Earth Science
Curriculum

Board Approved: July 17, 2014

Curriculum Committee

Joe Breen	Francis Howell North
Katie Schottmueller	Francis Howell
Vicky Faron	Francis Howell Central

High School Department Chairs

Steve Kelly	Francis Howell North
Janet Eubanks	Francis Howell
Luanne Scott	Francis Howell Central

Secondary Content Leader	Karen Hill
Director of Student Learning	Dr. Chris Greiner
Chief Academic Officer	Dr. Mary Hendricks-Harris
Superintendent	Dr. Pam Sloan

Francis Howell School District

Mission Statement

Francis Howell School District is a learning community where all students reach their full potential.

Vision Statement

Francis Howell School District is an educational leader that builds excellence through a collaborative culture that values students, parents, employees, and the community as partners in learning.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement for all
- Operating safe and well-maintained schools
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing character and leadership

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

The students in the Francis Howell School District will graduate with the knowledge, skills, and attitudes essential to leading a productive, meaningful life. Graduates will:

- Understand and apply principles of scientific investigation.
- Utilize the key concepts and principles of life, earth, and physical science to solve problems.
- Recognize that science is an ongoing human endeavor that helps us understand our world.
- Realize that science, mathematics, and technology are interdependent, each with strengths and limitations that impact the environment and society.
- Use scientific knowledge and scientific ways of thinking for individual and social purposes.

Course Rationale

Science education develops science literacy. Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. Scientific literacy has become a necessity for everyone.

To accomplish this literacy, science courses will reflect the following:

- Develop scientific reasoning and critical thinking skills.
- Extend problem-solving skills using scientific methods.
- Include lab-based experiences.
- Strengthen positive attitudes about science.
- Incorporate the use of new technologies.
- Provide relevant connections to personal and societal issues and events.

Course Description for Earth Science

Students will study the universality of change from the rock cycle through plate tectonics, as well as weather and the Earth's position in space. Topics include: physical properties of matter, rocks and minerals, weathering and erosion, historical geology, plate tectonics, volcanism and earthquakes, weather, natural disasters, and astronomy. Lab experiences are an integral part of this course.

Francis Howell School District
Earth Science Curriculum Map

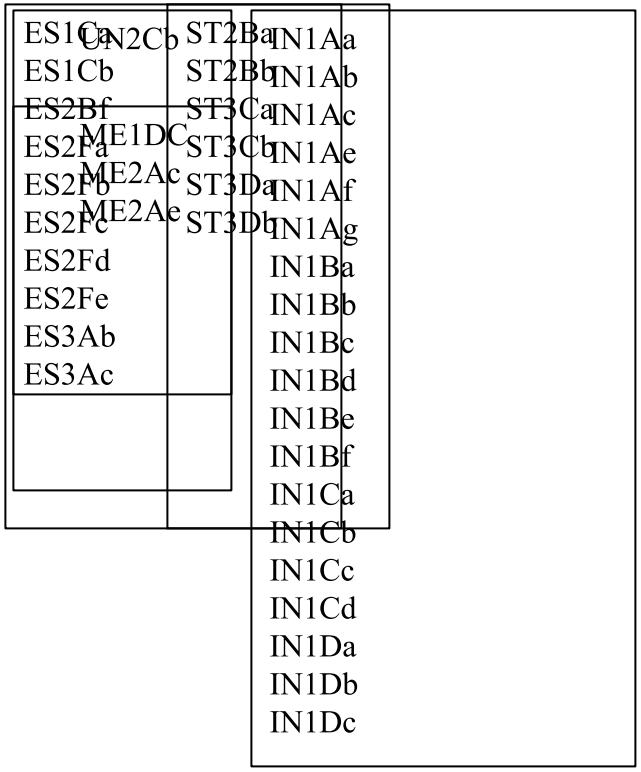
First Semester: (First and Second Quarter)

Earth's Systems – Part 1: Weather & Climate ***(6 Weeks)***

- Energy transfer and conservation of energy
- Weather patterns
- Global & local winds
- Natural phenomena
- Climate & weather
- Atmosphere

Inquiry

- Scientific process
- Measurement

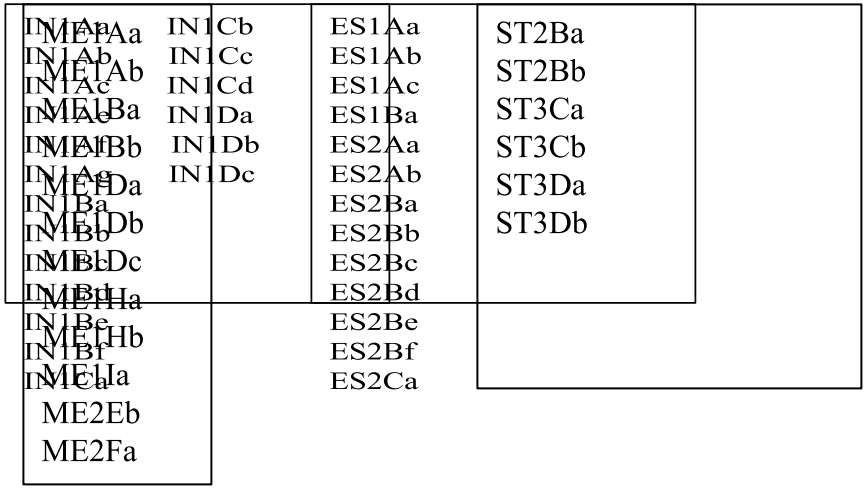


Earth's Systems – Part 2: Earth's Materials & Systems, Plate Tectonics & Large-Scale System Interactions, Role of Water in Earth's Surface Process ***(10 Weeks)***

- Density
- Rocks & Minerals
- Weathering
- Erosion
- Deposition
- Mass wasting
- Energy inside Earth
- Earthquakes
- Plate Tectonics
- Volcanoes
- Mountains

Inquiry

- Scientific process
- Measurement



Second Semester: (Third and Fourth Quarter)

Earth & Human Activity *(8 Weeks)*

- Time Scale
- Dating techniques
- Fossil evidence
- Natural resources
- Land use related to geomorphology
- Impact on Ecosystems
- Mining
- Soil

Inquiry

- Scientific process
- Measurement

IN1Aa, IN1Ab, IN1Ac, IN1Ae, IN1Af, IN1Ag, IN1Ba, IN1Bb, IN1Bc, IN1Bd, IN1Be, IN1Bf, IN1Ca, IN1Cb, IN1Cc, IN1Cd, IN1Da, IN1Db, IN1Dc

ST2Ba, ST3Bb, ST3Bc, ST3Ca, ST3Cb, ST3Da, ST3Db

ME2Ab, ME2Ac, ME2Eb

EC1Ca, EC2Ba, EC2Bb, ES1Ac, ES2Da, ES2Fe

Earth's Place in the Universe *(8 Weeks)*

- Astronomers & beliefs
- Tools/technologies
- Forces
- Science & technology
- Earth-Sun-Moon patterns
- Conditions specific to life on Earth
- Gravity and motions of planets in our solar system
- Revolution, rotation, and axis tilt
- Characteristics of the (EM) Spectrum
- Uses of EM spectrum
- Telescope types and probes
- Fusion as an energy producer in stars

Inquiry

- Scientific process
- Measurement

IN1Aa, IN1Ab, IN1Ac, IN1Ae, IN1Af, IN1Ag, IN1Ba, IN1Bb, IN1Bc, IN1Bd, IN1Be, IN1Bf, IN1Ca, IN1Cb, IN1Cc, IN1Cd, IN1Da, IN1Db, IN1Dc

ST2Ba, ST3Ba, ST3Ca, ST3Cb, ST3Da, ST3Db

ES2Da

UN1Aa, UN1Ba, UN1Bb, UN1Ca, UN1Cb, UN2Ca, UN2Cb, UN2Cc, UN2Cd, UN2Da

ME2Ad, ME2Ca, ME2Cb, ME2Ea, ME2Eb

Content Area: Science	Course: Earth Science	UNIT: Earth's Systems
Unit Description: In this unit, students will understand that the Earth is a system consisting of four major interacting components: geosphere, atmosphere, hydrosphere, and biosphere that are continuously changing due to constructive forces and destructive mechanisms. They will investigate the Earth's materials and systems, plate tectonics, large-scale system interactions, the roles of water in Earth's surface processes, weather and climate, and biogeology.	**Unit Timeline:** Part 1: Weather & Climate – 6 weeks Part 2: Earth's Materials & Systems, Plate Tectonics & Large-Scale System Interactions, Role of Water in Earth's Surface Processes – 10 weeks	

DESIRED RESULTS

Transfer Goal - ***Students will be able to independently use their learning to…***
Use system models to analyze the flow, cycles, and conservation of matter and energy.

