A+nyWhere Learning System® Teachers' Guide

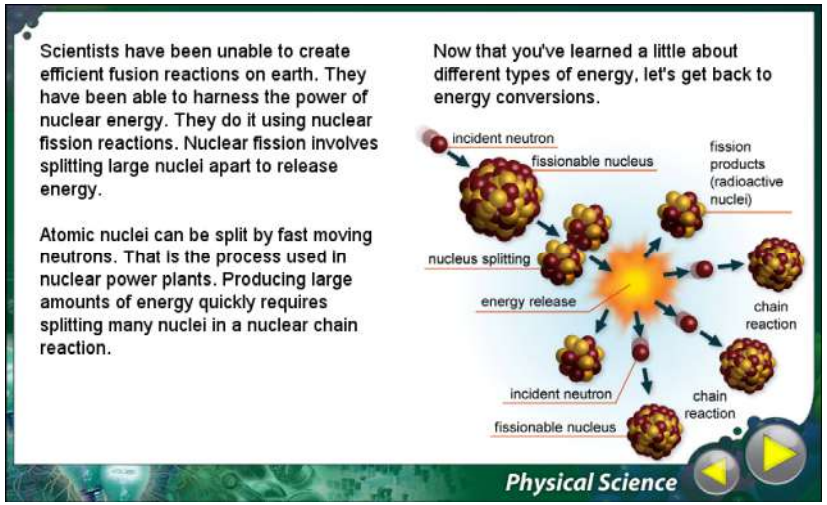
Physical Science
Grade Levels 9-10

Course Description

Physical Science is a comprehensive course that invites students to explore the universe of nonliving matter. This course offers several distinctive components: an in-depth examination of the biological functions of vision and sound in relation to physical laws; the impact of scientific discoveries on technology and society; and an overview of natural hazards, including the impact of humans on the environment. The Physical Science course covers the fundamentals of chemistry, matter, energy, and various scientific fields. The lessons are designed to move the student beyond the level of basic knowledge into critical thinking and learning activities.

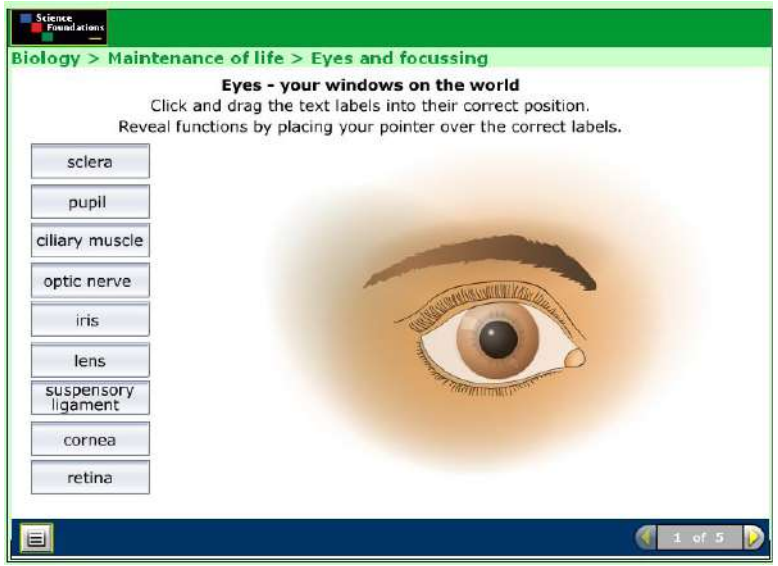
Course Features

Physical Science is presented as a semester-long high school elective course.



- All thirty-one lessons contain a study guide, a practice and mastery test, and an essay or constructed response.
- Lessons include a variety of essay types such as descriptive, persuasive, and expository. Directions for essays and rubrics for grading are provided for each of the writing assignments. Students will also complete a self-evaluation form to assess their performance.
- Lessons sold within the VIP bundle include Cambridge University Press (CUP) Learning Objects.
- The reading level of Physical Science is certified by MetaMetrics® with a Lexile® score.
- In addition, VIP packaging includes Encyclopedia Britannica (EB) workspaces that may contain articles, videos, or interactive media. Clearvue (CV) video clips may be included as well.

