

5th Grade Science

Pacing Guide and Unpacked Standards



**GROVEPORT
MADISON**
SCHOOLS

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Resources: School District U-46, of Chicago, IL, The Ohio Department of Education,
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Groveport Madison Science Pacing Guide

5	Science Inquiry and Application	Life Science	Physical Science	Earth and Space Science
1st 9 wks	<p>► Thinking Like a 21st Century Scientist/Engineer Intro to Science, Technology and Engineering: Lab Safety Procedures/Equipment; Team Building; Computer Technology; Engineering Design 3 weeks</p>	<p>► Interconnections with Ecosystems (5.LS.1, 5.LS.2) Dynamic Relationships Within Ecosystems: Symbiotic Relationships Food webs Energy Flow and transfer 6 weeks</p>		
2nd 9 wks	<p>► Thinking Like a 21st Century Scientist/Engineer (continue to integrate)</p>	<p>► Interconnections with Ecosystems Cont'd (5.LS.1, 5.LS.2) 3 weeks</p>	<p>► Energy (5.PS.2) Sound, Light 4 weeks</p> <p>► Motion (5.PS.1) Motion, Force Speed 2 weeks</p>	
3rd 9 wks	<p>► Thinking Like a 21st Century Scientist/Engineer (continue to integrate)</p>		<p>► Motion Cont'd (5.PS.1) 2 weeks</p>	<p>► Cycles (5.ESS.3) Rotation Revolution Earth's Tilt 4 weeks</p> <p>► Sun (5.ESS.2) Sun Characteristics Other Stars Constellations 3 weeks</p>
4th 9 wks	<p>► Thinking Like a 21st Century Scientist/Engineer (continue to integrate)</p>			<p>► Solar System (5.ESS.1) Planet Characteristics Asteroids, Meteors, Comets 4 weeks</p>

Ohio's Learning Standards- Clear Learning Targets

Science, Grade 5

5.ESS.1

CYCLES AND PATTERNS IN THE SOLAR SYSTEM

The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.

Vocabulary

8 Planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune)
 Asteroid
 Atmosphere
 Celestial bodies
 Comet
 Craters
 Gravity
 Impact
 Meteorite
 Orbit
 Physical characteristics
 Solar System

Dwarf planet
 Gravitational attraction
 Meteor
 Meteoroid

Essential Understandings:

- The distance from the sun, size, composition and movement of each planet are unique.
- Planets revolve around the sun in elliptical orbits.
- Some of the planets have moons and/or debris that orbit them.
- Comets, asteroids and meteoroids orbit the sun.

Essential Skills:

- The students can evaluate the characteristics of a planet as it relates to distance from the Sun, size, composition, and movement.**
- The students can design and construct a relative scaled-model that can demonstrate the planet size in relationship to the Sun and the Earth.**
- The students can compare and contrast the physical characteristics of meteoroids, meteors, asteroids, and comets**
- The students can describe the effects of meteoroids on the Earth's surface.**

Misconceptions

Common misconceptions about cycles and patterns in the Solar System at this grade level include:

- Meteors (shooting stars) are real stars. (Meteors are meteoroids burning up as they enter Earth's atmosphere.)
- Meteoroids will have the same impact on the moon that meteorites have On Earth. (Meteoroids will have a greater impact on the moon due to the lack of atmosphere on the moon).
- Meteorites and meteoroids are all meteors. (Meteoroids, meteorites and meteors are all smaller forms of asteroids. The meteoroid is a body moving in the Solar System before it enters Earth's atmosphere. As that small body enters Earth's atmosphere, it is a meteor. A meteorite is what remains from the meteor and has landed on the Earth.)
- Living in outer space is an idea of the future. (Astronauts are living and surviving on the International Space Station.)
- We could do everything on the other planets that we do here on Earth. (Based on resources and differences in gravity, life would be very different.)
- Pluto is a planet. (Pluto is now considered a dwarf planet due to its characteristics.)
- The Planets are evenly spaced. (The terrestrial planets are closer together, whereas the gas giants are farther apart.)

