Loudoun County Public Schools
Science Curriculum Guide

8th Grade Physical Science 2013-14

Modified from the 2010 Virginia Science Standards of Learning Curriculum Framework to include pacing and resources for instruction for the 2013-14 school year

2013-2014 Grade 8 Physical Science
Pacing Guide *At a Glance*

Quarter	Topic	Related SOL	No. of Lessons	Text Correlation	Target Date for Completion	LCPS Core Experience
1st	Force & Motion	PS.10 a, b, c, d PS.1a, b, c, d, e, f, g, h, i, j, k, l, m, n	16	1, 2.1 5, 6, 8	November 1, 2013	Force & Motion
	Energy	PS.6 a, b; PS.5 c PS.1a, b, c, d, g, l, m	5	9, 16.2		Simple Machines
2nd	Magnetism & Electricity	PS.11 a, b, c, d PS.1a, c, f, g, h, i, j, k, m	7	17, 18	January 24, 2014	Electricity & Magnetism
	Waves & Sound	PS.8 a, b, c, d PS.1a, b, f, m	7	20, 21 (not 21.4)		Sound Waves
	Transverse Waves (Light)	PS.9 a, b, c, d, e PS.1a, b, e, f, i, j, l, m	6	22, 23.2		Light
	Exams and Review		3			
3rd	Introduction to Matter	PS.2 a, c, d, e PS.1a	3	3	March 28, 2014	
	Heat	PS.7 a, b, c, d PS.1a, b, d	5	10		Heat & Heat Transfer
	Describing Matter	PS.2 b, d, e, f; PS 5a, b PS.1a	5	2.2, 4		
	Atomic Structure and the Periodic Table	PS.3 a, b; PS.4 a, b PS.1a, b, d, e, j, k, l, m	7	11, 12		Atomic Structure
4th	Chemical Bonding	PS.4 c; PS.5b PS.1a, b, d, f, g, h, i, j, l	8	13, 14		Chemical Reactions
	Properties of Matter Review – Acids and Bases	PS.2 b PS.1a, b, d, f, g, j, l	4	15.2		Acids & Bases
	SOL Review	all	2			
	Projects, lab and inquiry investigations		10		June 12, 2014	

* Scientific Investigation, Reasoning, and Logic (Science SOL PS.1) is infused with content throughout the year.

Introduction to Loudoun County Public Schools Science Curriculum

This Curriculum Guide and Framework is a merger of the Virginia Standards of Learning (SOL) and the Science Achievement Standards of Loudoun County Public Schools. Many sections are modifications of Virginia's SOL documents. Suggestions on pacing and resources represent the professional consensus of Loudoun's teachers concerning the implementation of these standards.

Contents

Science Learning Goals

The purposes of scientific investigation and discovery are to satisfy humankind's quest for knowledge and understanding and to preserve and enhance the quality of the human experience. Therefore, as a result of science instruction, students will be able to achieve the following objectives:

1. Develop and use an experimental design in scientific inquiry.
2. Use the language of science to communicate understanding.
3. Investigate phenomena using technology.
4. Apply scientific concepts, skills, and processes to everyday experiences.
5. Experience the richness and excitement of scientific discovery of the natural world through the collaborative quest for knowledge and understanding.
6. Make informed decisions regarding contemporary issues, taking into account the following:

   public policy and legislation;

   economic costs/benefits;

   validation from scientific data and the use of scientific reasoning and logic;

   respect for living things;

   personal responsibility; and

   history of scientific discovery.
7. Develop scientific dispositions and habits of mind including:

   curiosity;

   demand for verification;

   respect for logic and rational thinking;

   consideration of premises and consequences;

   respect for historical contributions;

   attention to accuracy and precision; and

   patience and persistence.
8. Develop an understanding of the interrelationship of science with technology, engineering and mathematics.
9. Explore science-related careers and interests.

Loudoun County Public Schools' Vision for STEM Education

According to the Congressional Research Service (2008), the United States ranks 20th among all nations in the proportion of 24-year-olds who earn degrees in natural science or engineering. In response, government, business and professional organizations have identified improvements in K-12 education in science, technology, engineering and mathematics (STEM) as a national priority. The National Academy of Sciences report, Rising Above the Gathering Storm (2007), calls for the strengthening of math and science education and for an urgent change in STEM education. The U.S. Department of Education's Report of the Academic Competitiveness Council lists several K-12 STEM Education goals. Foremost is a goal to prepare all students with science, technology, engineering, and math skills needed to succeed in the 21st century technological economy.

Increased performance in STEM fields requires STEM literacy. To become truly literate, students must have better understanding of the fields individually, and more importantly, they must understand how the fields are interrelated and interdependent. Clearly, formative experiences in STEM during their K-12 school years will allow for a deeper STEM literacy and better prepare them for university and beyond. In order to properly prepare our students, they must have a broad exposure to and a knowledge base in the STEM fields as part of their K-12 education.

The goal of STEM education at LCPS is to deepen students' knowledge, skills, and habits of mind that characterize science, technology, engineering, and mathematics. Loudoun County Public Schools has many exemplary programs designed to answer the call for STEM education. The Loudoun Governor's Career and Technical Academy at Monroe Technology Center and the Academy of Science at Dominion High School are specialized programs that meet these goals. Additionally, LCPS offers students a variety of STEM courses and opportunities that are rigorous, demanding, and help students develop skills required for the 21st century.

Based on the success of these programs, we are building capacity to provide integrated STEM education to all LCPS students. Integrated STEM in LCPS is defined as experiences that develop student understanding within one STEM area while also learning or applying knowledge and/or skills from at least one other STEM area.

Within this framework of integrated STEM, LCPS science courses will develop student's science understanding necessary to be scientifically literate; which includes science content, habits of mind, science process skills, and relevant application of scientific knowledge. Through integrated STEM science instruction students will develop an understanding of the connections with other STEM disciplines. Additionally, science instruction at LCPS is intended to generate a large pool of students prepared to pursue STEM areas in college or through further on-the-job training in the workplace.

LCPS STEM experiences will:

- Capitalize on student interest
- Build on what students already know
- Engage students in the practices of STEM
- Engage students with inquiry learning

Meaningful Watershed Educational Experiences

The "Stewardship and Community Engagement" Commitment of the *Chesapeake 2000* agreement clearly focuses on connecting individuals and groups to the Bay through their shared sense of responsibility and action. The goal of this Commitment formally engages schools as integral partners *to undertake initiatives* in helping to meet the Agreement.

Two objectives developed as part of this goal describe more specific outcomes to be achieved by the jurisdictions in promoting stewardship and assisting schools. These are:

> *Beginning with the class of 2005, provide a meaningful Bay or stream outdoor experience for every school student in the watershed before graduation from high school.*
>
> *Provide students and teachers alike with opportunities to directly participate in local restoration and protection projects, and to support stewardship efforts in schools and on school property.*

There is overwhelming consensus that knowledge and commitment build from firsthand experience, especially in the context of one's neighborhood and community. Carefully selected experiences driven by rigorous academic learning standards, engendering discovery and wonder, and nurturing a sense of community will further connect students with the watershed and help reinforce an ethic of responsible citizenship.

Defining *a Meaningful* Bay or Stream Outdoor Experience
A *meaningful* Bay or stream outdoor experience should be defined by the following.