Course Objectives



- The content in this course is based on specific standards developed by the National Science Education Standards (NSES).
- Requirements identified in the following standards under the Course Content section are: Science Inquiry, Physical Science, Earth and Space Science, Science and Technology, Science in Personal and Social Perspectives, and History and Nature of Science.
- Students learn the basics of chemistry and acquire the ability to understand and perform methods of scientific inquiry.
- Personal, social, and historical perspectives of science are observed in the areas of community, environment, and technology.
- Lessons explore the nature of scientific knowledge and elements of earth and space science, including the origin and evolution of the universe and earth system.

Practical Tips

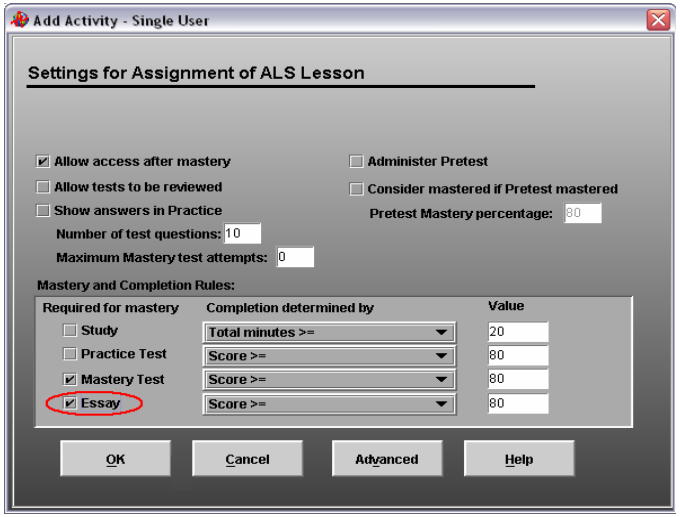
- Due to the interactive nature of the VIP Bundle, there are a few specific software requirements:
  - A web browser equipped with the Adobe® Flash® plug-in for the CUPS and EB interactive activities is available at: www.adobe.com, select the **Get Adobe Flash Player** button.
  - Some EB video clips utilize Quicktime™. Your workstations will need to have the Quicktime Video Player installed. Available at: www.apple.com/quicktime/download

- Some EB components deliver RealPlayer® videos. Your workstations will need to have the RealPlayer installed. Available at: www.real.com, select **Get RealPlayer - Free**.
- Some EB videos require the Windows Media Player. Your workstations will need to have the Windows Media Player installed. Available at: www.microsoft.com/windows/windowsmedia/download

- Two links to the Internet are provided as a resource for further exploration.
  An Internet connection is not required for completion of this course, but it is required to utilize the VIP Bundle's CUP and EB components.

- The Physical Science course requires students to read resources that are linked to the lessons. The vast majority of these documents are provided as Portable Document Files (PDFs). As a result, students will need Adobe Acrobat® Reader® available on their workstations. Available at: www.adobe.com, select the **Get Adobe Reader** button.

- Students are required to complete the essay section for lesson mastery. This setting must be enabled on the "Settings for Assignment of *A+LS* Lesson" dialog box. The default setting does not require the completion of the essay for assignment mastery. The circled item shows the proper setting.



