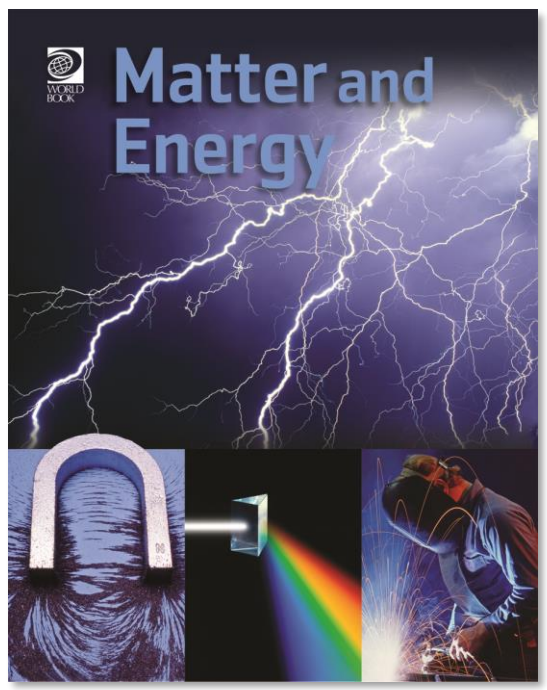
- Appreciate that science is a way of explaining the world and that science knowledge changes over time.
- Identify ways in which scientists work together and provide evidence to support their idea.
- Understand that water, air, rocks and soil, and life forms make up our planet and recognize that these are also earth's resources.
- Describe how natural features are changed and resources affected by natural events and human actions.
- Explain how living things are suited to their particular habitat and how they respond the environmental changes both natural and human-included.

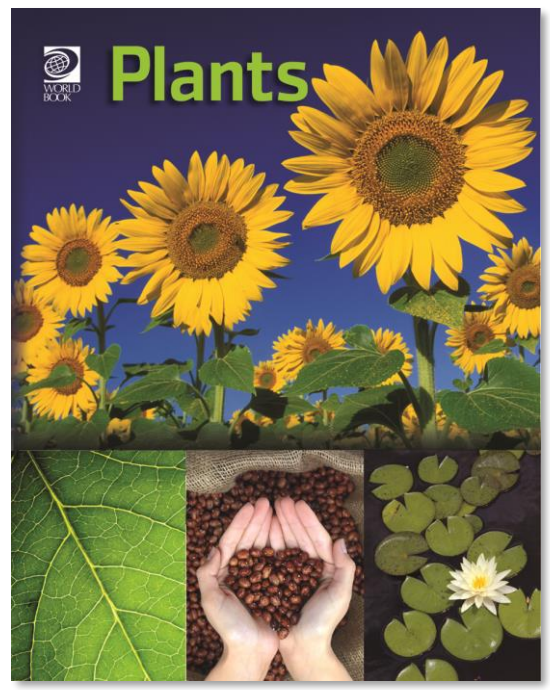
DISCOVERY SCIENCE ENCYCLOPEDIA

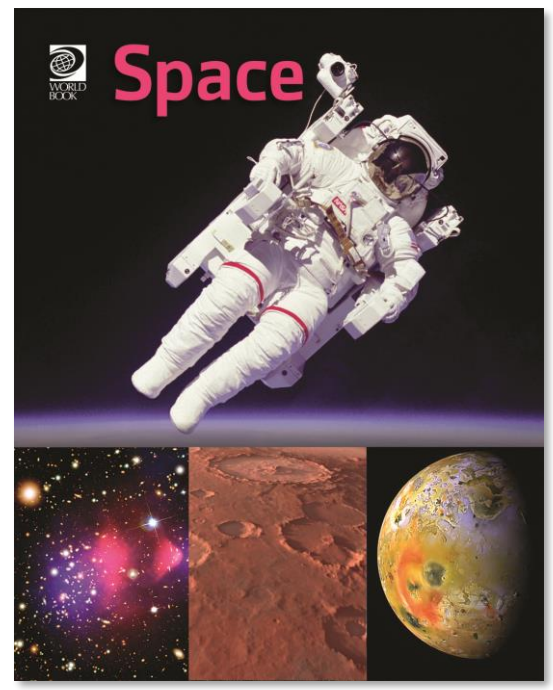
Recommended Age Rage: 9-13
Hard Cover, 9 volumes, 2,416 pages











QR codes link to videos and complementary information.