Experiences are investigative or project oriented.
Experiences include activities where questions, problems, and issues are investigated by the collection and analysis of data, both mathematical and qualitative. Electronic technology, such as computers, probeware, and GPS equipment, is a key component of these kinds of activities and should be integrated throughout the instructional process.

The nature of these experiences is based on learning standards and should include the following kinds of activities.

- Investigative or experimental design activities where students or groups of students use equipment, take measurements, and make observations for the purpose of making interpretations and reaching conclusions.

- Project-oriented experiences, such as restoration, monitoring, and protection projects, that are problem solving in nature and involve many investigative skills.

Experiences are richly structured and based on high-quality instructional design.

Experiences are an integral part of the instructional program.

Experiences are part of a sustained activity.

Experiences consider the watershed as a system.

Experiences involve external sharing and communication.

Experiences are enhanced by natural resources personnel.

Experiences are for all students.

Experiences such as tours, gallery visits, simulations, demonstrations, or “nature walks” may be instructionally useful, but alone do not constitute a *meaningful* experience as defined here.

The preceding text contains excerpts from:
Chesapeake Bay Program Education Workgroup
STEWARDSHIP AND MEANINGFULWATERSHED EDUCATIONAL EXPERIENCES
http://vaswcd.org/?s=meaningful+watershed+education+experience

The link is found in the Virginia Department of Education Instructional Resources for Science:
http://www.doe.virginia.gov/instruction/science/resources.shtml

http://www.doe.virginia.gov/instruction/science/elementary/lessons_bay/index.shtml

Each LCPS K-12 Science Pacing Guide indicates where the Meaningful Watershed Educational Experiences fit into the Virginia Standards of Learning. Resources for these experiences are cited in the *Resources* section of each standard.

Many of the resources are from *Lessons from the Bay* and *Virginia’s Water Resources a Toolkit for Teachers*.

K-12 Safety
In implementing the *Science Standards of Learning*, teachers must be certain that students know how to follow safety guidelines, demonstrate appropriate laboratory safety techniques, and use equipment safely while working individually and in groups.

Safety must be given the highest priority in implementing the K-12 instructional program for science. Correct and safe techniques, as well as wise selection of experiments, resources, materials, and field experiences appropriate to age levels, must be carefully considered with regard to the safety precautions for every instructional activity. Safe science classrooms require thorough planning, careful management, and constant monitoring of student activities. Class enrollment should not exceed the designed capacity of the room.

Teachers must be knowledgeable of the properties, use, and proper disposal of all chemicals that may be judged as hazardous prior to their use in an instructional activity. Such information is referenced through Materials Safety Data Sheets (MSDS). The identified precautions involving the use of goggles, gloves, aprons, and fume hoods must be followed as prescribed.

While no comprehensive list exists to cover all situations, the following should be reviewed to avoid potential safety problems. Appropriate safety procedures should be used in the following situations:

- observing wildlife; handling living and preserved organisms; and coming in contact with natural hazards, such as poison ivy, ticks, mushrooms, insects, spiders, and snakes;
- engaging in field activities in, near, or over bodies of water;
- handling glass tubing and other glassware, sharp objects, and labware;
- handling natural gas burners, Bunsen burners, and other sources of flame/heat;
- working in or with direct sunlight (sunburn and eye damage);
- using extreme temperatures and cryogenic materials;
- handling hazardous chemicals including toxins, carcinogens, and flammable and explosive materials;
- producing acid/base neutralization reactions/dilutions;
- producing toxic gases;
- generating/working with high pressures;
- working with biological cultures including their appropriate disposal and recombinant DNA;
- handling power equipment/motors;
- working with high voltage/exposed wiring; and
- working with laser beam, UV, and other radiation.

The use of human body fluids or tissues is generally prohibited for classroom lab activities. Further guidance from the following sources may be referenced:

OSHA (Occupational Safety and Health Administration);

ISEF (International Science and Engineering Fair) rules; and

public health departments’ and school divisions’ protocols.

For more detailed information about safety in science, consult the *LCPS Science Safety Manual*.

The Role of Instructional Technology in the Science Classroom

The use of current and emerging technologies is essential to the K-12 science instructional program. Specifically, technology must accomplish the following:

- Assist in improving every student's functional literacy. This includes improved communication through reading/information retrieval (the use of telecommunications), writing (word processing), organization and analysis of data (databases, spreadsheets, and graphics programs), presentation of one's ideas (presentation software), and resource management (project management software).
- Be readily available and regularly used as an integral and ongoing part of the delivery and assessment of instruction.
- Include instrumentation oriented toward the instruction and learning of science concepts, skills, and processes. Technology, however, should not be limited to traditional instruments of science, such as microscopes, labware, and data-collecting apparatus, but should also include computers, robotics, video-microscopes, graphing calculators, probeware, geospatial technologies, online communication, software and appropriate hardware, as well as other emerging technologies.

In most cases, the application of technology in science should remain "transparent" unless it is the actual focus of the instruction. One must expect students to "do as a scientist does" and not simply hear about science if they are truly expected to explore, explain, and apply scientific concepts, skills, and processes.

As computer/technology skills are essential components of every student's education, it is important that teaching these skills is a shared responsibility of teachers of all disciplines and grade levels.

Internet Safety

The Internet allows students to learn from a wide variety of resources and communicate with people all over the world. Students should develop skills to recognize valid information, misinformation, biases, or propaganda. Students should know how to protect their personal information when interacting with others and about the possible consequences of online activities such as social networking, e-mail, and instant messaging.

- Students need to know that not all Internet information is valid or appropriate.
- Students should be taught specifically how to maximize the Internet's potential while protecting themselves from potential abuse.
- Internet messages and the people who send them are not always what or who they seem.
- Predators and cyber bullies anonymously use the Internet to manipulate students. Students must learn how to avoid dangerous situations and get adult help.

Cyber safety should be addressed when students research online resources or practice other skills through interactive sites. Science teachers should address underlying principles of cybersafety by reminding students that the senses are limited when communicating via the Internet or other electronic devices and that the use of reasoning and logic can extend to evaluating online situations.

Listed below are 8th Grade Science Virginia Standards of Learning which lend themselves to integrating Internet safety with a brief explanation of how the two can be connected.

PS.1 If students are using online tools for written communications, address the general safety issues appropriate for this age group.

Don't be Fooled by a Photograph
http://www.nationalgeographic.com/xpeditions/lessons/03/g68/hoaxphoto.html
This lesson, based on a doctored photograph of a shark, can help students understand that not all they see online is true.

PS.1 Students doing research must explore the difference between fact and opinion and recognize techniques used to persuade others of a certain point of view.

Additional information about Internet safety may be found on the Virginia Department of Education's Website at
http://www.doe.virginia.gov/support/safety_crisis_management/internet_safety/index.shtml

Investigate and Understand

Many of the standards in the *Science Standards of Learning* begin with the phrase “Students will investigate and understand.” This phrase was chosen to communicate the range of rigorous science skills and knowledge levels embedded in each standard. Limiting a standard to one observable behavior, such as “describe” or “explain,” would have narrowed the interpretation of what was intended to be a rich, highly rigorous, and inclusive content standard.

“Investigate” refers to scientific methodology and implies systematic use of the following inquiry skills:

- observing;
- classifying and sequencing;
- communicating;
- measuring;
- predicting;
- hypothesizing;
- inferring;
- defining, controlling, and manipulating variables in experimentation;
- designing, constructing, and interpreting models; and
- interpreting, analyzing, and evaluating data.

