Virtual Schoolhouse

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1st 1	**Earth and Space Sciences: The Universe** Describe how night and day are caused by Earth's rotation.	Define and model ***Earth, sun, rotation, axis, day, night.*** Explain that Earth completes one rotation on its axis every 24 hours. Explain that a ***model*** is a representation or working version created to understand something that is too big, too small, or too complicated to understand otherwise. Discuss that the sun stays in a fixed position relative to the earth and is continually shining in all directions. Define ***star***: a dense, massive celestial sphere of plasma (superheated gas), held together by its own gravitation, that emits light and other forms of electromagnetic radiation. A star shines because nuclear fusion in its core releases energy which traverses the star's interior and then radiates into outer space. Almost all elements heavier than hydrogen and helium were created inside the cores of stars. Discuss that the nearest star to Earth, the ***Sun***, made of about ¾ hydrogen, ¼ helium, and other trace elements, has a surface temperature of about 9,600° F. The sun is a white color but Earth's atmosphere creates scattering of light that makes it appear yellow. The surface area of the sun is about 12,000	**A+ The Sciences II:** *Day and Night* **A+ The Sciences IV:** *The Solar System 2* Explore a model of Earth's daily rotation: http://www.classzone.com/books/earth_science/terc/content/visualizations/es0404/es0404page01.cfm?chapter_no=visualization Globe and light to simulate day and night on Earth. Place a sticker on globe to represent a location.	**A+ Course Assessment, Science, 5th Grade Pretest –** *Earth Science (A), Physical Science (A), Life Science (A), Nature and Skills of Science (A)* Begin science journal. Students write a paragraph that explains how night and day are caused by Earth's rotation. Students individually demonstrate a model of day turning to night and

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		times greater than Earth, its mass is over 330,000 times greater than Earth, and its volume is about 1.3 million times greater than Earth. The sun is about 93 million miles from Earth, and light takes about 8.3 minutes to travel from the sun to Earth.		night turning to day in Cleveland using a globe and light.
1st 2	**Earth and Space Sciences: The Universe** Explain that Earth is one of several planets to orbit the sun, and that the moon orbits Earth.	Discuss and model ***revolution, gravity, orbit, elliptical orbit, moon, eclipse,*** and ***astronomical unit.*** Explain that Earth completes one revolution around the sun every 365-1/4 days and that the moon (about ¼ size of earth) orbits the earth once every 29 days. These orbits are almost circular but not quite, being slightly elliptical. Some of the planets have a more elliptical orbit around the sun. Discuss that ***gravity*** is a force, a pull that every object exerts on every other object. The more massive an object, the greater the gravitational pull it exerts on other objects. Also, the amount of pull on an object depends on how far apart the objects are; the greater the distance, the less the pull. Gravitational attraction keeps astronomical objects in their orbits. Define an ***astronomical unit***, or AU, as the average distance	**A+ The Sciences IV:** *The Solar System 1* **A+ The Sciences V:** *The Solar System 1,2,3* Explore the Solar System (includes online activities): http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level1/solar_system.html Research an object's different weights on Earth, moon, other planets.	**A+ Course Assessment, Science, 5th Grade Pretest –** *Earth Science (B), Physical Science (B), Life Science (B), Nature and Skills of Science (B)* Students explain why Pluto is no longer called a planet by scientists. Students draw and label bodies of solar system in correct

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		between the Earth and the Sun. Distances within our solar system are often specified in terms of AU's. Discuss that Earth is the only planet with oceans of water and the only planet that supports animal and plant life. While temperatures vary considerably from equator to poles, overall Earth's temperatures are mild compared to other planets, due to our distance from sun and atmosphere which are "just right" for life. Describe the ***phases of the moon*** as it revolves around the earth and the different appearances caused by our different view of the dark side of the moon. Explain that the moon repeats the cycle about once per month. Explain that we experience both ***lunar eclipses*** (when Earth comes between sun and moon) and ***solar eclipses*** (when the moon blocks the sun from the earth. Earth is the only planet on which this happens) Explain the difference between ***planets*** and ***dwarf planets***. Planets are astronomical bodies that (1) are massive enough that they round their own bodies due to gravity, (2) are not so large that thermonuclear fusion begins in the core (forming a star), and (3) are large enough and enough time has passed	Wonderful Solar System Website (three levels of difficulty): http://www.windows.ucar.edu/cgi-bin/tour_def/our_solar_system/formation.html Research meteorite impact sites on Earth and other celestial bodies. Discuss theory of dinosaur extinction from effects of massive impact.	order indicating relative sizes including asteroid belt, Kuiper belt, and comets. Students explain what is a 'shooting star'.

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		that they have “cleared the neighborhood” of similarly sized objects. Recent discoveries have led Pluto to be reclassified by scientists as a dwarf planet because it does not meet the third requirement. *Additional background information*: In the end stages of planet formation, a planet will have ***cleared the neighborhood*** of its own orbital zone, meaning it has become gravitationally dominant, and there are no other bodies of comparable size other than its own satellites or those otherwise under its gravitational influence. The current definition of a planet adopted by the International Astronomical Union (IAU) only includes those bodies which have "cleared the neighborhood of its orbit". A large body which meets the other criteria for a planet but has not cleared its neighborhood is classified as a dwarf planet. This includes Pluto, which shares its orbital neighborhood with Kuiper Belt Objects such as the plutinos, celestial objects in the belt that are smaller than Pluto. The extent to which all the planets have cleared their neighborhoods is much greater, by any measure, than that of any dwarf planet or any candidate for dwarf planet known so far. Describe and diagram ***Solar system, Mercury, Venus, Mars, asteroid belt, Jupiter, Saturn, Uranus, Neptune, Kuiper Belt,***		

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		Pluto, Eris, Ceres, comets, Oort cloud. Draw diagram of solar system with roughly relative sizes of planets and orbits in correct order. Explain that all planets vary in size and that Earth is the biggest of the group of small planets including Mercuy, Venus, Mars, and dwarf planets including Pluto, Eris, and Ceres. The remaining planets Jupiter, Saturn, Uranus, and Neptune are known as the giant planets, or sometimes the gas planets and they are all at least 3-4 times bigger than the small planets. The ***asteroid belt***, between Mars and Jupiter, consists of many small bodies composed primarily of rock and metal. The largest known and first discovered asteroid, ***Ceres***, is the smallest of the three known dwarf planets, the other two being ***Pluto*** and ***Eris*** in the Kuiper belt. All other asteroids are currently classified as small solar system bodies, and are boulder-sized or larger. The vast majority of asteroids are found within the main asteroid belt, with elliptical orbits between those of Mars and Jupiter. It is thought that these asteroids are remnants of the protoplanetary disc (rotating disk of dense gas surrounding a young newly formed star), and in		

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		this region the incorporation of protoplanetary remnants into the planets was prevented by large gravitational perturbations induced by Jupiter during the formative period of the solar system. Some asteroids are in orbits out of the asteroid belt, and can crash into other objects including planets. The ***Kuiper belt*** is a region of the solar system beginning at the orbit of the farthest planet Neptune extending to about 55 AU from the sun, and is home to two of the three known dwarf planets Pluto and Eris (the third, Ceres, resides in the asteroid belt)**.** This area consists of many small bodies composed primarily of ices made of methane, ammonia, and water. The Kuiper belt is approximately 20 times wider than the asteroid belt and also contains far more bodies. Over 1000 bodies have been identified and over 70,000 bodies of substantial size (over 1 km) are believed to exist. Some comets are believed to originate in the Kuiper belt: some orbiting the sun, and others (known as *centaurs*) orbiting the gas giants. ***Eris*** is the largest known dwarf planet in the solar system and the ninth largest body orbiting the Sun directly. It is between 2,400 and 3,000 kilometers (1,490 to 1,860 miles) in diameter and 27% more massive than Pluto. Eris was discovered in 2005 by a Mount Palomar-based team led by Mike Brown. It		

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		is a trans-Neptunian object (TNO) native to a region of space beyond the Kuiper belt known as the scattered disc. Eris has one moon, named *Dysnomia*; recent observations found no evidence of further satellites. Their current distance from the Sun is some 97 AU, or roughly three times that of Pluto. With the exception of some comets, the pair are currently the most distant known objects in the Solar System. Eris' size resulted in its discoverers and NASA labeling it the solar system's tenth planet. This, along with the prospect of other similarly sized objects being discovered in the future, motivated the International Astronomical Union (IAU) to define the term "planet" for the first time. Under a new definition approved on August 24, 2006, Eris was designated a "dwarf planet" along with Pluto and Ceres. The ***Oort cloud*** is a postulated or hypothesized, spherical cloud of ***comets*** extending from about 50 to 50,000 AU from the sun (approximately 1000 times the distance from the sun to Pluto, almost a light year). The outer edge of the Oort cloud is considered to be the boundary of our solar system. A ***comet*** is a small body in the solar system that orbits the Sun and (at least occasionally) exhibits a coma (or atmosphere) and/or a tail — both primarily from the effects of solar radiation upon the comet's nucleus, which itself is a minor		