Instructional Strategies and Resources

- <http://www.bobthealien.co.uk/solar.htm> Bob the Alien's tour of the Solar System has information about the Solar System written in student friendly language.
- Discovery Ed: (www.unitedstreaming.com)
The Magic School Bus: Gets Lost in Space (29:08 minutes), The Planets (5:36 minutes), All About Comets (2:13 minutes), Asteroids and Meteoroids (3:29 minutes), Real World Science: Our Solar System (18:39 minutes), Science is Elementary: What's in Space: Stars and Planets (18:19 minutes), Science Lab: Our Solar System (game) Our Solar System: The Inner Planets [29:16], Our Solar System: The Outer Planets [30:07]
- Smart Exchange Lessons: Solar System by Melissa Love, Solar System submitted by LadyLiz2012, Space Objects submitted by Billyernst
- Ensuring that relevant and up-to-date information about the solar system is important. NASA's website offers a good starting point with helpful resources, references, content-specific data for the solar system, recent research and discoveries to help teachers prepare to teach about the solar system.
- Science News for Kids is a resource that provides topics and current events that include new discoveries and research related to the solar system and space. These articles can help form classroom discussions and research ideas for students.
- The University of Chicago provides ideas and background for student projects related to the solar system and solar exploration. One project combines science and investigation through the role of a reporter. Students collaborate and learn about asking investigative questions. By presenting the science material in a different format, students of all ability levels can be engaged in learning.
- NSTA provides learning modules called SciPacks that are designed to increase teacher content knowledge through inquiry-based modules. This module addresses the Earth, moon and sun.
- It is important to incorporate inquiry and student investigation into learning about the solar system. Researching the existing conditions on different planets or in space and comparing them to the conditions that support life on Earth can help in understanding the history of Earth and the solar system. Life on Mars is an example of a student research idea that helps with understanding properties. Using real planetary characteristics and sizes can make the research authentic.
- Helping students understand the distances within the solar system and the size of the solar system can be difficult. Using student-made scaled models of the solar system (based on actual data) can develop that understanding.

Career Connections

Planetary Scientist, Astronaut, Geologist, Geophysicist, Hydro geologist, Teacher/Professor of Science

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recall that the sun is the only star in the solar system; Describe characteristics of planets such as distance from the sun, size, movement, composition, and temperature.
- **Basic:** Recall that the orbital paths of planets, moons and celestial bodies are due to gravitational attraction; Select tools and technology needed to study the solar system, including Earth (e.g., telescopes, satellites, probes); Identify general information about asteroids, meteoroids, comets, and dwarf planets (e.g., composition, relative size, orbits).
- **Proficient:** Compare or summarize general characteristics (e.g., size, composition, distance, temperature, motion) of objects in the universe including, stars, planets, moons, asteroids and comets.
- **Accelerated:** Explain how using data about the compositions of planets can indicate distance from the sun.
- **Advanced:** Given data, provide evidence to support the fact that Earth orbits the sun in a nearly circular path.

Prior Knowledge

4.ESS.1: Earth's surface has specific characteristics and landforms that can be identified.

Future Knowledge

Grade 6: N/A

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 5

5.ESS.2

CYCLES AND PATTERNS IN THE SOLAR SYSTEM

The sun is one of many stars that exist in the universe.

Vocabulary

Earth
Stars
Sun
Astronomy
Atmosphere
Constellation
Mythology
Revolution
Rotation
Solar System
Universe

Essential Understandings:

- The sun appears to be the largest star in the sky because it is the closest star to Earth.
- Some stars are larger than the sun and some stars are smaller than the sun.

Essential Skills:

The students can experiment with round objects to test distances and size of stars.

Compare and contrast the stars to our closest star, the sun.

Research current and new discoveries about the stars and sun.

Explore star patterns called constellations.

Show the difference in size between the sun and Earth.

Misconceptions

Common misconceptions about cycles and patterns in the Solar System at this grade level include:

- Students believe the sun is moving behind the clouds. (The clouds are moving.)
- Day is replaced by night, the Sun sets behind the hills. (The Earth is rotating on its' axis is what causes day and night.)
- The sun and moon revolve around the stationary Earth every 24 hours. (The Earth revolves around the Sun and the moon revolves around the Earth.)
- The Earth rotates in an up/down direction and the Sun and moon are fixed on opposite sides. (The Earth rotates on its' axis and revolves around the Sun. The Sun also rotates in space very slowly.)
- The Earth gets heat from the Sun. (The Sun is actually too far from the Earth to heat it directly. Instead, the light from the Sun is reflected or absorbed by objects on Earth. Absorbed light usually increases the energy in an object, causing the object to heat up.)
- All stars in a constellation are near one another. (Each constellation is a collection of stars that are different distances from Earth. They appear to be near each other because we are viewing them from very faraway.)
- The North Star is the brightest star in the sky. (The North Star, Polaris, is in the top 50 brightest stars. The brightest star, besides the Sun, is Sirius.)
- Stars leave the sky during the daytime. (In reality we cannot see the stars during the day because of the Sun's bright light.)
- All stars are the same size. All stars are the same distance from the Earth. (Stars can be light years away.)
- The Sun rises exactly in the East and sets exactly in the West every day. (The Earth is rotating and revolving, making it look like the Sun is rising and setting.)
- Stars and constellations appear in the same place in the sky every night. (The position of stars depends on the rotation and revolution of the Earth.)
- The brightness of a star depends ONLY on its distance from the Earth. (The size, distance and age determines brightness. The North Star, Polaris, is in the top 50 brightest stars. The brightest star, besides the sun, is Sirius.)
- The Sun is not a star. (The Sun is a star. The closest star in our galaxy)
- The Sun will never burn out, it will last forever. (The Sun is a star and eventually it will run out of hydrogen in its core. This will take about 5 billion years.)
- NASA lists common misconceptions for all ages about the sun and the Earth at [http://www- istp.gsfc.nasa.gov/istp/outreach/sunearthmiscons.html](http://www-istp.gsfc.nasa.gov/istp/outreach/sunearthmiscons.html)
- For examples of misconceptions that elementary students may have about the solar system and space (astronomy), and resources to address misconceptions through investigation, visit <http://amasci.com/miscon/opphys.html>