“Understand” refers to various levels of knowledge application. In the *Science Standards of Learning*, these knowledge levels include the ability to:

- recall or recognize important information, key definitions, terminology, and facts;
- explain the information in one’s own words, comprehend how the information is related to other key facts, and suggest additional interpretations of its meaning or importance;
- apply the facts and principles to new problems or situations, recognizing what information is required for a particular situation, using the information to explain new phenomena, and determining when there are exceptions;
- analyze the underlying details of important facts and principles, recognizing the key relations and patterns that are not always readily visible;
- arrange and combine important facts, principles, and other information to produce a new idea, plan, procedure, or product; and
- make judgments about information in terms of its accuracy, precision, consistency, or effectiveness.

Therefore, the use of “investigate and understand” allows each content standard to become the basis for a broad range of teaching objectives.

Application

Science provides the key to understanding the natural world. The application of science to relevant topics provides a context for students to build their knowledge and make connections across content and subject areas. This includes applications of science among technology, engineering, and mathematics, as well as within other science disciplines. Various strategies can be used to facilitate these applications and to promote a better understanding of the interrelated nature of these four areas.

Physical Science Standards of Learning

The Physical Science standards continue to build on skills of systematic investigation with a clear focus on variables and repeated trials. Validating conclusions using evidence and data becomes increasingly important at this level. Students will plan and conduct research involving both classroom experimentation and literature reviews from written and electronic resources. Research methods and skills highlight practical problems and questions. Students will share their work using written reports and other presentations and will continue to use metric units (SI – International System of Units) as the primary unit of measurement for gathering and reporting data.

The Physical Science standards stress an in-depth understanding of the nature and structure of matter and the characteristics of energy. The standards place considerable emphasis on the technological application of physical science principles. Major areas covered by the standards include the organization and use of the periodic table; physical and chemical changes; nuclear reactions; temperature and heat; sound; light; electricity and magnetism; and work, force, and motion.

The Physical Science standards continue to focus on student growth in understanding the **nature of science.** This scientific view defines the idea that explanations of nature are developed and tested using observation, experimentation, models, evidence, and systematic processes. The nature of science includes the concepts that scientific explanations are based on logical thinking; are subject to rules of evidence; are consistent with observational, inferential, and experimental evidence; are open to rational critique; and are subject to refinement and change with the addition of new scientific evidence. The nature of science includes the concept that science can provide explanations about nature and can predict potential consequences of actions, but cannot be used to answer all questions.

Standard PS.1

The Physical Science Standards of Learning are listed successively in the pages that follow. See the *At A Glance* page at the beginning of this document for pacing and teaching sequence.

PS.1 The student will demonstrate an understanding of scientific reasoning, logic and the nature of science by planning and conducting investigations in which

a) chemicals and equipment are used safely;
b) length, mass, volume, density, temperature, weight, and force are accurately measured;
c) conversions are made among metric units, applying appropriate prefixes;
d) triple beam and electronic balances, thermometers, metric rulers, graduated cylinders, probeware, and spring scales are used to gather data;
e) numbers are expressed in scientific notation where appropriate;
f) independent and dependent variables, constants, controls, and repeated trials are identified;
g) data tables showing the independent and dependent variables, derived quantities, and the number of trials are constructed and interpreted;
h) data tables for descriptive statistics showing specific measures of central tendency, the range of the data set, and the number of repeated trials are constructed and interpreted;
i) frequency distributions, scatterplots, line plots, and histograms are constructed and interpreted;
j) valid conclusions are made after analyzing data;
k) research methods are used to investigate practical problems and questions;
l) experimental results are presented in appropriate written form;
m) models and simulations are constructed and used to illustrate and explain phenomena; and
n) current applications of physical science concepts are used.

Overview

The skills described in standard PS.1 are intended to define the "investigate" component of all of the other Physical Science standards (PS.2 – PS.11). The intent of standard PS.1 is that students will continue to develop a range of inquiry skills and achieve proficiency with those skills in the context of the concepts developed in the Physical Science curriculum. Standard PS.1 does not require a discrete unit on scientific investigation because the inquiry skills that make up the standard should be incorporated in all the other Physical Science standards. It is also intended that by developing these skills, students will achieve greater understanding of scientific inquiry and the nature of science, as well as more fully grasp the content-related Standards of Learning concepts. Models, simulations, and current applications are used throughout the course in order to learn and reinforce science concepts.

Across the grade levels, kindergarten through high school, the skills in the first standards form a nearly continuous sequence. It is very important that the Physical Science teacher be familiar with the skills in the sequence leading up to standard PS.1 (LS.1, 6.1, 5.1, 4.1).

Standard PS.1

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • The nature of science refers to the foundational concepts that govern the way scientists formulate explanations about the natural world. The nature of science includes the following concepts of a) the natural world is understandable; b) science is based on evidence - both observational and experimental; c) science is a blend of logic and innovation; d) scientific ideas are durable yet subject to change as new data are collected; e) science is a complex social endeavor; and f) scientists try to remain objective and engage in peer review to help avoid bias. • Systematic investigations require standard measures and consistent and reliable tools. International System of Units (SI or metric) measures, recognized around the world, are a standard way to make measurements. • Systematic investigations require organized reporting of data. The way the data are displayed can make it easier to see important patterns, trends, and relationships. Frequency distributions, scatterplots, line plots, and histograms are powerful tools for displaying and interpreting data. • Investigation not only involves the careful application of systematic (scientific) methodology, but also includes the review and analysis of prior research related to the topic. Numerous sources of information are available from print and electronic sources, and the researcher needs to judge the authority and credibility of the sources. • To communicate the plan of an experiment accurately, the independent variable, dependent variable, and constants must be explicitly defined. • The number of repeated trials needs to be considered in the context of the investigation. Often "controls" are used to establish a standard for comparing the results of manipulating the independent variable. Controls receive no experimental treatment. Not all experiments have a control, however.	In order to meet this standard, it is expected that students will • make connections between the components of the nature of science and their investigations and the greater body of scientific knowledge and research. • select appropriate equipment (probeware, triple beam balances, thermometers, metric rulers, graduated cylinders, electronic balances, or spring scales) and utilize correct techniques to measure length, mass, density, weight, volume, temperature, and force. • design a data table that includes space to organize all components of an investigation in a meaningful way, including levels of the independent variable, measured responses of the dependent variable, number of trials, and mathematical means. • record measurements, using the following metric (SI) units: liter, milliliter (cubic centimeters), meter, centimeter, millimeter, grams, degrees Celsius, and newtons. • recognize metric prefix units and make common metric conversions between the same base metric unit (for example, nanogram to milligram or kilometer to meter). • use a variety of graphical methods to display data; create an appropriate graph for a given set of data; and select the proper type of graph for a given set of data, identify and label the axes, and plot the data points. • gather, evaluate, and summarize information, using multiple and variable resources, and detect bias from a given source. • identify the key components of controlled experiments: hypotheses, independent and dependent variables, constants, controls, and repeated trials. • formulate conclusions that are supported by the gathered data. • apply the methodology of scientific inquiry: begin with a question, design an investigation, gather evidence, formulate an answer to the original question, communicate the investigative process and results, and realize this methodology does not always follow a prescribed

