

Lesson Plans for the Digitarium® Planetarium Systems and the National Science Education Standards Addressed by Each

Kindergarten Through 2nd Grade Lesson Plans

Summaries

- Moving Right Along (MRA): An introduction to Earth's rotation and revolution and how those movements affect our view of the sky.
- Sky Stories (SS): Introduces students to the pictures and stories of some Greco-Roman constellations, as well as reasons why constellations were created.
- What's Up? (WU): Explores what we can see in the sky (stars, planets, the moon) and differences between those objects.

<i>Text of Applicable K-4 Standards (for K-2nd lessons)</i>	<i>MRA</i>	<i>SS</i>	<i>WU</i>
Physical Science The position of an object can be described by locating it relative to another object or the background.	X	X	X
An object's motion can be described by tracing and measuring its position over time.	X	X	X
Heat can be produced in many ways, such as burning, rubbing, or mixing one substance with another. Heat can move from one object to another by conduction.	X	X	
Light travels in a straight line until it strikes an object. Light can be reflected by a mirror, refracted by a lens, or absorbed by the object.			X
Earth and Space Science The sun, moon, clouds, birds, and airplanes all have properties, locations, and movements that can be described.	X	X	X
The sun provides the light and heat necessary to maintain the temperature of the earth.	X	X	
Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.	X	X	X
Science and Technology People have always had questions about their world. Science is one way of answering questions and explaining the natural world.	X	X	X
People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.		X	X
History and Nature of Science Science and technology have been practiced by people for a long time.	X	X	X

<i>Text of Applicable K-4 Standards (for K-2nd lessons)</i>	<i>MRA</i>	<i>SS</i>	<i>WU</i>
Men and women have made a variety of contributions throughout the history of science and technology.	X	X	X
Although men and women using scientific inquiry have learned much about the objects, events, and phenomena in nature, much more remains to be understood. Science will never be finished.	X	X	X
Many people choose science as a career and devote their entire lives to studying it. Many people derive great pleasure from doing science.	X	X	X

3rd-5th Grade Lesson Plans (NOTE: These lessons span two age ranges of National Science Education Standards.)

Summaries

- Moons of the Solar System (MSS): explores differences between planets and moons, and introduces students to major moons.
- Planets (P): Explores the differences between stars and planets, how we can recognize a planet in the night sky, and planetary motion.
- Star Quest (SQ): Introduces some Greco-Roman constellations and stories; students also learn to use star maps to find the pictures in the sky.
- Stellar Lunar (SL): Explores stars, constellations, and the phases of the moon; students learn what causes the phases and the name of each phase as they model the earth, moon, and sun system.

<i>Text of Applicable K-4 Standards (for 3rd-5th lessons)</i>	<i>MSS</i>	<i>P</i>	<i>SQ</i>	<i>SL</i>
Physical Science The position of an object can be described by locating it relative to another object or the background.	X	X	X	X
An object's motion can be described by tracing and measuring its position over time.	X	X	X	X
Light travels in a straight line until it strikes an object. Light can be reflected by a mirror, refracted by a lens, or absorbed by the object.	X	X		X
Heat can be produced in many ways, such as burning, rubbing, or mixing one substance with another. Heat can move from one object to another by conduction.		X		X
Earth and Space Science The sun, moon, clouds, birds, and airplanes all have properties, locations, and movements that can be described.	X	X	X	X
The sun provides the light and heat necessary to maintain the temperature of the earth.		X		X
Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.	X	X	X	X
Science and Technology People have always had questions about their world. Science is one way of answering questions and explaining the natural world.	X	X	X	X
People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Trying to determine the effects of solutions helps people avoid some new problems.	X	X	X	
Tools help scientists make better observations, measurements, and equipment for investigations. They help scientists see, measure, and do things that they could not otherwise see, measure, and do.	X	X		
History and Nature of Science Science and technology have been practiced by people for a long time.	X	X	X	X

<i>Text of Applicable K-4 Standards (for 3rd-5th lessons)</i>	<i>MSS</i>	<i>P</i>	<i>SQ</i>	<i>SL</i>
Men and women have made a variety of contributions throughout the history of science and technology.		X	X	X
Although men and women using scientific inquiry have learned much about the objects, events, and phenomena in nature, much more remains to be understood. Science will never be finished.	X	X	X	X
Many people choose science as a career and devote their entire lives to studying it. Many people derive great pleasure from doing science.	X	X	X	

5th-8th grade standards for 3rd-5th grade lessons

<i>Text of Applicable 5th-8th Standards (for 3rd-5th lessons)</i>	<i>MSS</i>	<i>P</i>	<i>SQ</i>	<i>SL</i>
Physical Science The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.	X	X	X	X
Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object emitted by or scattered from it must enter the eye.	X	X		X
Earth and Space Science The earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system.	X	X		X
Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.	X	X	X	X
Gravity is the force that keeps planets in orbit around the sun and governs the rest of motion in the solar system. Gravity alone holds us to the earth's surface and explains the phenomena of the tides.		X		X
Science and Technology Many different people in different cultures have made and continue to make contributions to science and technology.	X	X	X	X
History and Nature of Science Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.	X	X	X	X