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		body composed of rock, dust, and ice. Comets' orbits are constantly changing: their origins are in the outer solar system, and they have a propensity to be highly affected (or *perturbed*) by relatively close approaches to the major planets. Some are moved into Sun-grazing orbits that destroy the comets when they near the Sun, while others are thrown out of the solar system forever. A new comet may be discovered photographically using a wide-field telescope or visually with binoculars. However, even without access to optical equipment, it is still possible for the amateur astronomer to discover a Sun-grazing comet by analyzing online the mountains of images accumulated by some satellite observatories such as SOHO. Most comets are believed to originate in a cloud (the Oort cloud) at large distances from the Sun consisting of debris left over from the condensation of the solar nebula; the outer edges of such nebulae are cool enough that water exists in a solid (rather than gaseous) state. Asteroids originate via a different process, but very old comets which have lost all their volatile materials may come to resemble asteroids. Explain that there are countless ***meteoroids*** moving around the solar system. Meteoroids are sand grain to boulder-sized particles and clumps composed mostly of stone, iron, or a		

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		mixture of the two, with a few other trace metals. Millions of meteoroids enter Earth's atmosphere each day, most being destroyed high in the atmosphere. When a meteoroid enters the atmosphere, air resistance causes the body to heat up and emit light, thus forming a fireball, also known as a ***meteor*** or ***shooting star***. A ***meteorite*** is a meteoroid that survives an impact with the Earth's surface without being destroyed. A small to medium sized meteorite can strike the earth with tremendous force and become buried beneath the surface and form craters. Very large stony objects, hundreds of meters in diameter or more, weighing tens-of-millions of tons or more, can reach the surface and cause large craters and widespread destruction, but are very rare. Such events are generally so energetic that the object is completely destroyed, leaving no meteorites. One of the leading theories for the cause of the Cretaceous-tertiary mass extinction that included the dinosaurs is a large meteor impact.		
1st 3	**Earth and Space Sciences: The Universe** Describe the characteristic	Demonstrate that the layers of earth from the center to the surface can be compared to a fruit, e.g. a peach, with a solid mostly iron ***inner core*** and a liquid iron and nickel ***outer core*** (like the seed area of the peach), a molten liquid rock ***mantle*** (like the fleshy part of the peach), and a thin, plated rock and soil ***crust*** 5-30 mi thick (like the outer skin or covering of the peach) that make up the ocean floor and continents. The crust	**A+ The Sciences IV:** *Inside Our Earth* **A+ The Sciences VI:** *Weather* Explore Earth from	Students draw and label a circular cross section of Earth showing inner and outer core, mantle, crust, ocean, continent,

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	s of Earth and its orbit about the sun	is covered by about ¾ ocean and ¼ dry land. Of the land, about 1/3 is unsuitable for humans due to mountains and cold. Another 1/3 of the land is unsuitable for humans due to desert and high heat. This leaves only about 1/12 of the entire earth surface that is suitable for human life. From Earth's surface up to space is called the ***atmosphere,*** made of approximately 78% nitrogen, 21% oxygen, 1% argon, water vapor that varies from 0 to 4%, averaging about 1%, carbon dioxide .04%, and trace gases. The atmosphere has different characteristics within layers and each layer has a name. The ***troposphere*** is the lowest layer; it starts at the earth's surface and rises taller than the highest mountains. It includes clouds and weather and surface life. Next is the ***stratosphere***, the layer that contains the highest concentrations of ***ozone***. This important layer of gas helps protects life on Earth from harmful ultraviolet rays coming from the sun. Above the stratosphere are the ***mesosphere, thermosphere, exosphere***, and then space. Use a globe to demonstrate the features of earth's surface. Explain and demonstrate that the earth is a nearly ***spherical*** (like a ball) planet, slightly flattened at the poles and bulging near the equator. The earth is in a slightly ***elliptical*** orbit (not	eight different perspectives: http://www.classzone.com/books/earth_science/terc/content/visualizations/es0101/es0101page01.cfm?chapter_no=01	polar ice, and atmosphere. Looking at models, students write a paragraph explaining (a) why there are seasons on Earth; (b) how seasons would be different if the Earth was not tilted on its axis; (c) if it was tilted 90 degrees.

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		perfectly circular) around the sun. The earth spins on a tilted axis compared to the plane of its orbit around the sun (23.5 degrees, varies slightly over long spans of time), creating ***seasons.***		
1st 4	**Earth and Space Sciences: The Universe** Explain that stars are like the sun, some being smaller and some larger, but so far away that they look like points of light.	Review ***star***: a dense, massive celestial sphere of plasma (superheated gas) held together by its own gravitation that emits light and other forms of electromagnetic radiation. A star shines because nuclear fusion in its core releases energy which traverses the star's interior and then radiates into outer space. Almost all elements heavier than hydrogen and helium were created inside the cores of stars. Review that the nearest star to Earth, the Sun, made of about ¾ hydrogen, ¼ helium, other trace elements, and has a surface temperature of about 9,600° F. The sun is a white color but Earth's atmosphere creates scattering of light that makes it appear yellow. The surface area of the sun is about 12,000 times greater than Earth, its mass is over 330,000 times greater than Earth, and its volume is about 1.3 million times greater than Earth. The sun is about 93 million miles from Earth, and light takes about 8.3 minutes to travel from the sun to Earth. Given the great distances involved in space, a unit of	**A+ The Sciences IV:** *The Sun* **A+ The Sciences IV:** *Beyond the Solar System* **A+ The Sciences V:** *The Solar System 4* Information about stars (includes definitions): http://starchild.gsfc.nasa.gov/docs/StarChild/universe_level1/stars.html Virtual Telescope: http://web.archive.org/web/20020213181746/	**A+ Adaptive Assessments, Science, Level 5** *Earth Science* Students name our galaxy, approximate how many stars are in a typical galaxy, and estimate how many total galaxies are in the universe. Oral or written exam: students explain how a star works and discuss life cycle of stars including various

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		measurement of length called a ***light-year*** was created. This is the distance light travels in a vacuum in one year, about ***5.9 trillion miles***. Explain that the ***universe*** (all the matter and energy that exists) contains billions of galaxies, and most ***galaxies*** contain billions of stars. The individual stars visible to the unaided eye are all in our own galaxy, the ***Milky Way***. The Sun and our solar system are about 26,000 light years from the center of our own galaxy, and it takes about 250 million years for the Sun to complete one orbit of the center of the Milky Way galaxy. The universe has expanded to be so large and the distance between astronomical bodies so great, most of the space of the universe is nearly empty, containing only sparse particles of gas and dust. A ***constellation*** is a group of stars visibly related to each other in a particular configuration or pattern, e.g. shapes of animals. As the groupings are more or less arbitrary, different cultures have named different constellations over time, and place varying degrees of importance to constellations. As with the Chinese zodiac, Indo-European astrologers understand the movement of the planets and the Sun through the zodiac as a method to explain and predict events on Earth. The constellations are stars grouped together into patterns which	www.geocities.com/thesciencefiles/tel/telescope.html Make star patterns on ceiling: Shine flashlight into box or oatmeal container with holes punched in end. Research and diagram relative sizes of stars and distances from Earth compared to sun.	end states.

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		the ancients thought resembled the object which gave the constellation its name. For example, the stars of the constellation Leo were thought to form a pattern in the shape of a lion. Explain that the closest galaxy like our own is the ***Andromeda Galaxy***, 2.5 million light years away, which can be seen with the unaided eye in areas without light pollution. Billions of galaxies are within the optical range of the largest telescope. A galaxy is a large aggregation of stars, gas, and dust, held together by the gravitational attraction between the matter within the galaxy. Its rotational motion keeps it from collapsing on itself. Clusters of galaxies are held together by gravitation, e.g. the galaxies nearest the Milky Way form a cluster called the ***Local Group***. Many large galaxies have smaller galaxies, called satellite galaxies, in close proximity. The ***Magellanic Clouds*** are satellite galaxies of the Milky Way. Diagram and explain that the vast majority of observed galaxies are classified as either ***spiral*** or ***elliptical***, with a small minority classified as irregular, e.g. the Magellanic Clouds. A typical spiral galaxy is shaped like a flat disk, about 100,000 light years in diameter, with a central bulge, or nucleus, containing old starts. Winding through the disk are		