Instructional Strategies and Resources

- Call the science department to use the StarLab.
- Field trip to COSI's planetarium.
- Field trip to Perkins Observatory at Ohio Wesleyan University.
- Discovery Education videos: The Magic School Bus Sees Stars (24 minutes), A Closer Look at Space: The Sun and Stars (2:24 minutes for segment Solar Energy, 20:59 minutes, entire video), TLC Elementary School: Exploring the Stars (All Segments 25 minutes)
- <http://mrscienceut.net/StarryNight1.html> (need to read the website to complete the Constellation Name Activity) www.dailygalaxy.com is a website that lists daily space discoveries and activities.
- NASA provides background data about the sun (including recent discoveries, research and photos) to help teachers prepare for teaching about the sun.
- It can be difficult for fourth-grade students to understand the size and scale of the solar system. Setting up scaled models (e.g., making the classroom into the solar system using actual distance data) or investigating the solar system by setting up a planetarium can increase understanding. It is important to use student inquiry and investigation in developing the models.
- New technology and discoveries are important to include in learning about the sun and the solar system. Projects such as NASA's Solar Orbiter or the Solar Probe Plus can be used in classroom discussions to engage student interest and ensure that new findings are part of the curriculum.

Career Connections

Astronomer, Meteorologist, Work at an observatory or planetarium, Astrologist, Astrophysicist, Teacher/Professor

Criteria for Success (Performance level Descriptors)

- **Limited:** Recall that the sun is the only star in the solar system.
- **Basic:** Select tools and technology needed to study the solar system, including Earth (e.g., telescopes, satellites, probes); Explain that other stars are much farther away from Earth than the sun, which causes them to appear much smaller; Recall the size and composition (e.g., made of gas) of stars, including the sun.
- **Proficient:** N/A
- **Accelerated:** Create a model to show the relationship between size, distance and appearance of stars.
- **Advanced:** N/A

Prior Knowledge

4.ESS.3: The surface of Earth changes due to erosion and deposition (gravitational force affects movements of water, rock, and soil).

Future Knowledge

Grade 6: N/A

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 5

5.ESS.3

CYCLES AND PATTERNS IN THE SOLAR SYSTEM

Most of the cycles and patterns of motion between the Earth and sun are predictable.

Vocabulary

Angle of rays	Globe
Axis	Revolution
Sunlight	Rotation
Elliptical	Tilt
Orbit	Sun
Hemispheres	Seasons
Moon	Rotate
Moon phases	Revolve

Essential Understandings

- Earth's revolution around the sun takes approximately 365 days.
- Earth completes one rotation on its axis in a 24-hour period, producing day and night.
- This rotation makes the sun, stars and moon appear to change position in the sky.

Note: Moon phases should not be the focus.

Essential Skills:

- The students can construct a model of the Earth, Sun and Moon in relation to how they revolve and rotate.**
- The students can experiment with rays of sunlight and the Earth's tilt to understand seasons.**
- The students can explain to someone else what causes day and night.**

Misconceptions

Common misconceptions about cycles and patterns in the Solar System at this grade level include:

- The Earth is flat. (The Earth is a sphere.)
- The Earth is not moving, but objects like the Sun move around it. (Earth is moving in space. It moves on its axis and around the Sun.)
- The sky is a horizontal surface above and parallel to the flat Earth. (The sky completely surrounds the spherical Earth.)
- Space is only above the Earth. (Space completely surrounds the Earth and spreads out in all directions from Earth.)
- Falling objects always fall in an absolute down direction no matter where one is on Earth. (Objects fall toward the center of the Earth, which looks like 'up' if looking at a picture of a globe and a person in the southern hemisphere.)
- We experience seasons because of the Earth's changing distance from the Sun. (Seasons are due to the tilt and rotation of the Earth.)
- The Earth goes around the Sun once a day. (The Earth rotates on its axis once a day, every 24 hours.)
- Beyond Penguins and Polar Bears is an online magazine for K-5 teachers. Misconceptions about why there are seasons are common at this age (e.g., the Earth is closer to the sun in the summer and that is why it is so hot).
<http://beyondpenguins.nsd.org/issue/column.php?date=May2008&departmentid=professional&columnid=professional!science&test>.
- NASA lists common misconceptions for all ages about the sun and the Earth at <http://www-istp.gsfc.nasa.gov/istp/outreach/sunearthmiscons.html>.
- For examples of misconceptions that elementary students may have about the solar system and space (astronomy), and resources to address misconceptions through investigation, visit <http://amasci.com/miscon/opphys.html>.