Understandings – ***Students will understand that… (Big Ideas)***

1. The Earth is a system consisting of four major interacting components: geosphere, atmosphere, hydrosphere, and biosphere that are continuously changing due to constructive forces and destructive mechanisms.
2. One change to Earth's surface can create feedbacks that cause changes to other Earth systems.
3. Water impacts Earth's materials and surface processes.
4. Variations in energy flow into and out of Earth's systems drives the movement and cycling of matter.

Essential Questions: *Students will keep considering…*

- How are continental and ocean-floor features formed and changed?
- Has Earth always looked like it does now?
- Do changes to one Earth system affect other Earth systems?
- How has water shaped the Earth to distinguish it from other terrestrial planets?
- What sources of energy drive Earth's processes?
- How does energy move and change matter?

Students Will Know…	Standard	Students Will Be Able to …	Standard
• Water is an important solvent in the environment as it relates to karst geology (dissolution and mineralization), acid rain, water pollution, erosion and deposition of rock and soil materials.	ES1Ba	• Explain the processes involved in the recycling of nitrogen, oxygen, and carbon through an ecosystem.	EC2Ba
		• Explain the importance of the recycling of nitrogen, oxygen, and carbon within an ecosystem.	EC2Bb
• Recognize how the geomorphology of Missouri (i.e., different types of Missouri soil and rock materials such as limestone, granite, clay, loam; land formations such as karst (cave) formations, glaciated plains, river channels) affects the survival of organisms and the development of land use by humans (e.g., agriculture, recreation, planning and zoning, waste management)	ES3Ad	• Classify minerals (rock-forming and ore) based on physical and chemical properties (e.g., color, streak, luster/reflectivity, hardness, cleavage, fracture, conductivity, density, melting point, boiling point, solubility, pH, chemical reactivity).	ES1Aa
		• Classify common igneous, metamorphic, and/or sedimentary rocks based on physical and chemical properties (e.g., mineral composition, texture, density, and other unique properties).	ES1Ab
		• Classify earth materials as minerals, rocks, and soils by comparing and contrasting their components, unique properties, and the processes which formed them.	ES1Ac
		• Relate the composition of gases and temperature of the layers of the atmosphere (i.e., troposphere, stratosphere, ionosphere) to cloud formation and transmission of radiation (e.g., ultraviolet, infrared).	ES1Ca
		• Explain the external processes (i.e., weathering, erosion, deposition of sediment) that result in the formation and modification of landforms.	ES2Aa

		• Describe the factors that affect rates of weathering and erosion of landforms (e.g., soil/rock type, amount and force of run-off, slope).	ES2Ab
		• Describe the internal source of energy on Earth that results in uneven heating of the mantle (i.e., decay of radioactive isotopes).	ES2Ba
		• Illustrate and explain the convection currents that result from the uneven heating inside the mantle and cause movement of crustal plates.	ES2Bb
		• Describe how the energy of an earthquake travels as seismic waves and provides evidence for the layers of the geosphere.	ES2Bc
		• Relate the densities of the materials found in continental and oceanic plates to the processes that result in each type of plate boundary (i.e., diverging, converging, transform).	ES2Bd
		• Describe the effects of the movement of crustal plates (i.e., earthquakes, sea floor spreading, mountain building, volcanic eruptions) at a given location on the planet.	ES2Be
		• Articulate the processes involved in the Theory of Plate Tectonics (i.e., uneven heating of the mantle due to the decay of radioactive isotopes, movement of materials via convection currents, movement of continental and oceanic plates along diverging, converging, or transform plate boundaries) and describe evidence that supports that theory (e.g., correlation of rock sequences, landforms, and fossils; presence of intrusions and faults; evidence of sea-floor spreading).	ES2Bf

		• Describe the rock cycle as it relates to the origin and transformation of rock types (i.e., igneous, metamorphic, and sedimentary).	ES2Ca
		• Predict the weather (patterns of change in the atmosphere) at a designated location using weather maps (including map legends) and/or weather data (e.g., temperature, barometric pressure, cloud cover and type, wind speed and direction, precipitation).	ES2Fa
		• Explain how global wind and ocean currents are produced on the Earth's surface (e.g., effects of unequal heating of the Earth's land masses, oceans, and air by the Sun due to latitude and surface material type; effects of gravitational forces acting on layers of air of different densities due to temperature differences; effects of the rotation of the Earth; effects of surface topography).	ES2Fb
		• Describe the effects of natural phenomena (e.g., burning organic material, volcanic eruptions, lightning, changes in global wind and ocean currents) on the properties of the atmosphere.	ES2Fc
		• Explain how climate and weather patterns in a particular region are affected by factors such as proximity to large bodies of water or ice/ocean currents, latitude, altitude, wind and ocean currents, amount of solar radiation, changes in the atmosphere due to natural phenomena (e.g., burning organic material, volcanic eruptions).	ES2Fd
		• Predict local and/or global effects of environmental changes when given a scenario describing how the composition of the geosphere, hydrosphere, or atmosphere is altered by natural phenomena or human activities.	ES3Ac

		• Identify pure substances (e.g., minerals, water, atmospheric gases) by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, cleavage, fracture, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity).	ME1Ab
		• Compare and contrast the properties of acidic, basic, and neutral solutions.	ME1Ba
		• Predict the effects of solvent and solute polarity on solubility ("like dissolves like"); and predict the effects of temperature, surface area, particle size, and agitation on rates of solubility	ME1Bb
		• Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change	ME1Da
		• Predict the effect of a temperature change on the properties (e.g., pressure, density) of earth materials (i.e., rock, water, air).	ME1Db
		• Predict the effect of pressure changes on the properties (e.g., temperature, density) of earth materials (i.e., rock, water, air).	ME1Dc
		• Compare and contrast the types of chemical bonds (i.e., ionic, covalent) as they relate to mineralization, changes in rock type within the rock cycle, formation of pollutant molecules (e.g., acid rain, ozone).	ME1Ha
		• Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change (e.g., cycling of minerals within rock cycle, process of	ME1Ia

		erosion/weathering, carbon dioxide-oxygen cycle, nitrogen cycle, water cycle, nuclear reaction) as support for the Law of Conservation of Mass.	
		• Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays).	ME2Ad
		• Interpret examples (e.g., land and sea breezes, plate tectonics) of heat transfer as convection, conduction, or radiation.	ME2Ae
		• Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., process of erosion/weathering, cycling of minerals within rock cycle, carbon dioxide-oxygen cycle, nitrogen cycle, water cycle, nuclear reaction).	ME2Fa
		• Explain seasonal phenomena (i.e., weather, length of day, temperature, intensity of sunlight) as a consequence of a planet's axial tilt as it rotates and a planet's orbital position as it revolves around the Sun.	UN2Cb
		• Formulate testable questions and hypotheses	IN1Aa
		• Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment.	IN1Ab
		• Design and conduct a valid experiment.	IN1Ac

		• Evaluate the design of an experiment and make suggestions for reasonable improvements.	IN1Ag
		• Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders).	IN1Ba
		• Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second.	IN1Bb
		• Determine the appropriate tools and techniques to collect, analyze, and interpret data.	IN1Bc
		• Judge whether measurements and computation of quantities are reasonable.	
		• Calculate the range, average/mean, percent, and ratios for sets of data.	IN1Bd
		• Use quantitative and qualitative data as support for reasonable explanation (conclusions)	IN1Be
		• Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable.	IN1Ca IN1Cb
		• Identify the possible effect of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions)	IN1Cc

		• Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models).	IN1Cd
		• Communicate the procedures and results of investigations and explanations through: ➢ Oral presentations ➢ Drawings and maps ➢ Data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ➢ Graphs (bar, single, and multiple line) ➢ Equations and writings (DOK3)	IN1Da
		• Communicate and defend a scientific argument. (DOK3)	IN1Db
		• Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work). (DOK2)	IN1Dc
		<u>Common Core Reading Standards for Grades 11-12</u>	
		Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	RST.1
		Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	RST.2
		Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical	RST.3

		tasks; analyze the specific results based on explanations in the text.	
		Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.	RST.4
		Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.	RST.6
		Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	RST.7
		Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	RST.8
		Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	RST.9
		By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.	RST.10
		<u>Common Core Writing Standards for Grades 11-12</u>	
		Write arguments focused on *discipline-specific content*. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from	WHST.1

		alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.	WHST.2

		c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). Students' narrative skills continue to grow in these grades. The Standards require that students be ab le to incorporate the narrative elements effectively into arguments and information/explanatory texts. In science, students must be able to write precise descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results. Produce writing in which the organization, development, substance, and style are appropriate to task, purpose, and audience. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information. Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and	WHST.3 WHST.4 WHST.6 WHST.8

		overreliance on any one source and following a standard format for citation. <u>ISTE Technology Standards</u> Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. a. Interact, collaborate, and publish with peers, experts, or others employing a variety of digital environments and media b. Communicate information and ideas effectively to multiple audiences using a variety of media and formats c. Develop cultural understanding and global awareness by engaging with learners of other cultures d. Contribute to project teams to produce original works or solve problems	 ISTE-S.2

EVIDENCE of LEARNING			
<u>Understanding</u> **g**	<u>Standards</u> <u>Part 1:</u>	**<u>Unit Performance Assessment</u>**: **Description of Assessment Performance Task(s):**	<u>R/R Quadrant</u> **D**

#1, #2, #3, #4, #5	ES2Fa IN1Ae IN1Ba IN1Ca IN1Cb IN1Cc IN1Da RST.4 RST.9 WHST.1c <u>Part 2:</u> ES1Ba ES2Aa ES2Ab IN1Ae IN1Ba IN1Ca IN1Cd IN1Da IN1Db RST.1 RST.2 RST.4 WHST.1b WHST.8 ISTE.S-2	**Part 1: Weather Map Project –** Students will be given approximately 4 days. **Part 2: Multimedia Earth's Systems Presentation –** Students will be given approximately 5 days. See Appendix 1.A - Part 1: Weather Map Project 1.B - Part 1: Weather Map Project Teacher Guide 1.C - Part 2: Multimedia Earth's Systems Presentation **Teacher will assess:** ● Part 1: assesses the ability to apply knowledge and skills gained during the unit to predict and explain weather patterns. ● Part 2: assesses the ability to apply their understanding of Earth's Systems to explain real world geological phenomena. ● In Part 1 & Part 2 the assessment measures the ability to synthesize information and apply it to real world situations to make predictions and explain geological phenomena. **<u>Performance:</u>** **Mastery:** *Students will show that they really understand when they…* Are able to complete the tasks with a level of proficiency of 80% or higher. **Scoring Guide:** See Appendix 1.D - Unit 1: Weather Map Project Scoring Guide Appendix 1.E - Unit 2: Multimedia Earth's Systems Presentation Scoring Guide Appendix 1.F - Unit 2: Multimedia Earth's Systems Presentation Exemplar	

SAMPLE LEARNING PLAN

Pre-assessment: Please see Appendix 0.A – Earth Science Pre-Assessment.
Appendix 0.B – Pre-Assessment Blueprint

Understanding	Standards	Major Learning Activities:	Instructional Strategy:	R/R Quadrant:
#1	ES2Fa IN1Ba IN1Bb IN1Ca RST.4 RST.8 WHST.1c	1. Activity: **Psychrometer Lab** ● Objective: Students will be able to use tools to calculate relative humidity and dew point. ● Appendix Document: 1.G - Psychrometer Lab Document	● Inquiry	**C**
#1, #2, #3, #4	ES2Fd IN1Ba IN1Bb IN1Ca RST.1 RST.4 WHST.1a WHST.1e	2. Activity: **Heating Earth's Surface Land vs. Water** ● Objective: Students will be able to explain how water impacts climate. ● Appendix Document: 1.H - Heating Earth's Surface Land vs. Water Activity Document	● Inquiry	**C**
#1, #4	ME1Db IN1Ba IN1Ca RST.4 WHST.1c	3. Activity: **Empty Can Lab** ● Objective: Students will be able to explain the relationship between temperature and pressure. ● Appendix Document: 1.I - Empty Can Lab	● Inquiry	**C**
#1	ME1As IN1Ba IN1Ca RST.1 RST.4 WHST.1c ISTE.S-4	4. Activity: **Density Online Lab Activity** ● Objective: Students will be able to apply their understanding of density to problem solve. ● Appendix Document: 1.J - Density Online Lab Activity Document	● Inquiry ● Technology Integration	**C**

#1, #2, #3, #4	ES2Aa IN1Ba IN1Bb IN1Ca IN1Da RST.1 RST.8 RST.10 WHST.1b	5. Activity: **Landslides & Mass Wasting Lab with Reading** ● Objective: Students will be able to explain and explore the factors that contribute to mass movements. Students will draw conclusions and make predictions with the information they gather. ● Appendix Document: 1.K - Landslides & Mass Wasting Lab with Reading Document	● Inquiry ● CALs Reading Technique	**D**
#1, #2, #3, #4	ES2Aa IN1Aa RST.1 RST.4 WHST.8	6. Activity: **Prediction-Anticipation Guide 5.1** ● Objective: Students will be able to describe and explain weathering. ● Appendix Document: 1.L - Prediction-Anticipation Guide 5.1	● CALs Reading Technique ● Generating and Testing Hypotheses	**B**
#4	ES2Ca	7. Activity: **Rock Cycle Quiz, Quiz, Trade** ● Objective: Students will be able to work cooperatively to explain and practice the rock cycle. ● Appendix Document: 1.M – Rock Cycle Quiz, Quiz, Trade Cards	● Cooperative Learning	**B**
#1, #2, #3, #4	ES1Ba ES2Aa ES2Ab IN1Ba IN1Ca IN1Cd RST.2 WHST.1c WHST.8	9. Activity: **Unit 2 Blogging Activity** ● Objective: Students will be able to use multimedia to collaborate and demonstrate their understanding of geologic processes. ● Appendix Document: 1.N - Unit 2 Blogging Activity Description and Rubric	● Summarizing and Note Taking ● Technology Integration	**C**

	ISTE.S-2			
#1	ME1As INIBa INIBb IN1Ca IN1Cb IN1Cd RST.4 WHST.8	10. Activity: **Earth Density** ● Objective: Students will be able to describe how density impacts Earth's structure. ● Appendix Documents: 1.O - Earth Density Activity Document	● Inquiry	**B**
#1, #2, #4	ES2Bc ES2Be IN1Ca IN1Cb IN1Cd IN1Da RST.1 RST.4 RST.8 WHST.1b WHST.1c	11. Activity: **Investigating Earth's Crustal Plates by Studying Earthquakes & Volcanoes** ● Objective: Students will be able to use data to describe Earth's crustal plates. ● Appendix Document: 1.P - Investigating Earth's Crustal Plates by Studying Earthquakes & Volcanoes Lab Document	● Inquiry	**C**
#1, #2, #4	ES2Bc ES2Be IN1Ba IN1Ca RST.4 RST.7 RST.8 WHST.1b WHST.1c	12. Activity: **Graham Cracker Model of Plate Tectonics** ● Objective: Students will be able use modeling to demonstrate their understanding of plate tectonics. ● Appendix Document: 1.Q - Graham Cracker Model of Plate Tectonics Activity Document	● Nonlinguistic Representations	**B**

UNIT RESOURCES

Teacher Resources:

- Prentice Hall Earth Science
- PhET website: https://phet.colorado.edu/
- AAAS: http://assessment.aaas.org/topics
- Climate and Energy Science: http://cleanet.org/index.html
- Digital Library for Earth System Education (DLESE): http://www.dlese.org/
- Performance Assessment Links in Science: http://pals.sri.com/
- Connecticut: http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890
- NSTA: http://learningcenter.nsta.org/search.aspx?action=browse&subject=38

Student Resources:

- Prentice Hall Earth Science
- PhET website: https://phet.colorado.edu/

Vocabulary:

- **Atmosphere**– a thin layer of air that forms a protective covering around the planet.
- **Ozone layer**– a layer in the atmosphere with a high level of ozone which absorbs harmful radiation from the sun.
- **Radiation** – energy transferred by waves or rays.
- **Conduction** –transfer of energy that occurs when molecules bump into each other.
- **Convection**—transfer of heat by the flow of material.
- **Condensation**—process by which water vapor changes to a liquid.
- **Evaporation**—the process by which a liquid changes to gaseous or vapor form.
- **Transpiration**—process by which water that is absorbed by plants, usually through the roots, is evaporated into the atmosphere.
- **Precipitation**—water falling from clouds—including rain, snow, sleet, and hail—whose form is determined by air temperature.
- **Dew point**—temperature at which air is saturated and condensation forms.
- **Humidity**—the amount of water vapor held in the air.
- **Relative humidity**—the measure of the amount of moisture held in the air compared with the amount it can hold at a given temperature; can range from 0 percent to 100 percent.
- **Barometric pressure**—the weight of the air above the earth.
- **Isobars**—lines drawn on a weather map that connect points having equal atmospheric pressure; also indicate the location of high- and lo-pressure areas and can show wind speed.
- **Isotherms**—lines connecting points having equal temperatures
- **Temperature**—a measure of the warmth or coldness of an object or substance.
- **Land breeze**—movement of air from land to sea at night, created when cooler, denser air from the land forces up warmer air over the sea.