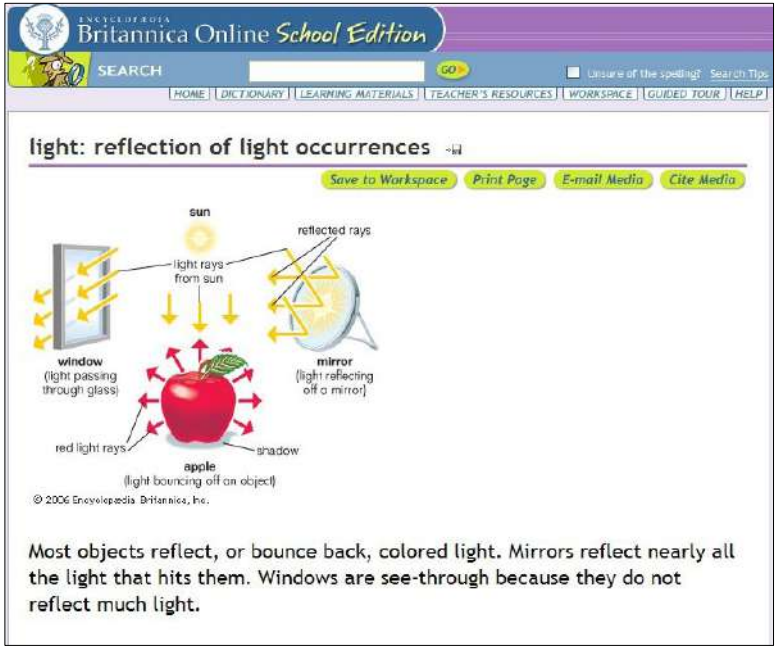
Lesson Content

Cambridge Learning Objects are animations and interactive activities that enhance learning about the concepts presented within the physical science lessons. Founded in 2003, Cambridge-Hitachi is the result of a joint venture between Cambridge University Press and Hitachi Software Engineering. Cambridge-Hitachi is committed to innovation in e-learning and applies information and communication technologies as powerful tools to enhance the quality of teaching and learning.

Encyclopedia Britannica Online School Edition has over 450 Teacher Resources and Student Learning Materials. The materials include a wide range of interactive lessons, research projects, animations, and worksheets that support the Physical Science curriculum. Physical Science contains Encyclopedia Britannica workspaces, and each may contain an article, diagram, study guide, video, or interactive media.

The lessons in the Physical Science course are divided into ten domains of study.

- Unit 1 – Introduction to Physical Science
- Unit 2 – Science Applications
- Unit 3 – Matter's Building Blocks
- Unit 4 – Structure and Properties of Matter
- Unit 5 – Matter and Motion
- Unit 6 – Energy and Work
- Unit 7 – Electricity and Magnetism
- Unit 8 – Waves, Sound, and Light
- Unit 9 – Physical Science and Society
- Unit 10 – The Physical Universe



The lessons in the *A+nyWhere Learning System* Physical Science course will enable the student to evaluate, describe, summarize, define, characterize, or demonstrate an understanding of the NSES standards listed below:

Science as Inquiry Standards
- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

***A+LS* Physical Science Lesson**
- Scientific Method

Science and Technology Standards
- Technological design
- Science and technology

***A+LS* Physical Science Lessons**
- Experiments and Data Collection
- Interpreting and Presenting Data
- Physical Science and Technology

History and Nature of Science Standards
- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

***A+LS* Physical Science Lessons**
- What Is Physical Science?
- History of Physical Science

Earth and Space Science Standards

- Energy in the earth system
- Geochemical cycles
- Origin and evolution of the earth system
- Origin and evolution of the universe

A+LS Physical Science Lessons

- Earth Science
- Climate and Weather
- Astronomy Basics

Science in Personal and Social Perspectives Standards

- Personal and community health
- Population growth
- Natural and human-induced hazards
- Environmental quality
- Natural resources
- Science and technology in local, national, and global challenges

A+LS Physical Science Lessons

- Careers in Physical Sciences
- Natural Hazards

Physical Science Standards

- Structure of atoms
- Structure and properties of matter
- Chemical reactions
- Motions and forces
- Conservation of energy and increase in disorder
- Interactions of energy and matter
- Vision and Light Technology

