\=-

Introduction to Indiana's Academic Standards for Science – 2010

Indiana's Academic Standards for Science were last revised in 2000. This new document, Indiana's Academic Standards for Science – 2010, reflects the ever-changing science content and the underlying premise that science education should be an inquiry-based, hands-on experience. These standards were adopted by the Indiana State Board of Education in April, 2010, and will be implemented in the 2011-12 school year.

Indiana's Academic Standards for Science – 2010 reflect a few significant changes that are worth noting. Primarily, there are fewer standards and each grade level focuses on the big ideas for each of these sub-disciplines: physical science; earth science; life science; and science, technology and engineering. The overarching organization of the standards has also changed; they are divided into two sections: Process Standards and Content Standards, which are described in greater detail below.

Process Standards

The Process Standards are the processes and skills that students are expected to learn and be able to do within the context of the science content. The separation of the Process Standards from the Content Standards is intentional; in doing so we want to make explicit the idea that what students are doing while they are learning science is extremely important. The Process Standards reflect the way in which students are learning and doing science and are designed to work in tandem with the science content, resulting in robust instructional practice.

The Process Standards are organized in the following grade bands: K-2, 3-5, 6-8. Within each grade band, the Process Standards address a particular topic or topics. Kindergarten introduces The Nature of Science, while grades 1 through 5, reflect two parts: The Nature of Science and The Design Process. In grades 6 through 8, Reading for Literacy in Science and Writing for Literacy in Science have been added to emphasize these processes in science. For high school, the Process Standards include Reading and Writing for Literacy in Science as well as The Nature of Science.

As noted in the previous paragraph, grades 6 through 8 and high school content courses will include Reading and Writing for Literacy in Science. It is important to note that these Process Standards emerged with the adoption of the Common Core State Standards in the area of Reading and Writing for Literacy in Science. The Literacy Standards establish that instruction in reading, writing, speaking, listening, and language is a shared responsibility. The Literacy Standards are predicated on teachers in the content areas using their unique disciplinary expertise to help students meet the particular challenges of reading, writing, speaking, listening, and language in their respective fields. It is important to note that the literacy standards are meant to complement rather than supplant content standards in the disciplines.

Part of the motivation behind the disciplinary approach to literacy promulgated by the Literacy Standards is extensive research establishing the need for college- and career-ready students to be proficient in reading complex informational text independently in a variety of content

ar5,/eas. Most of the required reading in college and workforce training programs is informational in structure and challenging in content. Postsecondary education programs typically provide students with both a higher volume of such reading than is generally required in K-12 schools and comparatively little scaffolding.

The Literacy Standards make clear that significant reading of informational texts should also take place outside ELA classrooms in order for students to be ready for college and careers. Future assessments will apply the sum of all the reading students do in a grade, not just their reading in the ELA context. The Literacy Standards demand that a great deal of reading should occur in all disciplines.

The Literacy Standards also cultivate the development of three mutually reinforcing writing capacities: writing to persuade, to explain, and to convey real or imagined experience. College and career readiness requires that writing focus significantly on writing to argue and to inform or explain.

The Literacy Standards use grade level bands to present the standards. Teachers teaching at the beginning of the grade band may need to provide scaffolding for students to be successful, where teachers teaching at the end of the grade band should expect students to demonstrate the standards independently.

Content Standards

In grades 1 through 8, the Content Standards are organized in four distinct areas: 1) physical science; 2) earth science; 3) life science; and 4) science, technology and engineering. Kindergarten has only the first three areas: physical, earth and life science. In each of these areas there is at least one core standard, which serves as the big idea at that grade level for that content area. For the high school science courses, the content standards are organized around the core ideas in each particular course, which are represented by the core standard. The core standard is not meant to stand alone or be used as an individual standard, but instead is meant to help teachers organize their instruction around the “big ideas” in that content area and for grades K-8, at that particular grade level. Beneath each core standard are indicators which serve as the more detailed expectations within each of the content areas.

Finally, in the development of these revised science standards, careful attention was paid to how ideas are articulated across the grade levels so that content and skills that students will need to succeed in a particular sub-discipline are introduced in an appropriate manner in the early elementary grades and then progressed as students move towards high school.