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		the characteristic spiral arms of dust, gas, and young stars. In the normal spiral, the arms, at least two in number, join smoothly with the nucleus. In the barred spiral , the arms project from a bank of stars that runs through the nucleus. The elliptical galaxies, lacking spiral arms entirely and containing little or no gas and dust, resemble the nuclei of spiral galaxies. Their shapes vary from nearly spherical to highly flattened ellipsoids. Elliptical galaxies have a much greater variation in size, mass, and luminosity than do spiral galaxies. Their sizes range from the largest known galaxies of all to dwarf ellipticals which can contain as few as a million stars. Explain that stars have a ***life cycle*** of sorts, a birth, life, and death. In astronomy, ***stellar evolution*** is the sequence of radical changes that a star undergoes during its lifetime (the time in which it emits light and heat). Depending on the size of the star, this period can range from hundreds of thousands to billions of years. Stellar evolution begins with a giant molecular cloud of gas and dust, also known as a ***stellar nursery***. The cloud is between 50 and 300 light years across and contains 100,000 to 10,000,000 times as much mass as our Sun. When sufficient energy triggers the cloud to collapse, often initiated by shockwaves from ***supernovae*** (massive stellar explosions) or		

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		the collision of two galaxies, the cloud breaks into many fragments. During the collapse, the temperature and pressure of each fragment of the cloud increase, and the fragments condense into rotating spheres of superhot gas known as ***protostars***. After a star has burned out its fuel supply, its remnants can take one of three forms, depending on the mass during its lifetime. For a star of 1 solar mass, the resulting ***white dwarf*** is of about 0.6 solar masses, compressed into approximately the volume of the Earth. White dwarfs are stable because the inward pull of gravity is balanced by the degeneracy pressure of the star's electrons. With no fuel left to burn, the star radiates its remaining heat into space for billions of years. In the end, all that remains is a cold dark mass sometimes called a ***black dwarf***. However, the universe is not old enough for any black dwarf stars to exist. If the white dwarf's mass increases, then electron degeneracy pressure fails due to electron capture and the star collapses. Depending upon the chemical composition and pre-collapse temperature in the center, this will either lead to collapse into a ***neutron star*** or runaway ignition of carbon and oxygen.		

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		Heavier elements favor continued core collapse, because they require a higher temperature to ignite. Higher core temperatures favor runaway nuclear reaction, which halts core collapse and leads to a Type Ia ***supernova***. These supernovae may be many times brighter than the Type II supernova marking the death of a massive star, even though the latter has the greater total energy release. If a white dwarf forms a close binary system with another star, hydrogen from the larger companion may accrete around and onto a white dwarf until it gets hot enough to fuse in a runaway reaction. Such an explosion is termed a ***nova***. When a stellar core collapses, the pressure causes electron capture, thus converting the great majority of the protons into neutrons. The electromagnetic forces keeping separate nuclei apart are gone (proportionally, if nuclei were the size of dust motes, atoms would be as large as football stadiums), and most of the core of the star becomes a dense ball of contiguous neutrons (in some ways like a giant atomic nucleus), with a thin overlying layer of degenerate matter (chiefly iron unless matter of different composition is added later). These stars, known as ***neutron stars***, are extremely small—on the order of radius 10km, no bigger than the size of a large city—and are phenomenally dense. Their period of		

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		revolution shortens dramatically as the star shrinks (due to conservation of angular momentum); some spin at over 600 revolutions per second. When these rapidly rotating stars' magnetic poles are aligned with the Earth, a pulse of radiation is received each revolution. Such neutron stars are called ***pulsars***, and were the first neutron stars to be discovered. If the mass of the stellar remnant is high enough, the neutron degeneracy pressure will be insufficient to prevent collapse. The stellar remnant thus becomes a ***black hole.*** The mass at which this occurs is not known with certainty, but is currently estimated at between 2 and 3 solar masses. Black holes are predicted by the theory of general relativity. According to classical general relativity, no matter or information can flow from the interior of a black hole to an outside observer, although quantum effects may allow deviations from this strict rule. The existence of black holes in the universe is well supported, both theoretically and by astronomical observation. Since the core collapse supernova mechanism itself is imperfectly understood, it is still not known whether it is possible for a star to collapse directly to a black hole without producing a visible supernova, or whether some supernovae		

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		initially form unstable neutron stars which then collapse into black holes; the exact relation between the initial mass of the star and the final remnant is also not completely certain. Resolution of these uncertainties requires the analysis of more supernovae and supernova remnants		
1st 5	**Scientific Inquiry: Doing Scientific Inquiry** Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g., thermometers	Define ***science***: a way of understanding the world around you. Discuss science as a tool to solve problems and to lead to development of technology. Explain the building process of scientific understanding through the use of prior knowledge. Begin to explain and demonstrate the skills of doing science. A central concept in science and the ***scientific method*** is that all evidence must be ***empirical***, or ***empirically*** based, that is, dependent on evidence or consequences that are observable by the senses. Scientific understanding advances through the use of working hypotheses that are testable using observation or experiment. The ***scientific method*** includes the following steps: 1. ***Observe*** a phenomenon 2. ***Hypothesize*** an explanation for the phenomenon 3. ***Predict*** a logical consequence of the guess 4. ***Test*** the prediction	**A+ The Sciences V:** *Science Skills* **A+ The Sciences VI:** *Science Skills*	Students write and explain the steps of the scientific method. Students demonstrate scientific method working in pairs to conduct simple experiments.

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	, timers, balances, spring scales, magnifiers, microscopes and other appropriate tools).	5. ***Review*** for any mistakes. As an example, review that scientists have come to believe that below Earth's mantle is a liquid outer core surrounding a solid inner core. Ask students how scientists figured that out, given that it's too hot and too far to go see in person or to drill down and send a camera or bring back samples. Discuss that scientists can observe and study material that comes out of the earth from volcanoes (noting different physical and chemical properties, and then question why), and use seismographs to make observations about how earthquake waves travel through the earth to locations on the surface (noting different paths, speeds, and other behaviors of waves, and then question why). An ***observation*** involves use of one or more of the senses: see, hear, feel, taste, and smell. From these studies, scientists hypothesized, predicted, and tested explanations for their observations. Through this process, scientists can now ***infer*** that the inner core is solid and the outer core is liquid. ***Inference*** is the act or process of deriving a conclusion based solely on what one already knows. Explain that nobody today can ***prove*** the inner core is solid and outer core is liquid. But rather, we accept it to be very probably true, knowing that as new scientific information comes along, it may either support or contradict present		

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		beliefs. When a hypothesis becomes generally accepted as sound by the scientific community, after review of repeated tests, it may become a ***theory***. However, a single newly discovered fact can prove a theory to be false. When a theory has been tested a very many times, it may become a ***scientific law***, an accurate description of some important part of the natural world. For example, the laws of conservation of energy and matter. Even still, a new discovery can prove a law to be incorrect.		
1st 6	*Week 1 of 2-Week Indicator* **Physical Sciences: Nature of Energy** Define temperature as the measure of thermal energy and describe the way it is	Define and model ***matter*** (anything that has mass and takes up space); ***atom*** (basic unit of matter so small cannot be seen, even with powerful microscope); ***protons*** (positively charged particles in nucleus of atom); ***neutrons*** (particles with no charge in nucleus of atom); ***electrons*** (negatively charged particles forming a cloud around the nucleus of an atom); ***molecule*** (two or more atoms joined by shared electrons); ***compound*** (a molecule containing different kinds of atoms). Discuss the 4 states of matter: ***solid, liquid, gas, plasma.*** Explain the comparative freedom of molecular or atomic movement for each state. **Solids**: molecules of a solid are limited to vibration about a	**A+ The Sciences V:** *Matter1,2* View animations of atoms and molecules on the internet.	Students draw various atoms, labeling particles. Students construct models of compounds using balls of differently colored clay. E.g. blue clay balls represent hydrogen atoms, red clay balls represent oxygen, and yellow clay balls represent

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	measured.	fixed position, giving a solid a definite volume and definite shape. As heat energy is added to a solid, the molecules vibrate more rapidly until they break out of their fixed position, becoming a fluid. The change from solid to liquid is called melting and occurs at a definite temperature for a given substance. **Liquids**: In a fluid, molecules are free to move about the fluid and roll over one another but are somewhat held together by intermolecular forces ***adhesion*** and ***cohesion*.** This gives liquid a definite volume but no definite shape. **Gases**: As more heat is added to a liquid, some molecules gain enough energy to break away into the surrounding space, called evaporation. When enough heat is added, molecules throughout the liquid have gained enough energy that bubbles of vapor, or gas, form throughout the liquid and rise to the surface, called boiling. This occurs at a definite temperature for a given substance. Gas molecules are free to move in every direction and expand away from one another to fill their container, thus a gas has neither a definite shape nor volume. **Plasma:** When enough heat is added to a gas, eventually the molecules move so rapidly they break apart into their component parts, leaving negatively charged electrons and		carbon atoms. Use toothpicks to connect model atoms to form H_2O water, CO_2 carbon dioxide, CH_4 methane Students physically show, point to, and/or explain a unique example of energy of (a) motion; (b) heat; (c) light; (d) chemical reaction; (e) sound; (f) electrical. Students write a paragraph that explains the difference between kinetic and potential energy,