Instructional Strategies and Resources

- Visit COSI's planetarium.
- <http://www.weatherwizkids.com/weather-climate.htm> Material written in kid friendly language to discuss the difference between weather and climate
- <http://www.weatherwizkids.com/weather-links.htm> Track severe weather around the globe.
- www.youtube.com/watch?V=DuiQvPLWziQ What Causes Earth's Season's video.
- <http://www.fearofphysics.com/SunMoon/sunmoon1.html> A short video of the motions of the Earth, Sun and Moon.
- Discovery Ed: Song-Music Makes It Memorable: "Planet Placement Dance" Information About Our Globe segment (3:07min.), Rotation and Revolution, segment (4:47min.) from TLC Elementary School: Rules of Motion and Forces the Reasons for the Seasons, only segments 5-13 (22:38min.) The Right-Hand Rule, Revolution and Ions (2:40min.) About the Moon (1:08min.) Space Exploration: What is an orbit? (1:30min.) This is our World, segment Day and Night, (1:08min.) A Closer Look at the Moon: Space Science (20min.) TLC Elementary School: Liftoff Into Space, Segment 7 Day and Night (7min.)
- The National Atlas mapping project provides maps that show areas within the United States that are effective in generating solar energy. This can be a starting resource for the Designing Solutions section listed in the classroom examples.
- Using specific data to determine the actual distances and sizes of objects within the solar system is an important part of understanding Earth's role in the solar system. The characteristics of the Earth and the relationship of the rotation and orbit of Earth and the seasons are all related to the cycles within the solar system.
- Modeling the movement within the solar system and the resultant moon and moon phases is important in understanding the processes required. Names of the lunar phases are not the emphasis; the processes and positions of the sun, Earth and moon during the phases should be the focus.

Career Connections

Astronomer, Meteorologist, Travel Agent, Work at an observatory or planetarium, Astrologist, Astrophysicist, Teacher/Professor

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recognize Earth's seasons, day and night, and the motion of the sun in the sky.
- **Basic:** Select tools and technology needed to study the solar system, including Earth (e.g., telescopes, satellites, probes).
- **Proficient:** Relate Earth's tilt and revolution to direct sunlight and seasons.
- **Accelerated:** Examine relationships and draw conclusions between direct sunlight and temperature, and the angle/altitude of the sun and amount of direct sunlight.
- **Advanced:** Use data and evidence to make a conclusion about how the positions of the Earth and the sun relate to seasonal weather patterns in specific regions; Given a scenario, determine relationships between direct sunlight and temperature and the angle/altitude of the sun and amount of direct sunlight.

Prior Knowledge

4.ESS.3: The surface of Earth changes due to erosion and deposition (gravitational force affects movements of water, rock, and soil).

Future Knowledge

Grade 6: N/A

Ohio's Learning Standards- Clear Learning Targets Science, Grade 5

5.PS.1

LIGHT, SOUND, AND MOTION

The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.

Vocabulary

Decrease
Distance
Direction
Force
Friction
Increase
Magnetism
Mass
Motion
Movement
Speed
Time
Weight

Essential Understandings:

- Movement can be measured by speed the speed of an object is calculated by determining the distance (d) traveled in a period of time (t).
- Any change in speed or direction of an object requires a force and is affected by the mass of the object and the amount of force applied.

Note: Differentiating between mass and weight is not necessary at this grade level.

Essential Skills:

The students can explain the gravitational force between an object and the Earth.

The students can use the formula ($\text{speed} = \text{distance} \div \text{time}$) in real world situations to calculate speed.

The students can conduct experiments to explain how the mass of an object affects the amount of force needed to move the object.

The students can conduct an experiment and explain how an object will remain at rest if it is not moving, and no force acts upon it.

The students can identify that when a force is applied in the same direction of the object's motion, the speed will increase.

The students can identify that when a force is applied in the opposite direction of an object's motion, the speed will decrease.

Misconceptions

Common misconceptions about forces and motion at this grade level include:

- Time can be measured without establishing the beginning of the interval.
- The only natural motion is for an object to be at rest.
- If an object is at rest, no forces are acting on the object.
- Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting on it.
- Force is a property of an object.
- An object has force and when it runs out of force, it stops moving.
- The motion of an object is always in the direction of the net force applied to the object.
- Large objects exert a greater force than small objects.
- A force is needed to keep an object moving with a constant speed.