Standard PS.1

Essential Understandings	Essential Knowledge, Skills, and Processes
• The analysis of data from a systematic investigation may provide the researcher with a basis to reach a reasonable conclusion. Conclusions should not go beyond the evidence that supports them. Additional scientific research may yield new information that affects previous conclusions. • Different kinds of problems and questions require differing approaches and research. Scientific methodology almost always begins with a question, is based on observation and evidence, and requires logic and reasoning. Not all systematic investigations are experimental. • It is important to communicate systematically the design and results of an investigation so that questions, procedures, tools, results, and conclusions can be understood and replicated. • Some useful applications of physical science concepts are in the area of materials science (e.g., metals, ceramics, and semiconductors). • Nanotechnology is the study of materials at the molecular (atomic) scale. Items at this scale are so small they are no longer visible with the naked eye. Nanotechnology has shown that the behavior and properties of some substances at the nanoscale (a nanometer is one-billionth of a meter) contradict how they behave and what their properties are at the visible scale. • New discoveries based on nanoscience investigations have allowed the production of superior new materials with improved properties (e.g., computers, cell phones).	sequence. • communicate in written form the following information about investigations: the purpose/problem of the investigation, procedures, materials, data and/or observations, graphs, and an interpretation of the results. • describe how creativity comes into play during various stages of scientific investigations. • use current technologies to model and simulate experimental conditions. • recognize examples of the use of nanotechnology and its applications.

Standard PS.1

Resources	Teacher Notes
★**LCPS Core Experiences**: *Force & Motion* *Simple Machines* *Electricity & Magnetism* *Sound Waves* *Light* *Heat & Heat Transfer* *Atomic Structure* *Chemical Reactions* *Acids & Bases* Text: Physical Science. Holt Science & Technology Chapters 1, 2.1 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Experimental Design Graphing Metric Measurement Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.2

PS.2	The student will investigate and understand the nature of matter. Key concepts include a) the particle theory of matter; b) elements, compounds, mixtures, acids, bases, and salts; c) solids, liquids, and gases; d) physical properties; e) chemical properties; and f) characteristics of types of matter based on physical and chemical properties.

Overview

The concepts in PS.2 build upon several science standards from previous grades, including K.4, 1.3, 2.3, 3.3, 5.4, and 6.4. These standards introduce and develop basic ideas about the characteristics and structure of matter. In PS.2, the ideas and terminology continue to be expanded and treated in greater depth, including more mathematical application. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.2

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Matter is anything that has mass and occupies space. All matter is made up of small particles called atoms. Matter can exist as a solid, a liquid, a gas, or plasma. • Matter can be classified as elements, compounds, and mixtures. The atoms of any element are alike but are different from atoms of other elements. Compounds consist of two or more elements that are chemically combined in a fixed ratio. Mixtures also consist of two or more substances, but the substances are not chemically combined. • Compounds can be classified in several ways, including: - acids, bases, salts - inorganic and organic compounds. • Acids make up an important group of compounds that contain hydrogen ions. When acids dissolve in water, hydrogen ions (H^+) are released into the resulting solution. A base is a substance that releases hydroxide ions (OH^-) into solution. pH is a measure of the hydrogen ion concentration in a solution. The pH scale ranges from 0–14. Solutions with a pH lower than 7 are acidic; solutions with a pH greater than 7 are basic. A pH of 7 is neutral. When an acid reacts with a base, a salt is formed, along with water. • Matter can be described by its physical properties, which include shape, density, solubility, odor, melting point, boiling point, and color. Some physical properties, such as density, boiling point, and solubility, are characteristic of a specific substance and do not depend on the size of the sample. Characteristic properties can be used to identify unknown substances. • Equal volumes of different substances usually have different masses. • Matter can also be described by its chemical properties, which include acidity, basicity, combustibility, and reactivity. A chemical property indicates whether a substance can undergo a chemical change.	In order to meet this standard, it is expected that students will • describe the particle theory of matter. • describe how to determine whether a substance is an element, compound, or mixture. • define compounds as inorganic or organic. (All organic compounds contain carbon). • describe what a salt is and explain how salts form. • describe the properties of solids, liquids, gases, and plasma. • distinguish between physical properties (i.e., shape, density, solubility, odor, melting point, boiling point, and color) and chemical properties (i.e., acidity, basicity, combustibility, and reactivity). • find the mass and volume of substances and calculate and compare their densities. • analyze the pH of a solution and classify it as acidic, basic, or neutral. • determine the identity of an unknown substance by comparing its properties to those of known substances. • design an investigation from a testable question related to physical and chemical properties of matter. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis. (Students should be able to use the inquiry skills represented in PS.1 and LS.1 to compose a clear hypothesis, create an organized data table, identify variables and constants, record data correctly, construct appropriate graphs, analyze data, and draw reasonable conclusions.)

Standard PS.2

Resources	Teacher Notes
★**LCPS Core Experience**: *Acids & Bases* Text: Physical Science. Holt Science & Technology Chapters 3, 10 Chapters 2.2, 3, 4, 16.2 Chapter 15.2 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Investigating Density Density of Liquids Properties of Mixtures and Solutions Particle Theory of Matter with Popcorn Acid-Base Tea Party Acid-Base Reactions in Photography Flower Indicators Gases Are Real Growing Balloons Properties of Gases Chemical Switch Trapped Inside The Effect of Temperature on a Bouncing Ball Tasty Phase Change - The Ice Cream Lab Soda Science Air Density Chromatography Layering Density Where Does My pH Rank? Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.3

PS.3	The student will investigate and understand the modern and historical models of atomic structure. Key concepts include a) the contributions of Dalton, Thomson, Rutherford, and Bohr in understanding the atom; and b) the modern model of atomic structure.

Overview

PS.3 builds upon science standards 3.3, 5.4, and 6.4, which introduce basic concepts and terminology related to the atom. PS.3 focuses more specifically on the basic structure of the atom and how models have been and are used to explain atomic structure. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.3

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Many scientists have contributed to our understanding of atomic structure. • The atom is the basic building block of matter and consists of subatomic particles (proton, neutron, electron, and quark) that differ in their location, charge, and relative mass. Protons and neutrons are made up of smaller particles called quarks. • Size at the atomic level is measured on the nanoscale. • Scientists use models to help explain the structure of the atom. Their understanding of the structure of the atom continues to evolve. Two models commonly used are the Bohr and the "electron cloud" (Quantum Mechanics) models. The Bohr model does not depict the three-dimensional aspect of an atom, and it implies that electrons are in static orbits. The "electron cloud" model better represents our current understanding of the structure of the atom.	In order to meet this standard, it is expected that students will • describe the historical development of the concept of the atom and the contributions of Dalton, Thomson, Rutherford, Bohr and other scientists (Schrödinger). • differentiate among the three basic particles in the atom (proton, neutron, and electron) and their charges, relative masses, and locations. • compare the Bohr atomic model to the electron cloud model with respect to its ability to represent accurately the three-dimensional structure of the atom.

Standard PS.3

Resources	Teacher Notes
Text: Physical Science. Holt Science & Technology Chapter 11 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Atomic Model Construction Demonstrating Quanta Making Atoms Come to Life Not So Bohring Atoms Indirect Measurement Indirect Measurement II Cloud Model of the Atom I Cloud Model of the Atom II Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.4

PS.4	The student will investigate and understand the organization and use of the periodic table of elements to obtain information. Key concepts include a) symbols, atomic number, atomic mass, chemical families (groups), and periods; b) classification of elements as metals, metalloids, and nonmetals; and c) formation of compounds through ionic and covalent bonding.