Integrated Chemistry and Physics

Process Standards

The Nature of Science

Scientific knowledge is scientists' best explanations for the data from many investigations. Ideas about objects in the microscopic world that we cannot directly sense are often understood in terms of concepts developed to understand objects in the macroscopic world that we can see and touch. Student work should align with this process of science and should be guided by those principles. Students should also understand that scientific knowledge is gained from observation of natural phenomena and experimentation by designing and conducting investigations guided by theory and by evaluating and communicating the results of those investigations according to accepted procedures. These concepts should be woven throughout daily work.

- Develop explanations based on reproducible data and observations gathered during laboratory investigations. *Labs- lab notebook*
- Recognize that their explanations must be based both on their data and other known information from investigations of others. *Labs- lab notebook*
- Clearly communicate their ideas and results of investigations verbally and in written form using tables, graphs, diagrams and photographs. *Labs- lab notebook ch 1.4*
- Regularly evaluate the work of their peers and in turn have their work evaluated by their peers. *Labs- lab notebook Labs- lab notebook ch 1.4*
- Apply standard techniques in laboratory investigations to measure physical quantities in appropriate units and convert quantities to other units as necessary. *Labs- lab notebook ch 1.3*
- Use analogies and models (mathematical andphysical) to simplify and represent systems that are difficult to understand or directly experience due to their size, time scale or complexity. Recognize the limitations of analogies and models.
  Ch. 1.2, 4.1, 4.2, 4.3
- Focus on the development of explanatory models based on their observations during laboratory investigations.
  Ch 1.1
- Explain that the body of scientific knowledge is organized into major theories, which are derived from and supported by the results of many experiments and allow us to make testable predictions.
  Ch 1.2, 3.1, 4.3
- Recognize that new scientific discoveries often lead to a re-evaluation of previously accepted scientific knowledge and of commonly held ideas.
  Ch 1.1, 1.2, 4.1, 4.2, 4.3,

- Describe how scientific discoveries lead to the development of new technologies and conversely how technological advances can lead to scientific discoveries through new experimental methods and equipment.
  Ch 1.1
- Explain how scientific knowledge can be used to guide decisions on environmental and social issues. Issues in Science

Reading Standards for Literacy in Science

The standards below begin at grade 9 and define what students should understand and be able to do by the end of grade 10.

Key Ideas and Details

9-10.RS.1 Cite specific textual evidence to support analysis of science texts, attending to the precise details of explanations or descriptions.

9-10.RS.2 Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

9-10.RS.3 Follow precisely a complex multistep procedure when carrying out experiments or taking measurements, attending to special cases or exceptions defined in the text.

Craft and Structure

9-10.RS.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 9-10 texts and topics*.

9-10.RS.5 Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., *force, friction, reaction force, energy*).

9-10.RS.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.

Integration of Knowledge and Ideas

9-10.RS.7 Translate quantitative information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

9-10.RS.8 Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific problem.

9-10.RS.9 Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

Range of Reading and Level of Text Complexity

9-10.RS.10 By the end of grade 10, read and comprehend science texts in the grades 9-10 text complexity band independently and proficiently.

Writing Standards for Literacy in Science

Text Types and Purposes

9-10.WS.1 Write arguments focused on *discipline-specific content*.

a. Introduce precise claim(s), distinguish the claim(s) from alternate or opposing claims, and create an organization that establishes clear relationships among the claim(s), counterclaims, reasons, and evidence.
b. Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline appropriate form and in a manner that anticipates the audience's knowledge level and concerns.
c. Use words, phrases, and clauses to link the major sections of the text, create cohesion, and clarify the relationships between claim(s) and reasons, between reasons and evidence, and between claim(s) and counterclaims.
d. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
e. Provide a concluding statement or section that follows from or supports the argument presented.