A+LS Physical Science Lessons

- Atoms
- Elements
- Chemical Compounds, Mixtures, and Solutions
- Chemical Reactions
- Properties and States of Matter
- Introduction to Motion and Forces
- Forces and Laws of Motion
- Forces in Materials
- Math in Forces and Motion
- Energy
- Heat
- Work and Simple Machines
- Electricity
- Electric Current and Circuits
- Magnetism
- Electronics
- Waves
- Sound
- Light and the EM Spectrum
- Vision and Light Technology

	Lesson Title	Lesson Content	Essays & Media
	All Lessons	Media common to all lessons in this subject	Essay: 2 .PDFs, directions & self-evaluation matrix
Unit 1: Introduction to Physical Science			
1	What Is Physical Science?	Definition of science; scientific knowledge; observation and evidence; pseudoscience; matter and energy; chemistry; forces and motion; basic and applied science; natural universe; scientific method; physical universe; forms of matter and energy; metaphysics; chemistry; forms of energy; astronomy; applied science; technology; fields of science; scientific discoveries	Study: EB Articles, EB Image Essay: Expository
2	History of Physical Science	Nicolaus Copernicus; Copernican revolution; Galileo Galilei; Sir Isaac Newton; Albert Einstein; theory of relativity; quantum theory; nuclear physics; subatomic particles; geologic time scale; plate tectonics; big bang theory; Johannes Kepler; atomic theory; electrons; protons; Max Planck; Niels Bohr; radioactivity; Marie Curie; geology; Charles Darwin; Georges Lemaitre; Edwin Hubble; George Gamow	Study: EB Articles, EB Videos Essay: Expository
Unit 2: Science Applications			
3	Scientific Method	Scientific method; hypotheses; inductive and deductive reasoning; experiments; models; data analysis; drawing conclusions; scientific reporting; peer review; theories and laws; technology	Study: .PDF Scientific Method, EB Study Guide Essay: Descriptive
4	Experiments and Data Collection	Experimental design; variables: independent and dependent; experimental control; hypothesis; data collection; models; science and technology; science safety	Study: EB Article, EB Study Guide, Web link to National Institute of Standards and Technology, .PDF Laboratory Safety Rules Essay: Research Plan
5	Interpreting and Presenting Data	Statistics and data analysis; data presentation: graphs and data tables, x-axis, y-axis, statistics, legends, error bars, mean, line graphs, variables, pie charts, diagrams; research presentations: research poster, research papers; abstract; application; using data to design a graph, chart, or table	Study: EB Article, 2 .PDFs Distance Chart, Research Poster Example Essay: Graph
Unit 3: Matter's Building Blocks			
6	Atoms	Atoms; elements; subatomic particles; atomic structure: nucleus, protons, neutrons, electrons; atomic mass unit (amu); scientific notation; density; orbiting electrons; cathode ray tube (CRT); Niels Bohr; electron clouds; atomic nucleus; force; isotopes; radioactive decay; Marie Curie; types of radioactive decay: alpha, beta, gamma; radiation; half-life; carbon atoms; nuclear technology; tracers; nuclear fission and fusion	Study: EB Article, EB Study Guide, EB Video, CUP Learning Object Essay: Descriptive