Misconceptions in physical science at this grade level include:

- Any quantity can be measured as accurately as you want.
- The only way to measure time is with a clock or a watch.
- Time has an absolute beginning.
- Gravity only acts on things when they are falling.
- Only animate things (people, animals) exert forces; passive ones (tables, floors) do not exert forces.
- A force applied by a hand (or other object), still acts on an object after the object leaves the hand.

Instructional Strategies and Resources

- Websites: www.sciencekids.co.nz , <http://www.engineeringinteract.org/resources/parkworldplot.htm> , http://www.bbc.co.uk/schools/scienceclips/ages/8_9/science_8_9.shtml ,
- Discovery Ed: (www.unitedstreaming.com) Physical Science: Force and Gravity (20:20 minutes), Roller Coasters: Momentum and energy in action (4:02 minutes), Segments from The Language of Science: Physical Science 3-5: Force & Motion -Forces (1:10 minutes), Changing Things (1:46 minutes), Moving Faster (1:20 minutes), Moving Slower (2:29 minutes), Gravity (1:19 minutes)
- Forces and movement, an interactive simulation from BBC Schools, gives students the chance to try different forces and weights to see how the movement of a car is changed.
- Field trip to COSI

Career Connections

Game Programmer, Architect, Mechanical Engineer, Astronaut, Physics Teacher, Physicist

Criteria for Success (Performance Level Descriptors)

- **Limited:** Describe that objects at rest require a force to start moving.
- **Basic:** Identify the effects of relative mass/weight and force (amount and direction) on an object's change in motion; Recognize measurements of motion involving speed, distance and time; Recall that an object moving at constant speed has no change in speed or direction if no force is acting on it.
- **Proficient:** Describe that an object moving at constant speed has no change in speed or direction if no force is acting on it; Compare the speed of objects, given distance and time data.
- **Accelerated:** Draw conclusions based on data and/or diagrams showing movement of an object over time; Compare and rank the relative change in motion for objects of different masses/weights that experience the same force.
- **Advanced:** Predict changes that take place when an object experiences differing magnitudes of forces and/or masses/weights; Design an investigation that determines how the mass/weight of an object (or amount of force acting on an object) affects how the motion of an object changes.

Prior Knowledge

4.PS.2: Energy can be transferred from one location to another or can be transformed from one form to another.

Future Knowledge

6.PS.2: Changes of state are explained by a model of matter composed of particles that are in motion.
6.PS.3: There are two categories of energy: kinetic and potential.
6.PS.4: An object's motion can be described by its speed and the direction in which it is moving.

Ohio's Learning Standards- Clear Learning Targets Science, Grade 5

5.PS.2

LIGHT, SOUND AND MOTION

Light and sound are forms of energy that behave in predictable ways.

Vocabulary

Sound Vocabulary

Absorbed	Audible sound
Emitted	Medium
Pitch	Range of Pitches
Rate of Vibration	Vibrating

Light Vocabulary

Absorbed	Angle of light
Concave	Convex
Emitted	Heat
Light travels	Magnifying lens
Prism	Reflected
Refracted	Shadow

Essential Understandings:

- Light travels and maintains its direction until it interacts with an object or moves from one medium to another and then it can be reflected, refracted or absorbed.
- Sound is produced by vibrating objects and requires a medium through which to travel.
- The rate of vibration is related to the pitch of the sound.

Note: At this grade level, the discussion of light and sound should be based on observable behavior. Waves are introduced at the middle school level.

Essential Skills:

- The students can produce sound by vibrating objects.**
- The students can change the pitch of the sound as it relates to the rate of vibration.**
- The students can explore how sound travels through different mediums.**
- The students can understand that light travels in a straight line until it interacts with an object or moves from one substance to another.**
- The students can experiment to determine the difference between light that is absorbed, reflected and refracted.**
- The students can experiment with temperature changes caused by light striking different surfaces.**
- The students can explain that light is faster than sound.**

Misconceptions

Common misconceptions about sound pertaining to this content statement and grade level include:

- Sounds can be produced without using any material objects.
- Hitting an object harder changes the pitch of the sound produced.
- Human voice sounds are produced by a large number of vocal cords that all produce different sounds.
- Loudness and pitch of sounds are the same things.
- You can see and hear a distinct event at the same moment.
- Sounds can travel through empty space (a vacuum).
- Sounds cannot travel through liquids and solids.
- In wind instruments, the instrument itself vibrates (not the internal air column).
- Music is strictly an art form; it has nothing to do with science.
- In actual telephones, sounds (rather than electrical impulses) are carried through the wires.
- Ultrasounds are extremely loud sounds.
- Megaphones create sounds.

