Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

Place Holder District Documentation

During the years of grades 9 through 12, all students must use the following scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas:

1 – Identify questions and concepts that guide scientific investigations;
2 – Design and conduct scientific investigations;
3 – Use technology and mathematics to improve investigations and communications;
4 – Formulate and revise explanations and models using logic and evidence (critical thinking);
5 – Recognize and analyze explanations and models; and
6 – Communicate and defend a scientific argument.

Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

Physical Science Year at a Glance 2015-2016

Unit	Title	Suggested Dates to be Taught
Unit 1:	**Lab Safety and Science Inquiry and Application**	**8/19-9/4**
Unit 2:	**Study of Matter: Classification of Matter, Atoms, Periodic Trends**	**9/8-10/2**
Unit 3:	**Study of Matter: Bonding and Compounds, Reactions of Matter*(Split 1-2 Q)***	**10/5-10/30**
Unit 4:	**Energy and Waves: Conservation of Energy, Transfer and Transformation**	**11/2-11/24**
Unit 5:	**Energy and Waves: Waves**	**11/30-12/18**
Unit 6:	**Energy and Waves: Thermal Energy**	**1/4-1/22**
Unit 7:	**Energy and Waves: Electricity**	**1/25-2/19**
Unit 8:	**Forces and Motion: Motion**	**2/22-3/11**
Unit 9:	**Force and Motion: Forces and Dynamics *(Spring Break Split)***	**3/14-4/15**
Unit 10:	**The Universe: History, Galaxies, Stars**	**4/18-5/13**

Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

Unit 1: Lab Safety and Science Inquiry and Application		**Suggested number of days: 13**
There is no science without inquiry. Scientific inquiry is a way of knowing and a process of doing science. It is the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas as well as an understanding of how scientists study the natural world. Teachers need to model scientific inquiry by teaching with inquiry. This unit is designed to help teach the proper lab safety rules and procedures. It is not intended to separate Science Inquiry and Application from the content. This introduction to inquiry ensures students use safe and appropriate lab procedures during their learning experiences throughout the year in science. **All teachers must take the Lab Safety Course on Blackboard prior to providing instruction in this unit.**		
ONLS Code(s): SC.9-12.SIAA (1-6) **Content Elaborations** 1 – Identify questions and concepts that guide scientific investigations; 2 – Design and conduct scientific investigations; 3 – Use technology and mathematics to improve investigations and communications; 4 – Formulate and revise explanations and models using logic and evidence (critical thinking); 5 – Recognize and analyze explanations and models; and 6 – Communicate and defend a scientific argument.	**Essential Questions** ***Same for All HS Courses?***	**I Can/I Will Statements** ***Same for All HS Courses?***

Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><td colspan="2">Unit 2: Study of Matter: Classification of Matter, Atoms, Periodic Trends of Elements</td><td>Suggested number of days: 16</td></tr>
<tr><td colspan="3">Building upon observation, exploration and analytical skills developed at the elementary level and middle school levels and foundational knowledge about matter (its basic particle composition and behavior under various conditions), an extensive understanding of matter, its composition and the changes it undergoes are further constructed. Substances within a closed system interact with one another in a variety of ways; however, the total mass and energy of the system remains the same. Instructional concepts include: The atom is composed of protons, neutrons and electrons that have measurable properties, including mass and, in the case of protons and electrons, a characteristic charge.
All atoms of a particular element have the same atomic number; an element may have different isotopes with different mass numbers. Atoms may gain or lose valence electrons to become anions or cations. Atomic number, mass number, charge and identity of the element can be determined from the numbers of protons, neutrons and electrons</td></tr>
<tr><td>ONLS Code(s): SC.HS.PS.1(1.1-1.4)