- **Sea breeze**—movement of air from sea to land during the day when cooler air from above the water moves over the land, forcing the heated, less dense air above the land to rise.
- **Weather**—the state of the atmosphere at a specific time and place, determined by factors including air pressure, amount of moisture in the air, temperature, wind, and precipitation.
- **Climate**—average weather pattern in an area over a long period of time; can be classified by temperature, humidity, precipitation, and vegetation.
- **Air mass**—large body of air that has the same characteristics of temperature and moisture content as the part of Earth's surface over which it formed.
- **Front**—boundary between two air masses with different temperatures, density, or moisture; can be cold, warm, occluded, and stationary.
- **Weathering** – the mechanical and chemical processes that change Earth's surface over time
- **Erosion**- the moving of weathered material, or sediment, from one location to another
- **Chemical Weathering** –The process that breaks down rock through chemical changes
- **Mechanical Weathering** – The type of weathering in which rock is physically broken into smaller pieces
- **Plate tectonics**– the theory that explains how large pieces of the Earth's outermost layer, called tectonic plates, move and change shape.
- **Convergent boundary** – the boundary formed by the collision of two lithospheric plates.
- **Divergent boundary** –the boundary between two tectonic plates that are moving away from each other.
- **Transform boundary**—the boundary between two tectonic plates that are sliding past each other horizontally.
- **Fault**—a break in a body of rock along which one block slides relative to another.
- **Magma**—molten rock.
- **Convection currents**—current in Earth's mantle that transfers heat in Earth's interior and is the driving force for plate tectonics.
- **Folding**—the bending of rock layers due to stress.
- **Seismic waves**—waves of energy that travel through the Earth and away form an earthquake in all directions.
- **Trench**—a long, narrow, steep-sided depression where one crustal plate sinks beneath another.
- **Subduction**—where oceanic and continental plates collide, the oceanic plate plunges beneath the less dense continental plate. As the plate descends, molten rock forms and rises toward the surface, creating volcanoes.
- **Mid ocean ridge**—the area in an ocean basin where new ocean floor is formed.
- **Rift valley**—a valley that forms when continental plates pull apart.
- **Minerals**—a naturally occurring inorganic solid that has a definite chemical composition and an orderly internal atomic structure.
- **Rocky cycle**—the series of processes in which a rock forms, changes from one type to another, is destroyed, and forms again by geological processes.
- **Igneous rock**—rock formed when magma or lava cools and hardens.
- **Metamorphic rock**—rock forms when heat, pressure, or fluids act on igneous, sedimentary, or other metamorphic rock to change its form or composition.
- **Sedimentary rock**—rock forms when sediments are compacted and cemented together or when minerals form from solutions.
- **Intrusive igneous rock**—rock formed from the slow cooling and solidification of magma beneath the Earth's surface.
- **Extrusive igneous rock**—rock that forms as a result of volcanic activity that cools quickly at or near the Earth's surface.
- **Density**—measurement of the mass of an object divided by its volume. ($D = m \div v$)

- **Matter**—anything that has mass and takes up space.
- **Mass**—the amount of matter in an object.

Content Area: Science	**Course: Earth Science**	**UNIT: Earth and Human Activity**

Unit Description:
In this unit, students will understand that human activity is influenced by natural resources, natural hazards, and climate and that human activity impacts Earth's systems. They will investigate Earth's history, natural resources, natural hazards, human impacts on Earth systems and global climate change.

Unit Timeline: 8 Weeks

DESIRED RESULTS

Transfer Goal - *Students will be able to independently use their learning to…*
Construct explanations of and design solutions pertaining to interrelated systems.

Understandings – *Students will understand that… (Big Ideas)*

1. Human activity is influenced by natural resources, natural hazards, and climate.
2. Humans utilize energy and mineral resources and the long term sustainability of these resources will impact the human population.
3. Changes in climate impact other Earth systems.
4. Human activity impacts Earth's systems.
5. Design solutions to problems that arise from human activity on Earth.

Essential Questions: *Students will keep considering…*

- How has the need for a steady supply of water and other natural resources and natural hazards shaped civilization?
- How can natural resources be managed in a way that prolongs their availability for future generations?
- How can the impact of human activity on Earth's systems be minimized?
- How could global warming make some places cooler?
- How does climate change impact Earth's systems and life on Earth?
- How do humans change the Earth?

Students Will Know…	Standard	Students Will Be Able to …	Standard
• There is a limited availability of some energy resources (i.e., solar radiation, wind, fossil fuels) and major mineral deposits in the United States (e.g., lead, petroleum, coal, copper, zinc, iron, gravel, aluminum) and there are factors that affect their availability.	ES3Aa	• Predict and explain how natural or human caused changes (biological, chemical and/or physical) in one ecosystem may affect other ecosystems due to natural mechanisms (e.g., global wind patterns, water cycle, ocean currents).	EC1Ca
• There are economic, political, social, and ethical constraints associated with obtaining and using natural resources (e.g., mining and use of different types of Missouri mineral resources such as lead mining, gravel dredging, strip mining, coal burning, production of fertilizers and explosives; use of fossil fuels versus renewable resources).	ES3Ae	• Describe the causes and consequences of observed and predicted changes in the ozone layer.	ES1Cb
		• Provide evidence (e.g., fossils, desertification, variation in sea level, glaciations, and permafrost layers) that supports theories of climate change due to natural phenomena and/or human interactions with the environment.	ES2Fe
		• Identify human activities that may adversely affect the composition of the atmosphere, hydrosphere, or geosphere.	ES3Ab
		• Describe sources and common uses of different forms of energy: chemical, nuclear, thermal, electromagnetic, mechanical (as transferred by moving objects, including rock, water, wind, waves).	ME2Ab
		• Identify and evaluate advantages/disadvantages of using various sources of energy (e.g., wind, solar, geothermal, hydroelectric, biomass, fossil fuel, electromagnetic radiation) for human activity.	ME2Ac
		• Identify the role of nuclear energy as it serves as a source of energy for the Earth, stars, and human activity (e.g., source of electromagnetic radiation, thermal energy within mantle, nuclear power plants, fuel for stars).	ME2Eb
		• Identify and analyze current theories that are being questioned, and compare them to new theories that have	ST2Bb

		emerged to challenge older ones (e.g., theories of evolution, extinction, global warming). (DOK 3)	
		• Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges). (DOK 3)	ST3Ba
		• Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research). (DOK 3)	ST3Bb
		• Analyze and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks), benefits, and factors (i.e., social, political, economic, ethical, and environmental) affecting progress toward meeting major scientific and technological challenges (e.g., use of alternative energies to reduce the use of satellite communications to gather information, deforestation, nuclear energy, space technology). (DOK 3)	ST3Bc
		• Identify the ethical issues involved in experimentation (i.e., risks to organisms or environment). (DOK 1)	ST3Cb
		• Identify and evaluate the role of models as an ethical alternative to direct experimentation (e.g., using a model for a stream rather than pouring oil in an existing stream when studying the effects of oil pollution). (DOK 1)	ST3Cc

		• Formulate testable questions and hypotheses	IN1Aa
		• Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment.	IN1Ab
		• Design and conduct a valid experiment.	IN1Ac
		• Evaluate the design of an experiment and make suggestions for reasonable improvements.	IN1Ag
		• Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders).	IN1Ba
		• Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second.	IN1Bb
		• Determine the appropriate tools and techniques to collect, analyze, and interpret data.	IN1Bc
		• Judge whether measurements and computation of quantities are reasonable.	IN1Bd
		• Calculate the range, average/mean, percent, and ratios for sets of data.	IN1Be
		• Use quantitative and qualitative data as support for reasonable explanation (conclusions)	IN1Ca
		• Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations	IN1Cb