Common misconceptions about light pertaining to this content statement and grade level include:

- Light is associated only with a source and/or its instantaneous effects. • Light is not considered to exist independently in space.
- Light is not conceived as moving from one point to another with a finite speed.
- An object is seen whenever light shines on it, with no recognition that light must move between the object and the observer's eye.
- A shadow is something that exists on its own.
- Light pushes the shadow away from the object to a wall, the ground or other surface where the shadow lies.
- Shadows are "dark reflections" of objects.
- Lines drawn outward from a light bulb in a sketch represent the "glow" surrounding the bulb.
- Light from a bulb only extends outward a certain distance and then stops. How far it extends depends on the brightness of the bulb.
- Light is reflected away from shiny surfaces, but light is not reflected from other surfaces.
- Light always passes straight through transparent material (without changing direction).
- When an object is viewed through a transparent material, the object is seen exactly where it is located.
- Light fills the room as water fills a bathtub.
- No mechanism between the light, the object and the eye produces vision.

Instructional Strategies and Resources

- Videos/Movies: Bill Nye the Science Guy: Sound
- Discovery Ed: (www.unitedstreaming.com) A First Look: Sound (17 minutes), The Magic School Bus in the Haunted House (29:15 minutes), Vibrations and Sound (1:11 minutes), The Medium Affects How Quickly Sound Travels (3:16 minutes), Pitch (3:25 minutes), Exploring Sound (22:14 minutes)
- The Utah Education Network shows how to construct lenses out of lemon Jell-O® that could be used for inquiry activities dealing with light for schools with limited resources.
- How We See Things, an interactive simulation from BBC Schools, allows students to explore the path light takes with different orientations of mirrors. Students place mirrors in different locations with different orientations to alter the path of light to hit a target.
- Changing Sounds, an interactive simulation from BBC Schools, demonstrates the differences between pitch and loudness and allows students to experiment with different ways to change the pitch and loudness of different types of sounds from a guitar.
- Light and Dark, an interactive simulation from BBC Schools, allows students to experiment with the differences between objects that can be seen because they give off light and objects that can be seen because they reflect light.
- Seeing the Light is an article from the December 2009 issue of Science and Children. It proposes that teaching the concepts of light from a photon model is more concrete for upper-elementary students than teaching from a wave model. It includes descriptions of how common light phenomena can be explained using a photon model

Career Connections

Videographer, Photographer, Theatrical Technician (sound person on a set for music or film), Audio Engineer, Audiologist, Optometrist, Lighting Engineer, Ultrasound Technician

Criteria for Success (Performance Level Descriptors)

- **Limited:** Investigate how the color of objects is related to light; Identify behaviors of light and sound.
- **Basic:** Investigate the behavior of light and sound when encountering a new medium (e.g., absorption, reflection, pass, or travel through).
- **Proficient:** Plan an investigation to explore the behavior of light when encountering a new medium (e.g., absorption, reflection, refraction, pass, or travel through); Explain how the color of objects relates to reflection and absorption; Explain how the pitch of sound and the vibration rate of an object are related; Interpret the behavior of sound when encountering a new medium (e.g., absorption, reflection, pass, or travel through).
- **Accelerated:** Compare and explain the differences between objects that emit light (e.g., the sun) and objects that reflect light (e.g., an apple, the moon); Predict how absorbed light causes objects to warm and the effects of the material, light intensity, angle, and time of exposure on the amount of heating; Plan an investigation to explore and predict movement of sound as it travels outward from its source through different media.
- **Advanced:** Test a design to explore how absorbed light causes objects to warm and the effects of the material, light intensity, angle, and time of exposure on the amount of heating; Design an object to illustrate the relationships between the pitch of a sound and the vibration rate of an object; Design an engineering solution to a real-world scenario involving light absorption and reflection of heat.

Prior Knowledge

4.PS.2: Energy can be transferred from one location to another or can be transformed from one form to another.

Future Knowledge

6.PS.3: There are two categories of energy: kinetic and potential.

Ohio's Learning Standards- Clear Learning Targets

Science, Grade 5

5.LS.1

INTERCONNECTIONS WITHIN ECOSYSTEMS

Organisms perform a variety of roles in an ecosystem.

Vocabulary

Abiotic	Biotic
Carnivore	Commensalism
Consumer	Decomposer
Dynamic Relationships	
Ecosystem	Energy/Energy Flow
Food Chains	Food Webs
Herbivore	Mutualism
Nutrients	Omnivore
Organisms	Parasitism
Photosynthesis	
Predator-Prey-Relationships	
Producer	Source of Energy
Species	Symbiotic
Threatened or Endangered	

Essential Understandings:

- Populations of organisms can be categorized by how they acquire energy.
- Food webs can be used to identify the relationships among producers, consumers and decomposers in an ecosystem.