How to use World Book Discovery Science Encyclopedia

http://bit.ly/13kOpzd

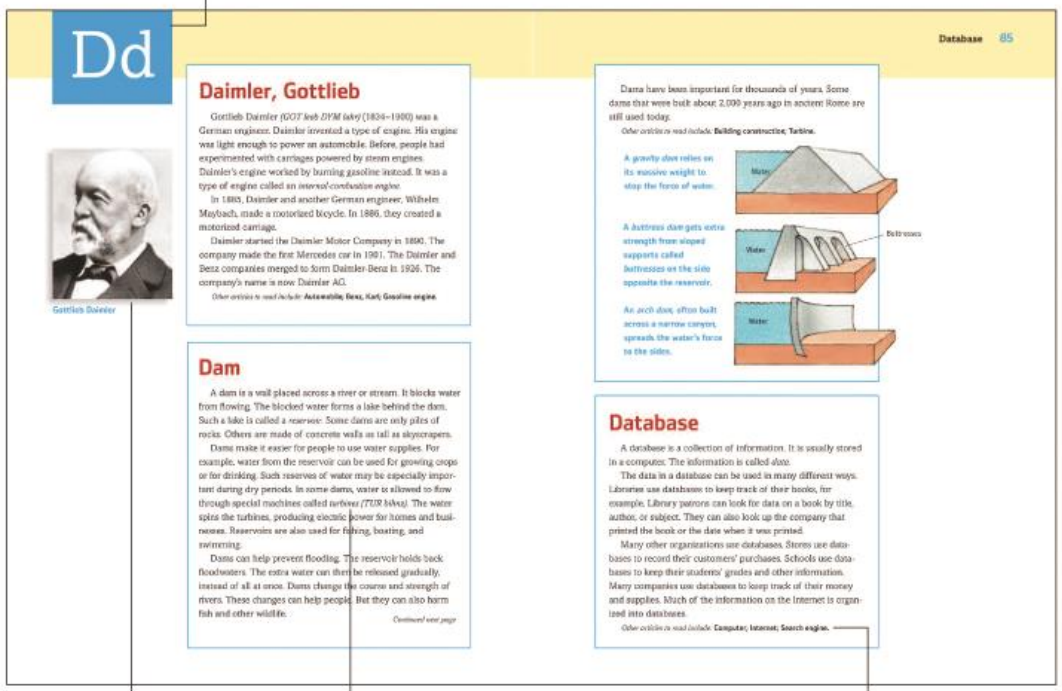
- Hundreds of illustrations
- Guide words
- Phonetic spellings
- Related article lists
- Experiments and activities
- QR codes

World Book Discovery Science Encyclopedia is filled with information about basic science concepts, tools, and discoveries as well as the world around us. Entries on people who have made important contributions to science are included, too. All entries are written in a way that makes them easy to understand.

Finding entries is easy, too. They are arranged in alphabetical order. There is also an index in each volume. The index lists all the entries, as well as topics that are covered in the volume but that are not themselves entries.

Science experiments and activities are also included in this volume. These and the many other features of *World Book Discovery Science Encyclopedia* make it an encyclopedia that you can use for research as well as reading just for fun.

Easy alphabetical access
Each letter of the alphabet is highlighted to help you locate entries alphabetically.



Illustrations
Each volume of *Discovery Science Encyclopedia* contains hundreds of photographs, drawings, maps, and other illustrations. Each illustration is labeled or explained in a caption.

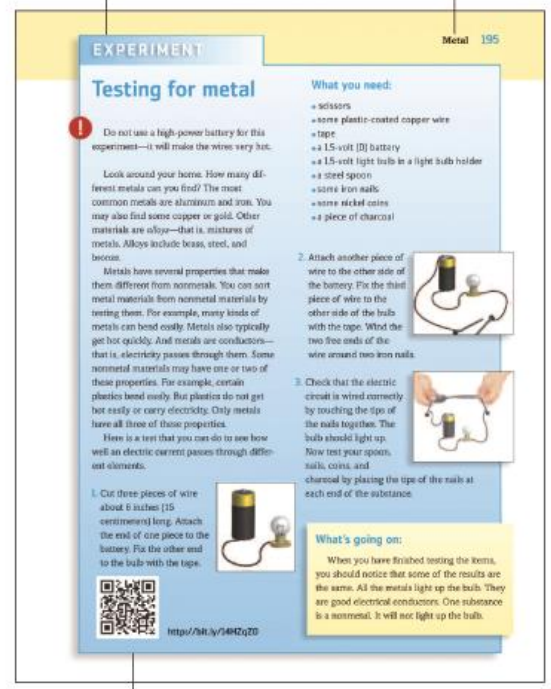
Pronunciations
The phonetic spelling for unusual or unfamiliar words is given. A key to the pronunciation is in the front of each volume.