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		positively charged ions. Plasma is very hot, fully ionized low density gas inside of stars and makes up interstellar gas. An ***ion*** is an atom that has gained or lost one or more electrons and thus is a charged particle.		and list two examples of each. Students in groups act as molecules in each state of matter.
1st 7	*Week 2 of 2-Week Indicator* **Physical Sciences: Nature of Energy** Define temperature as the measure of thermal energy and describe the way it is measured.	Define and list examples of ***energy***: ability to change shape, temperature, speed, position, or direction of something. Energy occurs in different forms: motion, heat, light, chemical, sound, thermal, electrical, nuclear, etc. Define ***kinetic energy***: energy contained in moving objects, e.g. a rock rolling down a hill, a baseball bat being swung, a propeller turning, electrons orbiting the nucleus of an atom, atoms and molecules vibrating in a solid, atoms and molecules moving and colliding in liquids and gases. ***Potential energy:*** stored energy that can become kinetic energy if something releases it. E.g. a rock at the top of a hill, food, gasoline, chemical bonds between atoms in molecules. Define ***thermal energy****:* the total amount of potential and kinetic energy of the atoms that make up a material. Explain that ***heat*** is the thermal energy that moves from a	**A+ The Sciences VI:** *Energy 1,2* **A+ The Sciences III:** *Heat* **A+ The Sciences IV:** *Heat* Thermometer(s) for demonstrations. Students demonstrate conversion of radiant energy from the sun to thermal energy and the effect of different	Students measure and neatly record in a constructed table the temperatures of various materials using both Fahrenheit and Celsius scales: e.g. air, cold water, warm water. Students explain why the temperature of warm water is higher than cold water (how it got that way and the

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		warmer object to a cooler one. It is the total kinetic energy of atoms or molecules in a substance not associated with bulk motion of the substance. Discuss examples: pot of cold water on a hot stove; home getting cold, then furnace heating it back up; sun heating earth by day, earth cooling by night. Explain that ***temperature*** is a measure of the average kinetic energy of a material's atoms; the speed of motion of a typical atom or molecule in a substance. Clarify that heat and temperature are not the same. A substance can have a low temperature but high heat content, and conversely, a substance can have high temperature but low heat content. For example, a match is so hot that you can't touch it without getting burned, but it doesn't provide much total heat. Also, lake or ocean water might feel cold to your hand, but large bodies of water contain immense amounts of heat. Demonstrate that ***thermometers*** are used to measure temperature, most commonly using ***Fahrenheit*** and ***Celsius*** scales.	materials on absorption of energy. Place 2 containers with equal volumes and temperatures of water in sunshine – one covered with black construction paper on bottom and side, the other covered with white paper. Place the thermometers in the water and record the water temperature at 5 minute intervals for up to 30 minutes.	difference in molecular kinetic energy). Students explain why a person can die from hypothermia (exposure to cold) in a lake or ocean that meanwhile has a high heat content.
1st 8	**Physical Sciences:**	Explain that ***thermodynamics*** is the study of how energy is transferred, rates of flow, and the transformation of energy	Place an empty balloon over the mouth of an	Students make a continuous energy

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	Nature of Energy Trace how thermal energy can transfer from one object to another by conduction.	from one form or quality to another. The ***first law of thermodynamics*** states that energy is conserved: it is neither created nor destroyed under normal conditions. It can be transferred or transformed, but the total amount of energy remains the same. For example, when you cook food in a microwave oven, microwave radiation energy is transformed to heat energy in the food. The kinetic energy of the molecules in the food increases as they vibrate faster and faster, increasing the temperature of the food and causing a chemical change to cook the food. The microwave energy from the machine is transferred to heat energy in the food, but overall the total amount of energy remains the same. The ***second law of thermodynamics*** states that with each successive energy transfer, energy degrades to a less useful state. In the example of microwaving food, more intense, higher quality microwave energy is transformed into lower quality, more dispersed heat energy. When plants convert intense, high quality light energy from the sun into chemical energy for food in the plant, which is then converted to kinetic energy and heat by the animal that eats the plant (you release heat to the atmosphere just by existing, even more heat is released when you move), at each step the energy is more dispersed and less useful. To demonstrate, which would be	empty, frozen, glass pop bottle and let stand at room temperature. Students observe thermal expansion of the air molecules as they warm. Place a coin on a glass bottle top. Students grasp hands around bottle and watch for coin to move up and down as the air inside the bottle warms and expands.	flow path diagram that includes examples of radiation, conduction, and convection. E.g. Sun radiates energy that is absorbed by earth which re-radiates infrared waves as heat. Air in vicinity is warmed by conduction, and warm air moves heat to other areas by convection.

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		more efficient and cost-effective, to generate electricity using a solar panel or to generate electricity from the same amount of energy released as heat from animals as they live their lives? Define and list examples of ***radiation*** (energy that travels by waves in all directions from its source); ***conduction*** (transfer of kinetic energy, from one molecule to another in form of either heat or electricity); ***convection*** (transfer of thermal energy from one place to another by movement of molecules in a gas or liquid) Discuss the example of a car with its windows closed on a sunny day. Sunlight radiates (transfers energy to) the earth and car by shining on them. Some of the energy is reflected off in light form, but some is absorbed and converted to infrared radiation (heat energy), warming up the earth and car. Heat is slowly conducted in all directions from warm areas to cooler ones and is slowly convected by air movement. As energy continues to be added from sunlight, energy absorption, conduction, and convection continue. The car continues to warm up, warmer than the outside air. When you get in the car and open the windows, heat quickly escapes to the cooler air outside by convection.		

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		Explain that applying heat to an object excites its molecules by increasing their kinetic energy. The molecules begin bumping into one another more often and with more force, and they spread apart a little. The object expands, called ***thermal expansion***. Discuss that a liquid thermometer works because of thermal expansion of the liquid in the thermometer. Ask students to brainstorm other examples of thermal expansion.		
1st 9	**Scientific Inquiry: Doing Scientific Inquiry** Evaluate observations and measurements made by other people and identify reasons for any discrepancies.	Conduct experiments that demonstrate and reinforce material from preceding weeks. Demonstrate and explain the need to: 1. Evaluate observations and measurements made by other people and identify reasons for any discrepancies. 2. Use evidence and observations to explain and communicate the results of investigations. 3. Keep records of investigations and observations that are understandable weeks or months later. Review ***science***: a way of understanding the world around you. Discuss science as a tool to solve problems and to lead to development of technology. Explain the building process of scientific understanding through the use of prior knowledge. Begin to explain and demonstrate the skills of doing science.	**A+ The Sciences VII:** *Science Skills* **A+ The Sciences VI:** *Safety*	Student performance during experiments.

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	____________ Use evidence and observations to explain and communicate the results of investigations. ____________ **Scientific Ways of Knowing: Ethical Practices** Keep records of investigations and observations that are understandab			

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	le weeks or months later.			

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
2nd 1	**Scientific Inquiry: Doing Scientific Inquiry** Identify one or two variables in a simple experiment. Identify potential hazards and/or precautions involved in an investigation. _____________ **Scientific Inquiry: Doing Scientific**	Conduct experiments that demonstrate material in upcoming weeks. Demonstrate and explain the need to: 1. Identify one or two variables in a simple experiment. Identify potential hazards and/or precautions involved in an investigation. 2. Explain why results of an experiment are sometimes different (e.g., because of unexpected differences in what is being investigated, unrealized differences in the methods used or in the circumstances in which the investigation was carried out, and because of errors in observations). Discuss the ***Science Fair project***. Distribute list of ideas for possible projects, timeline, rubric, and so on.	**A+ The Sciences V:** *Science Fair Project*	Student performance during experiments.