	Lesson Title	Lesson Content	Essays & Media
7	Elements	Elements; physical properties; Dmitri Mendeleev; Henry Moseley; periodic table: periodic law, atomic mass, chemical symbols, period, columns and groups, families, element classes: metals, nonmetals, metalloids; malleable and ductile metals; valence shell; valence electrons; molecule; chemical bond; metals: reactive, alkali, alkaline earth, transition; groups: boron, carbon, nitrogen, oxygen; nonmetals: halogens, noble gases; isotopes; ions; compounds; natural and artificial elements; promethium	Study: EB Articles, .PDF Periodic Table, CUP Learning Object Essay: Descriptive
Unit 4: Structure and Properties of Matter			
8	Chemical Compounds, Mixtures, and Solutions	Compounds; molecules; mixtures; elements; homogeneous; solvent; solute; soluble; insoluble; gases; liquids; alloys; solutions; saturated and unsaturated solutions; solubility; suspensions; heterogeneous mixtures; colloid; particles; chemical bonds: ionic, covalent, and metallic; crystalline lattice; diatomic molecules; hydrocarbons; biochemicals: carbohydrates, lipids (fats), proteins, and nucleic acids; DNA; RNA; carbon compounds	Study: EB Articles, EB Video, .PDF Periodic Table, CUP Learning Object Essay: Expository
9	Chemical Reactions	Chemical reactions: synthesis, decomposition, single and double replacement; reactants and products; chemical formula; law of conservation of mass; exothermic and endothermic reactions; law of conservation of energy; activation energy; chemical equations and formulas; symbols; subscript; coefficients; binary compounds; polyatomic ions; rates of reactions; catalysts; inhibitor; hydrogen; pH scale; acid; base; salt	Study: EB Articles, EB Video, CUP Learning Object Essay: Paragraph
10	Properties and States of Matter	Description of matter including mass and weight; states of matter: liquids, solids, gases, and plasmas; changes in the state of matter: melting, vaporization, freezing, condensation, and sublimation; gravity as a force; electromagnetism; measurements; newton; volume measurement; meniscus; physical properties; chemical properties; density; crystalline solids; amorphous solids; surface tension; viscosity; pressure; Boyle's law; Charles's law; ideal gas law; gas constant; compressed gases; plasmas; boiling point; temperature as a measure of energy in matter	Study: EB Articles, EB Video, CUP Learning Object Essay: Expository
Unit 5: Matter and Motion			
11	Introduction to Motion and Forces	Measuring motion; speed; velocity; constant velocity; resultant velocity; acceleration; positive acceleration; negative acceleration; deceleration; projectile; circular motion; centripetal acceleration; centrifugal force; force; net force; friction types: sliding, rolling, fluid, and static; momentum	Study: EB Study Guide, CUP Learning Object Essay: Compare and Contrast
12	Forces and Laws of Motion	Forces in nature: gravity, electromagnetism, and strong and weak nuclear forces; law of universal gravitation; acceleration of gravity; gravitational constant; Newton's laws of motion; law of conservation of momentum; terminal velocity; air resistance; free fall; motion and inertia; unbalanced forces; two-way nature of forces	Study: EB Articles, CUP Learning Object Essay: Expository

	Lesson Title	Lesson Content	Essays & Media
13	Forces in Materials	Fluids and forces; pressure; Pascal's principle; atmospheric pressure; density; pressure in gases; buoyant force; Archimedes' principle; moving fluids; Bernoulli's principle; air pressure; lift; thrust; drag; turbulence; tension and compression; elastic forces	Study: EB Articles, CUP Learning Object Essay: Expository
14	Math in Forces and Motion	Motion and speed; equations; velocity; constant velocity; resultant velocity; acceleration; force; net force; gravitational force; gravitational constant; pressure; pascal; Pascal's principle; buoyancy	Study: EB Articles, CUP Learning Object Essay: Paragraph
		Unit 6: Energy and Work	
15	Energy	Definition of energy; kinetic energy; potential energy; joule; mechanical energy; conservation of energy; energy transformation; types of energy: thermal, chemical, electrical, sound, light, and nuclear; transforming energy; law of entropy; energy sources: renewable, nonrenewable; fossil fuels; biomass; geothermal energy	Study: EB Article, EB Study Guides, CUP Learning Object Essay: Expository
16	Heat	Temperature; kinetic energy; liquid and digital thermometers; Fahrenheit scale; Celsius scale; Kelvin scale; heat; thermal energy; thermal equilibrium; conduction; conductors; insulator; convection; convection currents; radiation; thermal conductivity; specific heat; specific heat capacity; heat exchange; joule; calories; calorimeters	Study: EB Articles, EB Video, CUP Learning Object Essay: Descriptive
17	Work and Simple Machines	Work; force; direction of motion; calculating work; power; machines; work input; input force; work output; output force; joules; mechanical efficiency; mechanical efficiency calculation; simple machines: lever, inclined plane, wedge, screw, wheel and axle, and pulley; compound machines; lever and fulcrum; classes of levers	Study: EB Articles, EB Image Essay: Expository
		Unit 7: Electricity and Magnetism	
18	Electricity	Electricity as energy; electromagnetism; negative and positive charges; electric force; types of electric charges: friction, conduction, and induction; static electricity; conductors and insulators; electric field; conservation of charge; electroscope; lightning; heat lightning; lightning rods; electric currents; batteries; cells; electrolytes; electrodes; wet and dry cells; potential difference; volts; converting energy into electricity; thermocouple	Study: EB Articles, EB Study Guide, CUP Learning Object Essay: Expository
19	Electric Current and Circuits	Electric current; ampere; direct current (DC); alternating current (AC); voltage; resistance; ohms; super conductors; Ohm's law; electric power; wattages; kilowatts; loads; electric energy conversion; switches; circuits: series and parallel; circuit overloads; short circuits; fuses; circuit breakers; ground fault current interrupters (GFCI); power surges; surge protectors; ground wire	Study: EB Article, EB Study Guide, EB Video, CUP Learning Object Essay: Expository

