VALWOOD

GO BEYOND

Eighth Grade Science Curriculum

Physical Science Overview

Course Description	Topics at a Glance
Students are introduced to chemistry and physics through the investigation of the basic structure of matter. In the first part of this course, students will explore the nature of atoms and chemical reactions. In the second part, students create models exploring motion, acceleration, force, work and energy which is applied to concepts involving sound, light, electricity and magnetism. Emphasis is placed on developing such skills as critical thinking, problem solving, drawing conclusions, working cooperatively with others, following written and oral directions, writing, mathematics calculations, use of the scientific method, generating and interpreting graphs, and creating and manipulating models.	• Matter and Energy • Chemical Interactions • Motions and Forces • Wave, Sound, and Light • Electricity and Magnetism
Assessments	**Effective Components**
• Teacher created assessments • Lab reports • Standardized Test	• keep records of their observations, use those records to analyze the data they collect • recognize patterns in the data, use simple charts and graphs to represent the relationships they see • find more than one way to interpret their findings. • develop conceptual understanding of the laws of conservation of matter and conservation of energy • plan and carry out investigations, describe observations, and show information in graphical form.

Grade Level Expectations

1. Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations
2. Matter has definite structure that determines characteristic physical and chemical properties
3. Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy
4. Atoms bond in different ways to form molecules and compounds that have definite properties
5. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined
6. When energy changes form, it is neither created nor destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases
7. *Scientists use the tools of math to solve problems, analyze data, and evaluate the validity of results.*
8. *Scientists ask questions and state hypotheses using prior knowledge to help design and guide scientific investigations, using appropriate technology and safe laboratory practices.*

1. Physical Science

Students know and understand common properties, forms and changes in matter and energy.

Valwood Graduate Competencies
The Valwood graduate competencies are the preschool through twelfth-grade concepts and skills that all graduates will be able to demonstrate.

Valwood Graduate Competencies in the Physical Science standard:

- Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects
- Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions
- Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable
- *Engage in scientific inquiry by asking or responding to scientifically oriented questions, collecting and analyzing data, giving priority to evidence, formulating explanations based on evidence, connecting explanations to scientific knowledge, and communicating and justifying explanations.*

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Observe, explain, and predict natural phenomena governed by Newton's laws of motion, acknowledging the limitations of their application to very small or very fast objects

GRADE LEVEL EXPECTATION

Concepts and skills students master:

1. Identify and calculate the direction and magnitude of forces that act on an object, and explain the results in the object's change of motion

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Predict and evaluate the movement of an object by examining the forces applied to it • Identify the forces acting on a moving object and explain the effects of changes in both magnitude and direction b. Use mathematical expressions to describe the movement of an object • Calculate velocity given distance and time • Extension: Define and calculate acceleration given velocity and time • Extension: manipulate mathematical expressions to describe the movement (for example: solve for distance when given velocity and time) c. Develop and design a scientific investigation to collect and analyze speed and acceleration data to determine the net forces acting on a moving object • Based on the size and direction of a force applied, determine the direction an object will move	**Inquiry Questions:** 1. What relationships exist among force, mass, speed, and acceleration? 2. What evidence indicates a force has acted on a system? Is it possible for a force to act on a system without having an effect? **Relevance and Application:** 1. Engineers take forces into account when designing moving objects such as car tires, roller coasters, and rockets. 2. Vehicles and their propulsion systems are designed by analyzing the forces that act on the vehicle. For example, the designs of propellers and jet engines are based on the aerodynamics of airplanes. **Nature of Discipline:** 1. Recognize that our current understanding of forces has developed over centuries of studies by many scientists, and that we will continue to refine our understanding of forces through continued scientific investigations and advances in data collection. 2. Find, evaluate, and select appropriate information from reference books, journals, magazines, online references, and databases to answer scientific questions about motion and acceleration.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

GRADE LEVEL EXPECTATION

Concepts and skills students master:

2. There are different forms of energy, and those forms of energy can be changed from one form to another – but total energy is conserved

