# Physical Science 1st Semester Expectations *(Interactions Curriculum: Unit 1 Part 1, Unit 1 Part 2, Unit 2 Part 1 = 17 Weeks)*

<table>
<tr><th>Unit</th><th colspan="3">Standards addressed in that Unit</th><th>Learning Objectives</th><th>Pacing</th></tr>
<tr><td>Welcome<br><br>Unit 1: Part 1 Investigation O</td><td colspan="3">Back to School, Welcome, Culture Building, Procedures, etc.<br><br>**BCPS Topics Added<br>Graphing & Data<br>Scientific Notation & Converting in the Metric Units</td><td>In this investigation, students will begin to explore the basic beginning concepts of Physical Science.<br><br>How are graphs used to show data and trends in data?<br>How are really big numbers or really small numbers represented?<br>What is the metric system and how is it used in Science?</td><td>2 Weeks<br>(7 days of school)</td></tr>
<tr><td rowspan="2">Unit 1: Part 1<br>Why do some clothes stick together when they come out of the dryer?<br><br>Investigation 1<br>Why do some things stick together and other things don’t?<br><br>Charged Objects & Neutral Objects</td><td colspan="3">HS-PS2-4. Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and1 electrostatic forces between objects.</td><td rowspan="2">In this investigation, students will begin to develop a conceptual model of electrostatic interactions by exploring how various charged objects (scotch tape, balloons, rods of various materials, and a Van de Graaff generator) interact with each other and with uncharged objects (paper, water bottle, a hand). By the end of the investigation, the student model will include positive and negative charges as well as patterns that can be used to explain and predict how charged objects interaction.<br><br>Pretest (45 min)<br>Activity 1.1 What are some examples of things that stick together and things that don’t? (45 min)<br>Activity 1.2 What are some patterns in how things stick together or push apart? (60 min)<br>Activity 1.3 What effect do charged objects have on uncharged objects? (60 min)<br>Activity 1.4 How do I know if something is positively or negatively charged? (90 min)<br>Activity 1.5 How does an object’s charge affect its interactions with neutral objects? (60 min)<br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-cE9qYy10UENrejA/view</td><td rowspan="2">5 Activities<br><br>1.5 Weeks<br><br>Unit 1, Part 1<br>Pre/Post Rubric<br>https://drive.google.com/open?id=17_65bQq6Kkt1MEbwJjcAtN8ZEW1sfjmE7h5S682BmeI</td></tr>
<tr><td><u>Using Mathematics and Computational Thinking</u><br>Mathematical and computational thinking at the 9–12 level builds on K–8 and progresses to using algebraic thinking and analysis, a range of linear and nonlinear functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions.<br>* Use mathematical representations of phenomena to describe explanations. (HS-PS2-4)</td><td><u>PS2.B: Types of Interactions</u><br>Newton’s law of universal gravitation and Coulomb’s law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects. (HS-PS2-4)<br>* Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields. (HS-PS2- 4)</td><td><u>Patterns</u><br>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS2-4)</td></tr>
<tr><td rowspan="2">Unit 1: Part 1<br>Why do some clothes stick together when they come out of the dryer?<br><br>Investigation 2<br>What are factors that affect the interactions between objects?<br><br>Coulomb’s Law</td><td colspan="3">*HS-PS2-4*<br>HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.<br>*Standard Repeated*</td><td rowspan="2">In this investigation, students develop a model of electric fields to explain how charged objects interact. Students analyze how the charge on objects and the distance between them affects the strength of the interactions between those objects.<br><br>Activity 2.1 How can charged objects have an effect on each other without touching? (60 min) Activity 2.2 How do factors like distance and amount of charge affect the interactions between objects? (90 min)<br>Activity 2.3 How does our model of charge interactions connect with a variety of phenomena? (60 min)<br>Post Test (45 min)<br><br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-UnZEcVZmb19OZXc/view</td><td rowspan="2">3 Activities<br><br>1 Week</td></tr>