Overview

PS.4 formally introduces the periodic table of elements. This standard builds upon concepts of the atom presented in science standard 6.4. Standard PS.4 focuses on a student's ability to look at the organization of the periodic table and obtain information from it. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.4

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • There are more than 110 known elements. No element with an atomic number greater than 92 is found naturally in measurable quantities on Earth. The remaining elements are artificially produced in a laboratory setting. Elements combine in many ways to produce compounds that make up all other substances on Earth. • The periodic table of elements is a tool used to organize information about the elements. Each box in the periodic table contains information about the structure of an element. • An atom's identity is directly related to the number of protons in its nucleus. This is the basis for the arrangement of atoms on the periodic table of elements. • The vertical columns in the table are called groups or families. The horizontal rows are called periods. • Elements in the same column (family) of the periodic table contain the same number of electrons in their outer energy levels. This gives rise to their similar properties and is the basis of periodicity — the repetitive pattern of properties such as boiling point across periods on the table. • The periodic table of elements is an arrangement of elements according to atomic number and properties. The information can be used to predict chemical reactivity. The boxes for all of the elements are arranged in increasing order of atomic number. The elements have an increasing nonmetallic character as one reads from left to right across the table. Along the stair-step line are the metalloids, which have properties of both metals and nonmetals. • The nonmetals are located to the right of the stair-step line on the periodic table. • Metals tend to lose electrons in chemical reactions, forming positive ions. Nonmetals tend to gain electrons in chemical reactions, forming negative ions.	In order to meet this standard, it is expected that students will • use the periodic table to obtain the following information about the atom of an element: - symbol - atomic number - atomic mass - state of matter at room temperature - number of outer energy level (valence) electrons. • describe the organization of the periodic table in terms of - atomic number - metals, metalloids, and nonmetals - groups/families vs. periods. • recognize that an atom's identity is related to the number of protons in its nucleus. • categorize a given element as metal, nonmetal, or metalloid. • given a chemical formula of a compound, identify the elements and the number of atoms of each that comprise the compound. • recognize that the number of electrons in the outermost energy level determines an element's chemical properties or chemical reactivity. • describe the difference between ionic and covalent bonding. • predict what kind of bond (ionic or covalent) will likely form when metals and nonmetals are chemically combined.

Standard PS.4

Essential Understandings	Essential Knowledge, Skills, and Processes
• Gaining or losing electrons makes an atom an ion. • Gaining or losing neutrons makes an atom an isotope. However, gaining or losing a proton makes an atom into a completely different element. • Atoms react to form chemically stable substances that are held together by chemical bonds and are represented by chemical formulas. To become chemically stable, atoms gain, lose, or share electrons. • Compounds are formed when elements react chemically. When a metallic element reacts with a nonmetallic element, their atoms gain and lose electrons respectively, forming ionic bonds. Generally, when two nonmetals react, atoms share electrons, forming covalent (molecular) bonds.	

Resources	Teacher Notes
★**LCPS Core Experience**: *Atomic Structure* Text: Physical Science. Holt Science & Technology Chapters 11, 12, 13, 14.1 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Atomic Mass Metals, Non-Metals, Metalloids I Names and Symbols of Elements Candy Half-Life Atomic Number and Mass Atomic Model Construction Making Atoms Come to Life Not So Bohring Atoms Bonding Mapping Out the Periodic Table Cloud Model of the Atom I Cloud Model of the Atom II Chemical Switch The Universal Periodic Table Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.5

PS.5	The student will investigate and understand changes in matter and the relationship of these changes to the Law of Conservation of Matter and Energy. Key concepts include a) physical changes; b) chemical changes; and c) nuclear reactions.

Overview

This standard focuses on the concept that matter and energy can be changed in different ways, but the total amount of mass and energy is conserved. Students have previously investigated physical and chemical changes. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.5

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Matter can undergo physical and chemical changes. In physical changes, the chemical composition of the substances does not change. In chemical changes, different substances are formed. Chemical changes are often affected by the surface area/volume ratio of the materials involved in the change. • The Law of Conservation of Matter (Mass) states that regardless of how substances within a closed system are changed, the total mass remains the same. The Law of Conservation of Energy states that energy cannot be created or destroyed but only changed from one form to another. • A chemical equation represents the changes that take place in a chemical reaction. The chemical formulas of the reactants are written on the left, an arrow indicates a change to new substances, and the chemical formulas of the products are written on the right. Chemical reactions are classified into two broad types: ones in which energy is released (exothermic) and ones in which energy is absorbed (endothermic). (The study of synthesis, decomposition, and replacement reactions can be reserved for high school chemistry.) • Another type of change occurs in nuclear reactions. Nuclear energy is the energy stored in the nucleus of an atom. This energy can be released by joining nuclei together (fusion) or by splitting nuclei (fission), resulting in the conversion of minute amounts of matter into energy. In nuclear reactions, a small amount of matter produces a large amount of energy. However, there are potential negative effects of using nuclear energy, including radioactive nuclear waste storage and disposal.	In order to meet this standard, it is expected that students will • compare and contrast physical, chemical, and nuclear changes. • identify the reactants and products in a given chemical equation formula. • design an investigation that illustrates physical and chemical changes. • given chemical formulas, write and balance simple chemical equations. • analyze experimental data to determine whether it supports the Law of Conservation of Mass. • recognize that some types of chemical reactions require continuous input of energy (endothermic) and others release energy (exothermic). • describe, in simple terms, the processes that release nuclear energy (i.e., nuclear fission and nuclear fusion). Create a simple diagram to summarize and compare and contrast these two types of nuclear energy. • evaluate the positive and negative effects of using nuclear energy.

Standard PS.5

Resources	Teacher Notes
★**LCPS Core Experiences**: *Atomic Structure* *Chemical Reactions* Text: Physical Science. Holt Science & Technology Chapters 2.2, 3, 4, 16.2 Chapter 14 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Observing a Chemical Change with Mixed Solutions Finding Radiation More on Chemical Changes Growing Balloons Temperature Effects on Solubility More on Temperature and Solubility Physical and Chemical Changes Mass of Dissolved Salt Properties of Mixtures and Solutions Conservation of Matter and Balancing Chemical Equations Nuclear Fission and Nuclear Fusion Nuclear Reactions Personal Exposure to Radiation Protection from Radiation Crystallizing Borax Chemiluminescence Decomposition of Hydrogen Peroxide Electrolysis Tasty Phase Change - The Ice Cream Lab Chemical Switch Chromatography Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.6

PS.6	The student will investigate and understand forms of energy and how energy is transferred and transformed. Key concepts include a) potential and kinetic energy; and b) mechanical, chemical, electrical, thermal, radiant and nuclear energy.

Overview

The concepts in PS.6 build upon several science standards from previous grades, including 4.2, 4.3, 6.2, and 6.4. These standards introduce and develop basic ideas about states and forms of energy. At the sixth-grade level, this sequence culminates with the idea about energy transformations. In PS.6, concepts about energy forms, energy transformations, and potential and kinetic energy continue to be expanded and treated in greater depth, including more mathematical application. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.6

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Energy is the ability to do work. • Energy exists in two states. Potential energy is stored energy based on position or chemical composition. Kinetic energy is energy of motion. Students should know that the amount of potential energy associated with an object depends on its position. The amount of kinetic energy depends on the mass and velocity of the moving object. • Important forms of energy include radiant, thermal, chemical, electrical, mechanical, and nuclear energy. Visible light is a form of radiant energy and sound is a form of mechanical energy. • Energy can be transformed from one type to another. In any energy conversion, some of the energy is lost to the environment as thermal energy.	In order to meet this standard, it is expected that students will • differentiate between potential and kinetic energy. • use diagrams or concrete examples to compare relative amounts of potential and kinetic energy. • identify and give examples of common forms of energy. • design an investigation or create a diagram to illustrate energy transformations.