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	Inquiry Explain why results of an experiment are sometimes different (e.g., because of unexpected differences in what is being investigated, unrealized differences in the methods used or in the circumstances in which the investigation was carried out, and because of errors in observations).			
2nd 2	*Week 1 of 3-Week*	Begin Science Fair projects (complete in 10 weeks)	**A+ The Sciences III:** *Electricity*	Have students create static

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
	Indicator **Physical Sciences: Nature of Energy** Describe that electrical current in a circuit can produce thermal energy, light, sound and/or magnetic forces.	Discuss that ***electricity*** depends on movement of electrons (negatively charged). Electrons are attracted to positively charged protons and repelled by other negatively charged electrons, creating frequent movement of loosely held electrons from atom to atom. Electrons can be transferred in numerous ways, for example, by friction. Build-ups of electrons can be relieved through group transfer: ***static electric discharge****:* small discharges like touching your hand on metal and very large discharges like lightning.	**A+ The Sciences IV:** *Electricity* Use magnets to demonstrate like charge repulsion and unlike charge attraction. Rub inflated balloon on cloth and then attach balloon to wall or ceiling to demonstrate friction transfer and build-up of electrons.	electricity discharge using plastic chairs or other objects. Students explain group transfer of electrons through friction, which creates mass repulsion of nearby negative charges, resulting in mass attraction to remaining positive charges, which creates electrical discharge.
2nd 3	*Week 2 of 3-Week* *Indicator* **Physical Sciences: Nature of**	Continue Science Fair projects. Explain that ***current*** is a flow of electrical charges. A ***circuit*** is a closed loop of conductors through which charges flow. Electricity is used in electrical circuits by creating nonstop, controlled flow of electrons in unbroken	**A+ The Sciences V:** *Electricity 1* Build a battery using a potato and power an electric clock or other	Oral or written exam: Students explain the cause of static electric discharge, how current flows in a

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
	Energy Describe that electrical current in a circuit can produce thermal energy, light, sound and/or magnetic forces.	paths, usually through metal wires. Remember that ***conduction*** is the transfer of kinetic energy, from one molecule to another in form of either heat or electricity. A ***conductor*** is a material in which it is easy to get electrons to move and provide a flow of current. Conductors are mostly metals such as gold, silver, copper, iron, and lead. Other conductors include water, carbon, and some gases, e.g. in fluorescent tubes. ***Resistance*** is the ability to hinder (slow down) the flow of electricity. An ***insulator*** is a material though which electric charges cannot move. ***Switches*** are used to open and close circuits. Explain that a ***battery*** works by chemically separating positive and negative charges from one end of battery to other, thus creating potential energy available for use in circuits. Compare battery power (direct current, DC) to generated electricity from a power plant (alternating current, AC) that supplies business, homes, etc. A ***generator*** is a device for producing electrical current by moving a coil of wire in a magnetic field.	device. Many experiments online. Use wire, a light bulb, magnets, and a nail to generate electricity and light the bulb. Demonstration unit available in 6th grade classroom.	circuit, how a battery works, and how a generator works. List an example of each.

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2nd 4	*Week 3 of 3-Week Indicator* **Physical Sciences: Nature of Energy** Describe that electrical current in a circuit can produce thermal energy, light, sound and/or magnetic forces	Continue Science Fair projects. Discuss that electricity and ***magnetism*** are closely related because they both depend on electron arrangement. Magnets are made of atoms with electrons arranged in a certain way so that the atoms' negative poles all point in one direction and the atoms' positive poles point in the opposite direction. A ***magnetic field*** is the area around a magnet where magnetic forces act. Running electricity through a wire wrapped around an iron core (e.g. a nail) produces an ***electromagnet*** with a magnetic field around the iron core. Also, revolving a magnet around a nail wrapped in wire produces an electrical current in the wire. List examples of familiar electrical devices that are made in a way that the flow of electrons in the device produces heat (electric heater), light (light bulb), motion (elec motor), sound (speakers: coil of wire with magnet nearby vibrates on amplifier when current run through wire), or magnetic signals (doorbell).	**A+ The Sciences III:** *Magnetism* **A+ The Sciences IV:** *Magnetism* Use magnets and iron filings separated by paper to demonstrate magnetism. Use D battery, insulated bell wire, and 16d or larger steel nail to create an electromagnet – demonstrate magnetism with paperclips and magnetic field with iron filings. With each trial, record a prediction of the number of paperclips that	Students work in teams to discover how a compass works. Students create a research path: compass, magnetism, Earth's magnetic field.

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			will be picked up. Check if the bare nail picks up paperclips. Then wrap the wire around the nail one time and connect each end of the wire to each terminal on the battery with tape. Record the number of clips picked up in a table. Repeat with 10, 25, and 50 coils. Then repeat after unwinding to 10 and then 0 coils. Then repeat by adding a 2nd battery. Make a paper cup loudspeaker using coiled wire glued to a plastic cup, a portable radio, earphone plugs, and a magnet.	
2nd 5	**Physical Sciences: Nature of**	Continue Science Fair projects. Diagram an electrical circuit that would work including a	**A+ The Sciences V:** *Electricity 2*	Students will draw an electrical circuit that would

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	Energy Trace how electrical current travels by creating a simple electric circuit that will light a bulb.	power source, light fixture, and switch Make a working electrical circuit using a battery, wires, and light bulb. Describe electrical circuits found in classroom, home, city	Program that lets students explore electric circuits: http://web.archive.org/web/20050207185648/www.geocities.com/thesciencefiles/crocodile/clips.html Make working circuit using batteries, wires, light bulbs.	work including a power source, light fixture, and switch Students will make a working electrical circuit using a battery, wires, and light bulb. Students will orally describe electrical circuits found in classroom, home, city
2nd 6	**Earth and Space Sciences: Earth Systems** Explain how the supply of	Continue Science Fair projects Define ***natural resources***: things found in nature that organisms use to meet their needs, e.g. water, air, food, sunlight, trees, oil, minerals, fossil fuels (coal, oil, and natural gas formed form the remains of ancient plants and animals that can be burned to produce energy.)	**A+ The Sciences IV:** *Conservation* **A+ The Sciences V:** *Environment II* Learn all about	Students research amount of known reserves of nonrenewable resources (how much oil, natural gas, coal is

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	many non-renewable resources is limited and can be extended through reducing, reusing and recycling but cannot be extended indefinitely.	Explain that ***nonrenewable resources*** are resources that cannot be replaced by natural processes within about 100 years, e.g. oil, coal, natural gas, land. Define ***fossil fuels***: coal, oil, and natural gas formed form the remains of ancient plants and animals that can be burned to produce energy. Discuss that nonrenewable resources need to be used carefully because they take a very long time to be replaced, up to millions of years, and alternative energy sources that are as cost-effective have not been fully developed. Discuss ***solid waste*** as what people throw away and ***landfill*** as an area where garbage is deposited. Unregulated landfills often leak which contaminate soil and water supply. Also, much solid waste discarded on land and dumped in oceans ends up as litter and pollution around the world Explain the *3 R's—**reduce, reuse,** and **recycle*** to reduce amount of solid waste to help keep the environment clean and to reduce wasted energy to make and transport goods. Discuss the many points of collection for recycled	renewable and non-renewable resources: http://www.eia.doe.gov/kids/energyfacts/index.html Students research the change in human population over time. Students research the amount of available land per person on earth by finding estimates of the number of humans and the amount of usable land. Remind students that the earth is covered by about ¾ ocean and ¼ land. Of the land, about 1/3 is unsuitable for humans due to mountains and cold. Another 1/3 of the land is unsuitable for humans due to desert and	available and at projected usage levels, when are they expected to 'run out'). Students research the cost of various recycled products vs. cost of new from scratch. Students list ways to recycle. E.g. city pickup, paper collection in schools and businesses, aluminum can machines, plastic grocery bag bins at grocery stores, and so on.

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		materials. Show examples of the universal recycle symbol (3 green or black arrows in triangle) that indicate a material is recyclable and/or is made from recycled materials.	high heat. This leaves only about 1/12 of the entire earth surface that is suitable for human life.	Students describe ways to conserve fossil fuels and reduce pollution, e.g. increased use of mass transit and alternative energy sources.
2nd 7	*Week 1 of 2-Week Indicator* **Science and Technology: Understanding Technology** Investigate positive and negative impacts of human activity and technology on the	Continue Science Fair projects Discuss how living things react to changes in the environment, for example cutting down forests; building roads, factories, homes and farms; draining wetlands; pollution Explain that ***renewable resources*** are resources that can be replaced by natural processes in less than 100 years, for example fresh water, air, wildlife, and trees. Discuss that to maintain renewable resources, air and water needs to be kept clean, forests need to be managed, and the food chain kept safe. Define ***pollutant****:* any material that can harm living things by interfering with life processes.	**A+ The Sciences II:** *Our World* Students research information about the EPA. Explore various topics, e.g., what is the water quality throughout the watershed in which we live. Students research the effects of oil spills in lakes and oceans.	Students trace examples of pollution from point of source through various paths to plants and animals.