	Lesson Title	Lesson Content	Essays & Media
20	Magnetism	Magnets; magnetism; magnet domains; magnetic poles; magnetic fields; polarity; the earth and magnets; ferromagnetism; electromagnet; Hans Christian Oersted; temporary magnet; permanent magnet; electric motors; commutator; magnetic fields and motion; galvanometer; ammeter; voltmeter; electromagnetic induction; generators; transformers; electronic devices	Study: EB Articles, CUP Learning Object Essay: Compare and Contrast
21	Electronics	Electronics; circuits; circuit boards; light emitting diode (LED); semiconductors; doping; diodes; transistors; integrated circuits; telecommunications; electric signals; analog signals; vinyl records; tapes; digital signals; digital compact discs; pit; land; wire and wireless; electromagnetic energy; cathode ray tube (CRT); television; computer; computer components; microprocessors	Study: EB Articles, CUP Learning Object Essay: Compare and Contrast
		Unit 8: Waves, Sound, and Light	
22	Waves	Definition of a wave; types of waves: transverse, longitudinal, and combination; medium; electromagnetic waves; crests; troughs; rarefactions; compressions; sound waves; surface waves; amplitude; frequency; wavelength; hertz; wave speed; wave interaction: reflection, refraction, diffraction, and interference; constructive interference; destructive interference; standing wave; resonance	Study: EB Articles, EB Videos, CUP Learning Object Essay: Expository
23	Sound	Sound; sound movement; ears; eardrum; tympanic membrane; inner ear: hammer, anvil, and stirrup; cochlea; hearing; nerve deafness; tinnitus; sound properties; sound waves; decibels; frequency; hertz; infrasonic; ultrasonic; pitch; Doppler effect; oscilloscopes; echolocation; diffraction; interference; acoustics; sound barrier; sonic boom; standing waves; resonance frequency; octaves; sound quality; noise	Study: EB Articles Essay: Expository
24	Light and the EM Spectrum	Light as an electromagnetic (EM) wave; electromagnetic spectrum; radiation; absorption; refraction prism; white light; sunlight; fusion reactions; speed of light; radio waves; amplitude modulation (AM); frequency modulation (FM); microwave; radar; infrared (IR) radiation; visible light; visible spectrum; rainbows and sunlight; ultraviolet (UV) light; ozone; UV radiation protection; EM radiation: x-rays, gamma rays; light waves; law of reflection incidence; reflected light; regular reflection; diffuse reflection; absorption; photons; light scattering; Raleigh effect; light refraction; light diffraction; constructive and destructive interference; transmission; transparent; translucent; opaque; pigment	Study: EB Articles, EB Image, CUP Learning Object Essay: Paragraph