Content Elaborations
SC.HS.PS.1.1 – Matter can be classified in different ways depending upon characteristics that are observable and characteristics that can be observed with magnification.
SC.HS.PS.1.2 – Particulate nature of matter is represented by models because it is too small to see with the naked eye or with traditional visible-light microscopes.
SC.HS.PS.1.3 – Atomic structure determines the properties of an element and how the atom (of the element) will interact with other atoms. Neutrons have little effect on how an atom interacts with other atoms, but they do affect the mass and stability of the nucleus.
SC.HS.PS.1.4 – When elements are listed in order of increasing number of protons, the same sequence of properties appears over and over again. At times the masses do not correspond with periodic order, but the atomic number always does.</td><td>Essential Questions

What is the relationship of an elements properties to its location on the periodic table?</td><td>I Will Statements
I will…
..explain the characteristics of the components of an atom.
..design an accurate model of an element based on its characteristics.
..place and/or locate an element on the periodic table based on its characteristics.
..design a Bohr model of a specific element.
compare and contrast a metal, nonmetal, alkali metal and alkaline-earth metal.
..use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. (NGSS)</td></tr>
<tr><td colspan="2">Essential Vocabulary:
matter, element, atom, molecule, compound, pure substance, mixture, electron, nucleus, proton, neutron, atomic number, mass number, isotope, unified atomic mass unit, mole, orbital, valence electron, photon, periodic law, period, group, ion, metal, nonmetal, semiconductor, alkali metal, alkaline-earth metal, transition metal, noble gas, halogen
CCSS Connections:
ELA: RST.9-10.7, WHST.9-12.2, WHST.9-12.7, WHST.9-12.9
Math: MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3
Lessons/Activities:
CPO Science Link Investigations: CM: A1, A2, A4, A5, A8, B1, B2, B3, B4, B5, B6, C1, C2
ExploreLearning Gizmos: Bohr Model of Hydrogen, Bohr Model: Introduction, Element Builder, Electron</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 50, 118, 127, 132, 150, 155, 164.

Uncovering Student Ideas in Science(Page Keeley): Is it made of molecules? V1 / Pennies V3</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><td colspan="2">Unit 3: Study of Matter: Bonding and Compounds, Reactions of Matter (Split 1-2 Q)</td><td>Suggested number of days: 19</td></tr>
<tr><td colspan="3">Building upon observation, exploration and analytical skills developed at the elementary level and middle school levels and foundational knowledge about matter (its basic particle composition and behavior under various conditions), an extensive understanding of matter, its composition and the changes it undergoes are further constructed. Substances within a closed system interact with one another in a variety of ways; however, the total mass and energy of the system remains the same. Instructional concepts include:</td></tr>
<tr><td>ONLS Code(s): SC.HS.PS.1(1.5-1.8)

Content Elaborations
SC.HS.PS.1.5 – Bonding describes how atoms are arranged in molecules and rearrange in chemical reactions. Atoms may be bonded together by losing, gaining or sharing electrons.
SC.HS.PS.1.6 – Matter is conserved in all chemical/nonchemical analysis of mixtures. In a chemical reaction, the number, type of atoms and total mass are the same before and after the reaction.
SC.HS.PS.1.7 – Radioactive substances are unstable nuclei that undergo spontaneous nuclear decay emitting particles and/or high-energy wave-like radiation. Nuclear fission involves the decay of large nuclei into smaller nuclei.
SC.HS.PS.1.8 – Nuclear fusion is the joining of nuclei into a larger nucleus accompanied by the release of large quantities of energy. Nuclear fusion in the stars creates all the elements in the universe beyond helium.</td><td>Essential Questions

How does bonding in chemical reactions relate to the conservation of mass in the reaction?