Related references
The references listed at the bottom of many articles tell you which other articles to read to find out more or related information.

Experiments
Many experiments are found in *Discovery Science Encyclopedia*. These experiments extend or enrich the subject of the article they accompany and are suitable for use at home or in the classroom.

Guide words
Guide words at the top of a page help you quickly find the entry you are seeking.

Activities
Many activities are found in *Discovery Science Encyclopedia*. These simple activities, which can be done at home or in the classroom, extend or enrich the subject of the article they accompany.



QR codes
This symbol is a QR code. You can find QR codes on all the pages with experiments and activities in the *World Book Discovery Science Encyclopedia*. Simply scan a code with your smartphone or tablet to see a video about the experiment or activity or related information about the subject of the project. (You will need to download a QR code reader to your device if you have not already done so.) If you do not have a mobile device, you can still access the videos linked to experiments and activities by keying in the URL beneath each QR code into a browser on your computer.

You can also find a QR code on the opposite page. This code links to a video explaining how to use the *World Book Discovery Science Encyclopedia*.

A library of all the videos and related information included in the *World Book Discovery Science Encyclopedia* can be found at **http://www.worldbook.com/all/item/1876.**

Key to pronunciation

World Book Discovery Science Encyclopedia provides the pronunciations for many unusual or unfamiliar words. In the pronunciation, the words are divided into syllables and respelled according to the way each syllable sounds. The syllables appear in *italic letters*. For example, here are an article title and the respelled pronunciation for it:

Absorption *(ab SAWRP shuhn)*

The syllable or syllables that get the greatest emphasis when the word is spoken are in capital letters *(SAWRP)*.

More than 3,000 articles across more than 2,300 pages, and hundreds of photographs, illustrations, maps, and diagrams.

Beneath Ganymede's varied surface are a thick layer of ice, a rocky layer, and a metal core. A thin ocean of salty water may lay about 105 miles (170 kilometers) beneath the surface.

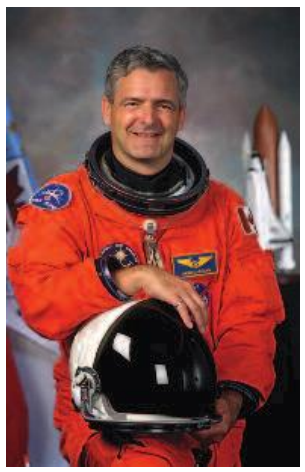
Ganymede

Ganymede *(GAN uh meed)* is the largest moon of the planet Jupiter. It is also the largest moon in the solar system. It is even larger than the planet Mercury. Ganymede orbits Jupiter every 7.15 Earth days at a distance of 664,900 miles (1,070,000 kilometers). Ganymede is one of the four moons of Jupiter discovered by the Italian astronomer Galileo Galilei in 1610.

Ganymede's surface is made up of almost equal amounts of dark and bright *terrain* (land). The dark areas are made mostly of ice mixed with pieces of dark rock. These areas have many *impact craters* and large cracks. The craters were made by asteroids and comets crashing into the surface. Forces released by the biggest impacts produced many of the cracks. Other cracks formed when changes in the structure and temperature of the moon caused it to expand.

The bright terrain is has many fewer craters. It formed as the surface expanded and cracked. Water, ice, or both flooded low-lying areas and craters. The cracking and stretching of the new terrain created parallel sets of ridges and valleys.

Other articles to read include: **Galileo** (scientist); **Impact crater; Jupiter; Satellite.**



Marc Garneau

Garneau, Marc

Marc Garneau *(gahr NO)* (1949 -) was the first Canadian to travel in space. He is a captain in the Royal Canadian Navy. Garneau flew with six American astronauts aboard the United States space shuttle Challenger from October 5 to 13, 1984. Garneau also made shuttle flights in 1996 and 2000.