9-10.WS.2 Write informative/explanatory texts, including scientific procedures/ experiments.

a. Introduce a topic and organize ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.
b. Develop the topic with well-chosen, relevant, and sufficient facts, extended definitions, concrete details, quotations, or other information and examples appropriate to the audience's knowledge of the topic.
c. Use varied transitions and sentence structures to link the major sections of the text, create cohesion, and clarify the relationships among ideas and concepts.
d. Use precise language and domain-specific vocabulary to manage the complexity of the topic and convey a style appropriate to the discipline and context as well as to the expertise of likely readers.
e. Establish and maintain a formal style and objective tone while attending to the norms and conventions of the discipline in which they are writing.
f. Provide a concluding statement or section that follows from and supports the information or explanation presented (e.g., articulating implications or the significance of the topic).

9-10.WS.3 *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/ explanatory texts. In science, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

9-10.WS.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

9-10.WS.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.

9-10.WS.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.

Research to Build and Present Knowledge

9-10.WS.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

9-10.WS.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectivity to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.

9-10.WS.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

9-10.WS.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Content Standards

Standard 1: Motion and Energy of Macroscopic Objects

Core Standard

Describe and explain the motion of macroscopic objects in terms of Newton's laws and use the concepts of kinetic and potential energy to describe motion.

ICP.1.1 Measure the motion of objects to understand the relationships among distance, velocity and acceleration. Develop deeper understanding through graphical analysis of the time dependence of acceleration, velocity and distance.

Ch 11.1, 11.2, 11.3

ICP.1.2 Describe and apply Newton's three laws of motion. By experimentation, determine the relationships among the variables in Newton's laws and how all three laws relate mass, acceleration and force as a triad of proportional variables, leading to the definitions of momentum and energy.

Ch 11.3, 12.2, 12.3

ICP.1.3 Describe how Newton's Law of Universal Gravitation and the laws of motion together explain the motions of objects on earth and of the moon, planets and stars.

Ch 1.1, 12.1, 12.2, 12.4

ICP.1.4 Describe the kinetic and potential energies of macroscopic objects and use measurements to develop an understanding of these forms of energy.

Ch 3.1, 15.1, 15.2

Standard 2: Mechanical Energy and Propagation of Energy by Waves

---

Core Standard

Explain that waves transmit energy, come in two forms (transverse and longitudinal) and occur throughout nature.

ICP 2.1 Identify properties of objects that vibrate by using Newton's laws to understand the motion. Understand that vibrating objects can give rise to mechanical waves.

Ch 17.2, 17.4

ICP.2.2 Identify properties of waves (e.g., frequency, wavelength, amplitude, energy and wave speed).

Ch 17.2

ICP 2.3 Describe how energy is propagated by waves without the transfer of mass using examples such as water waves, earthquakes and sound waves.

Ch 17.1, 17.2, 17.4

ICP.2.4 Apply the properties of waves to wave phenomena like reflection, refraction, transmission of energy and loss of energy.

Ch 17.2, 17.3, 18.3

Standard 3: Properties of Matter: Macroscopic as a Model for Microscopic

---

Core Standard

Understand how the energies and motions of atoms and molecules at the microscopic level can be used to understand and predict the macroscopic properties of gases, liquids and solids.

ICP.3.1 Describe how we use macroscopic properties of matter to model microscopic processes.

Ch 3.1, 3.3, 4.1, 4.2, 4.3, 6.3, 7.5, 8.3, 8.4

ICP.3.2 Study the characteristics of solids, liquids and gases and their changes of state. Interpret them in terms of a molecular model which describes their energies and motions.

Ch 1.1, 1.3, 2.2, 3.1, 3.2, 3.3, 8.1, 8.2, 9.1, 9.2

ICP 3.3 Understand how thermal energy (the microscopic motions of the atoms, molecules or both) is related to the macroscopic concept of temperature. Examine the differences in these concepts by measuring the temperature changes and determining specific heat capacity of water as it is heated or cooled.

Ch 3.2, 3.3, 8.1, 8.2, 16.1, 16.3

ICP.3.4 Understand how the microscopic kinetic molecular theory explains observations of macroscopic gas behavior in terms of temperature, volume, pressure and the number of particles (using the mole concept).

Ch 3.1, 3.2, 3.3

Standard 4: Energy Transport

Core Standard

Describe how vibrations and waves transport energy.

ICP.4.1 Using conservation of energy, calculate the thermal energy released or absorbed by an object and distinguish between exothermic and endothermic changes.