6th-8th Grade Lesson Plans

Summaries

- Halloween Astronomy (HA): introduces the history and mythology of Halloween and its relationship with solstices and equinoxes.
- Mars (M): explores how to recognize the Red Planet in the sky, what makes Mars interesting, and past and future exploration missions.
- Solstice and Equinox (SE): Explores the relevance of solstices and equinoxes and how they relate to the seasons.
- Stellar Navigation (SN): Introduces students to the idea of navigating by the stars; students learn to use stars to determine latitude and compass points, and observe how our location on Earth affects our view of the sky. Written for the northern hemisphere.
- World in Motion (WM): Explores what is in motion in our solar system. Explains that Earth's movements give us the day and the year, that gravity keeps planets in orbit around the sun and the moon in orbit around the earth, how to recognize a planet in the night sky, and prograde and retrograde planetary motion.

<i>Text of Applicable 5th-8th Standards (for 6th-8th lessons)</i>	<i>HA</i>	<i>M</i>	<i>SE</i>	<i>SN</i>	<i>WM</i>
Physical Science The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.	X	X	X		X
Earth and Space Science The earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets. The sun, an average star, is the central and largest body in the solar system.		X	X		X
Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.	X	X	X	X	X
Gravity is the force that keeps planets in orbit around the sun and governs the rest of motion in the solar system. Gravity alone holds us to the earth's surface and explains the phenomena of the tides.					X
The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of the day.			X		X
Science and Technology Many different people in different cultures have made and continue to make contributions to science and technology.	X	X	X	X	X
Science and technology are reciprocal. Science helps drive technology, as it addresses questions that demand more sophisticated instruments and provides principles for better instrumentation and technique. Technology is essential to science, because it provides instruments and techniques that enable observations of objects and phenomena that are otherwise unobservable due to factors such as quantity, distance, location, size, and speed. Technology also provides tools for investigations, inquiry, and analysis.		X		X	

<i>Text of Applicable 5th-8th Standards (for 6th-8th lessons)</i>	<i>HA</i>	<i>M</i>	<i>SE</i>	<i>SN</i>	<i>WM</i>
Science in Personal and Social Perspectives Science influences society through its knowledge and world view. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental.	X	X	X	X	X
Societal challenges often inspire questions for scientific research, and social priorities often influence research priorities through the availability of funding for research.		X		X	
Science and technology have advanced through contributions of many different people, in different cultures, at different times in history. Science and technology have contributed enormously to economic growth and productivity among societies and groups within societies.	X	X	X	X	X
Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Students should understand the difference between scientific and other questions. They should appreciate what science and technology can reasonably contribute to society and what they cannot do. For example, new technologies often will decrease some risks and increase others.		X			
History and Nature of Science Scientists formulate and test their explanations of nature using observation, experiments, and theoretical and mathematical models. Although all scientific ideas are tentative and subject to change and improvement in principle, for most major ideas in science, there is much experimental and observational confirmation. Scientists do and have changed their ideas about nature when they encounter new experimental evidence that does not match their existing explanations.	X	X			X
Many individuals have contributed to the traditions of science. Studying some of these individuals provides further understanding of scientific inquiry, science as a human endeavor, the nature of science, and the relationships between science and society.	X	X	X	X	X
In historical perspective, science has been practiced by different individuals in different cultures. In looking at the history of many peoples, one finds that scientists and engineers of high achievement are considered to be among the most valued contributors to their culture.	X		X	X	X
Tracing the history of science can show how difficult it was for scientific innovators to break through the accepted ideas of their time to reach the conclusions that we currently take for granted.		X		X	X

9th Through 12th Grade Lesson Plans

Summaries

- Astrology: Fact or Fiction? (A): Debunks astrology; explores the differences between science and pseudoscience; introduces students to the ecliptic and precession; and explains how and why the zodiac signs were created.
- How do we Know...?(HK): Explores how we know what we know about our universe by looking at developments in three major eras: Greco-Roman times, the 17th century, and the late 19th century to today.
- Hubble Space Telescope (HST): Explores why the Hubble Space Telescope is in space, as well as several discoveries it has made. **Note:** *The standards addressed by this lesson depend greatly on which HST images the teacher chooses to discuss and therefore will vary dramatically from teacher to teacher. Those listed here are addressed by the parts of the lesson plan before and after the image discussions.*

<i>Text of Applicable 9th-12th Standards</i>	<i>A</i>	<i>HK</i>	<i>HST</i>
Physical Science Atoms interact with one another by transferring or sharing electrons that are furthest from the nucleus. These outer electrons govern the chemical properties of the element.		X	
Objects change their motion only when a net force is applied. Laws of motion are used to calculate precisely the effects of forces on the motion of objects. The magnitude of the change in motion can be calculated using the relationship $F=ma$, which is independent of the nature of the force. Whenever one object exerts a force on another, a force equal in magnitude and opposite in direction is exerted on the first object.		X	
Gravitation is a universal force that each mass exerts on any other mass. The strength of the gravitational attractive force between two masses is proportional to the masses and inversely proportional to the square of the distance between them.		X	
The total energy of the universe is constant. Energy can be transferred by collisions in chemical and nuclear reactions, by light waves and other radiations, and in many other ways. However, it can never be destroyed. As these transfers occur, the matter involved becomes steadily less ordered.		X	
Waves, including sound and seismic waves, waves on water, and light waves, have energy and can transfer energy when they interact with matter.		X	
Electromagnetic waves result when a charged object is accelerated or decelerated. Electromagnetic waves include radio waves (the longest wavelength), microwaves, infrared radiation, x-rays, and gamma rays. The energy of electromagnetic waves is carried in packets whose magnitude is inversely proportional to the wavelength.		X	X
Earth and Space Science The sun, the earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago. The early earth was very different from the planet we live on today.		X	