Garneau was born in Quebec City. He earned a doctoral degree in electrical engineering from the Imperial College of Science and Technology in London. Garneau joined the Royal Canadian Navy in 1965. He became an expert on communications and weapon systems. In 1983, Garneau was chosen to be one of Canada's first six astronauts. He served as president of the Canadian Space Agency (CSA) from November 2001 to

Continued on the next page

November 2005. Garneau became the *chancellor* (head) of Carleton University in Ottawa in 2003. Garneau was elected to the Canadian Parliament in 2008.

Other articles to read include: **Astronaut; Canadian Space Agency; Space exploration.**

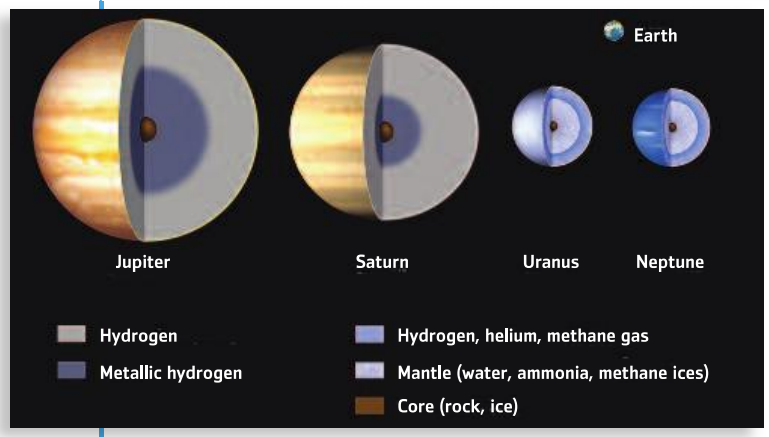
Gas giant

A gas giant is a type of planet made of mostly gases with little or no rock. The solar system has four such planets—Jupiter, Neptune, Saturn, and Uranus. The two most common gases that make up gas giants are hydrogen and helium. These chemical elements are the two most abundant substances in the universe.

Gas giants have also been found outside the solar system. Planets outside the solar system are called *extrasolar planets* or *exoplanets.* These extrasolar gas giants do not get much larger in size than Jupiter, but they can have much more *mass* (amount of matter).

Because of their large size, extrasolar gas giants are easier to spot *orbiting* (traveling around) faraway stars. Many of the exoplanets first discovered were gas giants orbiting very close to their home star. These gas giants are very hot and are sometimes called "hot Jupiters."

Other articles to read include: **Extrasolar planet; Jupiter; Neptune; Planet; Saturn; Uranus.**



The four outer planets of the solar system are often called the "gas giants." However, the two largest planets, Jupiter and Saturn, have a slightly different combination of materials than the two smaller gas giants, Neptune and Uranus do.

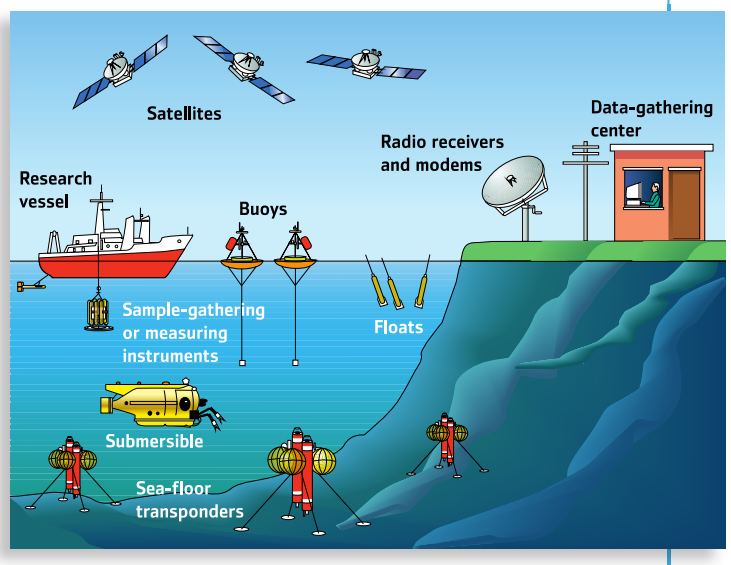
Complements individual learning styles with extension activities and science experiments.

Ocean *Continued from the previous page*

fishing, pollution, and changing habitats. Ocean *acidification (uh SIHD uh fuh KAY shuhn)* is a growing problem. The ocean is becoming more acidic because it is taking in increasing amounts of carbon dioxide from the atmosphere. The carbon dioxide comes chiefly from burning coal and other *fossil fuels.* Acidification can greatly damage coral reefs, shellfish, and other marine life.