<tr><td><u>Developing and Using Models</u><br>Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-5)</td><td><u>PS3.C: Relationship Between Energy and Forces</u><br>When two objects interacting through a field change relative position, the energy stored in the field is changed. (HS-PS3-5)</td><td><u>Cause and Effect</u><br>Cause and effect relationships can be suggested and predicted for complex natural and human designed systems by examining what is known about smaller scale mechanisms within the system. (HS-PS3-5)</td></tr>
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<tr><td rowspan="2">Unit 1: Part 2<br>Why do some clothes stick together when they come out of the dryer?<br><br>Investigation 3<br>What are all materials made of?<br><br>Particle Nature of Matter</td><td colspan="3">HS-PS1-3. Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.<br><br>**BCPS Added HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.</td><td rowspan="2">In this investigation, students will start by analyzing observations of matter in order to evaluate continuous and particle models of matter. Students will then use evidence from mixing water and ethanol to evaluate those models. Finally, students will apply their model to explain observations of gases.<br><br>Pretest (45 min)<br>Activity 3.1 Can the same piece of paper be cut into pieces indefinitely? (20 min)<br>Activity 3.2 Does 5 + 5 always equal 10? (60 min)<br>Activity 3.3 Is the particle model always better? (45 min)<br>Activity 3.4 Which model best supports our observations? (20 min)<br><br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-a21oY2VpcXZOWFk/view</td><td rowspan="2">4 Activities<br><br>1.5 Weeks<br><br>Unit 1, Part 2<br>Pre/Post Test<br>Rubric<br>https://drive.google.com/open?id=1TOxY24-KhRBXIYXB3T_dsHDtYIL0EpAHZjfcBcRdu2o</td></tr>
<tr><td><u>Planning and Carrying Out Investigations</u><br>Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.<br>* Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-PS1-3)</td><td><u>PS1.A: Structure and Properties of Matter</u><br>* The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3)<br><u>PS2.B: Types of Interactions</u><br>* Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS1-3)</td><td><u>Patterns</u><br>Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena. (HS-PS1-3)</td></tr>
<tr><td rowspan="2">Unit 1: Part 2<br>Why do some clothes stick together when they come out of the dryer?<br><br>Investigation 4<br>What are nature’s building blocks?<br><br>Atomic Structure</td><td colspan="3">HS-PS1-1. 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.<br><br>*HS-PS1-3*</td><td rowspan="2">This investigation follows the historical development of models of atomic structure and provides students with the opportunity to explore simulations of some of the experiments that led to these models. In addition, through hands-on activities involving representative objects, this investigation helps students gain insight into the size of atoms as compared with other small objects.<br><br>Activity 4.1 What are the particles that make up all substances and how small are they? (45 min) Activity 4.2 If you can’t see it, how do you know it’s there? (120 min)<br>Activity 4.3 How do we know what’s inside an atom? (90 min)<br>Activity 4.4 Where are the electrons? (45 min)<br><br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-MHJhU2VodjRaTnM/view</td><td rowspan="2">4 Activities<br><br>2 Weeks</td></tr>
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| | | forces<br>between material objects. (HS-PS1-1) | | | |
| **Unit** | **Standards addressed in that Unit** | | | **Learning Objectives** | **Pacing** |
| **Unit 1: Part 2**<br>**Why do some clothes stick together when they come out of the dryer?**<br><br>**Investigation 5**<br>How does an object become charged?<br><br>Atoms & Forces | *HS-PS1-1*<br><br>*HS-PS1-3* | | | By collecting evidence as to how the composition of an atom relates to its identity, students will build upon the model of atomic structure that they developed in the previous investigation. In addition, they will explore the forces involved in maintaining an atom's structure and the effect that introduction into an electric field has on electron distribution. Students will extend their conceptual model of electrostatic interactions to include 1) electron transfer as the mechanism for how an object becomes charged and 2) shifting electron distribution to explain how neutral objects can be attracted to both positively and negatively charged objects. Finally, students will revise their models of some phenomena developed during previous investigations.<br><br>Activity 5.1 What is the effect of changing the composition of an atom? (60 min)<br>Activity 5.2 How do objects become charged? (45 min)<br>Activity 5.3 What causes neutral objects and charged objects to interact with each other? (60 min)<br>Activity 5.4 Revisiting our models of charge interactions. (60 min)<br>Post Test (45 min)<br><br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-SkxBU25GRzFoYjQ/view | 4 Activities<br><br>**2.5 Weeks** |