		(e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable. ● Identify the possible effect of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) ● Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models). ● Communicate the procedures and results of investigations and explanations through: ➢ Oral presentations ➢ Drawings and maps ➢ Data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ➢ Graphs (bar, single, and multiple line) ➢ Equations and writings (DOK3) ● Communicate and defend a scientific argument. (DOK3) ● Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work). (DOK2) <u>Common Core Reading Standards for Grades 11-12</u> Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	IN1Cc IN1Cd IN1Da IN1Db IN1Dc

		Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	RST.1
		Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.	RST.2 RST.3
		Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.	RST.4
		Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.	RST.6
		Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	RST.7
		Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	RST.8
		Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	RST.9
		By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.	RST.10

		<u>Common Core Writing Standards for Grades 11-12</u> Write arguments focused on *discipline-specific content*. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.	WHST.1 WHST.2

		b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic. c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic). Students' narrative skills continue to grow in these grades. The Standards require that students be ab le to incorporate the narrative elements effectively into arguments and information/explanatory texts. In science, students must be able to write precise descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results. Produce writing in which the organization, development, substance, and style are appropriate to task, purpose, and audience. Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	WHST.3 WHST.4 WHST.6

		Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. <u>ISTE Technology Standards</u> Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information. a. Plan strategies to guide inquiry b. Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media c. Evaluate and select information sources and digital tools based on the appropriateness to specific tasks d. Process data and report results	WHST.8 ISTE-S.3

EVIDENCE of LEARNING			
<u>Understanding</u> #1, #2, #3, #4, #5	<u>Standards</u> ES2Fe ES3Ab ME2Ab ME2Eb ST2Bb ST3Bb ST3Bc IN1Ba IN1Ca IN1Cb IN1Da IN1Dc RST.1 RST.4	**<u>Unit Performance Assessment</u>**: **Description of Assessment Performance Task(s):** Conservation Campaign Performance Task **Earth & Human Activity** Students will be able to collect and analyze data to identify how humans negatively affect the environment and design and present a campaign around the environmental issue of their choice. See Appendix 2.A – Conservation Campaign Performance Task and Scoring Guide **Teacher will assess:** ● A student's ability to collect data, identify problems, propose solutions, and present information. **<u>Performance:</u>** **Mastery:** *Students will show that they really understand when they…*	<u>R/R Quadrant</u> **D**

	RST.10 WHST.1a WHST.8 ISTE-S.3	Are able to complete the tasks with a level of proficiency of 80% or higher **Scoring Guide:** See Appendix 2.A – Conservation Campaign Performance Task and Scoring Guide	

SAMPLE LEARNING PLAN				
Pre-assessment: Please see Appendix 0.A – Earth Science Pre-Assessment. Appendix 0.B – Pre-Assessment Blueprint				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy:**	**R/R Quadrant:**
#1, #2, #3, #4	ES3Ab IN1Ca RST.1 RST.10 WHST.4	1. Activity: **Eroding Futures Reading and Questions** ● Objective: Students will be able to understand, explain and explore factors that contribute to eroding. Students will draw conclusions and make predictions with the information they gather. ● Appendix Documents: Appendix 2.B – Eroding Futures Article from Futurist Appendix 2.C – Eroding Futures Reading Guide and Questions	● Inquiry ● CALs Reading Technique	**D**

#1, #2, #3, #4	ES1Cb IN1Aa RST.1 RST.8 RST.10 WHST.8	**2.** Activity: **Prediction-Anticipation Guide, 4.1** ● Objective: Students will be able to describe and explain Earth and Human Activity. ● Appendix Document: 2.D – Prediction-Anticipation Guide, 4.1	● CALs Reading Technique	**B**
#1, #4	ST2Bb IN1Ba IN1Ca IN1Cb IN1Cd RST.4 RST.10 WHST.1c	3. Activity: **Relative Dating Activity** ● Objective: Students will be able to use data to describe and explain relative dating. ● Appendix Document: 2.E – Relative Dating Activity	● Inquiry	**C**
#1	ES2Fe IN1Ba IN1Ca IN1Cd RST.4 WHST.1b	**4.** Activity: **How did the North Atlantic Form?** ● Objective: Students will use prediction and outcome methods to explain the relationship and formation of Earth's continents. ● Appendix Document: 2.F – How did the North Atlantic Form?	● Inquiry	**C**
#1, #2, #3, #4	EC1Ca ME2Ab IN1Da RST.7 WHST.4 WHST.8 ISTE-S.3	5. Activity: **Scaffolding Activity to the Performance Task: Alternative Energy Presentation** ● Objective: Students will be able to work cooperatively to explain and present alternate forms of Energy. ● Appendix Document: 2.G – Alternative Energy Presentation Description and Scoring Guide	● Cooperative Learning ● Technology Integration	**C**
#1, #2, #3, #4, #5	RST.10 WHST.1	6. Activity: **Micro-argument of a Textbook Reading** ● Objective: Students will select three important details from a selected reading. Using the Cooperative Learning structure called Give One/Get One, students will obtain 5	● Cooperative Learning	**B**

		more details so that they have a total of 8 details. Students then rank the 8 details in order of importance. Finally, students select the most important detail and write a micro-argument using reasoning and evidence to support their claim.		

UNIT RESOURCES

Teacher Resources:

- Prentice Hall Earth Science
- PhET website: https://phet.colorado.edu/
- AAAS: http://assessment.aaas.org/topics
- Climate and Energy Science: http://cleanet.org/index.html
- Digital Library for Earth System Education (DLESE): http://www.dlese.org/
- Performance Assessment Links in Science: http://pals.sri.com/
- Connecticut: http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890
- NSTA: http://learningcenter.nsta.org/search.aspx?action=browse&subject=38

Student Resources:

- Prentice Hall Earth Science
- PhET website: https://phet.colorado.edu/

Vocabulary:

Chapters 4, 5, 12, 13, 22, 23, 24, and 25

- Renewable Resource – A source that is virtually inexhaustible or that can be replenished over relatively short time spans.
- Non-Renewable Resource – Resource that takes millions of years to form.
- Fossil Fuel – General term for any hydrocarbon that may be used as a fuel, including coal, oil, and natural gas.
- Ore – A material from which a useful mineral or minerals may be mined for a profit.
- Hydroelectric Power – The power generated by falling water.
- Geothermal Energy – Energy that can be extracted from Earth's eternal heat.
- Point Source Pollution – Water pollution that comes from a known and specific location.
- Nonpoint Source Pollution – Water pollution that does not have a specific point of origin.
- Global Warming – The increase in average temperature of Earth and the atmosphere due in part to increased carbon dioxide levels.
- Conservation – The careful use of resources
- Compost – Partly decomposed organic material that is used as fertilizer.

Geologic Time

- Uniformitarianism – The concept that processes that have shaped Earth in the past are essentially the same as those operating today.
- Relative Dating – Process by which rocks are placed in their proper sequence or order; only the chronological order of events is determined, not the absolute age in years.

- Principle of Original Horizontality
- Principle of Cross-Cutting Relationships
- Unconformity – A surface that represents a break in the rock record, caused by erosion or lack of deposition.
- Correlation – Establishing the equivalence of rocks of similar age in different areas.
- Extinct – A term used to describe a type of organism that no longer exists anywhere on Earth.
- Fossil – The remains or traces of an organism preserved from the geologic past.
- Natural Selection – Process by which characteristics that make an individual better suited to its environment become more common in a species.
- Adaptation – A trait that helps an organism survive and reproduce.
- Index Fossil – A fossil that is associated with a particular span of geologic time.
- Radioactivity – The spontaneous decay of certain unstable atomic nuclei.
- Half-Life – The time required for one half of the atoms of a radioactive substance to decay.
- Radiometric Dating – The procedure of calculating the absolute ages of rocks and minerals that contain radioactive isotopes.
- Radiocarbon Dating – Method for determining age by comparing the amount of carbon – 14 to the amount of carbon - 12 in a sample.
- Geologic Time Scale – The division of Earth's history into blocks of time.