What role do the electrons and nuclei play in chemical changes and nuclear reactions?</td><td>I Will Statements

I will…

..use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.(NGSS)

.. apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs. (NGSS)

..develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.(NGSS)</td></tr>
<tr><td colspan="2">Essential Vocabulary:
chemical bond, chemical structure, bond length, bond angle, ionic bond, covalent bond, metallic bond, polyatomic bond, empirical formula, molecular formula, reactant, product, chemical energy, exothermic reaction, endothermic reaction, chemical equation, mole ratio, radioactive decay, nuclear radiation, alpha particle, beta particle, gamma ray, half-life, fission, nuclear chain reaction, critical mass, fusion
CCSS Connections:
ELA: WHST.9-12.2, WHST.9-12.5, WHST.9-12.7
Math: MP.2, MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3
Lessons/Activities:
CPO Science Link Investigations: CM: A4, A5, A6, A8, B2, B3, B4, B5, B6, B9, C3
ExploreLearning Gizmos: Covalent Bonds, Ionic Bonds, Chemical Equations, Equilibrium and Concentration, Nuclear Decay</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 182, 190, 196, 336, 342

Uncovering Student Ideas in Science(Page Keeley): Chemical Bonds V2 / Salt Crystals V4</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><th colspan="2">Unit 4: Energy and Waves: Conservation of Energy, Transfer and Transformation</th><th>Suggested number of days: 16</th></tr>
<tr><td colspan="3">Building upon knowledge gained in elementary and middle school, major concepts about energy and waves are further developed. Conceptual knowledge will move from qualitative understandings of energy and waves to ones that are more quantitative using mathematical formulas, manipulations and graphical representations.</td></tr>
<tr><td colspan="2">**ONLS Code(s): SC.HS.PS.2

Content Elaborations
**SC.HS.PS.2 - Energy is transformed and transferred all the while being conserved.
**SC.HS.PS.2.a- The conservation of energy and equations for kinetic and gravitational potential energy can be used to calculate values associated with energy (i.e., height, mass, speed) for situations involving energy transfer and transformation.
**SC.HS.PS.2.b- When energy is transferred from one system to another, some of the energy is transformed to thermal energy.</td><td>Essential Questions

How is energy transformation and transfer considered a system?</td><td>I Will Statements
I will…
..use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.(NGSS)

.. develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.(NGSS)

..design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.(NGSS)</td></tr>
<tr><td colspan="2">Essential Vocabulary:
energy, potential energy, kinetic energy, mechanical energy, efficiency
CCSS Connections:
ELA: WHST.9-12.7, WHST.9-12.9
Math: MP.2, MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3
Lessons/Activities:
CPO Science Link Investigations: CR: B7, B9 ECar: B2, B5, B7, B9, C1
ExploreLearning Gizmos: Air Track, Incline Plane: Sliding Objects, Roller Coaster Physics, Energy Conservation in a System, Energy of a Pendulum, 2D Collisions</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 451, 446

Uncovering Student Ideas in Science(Page Keeley): Ice Cold Lemonade V2 / Mixing Water V2 / Ice Water V4 / Warming Water V4</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><td colspan="2">Unit 5: Energy and Waves: Waves</td><td>Suggested number of days: 15</td></tr>
<tr><td colspan="3">Building upon knowledge gained in elementary and middle school, major concepts about energy and waves are further developed. Conceptual knowledge will move from qualitative understandings of energy and waves to ones that are more quantitative using mathematical formulas, manipulations and graphical representations.</td></tr>
<tr><td>ONLS Code(s): SC.HS.PS.2 (2.3-2.4)

Content Elaborations
SC.HS.PS.2.3 – Waves can be refracted, reflected, absorbed and superposed on one another. As waves enter a different medium, they can be reflected back into the original medium, absorbed by the new medium as energy. The waves may also be transmitted into the new medium which may result in bending the waves.
SC.HS.PS.2.4 – The wavelength of a wave depends upon the relative motion of the source and the observer. If either is moving toward the other, the wavelength is shorter; if either is moving away, the wavelength is longer.</td><td>Essential Questions

What is the relationship of waves to other waves and the medium in which they travel?</td><td>I Will Statements
I will…
..develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.(NGSS)
.. use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.(NGSS)

.. evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is</td></tr>
<tr><td colspan="2">Essential Vocabulary:
reflection, diffraction, refraction, interference, constructive interference, destructive interference, standing wave, amplitude, wavelength, period, frequency, Doppler effect, medium, mechanical wave, electromagnetic wave, transverse wave, longitudinal wave, crest, trough
CCSS Connections:
ELA: RST.9-10.8, WHST.9-12.2
Math: MP.2, MP.4, HSA-SSE.A.1, HSA-SSE.B.3, HSA.CED.A.4
Lessons/Activities:
ExploreLearning Gizmos: Basic Prism, Herschel Experiment, Refraction, Ripple Tank, Sound Beats and Sine Wave, Doppler Shift, Doppler Shift Advanced</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 529, 513, 523

Uncovering Student Ideas in Science(Page Keeley): Mirror On The Wall V3, Camping Trip V4</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><td colspan="2">Unit 6: Energy and Waves: Thermal Energy</td><td>Suggested number of days: 13</td></tr>
<tr><td colspan="3">In middle school, thermal energy is introduced as the energy of movement of the particles that make up matter. Processes of heat transfer, including conduction, convection and radiation, are studied. In other sections of this course, the role of thermal energy during heating, cooling and phase changes is explored conceptually and graphically. In this course, rates of thermal energy transfer and thermal equilibrium are introduced.</td></tr>
<tr><td>**ONLS Code(s): SC.HS.PS.2.5

Content Elaborations
**SC.HS.PS.2.5a - Thermal conductivity depends on the rate at which thermal energy is transferred from one end of a material to another.
**SC.HS.PS.2.5b - An object or system is continually absorbing and emitting thermal radiation.
**SC.HS.PS.2.5c - In thermal equilibrium, the amount of thermal energy absorbed is equal to the amount of thermal energy emitted.</td><td>Essential Questions

How can you demonstrate evidence that all objects and systems are emitting or absorbing thermal energy?</td><td>I Will Statements
I will…
..demonstrate that thermal energy can be transferred by conduction, convection or radiation.
..plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.(NGSS)

..plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of</td></tr>
<tr><td colspan="2">Essential Vocabulary:
temperature, thermometer, absolute zero, heat, thermal conduction, convection, convection current, radiation, specific heat
CCSS Connections:
ELA: WHST.9-12.7, WHST.9-12.9
Math: MP.2, MP.4, HSN-Q.A.1, HSN-Q.A.2, HSN-Q.A.3
Lessons/Activities:
ExploreLearning Gizmos: Energy Conversion in a System, Temperature and Particle Motion</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 479, 487

Uncovering Student Ideas in Science(Page Keeley): The Mitten Problem V1, Ice Cold Lemonade V2, Mixing Water V2, Thermometer V3, Ice Water V4, Warming Water V4</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

Unit 7: Energy and Waves: Electricity		**Suggested number of days: 19**
In earlier grades, these concepts were introduced: electrical conductors and insulators; and a complete loop is needed for an electrical circuit that may be parallel or in a series. In this course, circuits are explained by the flow of electrons, and current, voltage and resistance are introduced conceptually to explain what was observed in middle school. The differences between electrical conductors and insulators can be explained by how freely the electrons flow throughout the material due to how firmly electrons are held by the nucleus.		
****ONLS Code(s): SC.HS.PS.2.6**** **Content Elaborations** **SC.HS.PS.2.6.1 Movement of electrons: The differences between electrical conductors and insulators can be explained by how freely the electrons flow throughout the material. **SC.HS.PS.2.6.2 Current: By convention, electric current is the rate at which positive charge flows in a circuit. **SC.HS.PS.2.6.3 Electric potential (voltage): The potential difference or voltage across an energy source is a measure of potential energy. **SC.HS.PS.2.6.4 Resistors and transfer of energy: Electrons transfer energy to other objects and transform electrical energy into other forms in the resistors.	**Essential Questions** How can you justify that electrons in the atom are the cause of electricity?	**I Will Statements** **I will…** ..draw and diagram the flow of electrons through an electrical system and explain that flow accurately. .. analyze the differences between gravitational and electrical potential energies. ..calculate current and voltage across an electrical system. ..design an electrical system that will transfer energy to other objects.
Essential Vocabulary: electric charge, electrical conductor, electrical insulator, electric force, electric field, electrical potential energy, potential difference, cell, electric current, resistance **CCSS Connections:** ELA: RST.9-10.8, WHST.9-12.2 Math: MP.2, MP.4, HAS-SSE.A1 **Lessons/Activities:** CPO Science Link Investigations: EC: A1-C2 (All Investigations) ExploreLearning Gizmos: Electromagnetic Induction		**Formative Assessments** Holt Science Spectrum Text: pgs. 592, 599, 607 Uncovering Student Ideas in Physical Science V2 (Page Keeley): Section 1, Section 2
College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)		

Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><td colspan="2">Unit 8: Forces and Motion: Motion</td><td>Suggested number of days: 15</td></tr>
<tr><td colspan="3">Building upon content in elementary and middle school, major concepts of motion and forces are further developed. In middle school, speed has been dealt with conceptually, mathematically and graphically. The concept that forces have both magnitude and direction can be represented with a force diagram, that forces can be added to find a net force and that forces may affect motion has been addressed in middle school. At the high school level, mathematics (including graphing) is used when describing these phenomena, moving from qualitative understanding to one that is more quantitative.</td></tr>
<tr><td>ONLS Code(s): SC.HS.PS.2.1

Content Elaborations
SC.HS.PS.2.1 – Motion of an object is a measurable quantity that depends on the observer's frame of reference and is described in terms of position, speed, velocity, acceleration and time.</td><td>Essential Questions

How can you explain and justify that all motion is in relation to a point of reference?</td><td>I Will Statements
I will…
..design an investigation to measure speed and analyze the data in a graph.

..calculate displacement, velocity and acceleration of an object and design a graph to accurately represent the data.

.. analyze position-time and velocity-time graphs and describe the motion of the object.</td></tr>
<tr><td colspan="2">Essential Vocabulary:
motion, frame of reference, displacement, speed, velocity, acceleration
CCSS Connections:
Math: MP.2, MP.4, HSN.Q.A.1, HSN.Q.A.2, HSN.Q.A.3, HSA.SSE.A.1, HSA.SSE.B.3, HSA.CED.A.1, HSA.CED.A.2, HSA.CED.A.4, HSF-IF.C.7, HSS-IS.A.1
Lessons/Activities:
CPO Science Link Investigations: CR: A2, A3, A5, A6, B1, B2, B3, B4, C1, C2 ECar: A3, A4, A6, B1, B2, C2, C3
ExploreLearning Gizmos: Golf Range, Shoot The Monkey, Distance-Time Graphs, Distance-Time and Velocity-Time Graphs, Free-Fall Laboratory,</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 371, 377</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

<table>
<tr><td colspan="2">Unit 9: Force and Motion: Force and Dynamics (Spring Break Split)</td><td>Suggested number of days: 20</td></tr>
<tr><td colspan="3">Building upon content in elementary and middle school, major concepts of motion and forces are further developed. In middle school, speed has been dealt with conceptually, mathematically and graphically. The concept that forces have both magnitude and direction can be represented with a force diagram, that forces can be added to find a net force and that forces may affect motion has been addressed in middle school. At the high school level, mathematics (including graphing) is used when describing these phenomena, moving from qualitative understanding to one that is more quantitative.</td></tr>
<tr><td>ONLS Code(s): SC.HS.PS.2.2