Ch 15.2

ICP.4.2 Differentiate among conduction, convection and radiation and identify them as types of energy transfer.

Ch 16.2

ICP.4.3 Explain that electrons can absorb energy and can release energy and that electrons in atoms do this at specific energies.

Ch 4.3

ICP.4.4 Describe the relationships among velocity, frequency, wavelength and energy in electromagnetic waves. Describe the regions of the electromagnetic spectrum.

Ch 18.1, 18.2, 18.3, 18.4

ICP 4.5 Understand that from diffraction it is known that visible light is an electromagnetic wave.

Ch 18.1, 18.2, 18.3, 18.4

Standard 5: Chemical Energy, Reactions, and Bonding

Core Standard

Describe how energy is produced and absorbed in chemical reactions.

ICP.5.1 Recognize and describe physical properties of matter and use them to differentiate between pure substances and mixtures.

Ch 2.1, 2.2, 6.4

ICP 5.2 Use the periodic table to understand important patterns in properties of elements. Recognize that the pattern of properties of the elements correlates most closely with the configuration of the electrons in each element.

Ch 5.1, 5.2, 5.3, 6.1, 6.2

ICP.5.3 Understand that the atomic number is unique to each element and is the number of protons in the nucleus of the element.

Ch 4.2, 5.2, 5.3, 6.1, 6.2

ICP.5.4 Use the concept of the mole to relate number of moles and the mass of a sample of a pure substance of known chemical composition.

Ch 7.1, 7.2, 7.3

ICP.5.5 Using conservation principles, write and balance chemical equations.

Ch 7.1, 7.2, 7.3, 8.3

ICP.5.6 Identify key indicators of a chemical change and classify simple types of chemical reactions. Differentiate among covalent, ionic, hydrogen and Van der Waals bonding. Write formulas for and name compounds of each type.

Ch 2.3, 6.1, 6.2, 6.3, 7,2m 7.3, 7.4, 7.5, 9.4

ICP.5.7 Explain that in exothermic chemical reactions chemical energy is converted into other forms such as thermal, electrical, light and sound energy.

Ch 7.3, 9.4, 15.1

Standard 6: Electrical Energy Propagation and Magnetism

Core Standard

Describe how the movement and transfer of changed particles results in the transfer of electrical energy.

ICP.6.1 Explain that objects that carry a net charge will exert an electric force (attractive or repulsive) on other objects.

Ch 4.1, 20.1

ICP.6.2 Explain that, when charge is transferred from one object to another, the amount lost by one object equals the amount gained by the other, which is consistent with the principal of conservation of charge.

Ch 20.1

ICP.6.3 Using the example of electrolysis and its application in batteries, explain the relationship between chemical reactions and electrical energy. Ch 8.1 Ch 18.1, 18.2, 18.3, 18.4

ICP.6.4 Define and describe the relationships among voltage, current resistance and power in open and closed electrical circuits.
Ch 20.2, 20.3

ICP.6.5 Describe the current-flow differences in parallel and series circuits.
Ch 20.3

ICP.6.6 Explain that some objects, called magnets, exert magnetic forces with no direct contact**.**
Ch 12.4, 21.1, 21.2

ICP.6.7 Using the examples of motors and generators, explain that electrical energy can be transformed into mechanical energy and vice versa.
Ch 15.1, 21.2, 21.3

Standard 7: Nuclear Energy (fission and fusion)

Core Standard

Describe how the stability of nuclei in terms of the binding energies of their constituent protons and neutrons explains the energy production processes of fission and fusion.

ICP.7.1 Demonstrate how historical models and experiments supported the development of our current understanding of the atom and its nucleus.
Ch 4.1, 4.3

ICP.7.2 Differentiate among protons, neutrons and electrons and determine the number of these subatomic particles in each atom.
Ch 1.1, 4.2, 10.3

ICP.7.3 Understand that the stability of nuclei depend on their numbers of neutrons and protons.
Ch 10.4

ICP.7.4 Understand that fission results from large, less stable nuclei decomposing to form smaller, more stable nuclei.
Ch 10.4, 15.1

ICP.7.5 Understand that fusion results from two smaller nuclei combining to form one larger nucleus.
Ch 10.4, 15.1

ICP 7.6 Understand that the energy radiated from the sun derives from the fusion process.
Ch 10.4

ICP.7.7 Describe the various forms of emission that are typical of radioactive decay.
Ch 10.1, 10.2, 10.4

ICP 7.8 Relate the fission process to the human development and use of the fission process in war (uncontrolled) and in peace (controlled). Ch 10.4

Standard 8: Society (Energy production, environment, economics)

Core Standard

Understand the impact of energy production and use on society and the environment.