Earth's History

- Shields – A large, relatively flat expanse of ancient metamorphic rock within the stable continental interior.
- Photosynthesis – The process by which plants, algae, and certain prokaryotes use light energy to convert water and carbon dioxide into energy rich glucose molecules.
- Stromatolite – Structure produced by algae trapping sediment and forming layered mounds of calcium carbonate.
- Prokaryotes – Organism whose cells lack a nucleus and some other cell structures.
- Eukaryotes – An organism whose cells contain nuclei.
- Gondwana – Late Paleozoic continent that formed the southern portion of Pangaea, consisting of all or parts of present-day South America, Africa, Australia, India, and Antarctica.
- Laurasia – The continental mass that formed the northern portion Pangaea, consisting of present-day North America and Eurasia.
- Amphibian – A vertebrae that lives part of its life on land and part of its life in water.
- Reptile – Vertebrate with scaly skin that lays eggs with tough, leathery shells.
- Mammal – Animal that bears live young and maintains a steady body temperature.
- Gymnosperm – Seed-bearing plant that bears its seeds on the surface of cones.
- Milankovch Cycles – Cycles related to Earth's movements, such as its orbit around the sun, which scientists think may help to cause ice ages.

Content Area: Science	Course: Earth Science	UNIT: Earth's Place in the Universe
Unit Description: In this unit, students will understand that the Earth is part of a universe that can be investigated by light spectra, motion of distant galaxies, and composition of matter in the universe. They will investigate 1) the Universe and its stars and 2) Earth and the solar system.	**Unit Timeline:** 8 Weeks	

DESIRED RESULTS

Transfer Goal - ***Students will be able to independently use their learning to…***
Construct explanations of the formation and properties of the universe including Earth's place in the universe.

Understandings – ***Students will understand that… (Big Ideas)***

1. Nuclear fusion in the sun's core releases energy in the form of radiation.
2. The Big Bang theory was constructed using astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.
3. Stars produce elements.
4. Newtonian gravitational laws govern the motion of objects in the solar system.
5. Evidence and scientific reasoning can be used to determine an account of the formation and history of the earth.

Essential Questions: ***Students will keep considering…***
An Essential Question is meant to:

- Do stars only release light energy?
- How do humans study the universe?
- What forces shape the universe?
- Do all stars produce the same elements as the sun?
- How does Earth's proximity to the sun affect its composition?
- How did we determine when and how the Earth formed?
- How do we determine the age of Earth's structures?

Students Will Know…	**Standard**	**Students Will Be Able to …**	**Standard**

• Regular and predictable motion of objects in the universe can be described and explained as the result of gravitational forces.	UN2	• Identify information that the electromagnetic spectrum provides about the stars and the universe (e.g., chemical composition, temperature, age of the stars, location of black holes, motion of celestial bodies).	UN1C
• The Earth, Sun and moon are part of a larger system that includes other planets and smaller celestial bodies.	UN1A	• Predict the moon rise/set times, phases of the moon, and/ or eclipses when given the relative position of the moon, planet, and sun.	UN2B
• Most of the information we know about the universe comes from the electromagnetic spectrum.	UN1C	• Explain how gravitational forces, due to the relative positions of a planet, moon, and Sun determine the height and frequency of tides.	UN2Ce
• The regular and predictable motions of a planet and moon relative to the Sun explain natural phenomena, such as day, month, year shadows, moon phases eclipses, tides and seasons.	UN2C	• Explain the seasonal phenomena (i.e., weather, length of day, temperature, intensity of sunlight) as a consequence of a planets axial tilt as it rotates and revolves around the sun.	UN2Cb
• Gravity is a force of attraction between objects in the solar system that governs their motion.	UN2D	• Use evidence from relative and real dating techniques (e.g., correlation of trace fossils, landforms, and rock sequences; evidence of climate changes; presence of intrusions and faults; magnetic orientation; relative age of drill samples) to infer geologic history.	ES2Da
• Every object exerts a gravitational force on every other object.	FM2B	• Compare and describe the gravitational forces between two objects in terms of their masses and the distances between them.	FM2Ba
		• Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum.	ME2Aa
		• Identify stars as producers of electromagnetic energy.	ME2Ca

		• Describe how electromagnetic energy is transferred through space as electromagnetic waves of varying wavelength and frequency.	ME2Cb
		• Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission) result in emission of radiation.	ME2Ea
		• Describe and relate the positions and motions of the Sun-Earth solar system, the Milky-Way galaxy, and other galaxies within the universe (i.e., it is just one of several solar systems orbiting the center of a rotating spiral galaxy; that spiral galaxy is just one of many galaxies which orbit a common center of gravity; the expanding universe causes the distance between galaxies to increase).	UN1Aa
		• Explain how Earth's environmental characteristics and location in the universe (e.g., atmosphere, temperature, orbital path, magnetic field, mass-gravity, location in solar system) provide a life-supporting environment.	UN1Ba
		• Compare the environmental characteristics and location in the universe of Earth and other celestial bodies (e.g., planets, moons) to determine ability to support life.	UN1Bb
		• Identify information that the electromagnetic spectrum provides about the stars and the universe (e.g., chemical composition, temperature, age of stars, location of black holes, motion of celestial bodies).	UN1Ca
		• Evaluate the advantages/ disadvantages of using different tools (e.g., spectroscope, different types of telescopes, probes) to gather information about the universe (e.g., background radiation, magnetic fields, discovery of previously unknown celestial bodies).	UN1Cb

		• Relate units of time (i.e., day, month, year) to the regular and predictable motion of the planets and moons and their positions in the Solar system.	UN2Ca
		• Provide evidence that can be observed from Earth that supports the fact Earth rotates on its axis and revolves around the Sun.	UN2Cc
		• Predict the moon rise/set times, phases of the moon, and/or eclipses when given the relative positions of the moon, planet, and Sun.	UN2Cd
		• Explain how the gravitational forces, due to the relative positions of a planet, moon, and Sun, determine the height and frequency of tides.	UN2Ce
		• Explain orbital motions of moons around planets, and planets around the Sun, as the result of gravitational forces between those objects.	UN2Da
		• Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., model of the solar system, Theory of Plate Tectonics, Big Bang and nebular theory of the Universe). (DOK 2)	ST2Ba
		• Formulate testable questions and hypotheses	IN1Aa
		• Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment.	IN1Ab

		• Design and conduct a valid experiment.	IN1Ac
		• Evaluate the design of an experiment and make suggestions for reasonable improvements.	IN1Ag
		• Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders).	IN1Ba
		• Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second.	IN1Bb
		• Determine the appropriate tools and techniques to collect, analyze, and interpret data.	IN1Bc
		• Judge whether measurements and computation of quantities are reasonable.	IN1Bd
		• Calculate the range, average/mean, percent, and ratios for sets of data.	IN1Be
		• Use quantitative and qualitative data as support for reasonable explanation (conclusions)	IN1Ca
		• Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable.	IN1Cb
		• Identify the possible effect of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions)	IN1Cc

		• Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models).	IN1Cd
		• Communicate the procedures and results of investigations and explanations through: ➢ Oral presentations ➢ Drawings and maps ➢ Data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ➢ Graphs (bar, single, and multiple line) ➢ Equations and writings (DOK3)	IN1Da
		• Communicate and defend a scientific argument. (DOK3)	IN1Db
		• Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work). (DOK2)	IN1Dc
		<u>Common Core Reading Standards for Grades 11-12</u>	
		Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.	RST.1
		Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	RST.2
		Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical	RST.3

		tasks; analyze the specific results based on explanations in the text.	
		Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11–12 texts and topics*.	RST.4
		Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.	RST.6
		Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.	RST.7
		Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.	RST.8
		Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	RST.9
		By the end of grade 12, read and comprehend science/technical texts in the grades 11–CCR text complexity band independently and proficiently.	RST.10
		<u>Common Core Writing Standards for Grades 11-12</u>	
		Write arguments focused on *discipline-specific content*. a. Introduce precise, knowledgeable claim(s), establish the significance of the claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization	WHST.1

		that logically sequences the claim(s), counterclaims, reasons, and evidence. b. Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases. c. Use words, phrases, and clauses as well as varied syntax to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims. d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing. e. Provide a concluding statement or section that follows from or supports the argument presented.	
		Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. a. Introduce a topic and organize complex ideas, concepts, and information so that each new element builds on that which precedes it to create a unified whole; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension. b. Develop the topic thoroughly by selecting the most significant and relevant facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.	WHST.2

		c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among complex ideas and concepts. d. Use precise language, domain-specific vocabulary and techniques such as metaphor, simile, and analogy to manage the complexity of the topic; convey a knowledgeable stance in a style that responds to the discipline and context as well as to the expertise of likely readers. e. Provide a concluding statement or section that follows from and supports the information or explanation provided (e.g., articulating implications or the significance of the topic).	WHST.3
		Students' narrative skills continue to grow in these grades. The Standards require that students be ab le to incorporate the narrative elements effectively into arguments and information/explanatory texts. In science, students must be able to write precise descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results.	WHST.4
		Produce writing in which the organization, development, substance, and style are appropriate to task, purpose, and audience.	WHST.6
		Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.	WHST.8
		Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and	

		overreliance on any one source and following a standard format for citation.	