Standard PS.6

Resources	Teacher Notes
Text: Physical Science. Holt Science & Technology Chapters 9, 16.2 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Growing Balloons The Energy of A Bouncing Ball Observing the Transfer of Energy Energy of a Pendulum Energy of Sound Energy of a Cart on a Ramp (Version A) Energy of a Cart on a Ramp (Version B) Transfer of Heat by Radiation Energy Content of Fuels The Effect of Temperature on a Bouncing Ball Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.7

PS.7	The student will investigate and understand temperature scales, heat, and thermal energy transfer. Key concepts include a) Celsius and Kelvin temperature scales and absolute zero; b) phase change, freezing point, melting point, boiling point, vaporization, and condensation; c) conduction, convection, and radiation; and d) applications of thermal energy transfer.

Overview

This standard focuses on how thermal energy is transferred. Concepts introduced in previous grades and related to the states of matter are presented in standards 2.3 and 5.4. More complex concepts and terminology related to phase changes are introduced in PS.7, including the distinction between heat and temperature. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.7

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Heat and temperature are not the same thing. Heat is the transfer of thermal energy between substances of different temperature. As thermal energy is added, the temperature of a substance increases. • Temperature is a measure of the average kinetic energy of the molecules of a substance. Increased temperature means greater average kinetic energy of the molecules in the substance being measured, and most substances expand when heated. The temperature of absolute zero (–273^{o}C/0 K) is the theoretical point at which molecular motion stops. • Atoms and molecules are perpetually in motion. • The transfer of thermal energy occurs in three ways: by conduction, by convection, and by radiation. • As thermal energy is added to or taken away from a system, the temperature does not always change. There is no change in temperature during a phase change (freezing, melting, condensing, evaporating, boiling, and vaporizing) as this energy is being used to make or break bonds between molecules.	In order to meet this standard, it is expected that students will • distinguish between heat and temperature. • compare and contrast Celsius and Kelvin temperature scales and describe absolute zero. • illustrate and explain the effect of the addition or subtraction of thermal energy on the motion of molecules. • analyze a time/temperature graph of a phase change experiment to determine the temperature at which the phase change occurs (freezing point, melting point, or boiling point). • compare and contrast methods of thermal energy transfer (conduction, convection, and radiation) and provide and explain common examples. • explain, in simple terms, how the principle of thermal energy transfer applies to heat engines, thermostats, refrigerators, heat pumps, and geothermal systems. • design an investigation from a testable question related to thermal energy transfer. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.

Standard PS.7

Resources	Teacher Notes
★**LCPS Core Experience**: *Heat & Heat Transfer* Text: Physical Science. Holt Science & Technology Chapters 3, 10 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Heat Transfer Condensation Determining Absolute Zero Heat Conduction Change of State Heat of Fusion Evaporation and Heat Engines Thermometers How Does a Thermostat Work? Transfer of Heat by Radiation Mixing Cold and Warm Water Energy Content of Fuels Tasty Phase Change - The Ice Cream Lab Convection Currents and Density Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.8

PS.8	The student will investigate and understand the characteristics of sound waves. Key concepts include a) wavelength, frequency, speed, amplitude, rarefaction, and compression; b) resonance; c) the nature of compression waves; and d) technological applications of sound.

Overview

The focus of this standard is the mechanical wave-like nature of sound and some examples of its application. Sound is introduced in science standard 5.2, and it is expected that standard PS.8 will build upon and expand the concepts of the earlier standard. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.8

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Sound is produced by vibrations and is a type of mechanical energy. Sound travels in compression waves and at a speed much slower than light. It needs a medium (solid, liquid, or gas) in which to travel. In a compression wave, matter vibrates in the same direction in which the wave travels. • All waves exhibit certain characteristics: wavelength, frequency, and amplitude. As wavelength increases, frequency decreases. • The speed of sound depends on two things: the medium through which the waves travel and the temperature of the medium. • Resonance is the tendency of a system to vibrate at maximum amplitude at certain frequencies. • A compression (longitudinal) wave consists of a repeating pattern of compressions and rarefactions. Wavelength is measured as the distance from one compression to the next compression or the distance from one rarefaction to the next rarefaction. • Reflection and interference patterns are used in ultrasonic technology, including sonar and medical diagnosis.	In order to meet this standard, it is expected that students will • determine the relationship between frequency and wavelength. • analyze factors that determine the speed of sound through various materials and interpret graphs and charts that display this information. • identify examples illustrating resonance (e.g., musical instruments, Tacoma Narrows Bridge, crystal stemware). • model a compression (longitudinal) wave and diagram, label, and describe the basic components: wavelength, compression, rarefaction, and frequency. • describe technological applications of sound waves and generally how each application functions. • design an investigation from a testable question related to sound. The investigation may be a complete experimental design or may focus on systematic observation, description, measurement, and/or data collection and analysis.

Standard PS.8

Resources	Teacher Notes
★**LCPS Core Experience**: *Sound Waves* Text: Physical Science. Holt Science & Technology Chapters 20, 21 (not 21.4) VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Energy of Sound Terminology of Waves Wavelength and Frequency of Vibration Wavelength and Pitch Interference Fetal Ultrasound Mathematics of Music Sonar The Frequency of Sound Sound Stations Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.9

PS.9	The student will investigate and understand the characteristics of transverse waves. Key concepts include a) wavelength, frequency, speed, amplitude, crest, and trough; b) the wave behavior of light; c) images formed by lenses and mirrors; d) the electromagnetic spectrum; and e) technological applications of light.

Overview

This standard focuses on the nature of light and its applications. It builds upon standard 5.3, in which students investigate the characteristics of visible light. Standard PS.9 introduces students to the wave behavior of light. The speed of light in a vacuum is a constant. Light can change speed and direction as a result of moving from one medium to another. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.9

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Visible light is a form of radiant energy that moves in transverse waves. • All transverse waves exhibit certain characteristics: wavelength, crest, trough, frequency, and amplitude. As wavelength increases, frequency decreases. There is an inverse relationship between frequency and wavelength. • Radiant energy travels in straight lines until it strikes an object where it can be reflected, absorbed, or transmitted. As visible light travels through different media, it undergoes a change in speed that may result in refraction. • Electromagnetic waves are arranged on the electromagnetic spectrum by wavelength. All types of electromagnetic radiation travel at the speed of light, but differ in wavelength. The electromagnetic spectrum includes gamma rays, X-rays, ultraviolet, visible light, infrared, and radio and microwaves. • Radio waves are the lowest energy waves and have the longest wavelength and the lowest frequency. Gamma rays are the highest energy waves and have the shortest wavelength and the highest frequency. Visible light lies in between and makes up only a small portion of the electromagnetic spectrum. • Plane, concave, and convex mirrors all reflect light. Convex mirrors diverge light and produce a smaller, upright image. Concave mirrors converge light and produce an upright, magnified image if close and an inverted, smaller image if far away. • Concave and convex lenses refract light. Concave lenses ~~converge~~ **diverge** light. Convex lenses ~~diverge~~ **converge** light. • Diffraction is when light waves strike an obstacle and new waves are produced. • Interference takes place when two or more waves overlap and combine as a result of diffraction.	In order to meet this standard, it is expected that students will • model a transverse wave and draw and label the basic components. Explain wavelength, amplitude, frequency, crest, and trough. • describe the wave behavior of visible light (refraction, reflection, diffraction, and interference). • design an investigation to illustrate the behavior of visible light – reflection and refraction. Describe how reflection and refraction occur. • identify the images formed by lenses and mirrors. • compare the various types of electromagnetic waves in terms of wavelength, frequency, and energy. • describe an everyday application of each of the major forms of electromagnetic energy.