Other articles to read include: **Arctic Ocean; Atlantic Ocean; Benthos; Deep sea; Environmental pollution; Indian Ocean; Oceanography; Southern Ocean.**

A scientist explores the waters of the Gulf of Mexico using a small submarine called a submersible.



The Global Ocean Observing System (GOOS) is a worldwide network of data-collecting instruments. They are carried by satellites, research vessels, submersibles, *buoys* (floating platforms), and *floats* (devices that drift with currents). Sea-floor *transponders,* which receive signals and transmit responses, help scientists determine the precise locations of the instruments. The data gathered by these instruments are transmitted to receivers on shore. Such information helps scientists to study oceanic conditions, including currents, saltiness, and temperature.

ACTIVITY

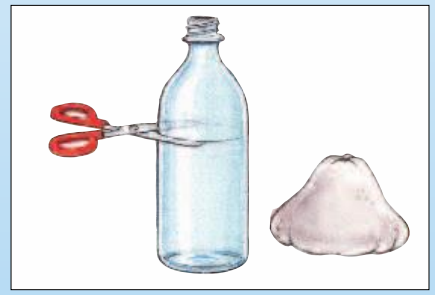
Make your own ocean and hot vent

The mineral wealth of the ocean extends to the deep-sea floor. The deep-sea floor contains vents from which hot water flows. These chimneylike structures, called hot vents or hydrothermal vents, discharge hot, mineral-rich water containing sulfur, copper, iron, and zinc.

Build a mini-oceanarium and hot vent to see what happens in the deep.

What you need:

- a small, plastic bottle or modeling clay
- scissors
- a small baby food jar
- large, clear container (the taller the better)
- a pot or a pitcher
- cold water
- hot water
- cool water
- red food coloring
- aluminum foil
- a long, dull knife



1. Take the cap off the plastic bottle. Have a teacher or other adult help you cut off a piece of the top big enough to fit over the small jar. Or shape a hot vent out of clay.

2. Fill the pot or pitcher with cold water. Set it aside.

3. Fill the small jar with hot water. Add red food coloring.

4. Working quickly, cover the small jar with foil and place it on the bottom of the clear pitcher under your plastic or clay vent

5. Pour cool water into the clear container until it reaches well above the top of the vent. Then use the knife to open the foil completely. Watch what happens.

Is some water redder than the rest? Try the experiment using only cold water. Compare the results.

http://bit.ly/Z725Hr

What's going on:

Hot fluids will rise in your minioceanarium, the way they do from ocean hot vents.

Highly illustrated, including many clear and instructive diagrams.

Tt

Surgeons use a variety of tools to perform operations. Such tools include *scalpels* (knives) to make cuts and *clamps* to hold body parts.

Surgery

Surgery *(SUHR juhr ee)* is the treatment of diseases and injuries by performing an operation on a person, called a *patient*. The doctor who performs the operation is called a *surgeon*.

In a surgical operation, many medicines, tools, and surgical methods must be used together to make sure that the patient stays safe and comfortable. Each operation also requires a special team of people. This team is usually made up of the chief surgeon, at least one assistant surgeon, a doctor known as an *anesthesiologist (AN uhs THEE zee OL uh jihst)*, and one or more nurses. The anesthesiologist gives medicine to keep the patient from feeling pain during the operation.

A surgeon uses a wide variety of tools to perform an operation. These tools include scissors, knives known as *scalpels*, and *retractors*, which hold back flaps of skin. Other tools are used to look inside—or remove bits of tissue from—body parts. *Lasers* may be used to make very precise cuts. A laser is a tool that makes light travel in a thin, powerful beam. *Sutures (SOO chuhrz)* are threads used to sew up surgical openings after the operation. All the tools a surgeon uses must be cleaned in a special way. Such cleaning keeps germs from entering the patient's body during the operation.

Surgeons sometimes use robots to assist them in an operation. Robots can make very precise moves in small spaces inside a patient's body. In some cases, a surgeon in one city can control a robot doing the operation in another city. This form of surgery is called *remote surgery*.

Other articles to read include: **Anesthesia; Anesthesiology; Medicine; Organ donation; Physician; Plastic surgery; Skin grafting; Transplant.**

A surgeon in New York City operates on a patient in France via a remote controlled robot. The screen displays the operation safely taking place over 4,000 miles (6,400 kilometers) away.