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	environment. ---------------------- **Earth and Space Sciences: Earth Systems** Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained.	Define ***acid rain***: damaging rain or snow that has been acidified when gases released by burning oil and coal mix with water in the air. Acid rain can kill fish when it falls into rivers and lakes and can kill plants and trees when it falls to ground. Discuss the many examples of burning oil and coal that create acid rain. Discuss examples of air, water, and land pollution and contamination: Mercury from factory into stream, then fish, then people who eat fish; Car burns gasoline made from oil, makes acid rain, kills trees; Oil poured into street drain, to river, to lake, to fish, to people. Discuss the role of the U.S. ***EPA*** (Environmental Protection Agency). Review ***Clean Water Acts*** and ***Clean Air Acts*** of the 1970's and amendments through present. To improve air quality, this legislation addressed reduction of acid rain, urban smog, toxic air pollutants, ozone protection, and other air health matters. To improve water quality, this legislation required permits to dump wastes and took other		

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		measures to work toward the goal of making all U.S. surface waters "fishable and swimmable". This goal has not been fully achieved, but according to the EPA we are about 90% there. Explain that a ***watershed*** is all the land drained by a stream or river. Retaining vegetation and ground cover in a watershed helps to hold back rainwater and lessens downstream floods. The EPA monitors water quality in and works to protect over 4,000 watersheds in the U.S.		
2nd 8	*Week 2 of 2-Week Indicator* **Science and Technology: Understanding Technology** Investigate positive and negative impacts of human	*(Include Review And Application Of 5.1.5 – 5.1.6)* Continue Science Fair projects Explain that with chemicals, ***hazardous*** means dangerous and ***toxic*** means poisonous. Discuss that living systems can be overwhelmed by receiving too high doses of any material, and that most chemicals have some safe level below which their effects are undetectable or insignificant. For example, 100 cups of strong coffee contain a lethal dose of caffeine for one person if taken at one time, but spread out a cup or two per day is safe. Taken in small doses, most toxins can be broken down or excreted by	**A+ The Sciences III:** *Conservation* Students research examples of past and present air, water and land pollution in the Cleveland area.	Students research federal and state EPA. Write a short report using examples of positive and negative impacts of human activity and technology on the environment and ways that Earth's renewable resources (e.g.,

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	activity and technology on the environment. ----------------------- **Earth and Space Sciences: Earth Systems** Investigate ways Earth's renewable resources (e.g., fresh water, air, wildlife and trees) can be maintained.	organisms before they do much harm. Also, any damage they cause can usually be repaired. Taken in too high doses all at once or over time, however, can cause illness or death. Explain that, similarly, Earth's capacity to absorb and recycle materials naturally (e.g., smoke, smog and sewage) can change the environmental quality depending on the length of time involved. Pollution is caused by both natural and ***anthropogenic*** (human-caused) sources. For example, air pollution can be created by factories, power plants, and automobiles, but also forest fires, dust storms, and volcanoes. In general, anthropogenic pollutants are considered more serious because they are so significantly and relentlessly created in a world of growing population and industrialization that they exceed the ability of natural systems to absorb contaminants and they tend to be centered in populated areas. From Earth's surface up to space is called the ***atmosphere,*** made of approximately 78% nitrogen, 21% oxygen, 1% argon, water vapor that varies from 0 to 4%, averaging about 1%, and carbon dioxide .04%. The atmosphere is		fresh water, air, wildlife and trees) can be maintained. Include examples of efforts of the EPA, other organizations, and individuals

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		the most important mechanism for distributing water around the world. The atmosphere has different characteristics within layers and each layer has a name. The ***troposphere*** is the lowest layer; it starts at the earth's surface and rises taller than the highest mountains. It includes clouds and weather and surface life. Next is the ***stratosphere***, the layer that contains the highest concentrations of ***ozone***. This important layer of gas helps protects life on Earth from harmful ultraviolet rays coming from the sun. Above the stratosphere are the ***mesosphere, thermosphere, exosphere***, and then space. As you travel up through these layers, there are fewer and fewer atmospheric molecules until you are in empty space. Discuss ***sources of air pollution***. Most pollutants are produced from burning fossil fuels, especially in coal-powered electric plants and in cars and trucks, as well as processing natural gas and oil. Others, especially sulfur and metals, are byproducts of mining and manufacturing processes. Explain the characteristics and origin of major pollutants. ***Sulfur dioxide*** (SO_2) is a colorless, corrosive gas that damages plants and animals. Sulfur dioxide and sulfate ions are a significant cause of air pollution-related health		

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		damage and reduce visibility through the air. ***Nitrogen oxides*** (NO_x) are formed when nitrogen-bearing fuel is burned in a vehicle or a furnace and are a major component of ***acid rain***, damaging rain or snow that has been acidified when gases released by burning oil and coal mix with water in the air. Acid rain can kill fish when it falls into rivers and lakes and can kill plants and trees when it falls to ground. Nitrogen dioxide is the reddish-brown gas that gives smog its distinctive color. ***Carbon monoxide*** (CO) is a colorless, odorless but highly toxic gas produced mainly by incomplete combustion of fuel (coal, oil, charcoal, wood, or gas). In the United States, 2/3 of the CO emissions are created by internal combustion engines in transportation. Land clearing fires and cooking fires also are major sources. CO inhibits respiration in animals. Review that materials that store carbon are called ***carbon sinks***, for example geologic formations, forests, and oceans. When carbon is released from sinks into the air faster than it can be absorbed by other sinks, it increases the ***carbon dioxide*** (CO_2) concentration in the atmosphere which, among other gases, many scientists believe		

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		contributes to ***global warming.*** ***Toxic metals and halogens*** are chemical elements that are toxic when concentrated and released in the environment. Principal metals of concern are lead, mercury, arsenic, nickel, beryllium, cadmium, thallium, uranium, cesium, and plutonium. Halogens (fluorine, chlorine, bromine, and iodine) are highly reactive toxic elements. Chlorine-based aerosols, especially chlorofluorocarbons (CFS's) and other halon gases, are the principal agents of ozone depletion in the stratosphere, a layer of the atmosphere that helps protect life on Earth from harmful ultraviolet rays coming from the sun. Most toxic metals and halogens are mined and used in manufacturing. Metals commonly occur as trace elements in fuels, especially coal.		
2nd 9	*Week 1 of 2-Week Indicator* **Physical Sciences: Nature of Energy** Explore and	Continue Science Fair projects Explain that light and other waves of the ***electromagnetic spectrum*** are emitted by stars and other energy sources in the universe and on Earth. Most ***electromagnetic waves*** are invisible to human eyes and include ***radiowaves, microwaves, infrared waves, ultraviolet (UV) rays, X rays,*** and ***gamma rays.*** Discuss examples of uses of various	**A+ The Sciences III:** *Light* **A+ The Sciences IV:** *Light* Reflect a flashlight beam off mirrors to	Students draw a light wave and diagram its wavelength. Vocabulary test.

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	summarize observations of the transmission, bending (refraction) and reflection of light.	electromagnetic waves. Discuss that waves have different properties that determine their type. Explain that all waves can be described by ***frequency*** (number of waves per second), ***wavelength*** (distance from a point on a wave to the corresponding point on the next wave), and ***speed*** (e.g. meters per second). Explain that wavelengths in the electromagnetic spectrum vary on a continuum from very short (10^{-15} m gamma rays) to very long (10^{5} m radiowaves.). Most wave types have very small wavelengths: radio waves range from about 10 cm to 100,000 m, and all other wavelengths are shorter than radio waves. Explain and demonstrate that light travels in straight lines and can ***reflect*** off surfaces. Show that the straight path can bend when light passes through different substance like water and glass (***refraction***). Demonstrate that the straight path can bend when light passes around a barrier (***diffraction***).	demonstrate straight path travel of light waves and property of reflection. Reflect a pencil against a window glass – explain that 2 images are seen because of reflections from 2 surfaces of glass.	

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3rd 1	*Week 2 of 2-Week Indicator* **Physical Sciences: Nature of Energy** Explore and summarize observations of the transmission, bending (refraction) and reflection of light.	Continue Science Fair projects Discuss that light energy can be ***absorbed*** and converted to other wavelengths (e.g. infrared) which is why sunlight heats the earth, and why a light colored surface stays cooler in sunlight than a dark surface which absorbs more energy. Explain that white light can be separated into a rainbow of colors by refraction and reflection. E.g. when it passes through a prism or droplets of water in sky and forms a rainbow. Through a prism, different wavelengths and frequencies of light are refracted in different amounts, producing colors. In a rainbow, sunlight is refracted as it enters the rain drops, reflected off the backside of the drops, then refracted again as it leaves the drop and passes to your eye. Explain the order of colors of the rainbow and that they are arranged from longest wavelength (red) to shortest (violet). Discuss the ROY G. BIV mnemonic device to help remember order of colors.	**A+ The Sciences VI:** *Light Energy* **A+ The Sciences VI:** *Images and Refraction* Make large soap bubbles, catch bubbles on flat surface (e.g. cookie sheet) and observe colors. Explain that *constructive interference* creates rainbow colors on bubble and that *destructive interference* creates black areas on bubble. Observe the rainbow colors on a CD. Explain that light is *diffracted* around each pit in the CD and comes together to	**Practice OATs now through April as needed.** Students diagram a continuous path of light including a reflection, refraction, and diffraction. E.g. Sunlight reflects off ground and is refracted through glass window and is diffracted on CD making colors. Students write a paragraph explaining why you feel warmer in a black shirt on

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		Rainbows of colors can be seen on soap bubbles and oil/gasoline slicks. The colors are seen because of ***interference*** of light waves reflected from different surfaces (inside vs. outside surfaces of bubble, oil or gas surface on water surface).	form a rainbow. Demonstrate diffraction by shining a light through a paper slit and observe the light spread out. Demonstrate light and heat absorption by placing a thermometer on a black paper and another thermometer on white paper, in separate jars with lids if possible, and place in sunshine.	a sunny day as compared to a white shirt. Students list the colors of the rainbow in order from longest wavelength to shortest.
3rd 2	**Scientific Ways of Knowing: Nature of Science** Summarize how conclusions and ideas change as new	Complete Science Fair projects. Conduct experiments that demonstrate and reinforce material from preceding weeks. Summarize how conclusions and ideas change as new knowledge is gained. Develop descriptions, explanations and models using evidence to defend/support findings.	Varies with experiment.	Student performance on experiments.