Essential Skills:

- The students can identify producers, consumers and decomposers in an ecosystem.**
- The students can identify herbivores, carnivores and omnivores.**
- The students can diagram energy flow through an ecosystem.**
- The students can investigate a locally threatened or endangered species.**
- The students can create a remediation program based on investigations of a locally threatened or endangered species.**
- The students can simulate predator-prey relationships.**
- The students can observe satellite imaging and determine the relationship between the producers and consumers within an ecosystem.**
- The students can explain symbiotic relationships, commensalism, mutualism and parasitism.**
- The students can identify animals that live within each of the 3 main types of symbiotic relationships.**

Misconceptions

- The Annenberg Media series Essential Science for Teachers can be used to provide greater insight to misconceptions children hold about living things and energy. Classroom videos and lessons are provided to help students avoid these misconceptions.
- AAAS' Benchmarks 2061 Online, Chapter 15, 5e, Flow of Matter and Energy, Plant and Animal Nutrition, outlines children's misconceptions about energy in relationship to producers and consumers.
- Plants are nonliving.
- Food webs are interpreted as simple food chains.
- Organisms higher in a food web eat everything that is lower in the food web.
- There are more herbivores than carnivores because people keep and breed herbivores.
- Food chains involve predator and prey, but not producers.
- Decomposers release some energy that is cycled back to plants.
- Carnivores have more energy or power than herbivores do.
- Carnivores are big or ferocious, or both. Herbivores are small and passive.
- Predator and prey populations are similar in size.
- Species coexist in ecosystems because of their compatible needs and behaviors; they need to get along.
- Ecosystems change little over time.

Instructional Strategies and Resources

- Field trip to the Columbus Metro Park.
- Guest speaker- invite a naturalist to speak to the class.
- Guest speaker- invite a zoologist to speak to the class or visit the zoo.
- Teacher resource- *Picture Perfect Science Lessons Using Children's Books to Guide Inquiry, 3-6*, NSTA Press Close Encounters of the Symbiotic Kind Lesson (p 133-152) Weird Friends; Unlikely Allies in the Animal Kingdom Joe Aruego and Ariane Dewey
- Discovery Education: (www.discoveryeducation.com) Debbie Greenthumb: How Plants Grow (12:59 min.), Real World Science: Seeds and Plants (12:26 min.) (segment: Closer Look at Seeds and Germination 1:40 min)
- Conduct a field study involving a hands-on investigation of a rotting log in a temperate forest. Examine the relationships among organisms (e.g., decomposers, green plants, insects, worms) found in the soil.
- Based on observations of the local environment, build a food web describing each organism's role and impact within the food web.
- NSTA offers a content-rich segment for ecosystem study. Coral Reef Ecosystems: Interdependence develops understanding of the interactions and energy flow between organisms in a foodweb.
- ODNR-Division of Wildlife's A to Z Species Guide has photos, information, tracks and sounds of Ohio's wild animals. The guide also includes the diet of organisms.

-Project Wild was developed through a joint effort of the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education. This program helps students learn basic concepts about wild animals, their needs and importance and their relationships to people and the environment. The activity guides are available to educators free of charge when they attend a workshop. Information about upcoming workshops are available on the ODNR Website. The following activities are helpful in teaching this content. Quick Frozen Critters—Through a game of freeze tag, students will become part of a predator/prey interaction. What’s for Dinner— Students list and analyze sources of food to illustrate that all animals, including people, depend on plants as a food source. Surprise Terrarium—students create a classroom terrarium to illustrate animal behavior. Good Buddies—students research pairs of animals, play a card game, and classify the pairs of animals according to the three major forms of symbiotic relationships. Designing a Habitat (Aquatic WILD)—Students design a habitat suitable for aquatic wildlife to survive.

Career Connections

Naturalist, work in a greenhouse or at the botanical gardens, Farmer, Work at a park, Forest Ranger, Soil Scientist, Environmental: architect, chemist, educator, journalist, lawyer, Paleontologist, Water Conservation Specialist

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recognize that organisms within an ecosystem have roles and relationships.
- **Basic:** Identify that roles of living organisms are determined by how they acquire energy (e.g., producers, consumers, decomposers); Recognize that producers are the foundation of the food web; Identify the roles and relationships (e.g., symbiotic) of organisms within an ecosystem.
- **Proficient:** Compare roles of living organisms, determined by how they acquire energy (e.g., producers, consumers, decomposers).
- **Accelerated:** Explain and provide evidence to support why producers are the foundation of the food web; Predict the impact on the ecosystem as species are introduced or removed (e.g., endangered or threatened species, invasive species).
- **Advanced:** Use data from an ecosystem to interpret the change of energy flow in an ecosystem when species are introduced or removed; Use data to form conclusions about the roles of organisms within a given ecosystem and explain how the evidence supports that conclusion; Plan an investigation based on data from a real-world scenario to determine the impact of the introduction of an invasive species on the population of a local species.

Prior Knowledge

4.LS.1: Changes in an organism’s environment are sometimes beneficial to its survival and sometimes harmful.