Standard PS.9

Resources	Teacher Notes
★**LCPS Core Experience**: *Light* Text: Physical Science. Holt Science & Technology Chapters 22, 23.2 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Refraction Reflection Convex Lenses Curved Mirrors Electromagnetic Spectrum Polarized Light Neon Bulbs and Motion of Charge Total Internal Reflection Waves and Particles Visible Spectrum Polarized Filters Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.10

PS.10	The student will investigate and understand the scientific principles of work, force, and motion. Key concepts include a) speed, velocity, and acceleration; b) Newton's laws of motion; c) work, force, mechanical advantage, efficiency, and power; and d) technological applications of work, force, and motion.

Overview

Standard PS.10 builds upon the concepts of simple machines, force, and work introduced in science standards 3.2 and 4.2. Standard PS.10 reviews and expands these basic ideas and introduces students to more mathematical concepts of motion. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.10

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Acceleration is the change in velocity per unit of time. An object moving with constant velocity has no acceleration. A decrease in velocity is negative acceleration or deceleration. A distance-time graph for acceleration is always a curve. Objects moving with circular motion are constantly accelerating because direction (and hence velocity) is constantly changing. • Newton's three laws of motion describe the motion of all common objects. • Mass and weight are not equivalent. Mass is the amount of matter in a given substance. Weight is a measure of the force due to gravity acting on a mass. Weight is measured in newtons. • A force is a push or pull. Force is measured in newtons. Force can cause objects to move, stop moving, change speed, or change direction. Speed is the change in position of an object per unit of time. Velocity may have a positive or a negative value depending on the direction of the change in position, whereas speed always has a positive value and is nondirectional. • Work is done when an object is moved through a distance in the direction of the applied force. • A simple machine is a device that makes work easier. Simple machines have different purposes: to change the effort needed (mechanical advantage), to change the direction or distance through which the force is applied, to change the speed at which the resistance moves, or a combination of these. Due to friction, the work put into a machine is always greater than the work output. The ratio of work output to work input is called efficiency. • Mathematical formulas are used to calculate speed, force, work, and power.	In order to meet this standard, it is expected that students will • make measurements to calculate the speed of a moving object. • apply the concepts of speed, velocity, and acceleration when describing motion. • differentiate between mass and weight. • identify situations that illustrate each Law of Motion. • explain how force, mass, and acceleration are related. • apply the concept of mechanical advantage to test and explain how a machine makes work easier. • make measurements to calculate the work done on an object. • make measurements to calculate the power of an object. • solve basic problems given the following formulas: Speed = distance/time ($s = d/t$) Force = mass × acceleration ($F = ma$) Work = force × distance ($W = Fd$) Power = work/time ($P = W/t$). • explain how the concepts of work, force, and motion apply to everyday uses and current technologies.

Standard PS.10

Resources	Teacher Notes
★**LCPS Core Experiences**: *Force & Motion* *Simple Machines* Text: Physical Science. Holt Science & Technology Chapters 5, 6, 8 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Galileo's Gravitational Experiment Levers Newton's First Law Newton's Second Law Newton's Second Law of Motion Newton's Third Law Pulleys Compound Machines Human Motion Styrofoam Helicopters The Effect of Temperature on a Bouncing Ball Flying High Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Standard PS.11

PS.11	The student will investigate and understand basic principles of electricity and magnetism. Key concepts include a) static electricity, current electricity, and circuits; b) relationship between a magnetic field and an electric current; c) electromagnets, motors, and generators and their uses; and d) conductors, semiconductors, and insulators.

Overview

Science standards 4.3 provide students with a strong foundation in the characteristics of electricity and simple circuits. Students in fourth grade construct series and parallel circuits and make electromagnets. Standard PS.11 is intended to provide a more in-depth and mathematical focus on circuits, current, static electricity, and the relationship between electricity and magnetism. It is intended that students will actively develop scientific investigation, reasoning, and logic skills, and the nature of science (PS.1) in the context of the key concepts presented in this standard.

Standard PS.11

Essential Understandings	Essential Knowledge, Skills, and Processes
The critical scientific concepts developed in this standard include the following: • Several factors affect how much electricity can flow through a system. Resistance is a property of matter that affects the flow of electricity. Some substances have more resistance than others. • Friction can cause electrons to be transferred from one object to another. These static electrical charges can build up on an object and be discharged slowly or rapidly. This is often called static electricity. • Electricity is related to magnetism. Magnetic fields can produce electrical current in conductors. Electricity can produce a magnetic field and cause iron and steel objects to act like magnets. • Electromagnets are temporary magnets that lose their magnetism when the electric current is removed. Both a motor and a generator have magnets (or electromagnets) and a coil of wire that creates another magnetic field. • A generator is a device that converts mechanical energy into electrical energy. Most of the electrical energy we use comes from generators. Electric motors convert electrical energy into mechanical energy that is used to do work. Examples of motors include those in many household appliances, such as blenders and washing machines. • A conductor is a material that transfers an electric current well. An insulator is material that does not transfer an electric current. A semiconductor is in-between a conductor and an insulator. • The diode is a semiconductor device that acts like a one way valve to control the flow of electricity in electrical circuits. Solar cells are made of semiconductor diodes that produce direct current (DC) when visible light, infrared light (IR), or ultraviolet (UV) energy strikes them. Light emitting diodes (LED) emit visible light or infrared radiation when current passes through them. An example is the transmitter in an infrared TV remote or the lighting course behind the screen in an LED TV or notebook computer screen. • Transistors are semiconductor devices made from silicon, and other semiconductors. They are used to amplify electrical signals (in stereos, radios, etc.) or to act like a light switch turning the flow of electricity on and off.	In order to meet this standard, it is expected that students will • design an investigation to illustrate the effects of static electricity. • construct and compare series and parallel circuits. • create an electromagnet and explain how it works. • explain the relationship between a magnetic field and an electric current. • construct simple circuits to determine the relationship between voltage, resistance, and current. • compare and contrast generators and motors and how they function. • identify situations in everyday life in which motors and generators are used. • provide examples of materials that are good conductors, semiconductors, and insulators. • identify current applications of semiconductors and their uses (e.g., diodes and transistors).