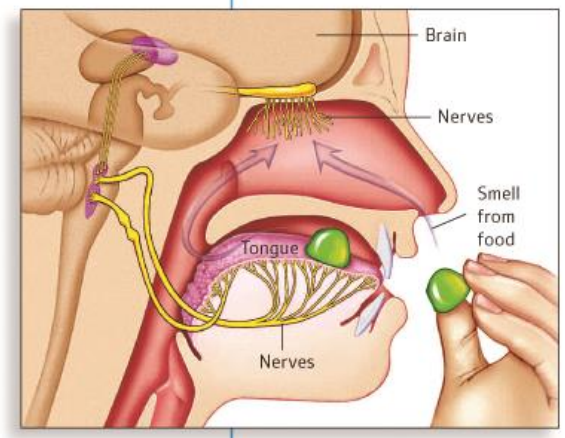
Taste

Taste is an important *sense* in people and many other animals. A sense helps us know what is happening around us. Our sense of taste helps us decide which foods to eat.

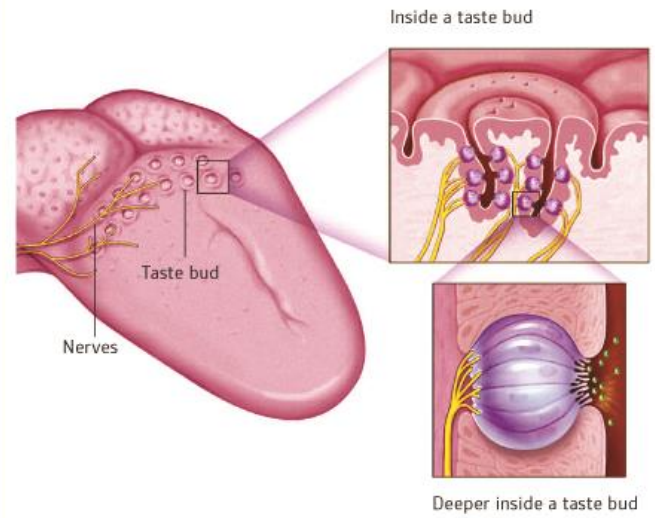
We taste food when it touches groups of cells called *taste buds* on our tongues. Taste buds on different areas of the tongue are sensitive to different tastes, such as sweet or sour. Some of the tastes in food are most easily picked up by taste buds on the front of the tongue. Other tastes are picked up more easily by taste buds on the back or sides of the tongue.

When food touches the taste buds, they send information about the food to cells called *nerves*. The nerves send this information to the brain. We then notice the taste of the food.

Other articles to read include: **Food; Nervous system; Senses; Smell; Tongue.**



The tastes in food are picked up by *taste buds* on the tongue. Information about the taste then travels through nerves to the brain. This information is combined with information about the smell of the food.



The tongue has many taste buds on its surface. Inside each taste bud are clusters of special skin cells. These cells touch tiny bits of food and then send information about the taste to nerves.

DISCOVERY SCIENCE ENCYCLOPEDIA

Focus on Curriculum

English/Language Arts

- Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning or its part of speech.
- Use text features and search tools (e.g., key words, sidebars, Table of Contents, captions) to locate information relevant to a given topic efficiently.
- Use information gained from illustrations (e.g., maps, photographs) and the words in a text to demonstrate understanding of the text (e.g., where, when, why, and how key events occur).
- Interpret information presented visually, orally, or quantitatively (e.g., in charts, graphs, diagrams, time lines, animations, or interactive elements on Web pages) and explain how the information contributes to an understanding of the text in which it appears.

STEM/NGSS

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- Develop a model based on evidence to illustrate the relationships between systems or between components of a system
- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data.

Additional Reading…

Earth's Changing Climate
Explains how climate change affects the weather, wildlife, our oceans, and the habitats of living things around the world.

Building Blocks of Life Science
Creatively pair humor, action, and real-life examples with scientifically accurate illustrations.

Building Blocks of Physical Science
Introduces elementary and middle school physical science topics including sound, gravity, electricity, and more.

Living Green
Examine important contemporary environmental issues, green-living practices, and fun "green" facts.

Endangered Animals of the World
Studies the physical characteristics, behaviors, threat levels, and reasons for endangerment of selected animals on each continent.