	Lesson Title	Lesson Content	Essays & Media
25	Vision and Light Technology	Human eye: cornea, pupil, iris, lens, retina, rods and cones, nearsightedness, farsightedness, astigmatism, color blindness, color deficiency, vision; luminous; illuminated; incandescent; types of lights: halogen, vapor, incandescent, fluorescent, and neon; light waves; ray; mirrors: plane, concave, and convex; virtual image; optical axis; focal point; focal length; real images; ray diagrams; lenses: convex and concave; ocular; eyepiece; objective lens; light technology; lasers; holographic images; fiber optics	Study: EB Articles, EB Video, CUP Learning Object Essay: Expository
	Unit 9: Physical Science and Society		
26	Physical Science and Technology	Interrelationship between basic and applied science (technology); chemical elements; chemistry; states of matter; forces and motion; fluids; energy and matter; thermodynamics; energy in technology; machines; electricity; magnetism; electronics; waves; light technology; technology solutions; nuclear technology	Study: EB Articles Essay: Expository
27	Careers in Physical Sciences	Careers in physical science; engineers; aeronautical engineering; physical science branches; astronomy; earth sciences; astronomers; chemists; geographers; geographic information systems (GIS); hydrologists; meteorologists; physicists; engineers: electrical, computer, agricultural, environmental, biomedical, chemical, material, nuclear, design, and civil; research scientists	Study: EB Articles, Web link to Bureau of Labor Statistics Essay: Compare and Contrast
	Unit 10: The Physical Universe		
28	Earth Science	Layers of the earth: inner core, outer core, mantle, and crust; plates; plate tectonics; continental drift; earthquakes; earth spheres: lithosphere, hydrosphere, atmosphere, biosphere; troposphere; stratosphere; mesosphere; exosphere; thermosphere; geochemical cyclings; soil; minerals; rocks: igneous, sedimentary, and metamorphic; fossils; erosion: weathering, stream, glacial, and chemical; sedimentation; mountains; scarp; subduction; trenches; oceanic crust; continental crust; seafloor spreading; ocean ridges; ancient earth; strata; geologic time scale; Precambrian era; Paleozoic era; Mesozoic era; Cenozoic era	Study: EB Articles, EB Image, EB Video, CUP Learning Object Essay: Expository
29	Climate and Weather	Climate and weather; seasons; equator; lines of latitude; tilt of the earth; summer solstice; winter solstice; equinoxes; night and day; temperature and pressure; cloud types: cirrus, stratus, and cumulus; atmosphere; Coriolis effect; Hadley cells; Polar cells; Ferrel cells; atmospheric circulation; doldrums; air masses; climate changes; greenhouse effect; global warming; chlorofluorocarbons; ozone layer	Study: EB Articles, EB Videos, CUP Learning Object, Web link to NASA Essay: Expository

	Lesson Title	Lesson Content	Essays & Media
30	Natural Hazards	Magma; hotspots; mantle plumes; black smokers; Pacific Ring of Fire; lava; shield volcano; cinder cone volcano; stratovolcano; strata; supervolcano; caldera; active and dormant volcano; extinct volcano; tsunami; earthquake; fault line; stress; seismic waves; magnitude; Richter scale; hurricane; tropical cyclone; tornado; super cell; Enhanced Fujita (EF) scale; pollution; Environmental Protection Agency (EPA)	Study: EB Articles, EB Videos, CUP Learning Object Essay: Compare and Contrast
31	Astronomy Basics	Universe; big bang theory; astronomy; quarks; leptons; galaxies; stars; Milky Way; solar system; comets; ort cloud; stars; planetesimals; planets; planetoids; asteroids; meteoroids; meteors; meteorites; moon; satellite; craters; astronomical units (AU); spectrometer; spectral analysis; characteristics of stars; apparent brightness; intrinsic brightness; main sequence; red giants; white dwarfs; Hertzsprung-Russell diagram; neutron stars; pulsar; black holes; galaxy movements; galactic nebulae; cosmic rays	Study: EB Articles, EB Video, CUP Learning Object Essay: Paragraph