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Gather, analyze, and interpret data to describe the different forms of energy and energy transfer b. Develop a research-based analysis of different forms of energy and energy transfer c. Use research-based models to describe energy transfer mechanisms, and predict amounts of energy transferred	**Inquiry Questions:** 1. Which forms of energy can be directly observed, and which forms of energy must be inferred? 2. What evidence supports the existence of potential and kinetic energy? 3. Is there a limit to how many times energy can be transferred? Explain your answer.
	Relevance and Application: 1. Photos and measurements of accident investigations provide evidence of energy transfers during such events. 2. Kinetic energy often is turned into heat such as when brakes are applied to a vehicle or when space vehicles re-enter Earth's atmosphere. 3. Energy transfers convert electricity to light, heat, or kinetic energy in motors. 4. There are ways of producing electricity using both nonrenewable resources such as coal or natural gas and renewable sources such as hydroelectricity or solar, wind, and nuclear power.
	Nature of Discipline: 1. Share experimental data, and respectfully discuss conflicting results. 2. Recognize and describe the ethical traditions of science: value peer review; truthful reporting of methods and outcomes; making work public; and sharing a lens of professional skepticism when reviewing the work of others. 3. Use tools to gather, view, analyze, and report results for scientific investigations designed to answer questions about energy transformations.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

GRADE LEVEL EXPECTATION

Concepts and skills students master:

3. Distinguish between physical and chemical changes, noting that mass is conserved during any change

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify the distinguishing characteristics between a chemical and a physical change • Define chemical change as a change in which existing substances react to form new substances with different properties b. Gather, analyze, and interpret data on physical and chemical changes c. Gather, analyze, and interpret data that show mass is conserved in a given chemical or physical change d. Identify evidence that suggests that matter is always conserved in physical and chemical changes • Explain that mass will remain the same in a closed system even if changes take place within the system e. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate physical and chemical changes f. Extension: Understand that a chemical equation describes a chemical change g. Extension: Count the atoms of different elements on both the reactant and product side of a chemical equation h. Extension: Balance a chemical equation using coefficients	**Inquiry Questions:** 1. What evidence can indicate whether a change is physical or chemical? 2. Is it easier to observe the conservation of mass in physical or chemical changes? Why? 3. What would happen if mass were not conserved? **Relevance and Application:** 1. The freezing, thawing, and vaporization of Earth's water provide examples of physical changes. 2. An understanding of chemical changes has resulted in the design of various products such as refrigerants in air conditioners and refrigerators. 3. Physical and chemical changes are involved in the collection and refinement of natural resources such as using arsenic in gold mining. 4. Living systems conserve mass when waste products from some organisms are nutrients for others. **Nature of Discipline:** 1. Evaluate the reproducibility of an experiment, and critically examine conflicts in experimental results. 2. Share experimental data, and respectfully discuss conflicting results emulating the practice of scientists.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable

GRADE LEVEL EXPECTATION

Concepts and skills students master:

4. Recognize that waves such as electromagnetic, sound, seismic, and water have common characteristics and unique properties

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Compare and contrast different types of waves b. Describe for various waves the amplitude, frequency, wavelength, and speed c. Describe the relationship between pitch and frequency in sound d. Develop and design a scientific investigation regarding absorption, reflection, and refraction of light	**Inquiry Questions:** 1. What are some different ways to describe waves?
	Relevance and Application: 1. Different vibrations create waves with different characteristics. For example, a vibrating low-pitch guitar string feels different to the touch than a high-pitch guitar string. 2. Dealing with different types of waves presents design challenges. For example, higher frequency waves have shorter wavelengths, which affect ships, buildings, and antenna design. 3. Energy from different types of waves can affect the environment. For example, natural waves cause different beach erosion than boat wakes. 4. There are many applications of light and lasers such as using fiber optics in high speed communication and lasers in surgery. 5. Living organisms collect and use light and sound waves – such as for hearing and vision – to gather information about their surroundings.
	Nature of Discipline: 1. Evaluate models used to explain and predict wave phenomena that cannot be directly measured. 2. Understand that scientists work from the assumption that the universe is a single system in which the basic rules are the same everywhere. For example, the speed of light in a vacuum is constant across space and time. 3. Select and use technology tools to gather, view, analyze, and report results for scientific investigations about the characteristics and properties of waves.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

GRADE LEVEL EXPECTATION

Concepts and skills students master:

5. Mixtures of substances can be separated based on their properties such as solubility, boiling points, magnetic properties, and densities