| **Unit 1: Part 2**<br><br>**Investigation 6**<br>BCPS Added<br><br>Periodic Table Extensions | **BCPS Added topics: 1st 20 elements, Periodic Table Trends, Balance Equations, Protons, Neutrons, Electrons, Bohr Model (focus on distance of electrons from nucleus), Scientific Notation & Metric Conversions (if not done at start of year) | | | | **1 Week** |

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<tr><td rowspan="2">Unit 2: Part 1<br>How does a small spark trigger a huge explosion?<br><br>Investigation 1: What is happening when a spark occurs?<br><br>Energy Transfer & Conservation</td><td colspan="3">HS-PS3-2. Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative positions of particles (objects).</td><td rowspan="2">In this investigation, students begin talking about the idea of energy. Students start by defining energy and investigating differences between potential and kinetic energy. They then explore energy transfer and energy conservation. Finally, they connect energy to charges and atomic structure of matter.<br><br>Pretest (45 min)<br>Activity 1.1 Can my finger start a fire? (45 min)<br>Activity 1.2 What happens to energy when objects collide? (180 min)<br>Activity 1.3 If moving objects have kinetic energy, do moving atoms have kinetic energy? (45 min)<br>Activity 1.4 If energy cannot go away, why don’t things move forever? (45 min)<br><br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-NXd2bjFJWXRHME0/view</td><td rowspan="2">4 Activities<br><br>2.5 Weeks</td></tr>
<tr><td><u>Developing and Using Models</u> Modeling in 9–12 builds on K–8 and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.<br>* Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS3-2)</td><td><u>PS3.A: Definitions of Energy</u><br>*Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system’s total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-2)<br>*At the macroscopic scale, energy manifests itself in multiple way s, such as in motion, sound, light, and thermal energy . (HS-PS3-2)<br>* These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration. In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)</td><td><u>Energy and Matter</u><br>Energy cannot be created or destroyed—only mov es between one place and another place, between objects and/or fields, or between systems. (HS-PS3-2)</td></tr>
<tr><td rowspan="2">Unit 2: Part 1<br>How does a small spark trigger a huge explosion?<br><br>Investigation 2: Where does the energy of a spark come from?<br><br>Energy & Fields</td><td colspan="3">*HS-PS3-5*<br>HS-PS3-4. 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 thermodynamics).</td><td rowspan="2">In this investigation, students define potential energy and factors that impact the amount of potential energy that exists in a system. Students start by defining potential energy as energy that is stored in a system of interacting objects. Student then explore the relationship between potential energy and fields in order to explain how the objects interact without touching. Finally, students evaluate factors that affect the amount of potential energy stored in a system.<br><br>Activity 2.1 How does potential energy change when things are pushed or pulled? (75 min)<br>Activity 2.2 Where does the energy that was used to charge the Van de Graaff generator go? (75 min)<br>Activity 2.3 Why is lightning so much bigger than a spark from the Van de Graaff generator? (140 min)<br>Activity 2.4 Why do I get shocked if I am too close the Van de Graaff generator? (50 min)<br>Post Test (45 min)<br><br>Teacher Guide:<br>https://drive.google.com/file/d/0B3CjsmmlXRF-TGwxM1RTQ1FLSVk/view</td><td rowspan="2">4 Activities<br><br>3 Weeks</td></tr>
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