Future Knowledge

6.LS.3: Cells carry on specific functions that sustain life.

Ohio's Learning Standards- Clear Learning Targets

Science, Grade 5

5.LS.2

INTERCONNECTIONS WITHIN ECOSYSTEMS

All of the processes that take place within organisms require energy.

Vocabulary

Abiotic	Biotic
Carnivore	Commensalism
Consumer	Decomposer
Dynamic Relationships	
Ecosystem	
Energy/flow	Food Chains
Food Webs	Herbivore
Mutualism	Nutrients
Omnivore	Organisms
Parasitism	Photosynthesis
Predator-Prey-Relationships	
Producer	Species
Symbiotic	Threatened
Endangered	Transfer Energy
Transform Energy	

Essential Understandings:

- For ecosystems, the major source of energy is sunlight.
- Energy entering ecosystems as sunlight is transferred and transformed by producers into energy that organisms use through the process of photosynthesis. That energy is used or stored by the producer and can be passed from organism to organism as illustrated in food webs.

Essential Skills:

- The students can categorize organisms by how they obtain their energy.
- The students can identify that producers change energy from the sun and make food through a process called photosynthesis.
- The students can describe and identify the process of photosynthesis.
- The students can observe satellite imaging and determine the relationship between the producers and consumers within an ecosystem.

Misconceptions

- Beyond Penguins and Polar Bears is an online magazine for K-5 teachers that provide information for misconceptions about plants and how they acquire energy.
- The Annenberg Media series Essential Science for Teachers can be used to provide greater insight to misconceptions children hold about living things and energy. Classroom videos and lessons are provided to help students avoid these misconceptions.
- AAAS' Benchmarks 2061 Online, Chapter 15, 5e, Flow of Matter and Energy, Plant and Animal Nutrition, outlines children's misconceptions about energy in relationship to producers and consumers.

Instructional Strategies and Resources

- Field trip to the Columbus Metro Park.
- Guest speaker- invite a naturalist to speak to the class.
- Guest speaker- invite a zoologist to speak to the class or visit the zoo.
- Teacher resource- *Picture Perfect Science Lessons Using Children's Books to Guide Inquiry, 3-6*, NSTA Press Close Encounters of the Symbiotic Kind Lesson (p 133-152) Weird Friends; Unlikely Allies in the Animal Kingdom Joe Aruego and Ariane Dewey
- Given an ecosystem, create an illustration to explain the flow of energy within that system (food web, food chain). For example, as part of research on an endangered species, the species' energy relationships could be documented in a food web. The focus at this stage is on what eats what in various environments, not the chemical processes of energy transformation and transfer. ODNR-Division of Wildlife's A to Z Species Guide has photos, and information, including diet, of Ohio's wild animals.
- The Annenberg Media series Essential Science for Teachers: Life Science: Session 7 provides information about populations of organisms that live and interact together. The focus is on the process of energy flow between producers, consumers and decomposers.
- Project Wild was developed through a joint effort of the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education. This program helps students learn basic concepts about wild animals, their needs and importance and their relationships to people and the environment. The activity guides are available to educators free of charge when they attend a workshop. Information about upcoming workshops are available on the ODNR Website. In Move Over Rover students play a game where they have to identify characteristic animals found in several ecosystems, match those animals to the environments in which they live and identify food chains and food webs within the ecosystems. In Surprise Terrarium (Wild) and Designing a Habitat (Aquatic Wild) students design and build habitats for animals.

Career Connections

Landscaper, Botanist, Horticulturalist, Agriculturalist, Farmer, Agriculture Technology, Bioinformatics, Biotechnology

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recall the sun is the primary source of energy for most ecosystems.
- **Basic:** Identify that roles of living organisms are determined by how they acquire energy (e.g., producers, consumers, decomposers); Recall that photosynthesis is the process plants use to produce food from sunlight.
- **Proficient:** Compare roles of living organisms, determined by how they acquire energy (e.g., producers, consumers, decomposers); Explain that photosynthesis is the process through which sunlight is transformed by producers into energy; Create a food web to illustrate how energy is transferred and transformed in an ecosystem through interactions of organisms.
- **Accelerated:** Develop a model to illustrate the flow of energy based on a scenario and explain the roles and relationships (e.g., symbiotic) of organisms within an ecosystem; Predict the impact on the ecosystem as species are introduced or removed (e.g., endangered or threatened species, invasive species).
- **Advanced:** Use data from an ecosystem to interpret the change of energy flow in an ecosystem when species are introduced or removed.

Prior Knowledge

4.LS.1: Changes in an organism's environment are sometimes beneficial to its survival and sometimes harmful.

Future Knowledge

6.LS.1: Cells are the fundamental unit of life.

6.LS.3: Cells carry on specific functions that sustain life.