EVIDENCE of LEARNING			
Understanding	Standards	**Unit Performance Assessment**: **Description of Assessment Performance Task(s):**	R/R Quadrant
#4	UN2Cb IN1Bb IN1Be RST.4 RST.8 WHST.1 WHST.8	**Ellipses Lab Activity** Students will perform an ellipses lab activity that demonstrates Kepler's First law of Planetary Motion by calculating the eccentricity of ellipses. The lab will show that the Earth and other planets revolve around the sun in a geometric shape called an ellipse. An ellipse has two "center points". Each on is called a focus. The Sun is not in the exact middle of the Earth's orbit, rather it is found at one of the focal points. See Appendix 3.A – Ellipses Lab Activity **Teacher will assess:** ● The accuracy of an ellipse lab report that shows how they measured and calculated the eccentricity of each orbit drawn. ● The accuracy of the response about the relationship between distance between two points and the eccentricity of each orbit. **Performance:** **Mastery:** *Students will show that they really understand when they…* Have correctly drawn, measured and calculated several examples of ellipses. **Scoring Guide:** See Appendix 3.B – Ellipses Lab Activity Scoring Guide	**C**

SAMPLE LEARNING PLAN				
Pre-assessment: Please see Appendix 0.A – Earth Science Pre-Assessment. Appendix 0.B – Pre-Assessment Blueprint				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy:**	**R/R Quadrant:**
#4	UN2Cd IN1Ba IN1Ca IN1Cd RST.4 RST.8 WHST.8	1. Activity: **Understanding Lunar and Planetary Phases** ● Objective: Students will be able to discover the regular and predictable motions of the moon causes moon phases. ● Appendix Document: 3.C – Understanding Lunar and Planetary Phases Document	● Inquiry	**C**
#5	UN2Cb IN1Ba IN1Ca IN1Cb IN1Cd RST.4 RST.9 WHST.8	2. Activity: **Seasons Activity** ● Objective: Students will be able to explain seasonal phenomena are a consequence of a planet's axial tilt as it rotates and a planet's orbital position as it revolves around the Sun. ● Appendix Document: 3.D – Seasons Activity Document	● Inquiry	**C**
#1, #3	UN1Ca IN1Ba IN1Cd RST.9 WHST.8	3. Activity: **Stellar Evolution Lab** ● Objective: Students will be able to explain that the life of a star goes through stages has it ages. ● Appendix Document: 3.E – Stellar Evolution Lab Document	● Inquiry	**C**
#5	UN2Ce IN1Ba IN1Ca IN1Cb RST.8 WHST.1	**4.** Activity: **Investigating Tides** ● Objective: Students will be able to determine and explain the patterns of tides. ● Appendix Document: 3.F – Investigating Tides Document	● Inquiry	**C**
#4, #5	UN2Cd IN1Ba IN1Ca IN1Cd	5. Activity: **Phases of the Moon** ● Objective: Students will be able to determine and explain the phases of the moon. ● Appendix Document: 3.G – Phases of the Moon Document	● Inquiry	**C**

	RST.4 RST.7 WHST.1			
#1, #2, #3, #4, #5	UN1Aa UN1Ca IN1Aa RST.8 WHST.8	6. Activity: **Prediction-Anticipation Guide 25.3** ● Objective: Students will be able to explain the components of the Big Bang Theory and the effects the Big Bang generated. ● Appendix Document: 3.H – Prediction-Anticipation Guide 25.3 Document	● CALs Reading Technique ● Generating and Testing Hypotheses	**B**

UNIT RESOURCES

Teacher Resources:

- Earth Science, Prentice Hall
- PhET website: https://phet.colorado.edu/
- AAAS: http://assessment.aaas.org/topics
- Climate and Energy Science: http://cleanet.org/index.html
- Digital Library for Earth System Education (DLESE): http://www.dlese.org/
- Performance Assessment Links in Science: http://pals.sri.com/
- Connecticut: http://www.sde.ct.gov/sde/cwp/view.asp?a=2618&q=320890
- NSTA: http://learningcenter.nsta.org/search.aspx?action=browse&subject=38

Student Resources:

- Earth Science, Prentice Hall
- PhET website: https://phet.colorado.edu/

Vocabulary:

- Ellipse – closed plane curve consisting of all points for which the sum of the distances between a point on the curve and two fixed points (foci) is the same.
- Eccentricity- in astrodynamics, calculated from orbital state vectors as an absolute value of eccentricity vector or using other methods based on orbital energy and angular momentum.
- Focus- a point having the property that the distances from any point on a curve to it and to a fixed line have a constant ratio for all points on the curve.
- Nebula- a cloud of interstellar gas and dust.
- Proto star- an early stage in the evolution of a star, after the beginning of the collapse of the gas cloud from which it is formed, but before sufficient contraction has occurred to permit initiation of nuclear reactions at its core.
- Main sequence star- is a star that is contained in the main sequence, which is a specific band of stars on color-magnitude plots.

- Red Giant- a star in an intermediate stage of evolution, characterized by a large volume, low surface temperature, and reddish hue.
- White dwarf- a star, approximately the size of the earth, that has undergone gravitational collapse and is in the final stage of evolution for low-mass stars, beginning hot and white and ending cold and dark.
- Supernova- the explosion of a star, possibly caused by gravitational collapse, during which the star's luminosity increases by as much as 20 magnitudes and most of the star's mass is blown away at very high velocity, sometimes leaving behind an extremely dense core.
- Black hole- is a place in space where gravity pulls so much that even light can not get out.
- Equinox- the time when the sun crosses the plane of the earth's equator, making night and day of approximately equal length all over the earth and occurring about March 21 (vernal equinox or spring equinox) and September 22 (autumnal equinox)
- Solstice- either of the two times a year when the sun is at its greatest distance from the celestial equator: about June 21, when the sun reaches its northernmost point on the celestial sphere, or about December 22, when it reaches its southernmost point. Compare summer solstice, winter solstice.

Origin of Modern Astronomy

- Astronomy- the science that deals with the material universe beyond the earth's atmosphere.
- Geocentric- having or representing the earth as a center: a geocentric theory of the universe.
- Orbit- the curved path, usually elliptical, described by a planet, satellite, spaceship, etc., around a celestial body, as the sun
- Heliocentric- having or representing the sun as a center: the heliocentric concept of the universe.
- Retrograde Motion- is the apparent motion of a planet to move in a direction opposite to that of other bodies within its system.
- Ellipse- a plane curve such that the sums of the distances of each point in its periphery from two fixed points, the foci, are equal.
- Astronomical Unit (AU)- a unit of length, equal to the mean distance of the earth from the sun: approximately 93 million miles (150 million km). Abbreviation: AU
- Rotation- the movement or path of the earth or a heavenly body turning on its axis.
- Revolution- the orbital motion of one body, such as a planet or satellite, around another.
- Precession- the slow, conical motion of the earth's axis of rotation, caused by the gravitational attraction of the sun and moon, and, to a smaller extent, of the planets, on the equatorial bulge of the earth.
- Perihelion- the point in the orbit of a planet or comet at which it is nearest to the sun.
- Aphelion- the point in the orbit of a planet or a comet at which it is farthest from the sun.
- Perigee- the point in the orbit of a heavenly body, especially the moon, or of an artificial satellite at which it is nearest to the earth.
- Apogee- the point in the orbit of a heavenly body, especially the moon, or of a man-made satellite at which it is farthest from the earth.
- Phases of the Moon- As the moon circles the Earth, the shape of the moon appears to change; this is because different amounts of the illuminated part of the moon are facing us.
- Solar Eclipse- obscuration of the light of the sun by the intervention of the moon between it and a point on the earth.
- Lunar Eclipse- the obscuration of the light of the moon by the intervention of the earth between it and the sun.
- Crater- on the surface of the moon a circular or almost circular area having a depressed floor
- Ray- any of a number of bright streaks that radiate from the youngest lunar craters, such as Tycho; they are composed of crater ejecta not yet darkened, and extend considerable distances

- Mare- any of any of the several large, dark plains on the moon and Mars: Galileo believed that the lunar features were seas when he first saw them through a telescope. a number of bright streaks that radiate from the youngest lunar craters.
- Rille- any of certain long, narrow, straight or sinuous trenches or valleys observed on the surface of the moon.
- Lunar Regolith- is composed in part of rock and mineral fragments that were broken apart from underlying bedrock by the impact of meteorites.