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	knowledge is gained. ___________ **Scientific Ways of Knowing: Nature of Science** Develop descriptions, explanations and models using evidence to defend/support findings.			
3rd 3	**Physical Sciences: Nature of Energy** Describe and summarize observations of the	Science Fair Explain that a sound is made when an object vibrates, compressing bands of molecules of a solid, liquid, or gas, producing pressure waves that travel in straight lines to the ear and are interpreted by the brain as sound. To be heard by humans, the wave frequency must be between about 20 to 20,000 vibrations per second. A ***compression*** is the part	**A+ The Sciences III:** *Sound* Sound Webquest: http://library.thinkquest.org/19537/?tqskip1=1	Students make a continuous flow diagram of a sound being created, transmitted, reflected, refracted, and

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	transmission, reflection, and absorption of sound.	of the wave made of compressed molecules and the ***rarefaction*** is the part of the wave with few molecules. Discuss that sound waves cannot travel through a vacuum, as in space, as they are dependent on a medium to transport the wave. The denser the medium, the better the conductor, and so sound waves travel through solids the fastest, then liquids, then gases like air the slowest. Discuss that the medium itself does not move except to oscillate as the wave passes. The energy transfer from molecule to molecule drives the wave and it is the energy that moves forward along the wave. The individual molecules of medium do not move along with the wave. Explain that sound waves can be reflected, refracted (bent), and absorbed, like light waves. Discuss examples of reflection (an echo, safety earplugs), refraction (shouting from air through water), and absorption (sound absorption panels in recording studio).		absorbed. E.g. hearing someone talking in the hallway. Vocal chord vibrates, compressing air which travels in waves that are reflected off walls, floor, and ceiling and refracted around doorway then absorbed by eardrum and interpreted by brain.
3rd 4	**Physical Sciences: Nature of Energy** Describe that	Science Fair Explain that the higher the vibration frequency, the higher the ***pitch*** of the tone. Discuss Doppler Effect as compressed sound waves from	**A+ The Sciences IV:** *Sound* Demonstrate pitch and loudness using musical	Make a musical instrument, play it for the class, and explain what makes the sound.

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	changing the rate of vibration can vary the pitch of a sound.	rapidly approaching object that suddenly spread out after passing by listener, thus lowering frequency = lower pitch. Discuss ***amplitude*** of a wave as the height of the wave from the centerline. The greater the amplitude of a sound wave, the greater the loudness or intensity of the sound. Explain that sound waves lose energy the farther from the source, and as the wave amplitude decreases, the loudness decreases. Loudness is measured in units called ***decibels***.	instruments: stringed (e.g. guitar, violin, piano by vibrating strings which vibrate air), percussion (e.g. drums by vibrating flat surface heads which vibrate air, and wind (e.g. saxophone and trumpet by vibrating reeds and mouthpieces and columns of air). Make a Kazoo: http://whyfiles.larc.nasa.gov/text/educators/activities/2000_2001/athome/make_a_kazoo.html	Vary pitch and loudness and explain the associated wave behavior.
3rd 5	**Scientific Ways of Knowing: Nature of Science** Explain why an experiment must be	Conduct experiments that demonstrate and reinforce material from preceding and upcoming weeks. Explain why an experiment must be repeated by different people or at different times or places and yield consistent results before the results are accepted.	Varies with experiment.	**A+ Adaptive Assessments, Science, Level 5** *Earth Science, Physical Science*

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	repeated by different people or at different times or places and yield consistent results before the results are accepted.			
3rd 6	**Scientific Ways of Knowing: Nature of Science** Identify how scientists use different kinds of ongoing investigations depending on the questions	Conduct experiments that demonstrate and reinforce material from preceding and upcoming weeks. Identify how scientists use different kinds of ongoing investigations depending on the questions they are trying to answer (e.g., observations of things or events in nature, data collection and controlled experiments).	Varies with experiment.	Student performance during experiments.

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	they are trying to answer (e.g., observations of things or events in nature, data collection and controlled experiments).			
3rd 7	*Week 1 of 2-Week Indicator* **Life Sciences: Diversity and Inter-dependence of Life** Summarize that organisms can survive only in ecosystems	Review that an ***organism*** is a living thing that has all the traits of life (a trait is a specific feature of something). Some traits of life include ***response, movement, showing organization, reproduction, growing*** and ***developing.*** Review that an organism's ***environment*** includes everything in its surrounding, e.g. other organisms, water, weather, temperature, soil, sound, light, and so on. Review that all organisms on life can be separated into six large groups called ***kingdoms***. Each kingdom's organisms share certain features, distinguished by how many cells they are made up of, what their cells look like, whether or not they can move from place to place, and how they obtain energy. The kingdoms most familiar to many people	**A+ The Sciences IV:** *Living Things* **A+ The Sciences V:** *Animal Adaptations 2* Explore Ecosystems: http://www.fi.edu/tfi/units/life/habitat/habitat.html	Draw and label an environmental scene with at least 3 ecosystems, 5 biotic factors, and 5 abiotic factors.

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	in which their needs can be met (e.g., food, water, shelter, air, carrying capacity and waste disposal). The world has different ecosystems and distinct ecosystems support the lives of different types of organisms.	are Plants and Animals. ***Plants*** are many-celled organisms; most contain the green chemical chlorophyll which enables them to make food. ***Animals*** are many-celled organisms and the only organisms you can see moving around from place to place. Kingdoms can be subdivided into smaller groups based on shared traits, e.g. some animals have bones, and some don't. Animals without bones include sponges, worms, crabs, and insects. There are five groups of animals with bones: *Fish* live in water and have gills for breathing, most have fins for easy swimming. *Amphibians*, e.g. frogs live both in water and on land. *Reptiles* live on land and include turtles, alligators, and snakes. They have dry skin and most lay eggs. Animals that have feathers are called *birds.* Animals that have hair and give birth to live offspring are called *mammals*, the exception being whales with no hair. Mammal mothers nurse their babies. ***Fungi*** make up another kingdom, and include mushrooms and mold. Fungi seem like plants but they do not make their own food, instead they get it from the things they grow on top of. ***Protists*** have a unique cell structure and include algae, seaweed, kelp, and many single-celled animal-like organisms.		

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		Bacteria are single celled organisms with thousands of known species and possibly millions in existence. They are divided into two kingdoms based on the environment in which they live. Some bacteria are useful, e.g. making yogurt and some cheeses; many bacteria are harmful, causing diseases in other organisms. Note: A ***virus*** is a particle that is like both living and nonliving things. They can reproduce, but only inside living cells. However they do not grow, eat, or respond to their environment. Viruses spread throughout an organism by invading a cell and then copying itself. Eventually the infected cell ruptures and the many reproduced viruses attack other cells and the cycle repeats. Viruses cause measles, AIDS, colds, chicken pox, cold sores and can cause cancer. Viruses can infect living things in all six kingdoms of life. Define ***ecosystem*** as a large or small area where living things and nonliving factors interact to form a working unit. E.g. a stream, a garden bed, a neighborhood, a forest, a desert, a rotting tree trunk, a mountain range. In each case the living plants and animals (***biotic factors***) depend on other living things for food and reproduction and they also depend on nonliving things (***abiotic factors***) like water, sunlight, and soil for drink, heat, and growth of		

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		food.		
3rd 8	*Week 2 of 2-Week Indicator* **Life Sciences: Diversity and Inter-dependence of Life** Summarize that organisms can survive only in ecosystems in which their needs can be met (e.g., food, water, shelter, air, carrying capacity and waste	Define ***population***: group of the same type of organisms living in the same area at the same time. ***Community***: all of the populations in an area. ***Limiting factors***: the things that limit the size of the population. ***Predation*****:** act of one organism (***predator***) feeding on another (***prey***). ***Niche****:* the role of an organism in an ecosystem. ***Habitat***: place where an organism lives out its life. Discuss that the world has different ecosystems and distinct ecosystems support the lives of different types of organisms. ***Endangered species***: so few of its members are living that the entire species may become ***extinct. Threatened species***: needs to be protected but is not in immediate danger of becoming extinct.	**A+ The Sciences IV:** *Animal Behavior* **A+ The Sciences V:** *Animal Adaptations 1* **A+ The Sciences IV:** *Animal Populations* Students research differences in plant and animal life for the 3 main *soil types* in the U.S.: Midwest = rich, black soil South = red clay soil Coastal = sandy soil Students research differences in plant and animal life for the main *climate* types in the U.S.	Go on a nature walk and have each student point out a population, habitat, and limiting factor. Students research an extinct species and an endangered species. Write a report discussing the history of each population and why it is extinct or endangered.