ICP.8.1 Describe how energy needs have changed throughout history and how energy needs are met in modern society.
Ch 15.3, 21.3

ICP.8.2 Describe the benefits and risks of the development of non-renewable forms of energy such as coal, oil, natural gas and uranium fission sources.
Ch 9.1, 9.3, 15.3

ICP.8.3 Describe the benefits and risks of the development of renewable forms of energy such as solar energy, wind-energy, geothermal energy, fusion energy and biofuels.
Ch 15.3

ICP.8.4 Describe how efficient use of renewable and non-renewable energy sources is essential to maintaining an acceptable environment.
Ch 9.1, 15.3, 16.3

ICP.8.5 Describe how the availability of energy resources is essential to the development of an economically viable society.
Ch 15.3

ICP.8.6 Contrast the dependence on and use of energy and other natural resources in the economies of industrial nations, of developing nations and of undeveloped nations.
Ch 15.3, 21.3

ICP.8.7 Describe the energy needs of a modern urban city. Compare and contrast these needs with those of a modern rural community.

Ch 15.3, 21.3

INDIANA STATE SCIENCE STANDARDS

Approved 03.29.10

Chemistry I

Students should understand that scientific knowledge is gained from observation of natural phenomena and experimentation, by designing and conducting investigations guided by theory, and by evaluating and communicating the results of those investigations according to accepted procedures. Thus, scientific knowledge is scientists' best explanations for the data from many investigations. Further, ideas about objects in the microscopic world that we cannot directly sense are often understood in terms of concepts developed to understand objects in the macroscopic world that we can see and touch. In the science classroom student work should align with this process of science and should be guided by the following principles. These should be woven throughout the daily work that students are doing when learning the content presented in the standard indicators.

- Develop explanations based on reproducible data and observations gathered during laboratory investigations.
- Recognize that their explanations must be based both on their data and other known information from investigations of others. Labs and lab notebook
- Clearly communicate their ideas and results of investigations verbally and in written form using tables, graphs, diagrams, and photographs. Labs and lab notebook ch1.3
- Regularly evaluate the work of their peers and in turn have their work evaluated by their peers.
- Apply standard techniques in laboratory investigations to measure physical quantities in appropriate units and convert known quantities to other units as necessary. Labs, lab notebook, ch 12.1, 12.2, 12.3
- Use analogies and models (mathematical and physical) to simplify and represent systems that are difficult to understand or directly experience due to their size, time scale, or complexity, and recognize the limitations of analogies and models. Ch 9.1, 12.1
- Focus on the development of explanatory models based on their observations during laboratory investigations. ch 4.1, 4.2, 4.3
- Explain that the body of scientific knowledge is organized into major theories, which are derived from and supported by the results of many experiments, and allow us to make testable predictions.
- Recognize that new scientific discoveries often lead to a re-evaluation of previously accepted scientific knowledge and of commonly held ideas. ch 1.1, 4.1, 4.2, 4.3
- Describe how scientific discoveries lead to the development of new technologies, and conversely how technological advances can lead to scientific discoveries through new experimental methods and equipment. ch 4.1, 4.2, 5.1
- Explain how scientific knowledge can be used to guide decisions on environmental and social issues.

ch 1.2

Standard 1: Properties and States of Matter

Standards met with Pearson Chemistry text - see chapters listed next to each standard.

Core Standard
Describe the nature of physical and chemical properties and changes of matter.

Core Standard
Compare and contrast states of matter at the molecular level.