Touring Our Solar System

- Terrestrial Planet- The four inner planets of the solar system — those closest to the sun — are terrestrial planets having Earth-like features.
- Jovian Planet- one of the four planets in our solar system that are composed chiefly of hydrogen and helium, namely Jupiter, Saturn, Uranus, and Neptune
- Nebula- a diffuse cloud of particles and gases mainly hydrogen.

- Planetesimal- one of the small celestial bodies that, according to one theory (planetesimal hypothesis) were fused together to form the planets of the solar system.
- Dwarf Planet- a spherical celestial body revolving about the sun, similar to a planet but not large enough to gravitationally clear its orbital region of most or all other celestial bodies. Pluto is a dwarf planet.
- Asteroid- any of the thousands of small bodies of from 480 miles (775 km) to less than one mile (1.6 km) in diameter that revolve about the sun in orbits lying mostly between those of Mars and Jupiter.
- Comet- a celestial body moving about the sun, usually in a highly eccentric orbit, consisting of a central mass surrounded by an envelope of dust and gas that may form a tail that streams away from the sun
- Coma- the nebulous envelope around the nucleus of a comet.
- Meteoroid- any of the small bodies, often remnants of comets, traveling through space: when such a body enters the earth's atmosphere it is heated to luminosity and becomes a meteor.
- Meteor- a very small meteoroid that has entered the earth's atmosphere
- Meteorite- a mass of stone or metal that has reached the earth from outer space; a fallen meteoroid.
- Kuiper Belt- is a collection of bodies outside the orbit of Neptune
- Oort Cloud- a region of the solar system far beyond the orbit of the dwarf planet Pluto in which billions of comets move in nearly circular orbits unless one is pulled into a highly eccentric elliptical orbit by a passing star
- Halley's Comet- a comet with a period averaging 76 years. In this century it was visible to terrestrial observers just before and after reaching perihelion in 1910 and again in 1986.

Studying The Sun

- Electromagnetic Spectrum- the entire spectrum, considered as a continuum, of all kinds of electric, magnetic, and visible radiation, from gamma rays.
- Photon- a quantum of electromagnetic radiation, usually considered as an elementary particle that is its own antiparticle and that has zero rest mass and charge and a spin of one

- Spectroscopy- the science that deals with the use of the spectroscope and with spectrum analysis.
- Continuous Spectrum- a spectrum apparently having all wavelengths over a comparatively wide range, usually characteristic of solids and other substances at high temperatures
- Absorption Spectrum- the spectrum formed by electromagnetic radiation that has passed through a medium in which radiation of certain frequencies is absorbed.
- Emission Spectrum- the continuous spectrum or pattern of bright lines or bands seen when the electromagnetic radiation emitted by a substance is passed into a spectrometer.
- Doppler Effect- the shift in frequency (Doppler shift) of acoustic or electromagnetic radiation emitted by a source moving relative to an observer as perceived by the observer: the shift is to higher frequencies when the source approaches and to lower frequencies when it recedes.
- Refracting Telescope- a system consisting of an antenna, either parabolic or dipolar, used to gather radio waves emitted by celestial sources and bring them to a receiver placed in the focus.
- Chromatic Aberration- the variation of either the focal length or the magnification of a lens system with different wavelengths of light, characterized by prismatic coloring at the edges of the optical image and color distortion within it.
- Reflecting Telescope- consists essentially of an objective lens set into one end of a tube and an adjustable eyepiece or combination of lenses set into the other end of a tube that slides into the first and through which the enlarged object is viewed directly
- Radio Telescope- an instrument consisting of an antenna or system of antennas connected to one or more radio receivers, used in radio astronomy to detect and analyze radio waves from space
- Photosphere - the luminous visible surface of the sun, being a shallow layer of strongly ionized gases.
- Chromosphere- a gaseous layer of the sun's atmosphere extending from the photosphere to the corona and visible during a total eclipse of the sun
- Corona- a faintly luminous envelope outside of the sun's chromosphere, the inner part consisting of highly ionized elements.
- Solar Wind-is a stream of charged particles (a plasma) released from the upper atmosphere of the Sun. It mostly consists of electrons and protons.
- Sunspot- one of the relatively dark patches that appear periodically on the surface of the sun and affect terrestrial magnetism and certain other terrestrial phenomena.
- Prominence- an eruption of incandescent gas from the sun's surface that can reach an altitude of several hundred thousand kilometres. Prominences are visible during a total eclipse.
- Solar Flare- a brief powerful eruption of particles and intense electromagnetic radiation from the sun's surface, associated with sunspots and causing disturbances to radio communication on earth
- Aurora- an atmospheric phenomenon consisting of bands, curtains, or streamers of light, usually green, red, or yellow, that move across the sky in polar regions. It is caused by collisions between air molecules and charged particles from the sun that are trapped in the earth's magnetic field.
- Nuclear Fusion- a reaction in which two nuclei combine to form a nucleus with the release of energy.

Beyond Our Solar System

- Constellation- any of various groups of stars to which definite names have been given, as Ursa Major, Ursa Minor, Boötes, Cancer, Orion.
- Parallax- the apparent displacement of an observed object due to a change in the position of the observer
- Binary Star- a system of two stars that revolve about their common center of mass.

- Light-Year- the distance traversed by light in one mean solar year, about 5.88 trillion mi. (9.46 trillion km): used as a unit in measuring stellar distances.
- Apparent Magnitude- the magnitude of a star as it appears to an observer on the earth.
- Absolute Magnitude - the magnitude of a star as it would appear to a hypothetical observer at a distance of 10 parsecs or 32.6 light-years.
- Main-Sequence Star- any star lying on a diagonal band that extends from hot stars of high luminosity to cool stars of low luminosity; any stars in the Hertzsprung-Russell diagram from the upper left to the lower right of the diagram
- Red Giant- a star in an intermediate stage of evolution, characterized by a large volume, low surface temperature, and reddish hue.
- Supergiant- an exceptionally luminous star whose diameter is more than 100 times that of the sun.
- Cepheid Variable- a variable star in which changes in brightness are due to alternate contractions and expansions in volume.
- Nova- a star that suddenly becomes thousands of times brighter and then gradually fades to its original intensity.
- Super Nova- the explosion of a star, possibly caused by gravitational collapse, during which the star's luminosity increases by as much as 20 magnitudes and most of the star's mass is blown away at very high velocity, sometimes leaving behind an extremely dense core.
- Nebulae- a cloud of interstellar gas and dust.
- Protostar- an early stage in the evolution of a star, after the beginning of the collapse of the gas cloud from which it is formed, but before sufficient contraction has occurred to permit initiation of nuclear reactions at its core.
- White Dwarf- a star, approximately the size of the earth, that has undergone gravitational collapse and is in the final stage of evolution for low-mass stars, beginning hot and white and ending cold and dark.
- Neutron Star- an extremely dense, compact star composed primarily of neutrons, especially the collapsed core of a supernova.
- Pulsar- one of several hundred known celestial objects, generally believed to be rapidly rotating neutron stars, that emit pulses of radiation, especially radio waves, with a high degree of regularity.
- Black hole- a theoretical massive object, formed at the beginning of the universe or by the gravitational collapse of a star exploding as a supernova, whose gravitational field is so intense that no electromagnetic radiation can escape.
- Galaxy- a large system of stars held together by mutual gravitation and isolated from similar systems by vast regions of space
- Galaxy Cluster- is a structure that consists of anywhere from hundreds to thousands of galaxies bound together by gravity.
- Hubble's Law- a law stating that the velocity of recession of a galaxy is proportional to its distance from the observer.
- Big Bang Theory- a theory that deduces a cataclysmic birth of the universe (big bang) from the observed expansion of the universe, cosmic background radiation, abundance of the elements, and the laws of physics.