Standard PS.11

Resources	Teacher Notes
★**LCPS Core Experience**: *Electricity & Magnetism* Text: Physical Science. Holt Science & Technology Chapters 17, 18 VA SOL Physical Science Activities from the University of Virginia: http://galileo.phys.virginia.edu/outreach/8thGradeSOL/home2.htm Conductor or Insulator? Electromagnet Parallel and Series Balloon Electroscope Static Electricity Static Electricity Salt and Pepper Neon Bulbs and Motion of Charge Magnetic Field Introduction to Static Electricity Chemical Switch Investigating Magnetic Fields Sample Lesson Plans from the VA Department of Education Science Enhanced Scope and Sequence – 8th Grade Science. http://www.doe.virginia.gov/testing/sol/standards_docs/science/index.shtml	

Appendix A - 8th Grade Physical Science – Focal Points

Nature of Science & Science Skills – PS.1
- Lab safety
- Metric system conversions and prefixes
- Match laboratory equipment to measurement:
  - triple beam balance, electronic balance and spring scale for mass/weight
  - thermometer for temperature
  - measuring tape or metric ruler for length (meters)
  - graduated cylinders, beakers for volume (liters)
- Probeware
- Experimental design: independent variable (change) and dependent variable (measure), constants, control
- Graphing discrete and continuous data, analyzing data/graphs, and creating data tables

Force & Motion – PS. 10
- Gravity (mass vs. weight)
- Work
- Friction
- Speed, velocity & acceleration
- Mechanical advantage and efficiency
- Newton's three laws of motion
- Power
- Force
- Simple machines & compound machines
- Ability to solve related formulas

Energy – PS. 5, 6
- Types of energy: electrical, chemical, mechanical, thermal, radiant, nuclear (fission and fusion)
- Potential and kinetic energy

Magnetism & Electricity – PS. 11
- Series and parallel circuits
- Voltage, resistance, current
- Static electricity
- Electromagnetism
- Magnets & magnetic fields
- Differences between generators and motors
- Conductors, semiconductors and insulators

Waves & Sound – PS. 8
- Types: mechanical vs. electromagnetic Transverse v. longitudinal
- Characteristics of longitudinal (compression) waves: wavelength, frequency, amplitude compression, rarefaction
- Interactions: interference, reflection, diffraction and resonance
- Speed of sound
- Applications of sound including sonar and radar

Transverse Wave (Light) – PS. 9
- Characteristics of transverse waves: wavelength, frequency, amplitude, crest, trough
- Interactions: reflection, refraction, diffraction, interference
- Electromagnetic spectrum
- Particle wave theory
- Concave/convex lenses & mirrors

Properties of Matter – PS. 2
- Matter
- Four states of matter

Heat – PS. 7
- Temperature scales (Celsius & Kelvin)
- Absolute zero
- Types of phase changes& phase change diagrams
- Conduction, convection & radiation
- Heat vs. temperature

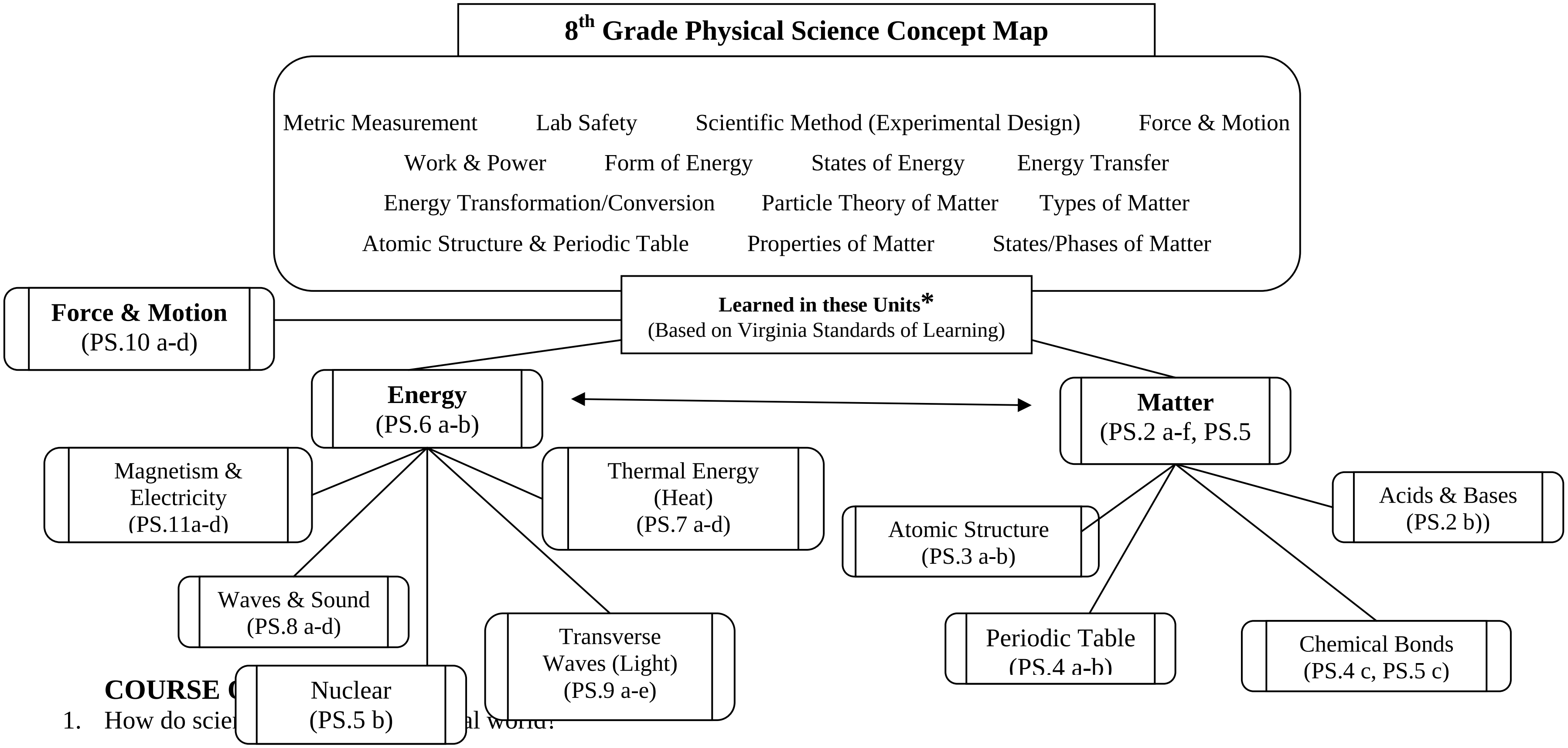
Describing Matter – PS. 2, 5
- Element
- Compound
- Mixture
- Chemical and physical properties
- Chemical and physical changes

Atomic Structure & Periodic Table – PS. 3, 4
- Atomic structure
- Bohr model, electron cloud model
- Historical development of the atom
- Atomic number
- Atomic mass
- Isotopes
- Patterns in the Periodic Table of Elements
- Families, Periods, groups, oxidation #
- Metals, metalloids, and non-metals
- Valence electrons/valence shell

Chemical Bonding – PS 4, 5
- Chemical bonding: ionic, covalent
- Interpreting chemical formulas
- Molecules
- Law of conservation of matter (mass)
- Balance chemical equations
- Types of chemical reactions: synthesis, decomposition, single & double replacement
- Endothermic
- Exothermic

Acids and Bases – PS. 2
- Acids, bases and salts
- pH scale

Appendix B – Physical Science Concept Map and Course Questions



COURSE C

1. How do scie ... al world?
2. What are the different forms and states of energy, and how i

*Inquiry Skills (PS.1 a-n) will be integrated throughout the year in each unit

3. What is the relationship between work and energy?
4. What are the characteristics and structure of matter, and how does matter change?