C.1.1 Based on physical properties, differentiate between pure substances and mixtures. Chapter 2.1, 2.2

C.1.2 Observe and describe chemical and physical properties of different types of matter and designate them as either extensive or intensive.

chapter 2.1

C.1.3 Recognize observable indicators of chemical changes.

chapter 2.4

C.1.4 Describe physical and chemical changes at the molecular level.

chapter 2.1, 2.4, 11.1, 11.2,. 11.3

C.1.5 Describe the characteristics of solids, liquids, and gases and state changes at the molecular level.

ch 2.1,

C.1.6 Explain and apply the law of conservation of mass as it applies to chemical processes.

ch 2.4, 12.1, 12.2

C.1.7 Define density and distinguish among materials based on densities. Perform calculations involving density.

chapter 3.2

Standard 2: Atomic Structure and the Periodic Table

Core Standard
Describe how the properties and arrangement of the subatomic particles contributes to the structure of the atom.

Core Standard
Describe how the structure of the periodic table reflects the numbers of electrons and protons and the configuration of the electrons in an atom.

C.2.1 Describe how models of atomic structure changed over time based on available experimental evidence and understand the current model of atomic structure.

chapter 4.4, 4.2, 4.3, 5.1, 5.2, 5.3

C.2.2 Describe how the subatomic particles (protons, neutrons, and electrons) contribute to the structure of an atom and recognize that the particles within the nucleus are held together against the electrical repulsion of the protons.

Chapter 4.2, 4.3, 5.1, 5.2, 5.3

C.2.3 Determine the number of protons, neutrons, and electrons in isotopes and in those isotopes that comprise a specific element. Relate these numbers to atomic number and mass number.

Chapter 4.2, 4.3

C.2.4 Calculate the average atomic mass of an element from isotopic abundance data.

Chapter 4.2

C.2.5 Write the electron configuration of an element and relate this to its position on the periodic table.

Chapter 6.2

C.2.6 Use the periodic table and electron configurations to determine an element's number of valence electrons, and chemical and physical properties.

chapter 6.1, 6.2, 6.3, 7.1

C.2.7 Compare and contrast nuclear reactions with chemical reactions. For nuclear reactions, describe how the fusion and fission processes transform elements present before the reaction into elements present after the reaction.

Chapter 25.1, 25. 2, 25. 3 , 25.4

C.2.8 Understand that the radioactive decay process is random for any given atom, but that this property leads to a predictable and measurable exponential decay of a sample of radioactive material. Calculate the initial amount, the fraction remaining, or the half-life of a radioactive isotope, given two of the three variables.

chapter 25.2

Standard 3: Bonding and Molecular Structure

c

Core Standard

Describe how the configuration of electrons within an atom determines its interactions with other atoms.

Core Standard

Describe the attractive forces between molecules and how their effect on chemical and physical properties.

C.3.1 Describe, compare, and contrast the characteristics of the interactions between atoms in ionic and covalent compounds.

chapter 7.2, 8.1, 8.3, 8.4

C.3.2 Compare and contrast how ionic and covalent compounds form.

chapter 7.2, 8.1, 8.2, 8.3, 8.4

C.3.3 Compare and contrast ionic, covalent network, metallic and polar and non-polar molecular crystals with respect to constituent particles, strength of bonds, melting and boiling points and conductivity; provide examples of each type.

chapter 7.1, 7.2, 8.1, 8.2, 8.3, 8.4

C.3.4 Draw structural formulas for and name simple molecules.

chapter 8.3, 9.3, 9.4, 9.5

C.3.5 Write chemical formulas for ionic compounds given their names and vice versa.

chapter 9.1, 9.2

Standard 4: Reactions and Stoichiometry

Core Standard

Use balanced chemical equations and the mole concept to determine the quantities of reactants and products.