Content Elaborations
SC.HS.PS.2.2 – An object does not accelerate (remains at rest or maintains a constant speed and direction of motion) unless an unbalanced net force acts on it. The rate at which motion changes (speed or direction) is proportional to applied force and inversely proportional to the mass. A force is an interaction between two objects; both objects in the interaction experience an equal amount of force, but in opposite directions.</td><td>Essential Questions

How can you prove that force and motion are always acting upon each other?</td><td>I Will Statements
I will…

..analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. (NGSS)

.. use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.(NGSS)

..apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. (NGSS)</td></tr>
<tr><td colspan="2">Essential Vocabulary:
force, friction, static friction, inertia, weight, free fall, terminal velocity, projectile motion, momentum
CCSS Connections:
Math: Math: MP.2, MP.4, HSN.Q.A.1, HSN.Q.A.2, HSN.Q.A.3, HSA.SSE.A.1, HSA.SSE.B.3, HSA.CED.A.1, HSA.CED.A.2, HSA.CED.A.4, HSF-IF.C.7, HSS-IS.A.1
Lessons/Activities:
CPO Science Link Investigations: CR: A4, A5, A6, A7, A8, B4, B5, B6, B7, B8, C1, C2, C3 ECar: A5, A6, A7, A8, B3, B4, B5, B7, B9, C1, C2
ExploreLearning Gizmos: Gravitational Force, Pith Ball Lab, Atwood Machine, Fan Cart Physics, Free-Fall Lab</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 385, 402, 410, 417

Uncovering Student Ideas in Science V2 (Page Keeley): Standing on One Foot V4</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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Sequenced Units for Ohio's New Learning Standards for Science
Physical Science

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<tr><td colspan="2">Unit 10: The Universe: History, Galaxies, Stars</td><td>Suggested number of days: 20</td></tr>
<tr><td colspan="3">The Universe: Building a unified understanding of the universe from elementary and middle school science, insights from history, and mathematical ways of thinking, provides a basis for knowing the nature of the universe. Concepts from the previous section, Forces, Motion and Energy, are also used as foundational knowledge. The role of gravity in forming and maintaining the organization of the universe becomes clearer at this level, as well as the scale of billions and speed of light used to express relative distances. Instructional content includes:</td></tr>
<tr><td>ONLS Code(s): SC.HS.PS.3(3.1-3.4)

Content Elaborations
SC.HS.PS.3.1 – The stars differ from each other in size, temperature and age.
SC.HS.PS.3.2 – Stars transform matter into energy in nuclear reactions. These and other processes in stars have led to the formation of all elements. The process of star formation and destruction continues.
SC.HS.PS.3.3 – Early in the history of the universe, gravitational attraction caused matter to clump together to form countless trillions of stars and billions of galaxies.
SC.HS.PS.3.4 – The red shift provides evidence that the universe is and has been expanding. Data from measurements of this expansion have been used in calculations that estimate the age of the universe to be over ten billion years old.</td><td>Essential Questions

How can you show a relationship of our Sun to other stars?

What do characteristics of waves have to do with the Big Bang Theory?</td><td>I Will Statements
I will…

. communicate scientific ideas about the way stars, over their life cycle, produce elements.(NGSS)

.. develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.(NGSS)

.. construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.(NGSS)</td></tr>
<tr><td colspan="2">Essential Vocabulary:
star, light-year, red giant, white dwarf, supernova, black hole, galaxy, cluster, interstellar matter, quasar, universe, Doppler effect, big bang theory
CCSS Connections:
ELA: WHST.9-12.2
Math: MP.2, MP.4, HSN-Q.A.3
Lessons/Activities:
ExploreLearning Gizmos: H-R Diagram, Star Spectra</td><td>Formative Assessments
Holt Science Spectrum Text:
pgs. 701, 707, 717

Uncovering Student Ideas in Astronomy (Page Keeley): Section 5</td></tr>
<tr><td colspan="3">College and Career Readiness Connections: PBS NOVA Career and College Resources (http://goo.gl/7kUfwd)</td></tr>
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