<i>Text of Applicable 9th-12th Standards</i>	<i>A</i>	<i>HK</i>	<i>HST</i>
The origin of the universe remains one of the greatest questions in science. The “big bang” theory places the origin between 10 and 20 billion years ago, when the universe began in a hot, dense state; according to this theory, the universe has been expanding ever since.		X	X
Early in the history of the universe, matter, primarily the light atoms hydrogen and helium, clumped together by gravitational attraction to form countless trillions of stars. Billions of galaxies, each of which is a gravitationally bound cluster of billions of stars, now form most of the visible mass in the universe.		X	
Stars produce energy from nuclear reactions, primarily the fusion of hydrogen to form helium. These and other processes in stars have led to the formation of all the other elements.		X	
Science and Technology Science often advances with the introduction of new technologies. Solving technological problems often results in new scientific knowledge. New technologies often extend the current levels of scientific understanding and introduce new areas of research.	X	X	X
Creativity, imagination, and a good knowledge base are all required in the work of science and engineering.	X	X	X
Science in Personal and Social Perspectives Progress in science and technology can be affected by social issues and challenges. Funding priorities for specific health problems serve as examples of ways that social issues influence science and technology.	X	X	X
Individuals and society must decide on proposals involving new research and the introduction of new technologies into society. Decisions involve assessment of alternatives, risks, costs, and benefits and consideration of who benefits and who suffers, who pays and gains, and what the risks are and who bears them. Students should understand the appropriateness and value of basic questions--“What can happen?”--“What are the odds?”--and “How do scientists and engineers know what will happen?”	X	X	X
History and Nature of Science Individuals and teams have contributed and will continue to contribute to the scientific enterprise. Doing science or engineering can be as simple as an individual conducting field studies or as complex as hundreds of people working on a major scientific question or technological problem. Pursuing science as a career or as a hobby can be both fascinating and intellectually rewarding.	X	X	X
Scientists have ethical traditions. Scientists value peer review, truthful reporting about the methods and outcomes of investigations, and making public the results of work. Violations of such norms do occur, but scientists responsible for such violations are censured by their peers.	X	X	X
Scientists are influenced by societal, cultural, and personal beliefs and ways of viewing the world. Science is not separate from society but rather science is a part of society.	X	X	
Science distinguishes itself from other ways of knowing and from other bodies of knowledge through the use of empirical standards, logical arguments, and skepticism, as scientists strive for the best possible explanations about the natural world.	X	X	X

<i>Text of Applicable 9th-12th Standards</i>	<i>A</i>	<i>HK</i>	<i>HST</i>
<p>Scientific explanations must meet certain criteria. First and foremost, they must be consistent with experimental and observational evidence about nature, and must make accurate predictions, when appropriate, about systems being studied. They should also be logical, respect the rules of evidence, be open to criticism, report methods and procedures, and make knowledge public. Explanations on how the natural world changes based on myths, personal beliefs, religious values, mystical inspiration, superstition, or authority may be personally useful and socially relevant, but they are not scientific.</p>	X	X	
<p>Because all scientific ideas depend on experimental and observational confirmation, all scientific knowledge is, in principle, subject to change as new evidence becomes available. The core ideas of science such as the conservation of energy or the laws of motion have been subjected to a wide variety of confirmations and are therefore unlikely to change in the areas in which they have been tested. In areas where data or understanding are incomplete, such as the details of human evolution or questions surrounding global warming, new data may well lead to changes in current conflicts. In situations where information is still fragmentary, it is normal for scientific ideas to be incomplete, but this is also where the opportunity for making advances may be greatest.</p>	X	X	X
<p>In history, diverse cultures have contributed scientific knowledge and technologic inventions. Modern science began to evolve rapidly in Europe several hundred years ago. During the past two centuries, it has contributed significantly to the industrialization of Western and non-Western cultures. However, other, non-European cultures have developed scientific ideas and solved human problems through technology.</p>		X	
<p>Occasionally there are advances in science and technology that have important and long-lasting effects on science and society. Examples of such advances include the following: Copernican revolution, Newtonian mechanics, relativity, geologic time scale, plate tectonics, atomic theory, nuclear physics, biological evolution, germ theory, industrial revolution, molecular biology, information and communication, quantum theory, galactic universe, medical and health technology.</p>		X	
<p>The historical perspective of scientific explanations demonstrates how scientific knowledge changes by evolving over time, almost always building on earlier knowledge.</p>	X	X	X