C.4.1 Predict products of simple reactions such as synthesis, decomposition, single replacement and double replacement.

chapter 11.1, 11.2, 11.3

C.4.2 Balance chemical equations using the law of conservation of mass and use them to describe chemical reactions.

chapter 11.1, 12.1

C.4.3 Use the mole concept to determine the number of moles and number of atoms or molecules in samples of elements and compounds, given mass of the sample.

chapter 10.1, 10.2, 10.3, 12.1 12.2, 12.3

C.4.4 Using a balanced chemical equation, calculate the quantities of reactants needed and products made in a chemical reaction that goes to completion.

chapter 12.2, 12.3

C.4.5 Describe, classify and give examples of various kids of reactions-synthesis (combination), decomposition, single displacement, double displacement and combustion.

chapter 11.2, 11.3,

C.4.6 Determine oxidation states, and identify the substances apparently gaining and losing electrons in redox reactions.

chapter 11.1, 11.2

C.4.7 Perform calculations to determine percent composition by mass of a compound or mixture when given the formula.

chapter 10.3

Standard 5: Behavior of Gases

Core Standard
Using the kinetic molecular theory, describe and explain the behavior of ideal gases.

Core Standard
Examine the relationship between number of moles, volume, pressure, and temperature for ideal gases, using the ideal gas equation of state *PV* = *nRT*.

C.5.1 Use kinetic molecular theory to explain changes in gas volumes, pressure, moles, and temperature.

chapter 10.2, 12.2

C.5.2 Using the ideal gas equation of state, *PV* = *nRT,* calculate the change in one variable when another variable is changed and the others are held constant.

chapter 10.2, 12.2

C.5.3 Given the equation for a chemical reaction involving one or more gases as reactants and/or products calculate the volumes of gas assuming the reaction goes to completion and the ideal gas law holds.

chapter 12.2, 12.3

Standard 6: Thermochemistry

Core Standard
Recognize that chemical reactions result in either the release or absorption of energy.

Core Standard
Apply the law of conservation of energy.

C.6.1 Explain that atoms and molecules that make up matter are in constant motion and that this motion increases as thermal energy increases.

ch 2.1, 2.2

C.6.2 Distinguish between the concepts of temperature and heat flow in macroscopic and microscopic terms.

ch 2.1, 2.4

C.6.3 Solve problems involving heat flow and temperature changes, using known values of specific heat and/or phase change constants (latent heat values).

C.6.4 Classify chemical reactions and phase changes as exothermic or endothermic.

ch 2.1, 2.1, 2.3, 2.4, ch 11.2

Standard 7: Solutions

Core Standard
Describe the composition and characteristics of solutions.

Core Standard
Identify the factors that qualitatively affect solubility, reaction rates and dynamic equilibrium.

C.7.1 Describe the composition and properties of types of solutions.
ch 11.3

C.7.2 Explain how temperature, pressure and polarity of the solvent affect the solubility of a solute.

ch 8.4, 11.3

C.7.3 Describe the concentration of solutes in solution in terms of molarity. Perform calculations using molarity, mass, and volume.

ch 10.2

C.7.4 Prepare a specific volume of a solution of a given molarity when provided with a know solute.

C.7.5 Explain how the rate of a reaction is qualitatively affected by changes in concentration, temperature, surface area, and the use of a catalyst.

C.7.6 Write equilibrium expressions for reversible reactions.
ch 11, 12

Standard 8: Acids and Bases

Core Standard
Use acid-base definitions to identify acids and bases given their formulas and reactions

Core Standard
Explain the meaning of the value indicated by the pH scale in terms of the hydrogen ion concentration for any aqueous solution.

C.8.1 Use Arrhenius and Bronsted-Lowery definitions to classify substances as acids or bases.

C.8.2 Describe the characteristic properties of acids and bases.

ch 11

C.8.3 Compare and contrast the dissociation and strength of acids and bases in solution.

C.8.4 Given the hydronium (H_3O^+) ion concentration in a solution, calculate the pH, and vice versa. Explain the meaning of these values.

C.8.5 From acid-base titration data, calculate the concentration of an unknown solution.

Standard 9: Organic Chemistry and Biochemistry

Core Standard

Describe the unique nature of carbon atoms demonstrated by their ability to bond to one another and other elements, forming countless carbon-based substances and macromolecules.

C.9.1 Use structural formulas to illustrate carbon atoms' ability to bond covalently to one another to form many different substances.

ch 8, 9

C.9.2 Illustrate the variety of molecular types formed by the covalent bonding of carbon atoms and describe the typical properties of these molecular types.

ch 8, 9