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	disposal). The world has different ecosystems and distinct ecosystems support the lives of different types of organisms.		and/or world. Students research differences in plant and animal life for the main *topography* types in the U.S. and/or world.	
3rd 9	**Life Sciences: Diversity and Inter-dependence of Life** Describe the role of producers in the transfer of energy entering ecosystems as sunlight to chemical	For energy to live, organisms either eat other living things or produce their own food within themselves. Organisms that make their own food are called ***producers*** (plants, green algae, and many types of bacteria). This food-making process, ***photosynthesis***, uses energy from sunlight to convert water and carbon dioxide from the atmosphere to food for the plant and oxygen as a byproduct. Photosynthesis occurs inside the ***chloroplasts***, the plant cell organelles that give plants their green color and trap energy from sunlight and turn it into food.	**A+ The Sciences V:** *Environment 1* **A+ The Sciences IV:** *Plants 1* Photosynthesis Video: http://www.newtonsapple.tv/video.php?id=915 Plant experiment: http://www.eduref.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Botan	Diagram and label an energy flow diagram from sun to human.

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
	energy through photosynthesis.		y/BOT0046.html	

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4th 1	**Life Sciences: Diversity and Inter-dependence of Life** Explain how almost all kinds of animals' food can be traced back to plants. **Life Sciences: Diversity and Inter-dependence of Life** Trace the organization of simple food chains and food webs (e.g., producers,	Explain that organisms that eat other organisms are called ***consumers***. A ***food web***, composed of many ***food chains***, is a model that shows the feeding interactions of consumers and the flow of energy beginning from the producers. Explain that each level of a food chain is called a ***trophic level***. Explain that each successive trophic level, or feeding level, contains only about 10% of the energy captured by the level below it. The remainder is lost as heat (because of the work that organisms must perform) or in remains of dead organisms. Define and list examples of ***herbivores***, ***carnivores***, ***omnivores***, and ***decomposers.*** Herbivores eat plants (e.g. a horse), carnivores eat flesh (e.g. a wolf), and omnivores eat both plants and animals (e.g. a human). Sometimes you can tell what type of consumer is an organism by looking at its teeth to see if cutting and crushing surfaces are highly adapted for one specific kind of food or many. Decomposers are organisms such as fungi and bacteria that complete the final	**A+ The Sciences III:** *The Food Chain* **A+ The Sciences IV:** *Animal Habitats* Complete the Food Chain Game: http://www.bgfl.org/bgfl/custom/resources_ftp/client_ftp/ks3/science/hamshall/food_chains/index.htm	Students list 1-2 examples each of producers, herbivores, carnivores, omnivores, and decomposer for a given ecosystem. Then make a food web that includes the selected organisms. Use different colors, say, green for producers and red for consumers. Cut circles out of construction paper and connect with string or yarn, or draw on paper. Example:

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	herbivores, carnivores, omnivores and decomposers).	breakdown of the dead bodies and waste products of other organisms and return nutrients to the soil to fertilize the primary producers.		Forest ecosystem with rabbits, squirrels, deer, wolves, ferns, acorns, oak trees, grass, mushrooms, bacteria. Take a trip to the natural history museum and students find list examples of herbivores, carnivores, omnivores, and decomposers.
4th 2	**Life Sciences: Diversity and Inter-dependence of Life** Support how an organism's	Discuss examples of the relationship between an organism's behavior to its ecosystem Research project: Students will study in detail an organism in an ecosystem at or near home or on school grounds.	**A+ The Sciences IV:** *The Food Chain* Conduct field and internet research for research project.	**A+ Adaptive Assessments, Science, Level 5**, *Life Science* Write a report

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	patterns of behavior are related to the nature of that organism's ecosystem, including the kinds and numbers of other organisms present, the availability of food and resources, and the changing physical characteristics of the ecosystem.			discussing how the organism's patterns of behavior are related to the nature of that organism's ecosystem, including the kinds and numbers of other organisms present, the availability of food and resources, and the changing physical characteristics of the ecosystem.
4th 3	**Life Sciences: Diversity and Inter-dependence of Life** Analyze how all	Update previous week's work on an organism's behavior relationship to its ecosystem with ways that the organism can cause changes in its ecosystem. Define ***exotic species***, or ***invasive*** species introduced by humans from another continent. Exotic species are	**A+ The Sciences IV:** *Science Terms Review* **A+ The Sciences V:** *Assessment Test – Earth Sciences*	Students write a 1-2 pg research paper on an invasive plant or animal species of their choice.

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	organisms, including humans, cause changes in their ecosystems and how these changes can be beneficial, neutral or detrimental (e.g., beaver ponds, earthworm burrows, grasshoppers eating plants, people planting and cutting trees and people introducing a new species).	introduced intentionally and unintentionally and with mixed results. Sometimes an exotic species will aggressively invade and alter the local environment because they arrive without natural predators. Many plants are introduced for beauty in landscaping but then run rampant and kill off native plants. Rats were brought to Hawaii on ships unintentionally. Then mongooses were introduced intentionally to control rats. But rats are active at night and mongooses are active in day and they ignored one another. Mongooses began to attack defenseless native birds, and so 3 problems exist where there used to be 1: too many rats, too many mongooses, and dead birds.	Internet research on exotic, invasive species. Include one example in Lake Erie.	Include the name of the species, when/where/why it was introduced, the effect, and past, present, future actions to deal with the invasion.
4th 4	*Week 1 of 2-Week Indicator* **Scientific Ways of Knowing: Science and**	Ohio Achievement Tests Final Prep Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform.	**A+ The Sciences V:** *Science Terms Review* **A+ The Sciences V:** *Assessment Test –*	Performance on A+ assessments.

Virtual Schoolhouse

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
	Society Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform.		*Physical Sciences* **A+ The Sciences V:** *Assessment Test – Life Sciences* **A+ The Sciences VI:** *Scientists* Science and Technology Careers (Female-oriented website): http://www.girlpower.gov/girlarea/sciencetech/jobs/index.htm	
4th 5	Ohio Achievement Tests			
4th 6	*Week 2 of 2-Week Indicator* **Scientific Ways of Knowing: Science and Society** Identify a variety	Post-tests/placement tests for year's progress, present levels performance, IEP update Identify a variety of scientific and technological work that people of all ages, backgrounds and groups perform.		**A+ Course Assessment, Science, 5th Grade Post-test** *– Earth Science (A), Physical Science (A), Life*

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	of scientific and technological work that people of all ages, backgrounds and groups perform.			*Science (A), Nature and Skills of Science (A)*
4th 7	*Week 1 of 3-Week Indicator* **Science and Technology: Abilities To Do Technological Design** Revise an existing design used to solve a problem based on peer review. **Science and Technology: Abilities To Do Technological Design** Explain how the	Revise an existing design used to solve a problem based on peer review. Explain how the solution to one problem may create other problems. E.g., fossil-fuel and electric energy power supplies replaced steam and other less efficient power supplies in machines around the world, but now we have pollution problem (including from electricity, because fossil fuels are burned to generate electricity).	**A+ The Sciences V:** *Technology* Students research various existing inventions and select one to improve upon. Students create mockup or working model to demonstrate and explain pros and cons associated with the improvement.	**A+ Course Assessment, Science, 5th Grade Post-test** *– Earth Science (B), Physical Science (B), Life Science (B), Nature and Skills of Science (B)*

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
	solution to one problem may create other problems.			
4th 8	*Week 2 of 3-Week Indicator* **Science and Technology: Abilities To Do Technological Design** Revise an existing design used to solve a problem based on peer review.	Student continue design improvement project.	As needed for design improvement project.	Progress on design improvement project.
4th 9	*Week 3 of 3-Week Indicator* **Science and Technology: Abilities To Do Technological Design** Revise an existing	Students complete and present design improvement project.	As needed for design improvement project.	Completion and presentation of design improvement project.

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Qtr-Week	Benchmark/ Indicator	Lesson Makeup	Materials/Technology Component	Assessment
	design used to solve a problem based on peer review.			