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify properties of substances in a mixture that could be used to separate those substances from each other b. Develop and design a scientific investigation to separate the components of a mixture	**Inquiry Questions:** 1. What techniques can be used to separate mixtures of substances based their properties? 2. Which properties are the most useful in trying to separate mixtures of substances? 3. How much difference must there be among the properties of substances for the properties to be useful in separating the substances?
	Relevance and Application: 1. Materials are sorted based on their properties in a variety of applications. For example, water filtration systems rely on the solubility, density, and physical sizes of substances, and recycling facilities use the properties of materials to separate substances in single-stream recycling systems. 2. Mining and oil refining processes use properties to separate materials. 3. The kidneys use properties to filter wastes from the blood.
	Nature of Discipline: 1. Ask testable questions and make a falsifiable hypothesis about using properties to perform separations, and design a method to find an answer. 2. Evaluate and critique experimental procedures designed to separate mixtures.

	3. Share experimental data, and respectfully discuss inconsistent results. 4. Describe several ways in which scientists would study mixtures, and suggest ways that this has contributed to our understanding of materials.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

GRADE LEVEL EXPECTATION

Concepts and skills students master:

6. All matter is made of atoms, which are far too small to see directly through a light microscope. Elements have unique atoms and thus, unique properties. Atoms themselves are made of even smaller particles

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Identify evidence that suggests there is a fundamental building block of matter • Explain all matter is comprised of atoms b. Use the particle model of matter to illustrate characteristics of different substances • Describe the relative location, charge, and mass of subatomic particles (protons, neutrons, and electrons) • Explain how number of protons in an atom determines what element it is • Predict how the atomic structure affects properties of elements • Identify the basic parts of an entry in the Periodic Table • Collect and apply information from the Periodic Table to elements (determine number of protons, electrons, and neutrons and atomic mass) c. Develop an evidence based scientific explanation of the atomic model as the foundation for all chemistry d. Find and evaluate appropriate information from reference books, journals, magazines, online references, and databases to compare and contrast historical explanations for the nature of matter • Understand people of different times and places contributed to the development of modern atomic theory (Dalton, Rutherford, Thomson, Bohr, etc) e. Extension: Explain atoms of the same element that have the same number of protons but different numbers of neutrons are called isotopes.	**Inquiry Questions:** 1. In the world of science what makes something a building block? **Relevance and Application:** 1. Living things consist of the same matter as the rest of the universe. **Nature of Discipline:** 1. Work in groups using the writing process to effectively communicate an understanding of the particle model of matter. 2. Use technology to share research findings about historical explanations for the nature of matter and to publish information to various audiences. 3. Create models that explain the particle theory of matter. 4. Recognize and describe the ethical traditions of science: value peer review; truthful reporting of methods and outcomes; making work public; and sharing a lens of professional skepticism when reviewing others work.

f. Extension: Calculate average atomic mass using isotopic masses and abundances g. Extension: Use Bohr models to show electron configuration h. Extension: Apply classification systems to other groups of objects by making new Periodic Tables i. Extension: Describe periodic trends on the Periodic Table	

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

GRADE LEVEL EXPECTATION

Concepts and skills students master:

7. Atoms may stick together in well-defined molecules or be packed together in large arrays. Different arrangements of atoms into groups compose all substances

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Explain the similarities and differences between elements and compounds • Two or more atoms chemically combine to form a molecule • Molecules are represented by a chemical formula that show the ratio of each element in the molecule b. Identify evidence suggesting that atoms form into molecules with different properties than their components • The smallest unit of a compound that still retains the properties of the compound is a molecule • A compound is chemically bonded while a mixture is physically mixed c. Find and evaluate information from a variety of resources about molecules d. Extension: Count the number of atoms in a molecule using subscripts and coefficients ***e.*** Extension: Recognize the shape and chemical formula for common compounds on Earth and in the atmosphere (water, carbon dioxide, ozone, carbon monoxide, nitrogen, oxygen, etc.)	**Inquiry Questions:** 1. Why do substances behave differently? For example, why does water pour rapidly while syrup pours slowly? **Relevance and Application:** 1. Different arrangements of atoms provide different properties. 2. Very small devices consist of large numbers of arranged groups of atoms that perform a specific function. **Nature of Discipline:** 1. Use models and/or electronic media to show and understand how molecules are made of atoms. 2. Investigate how our current understanding of matter has developed through centuries of scientific investigations.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

GRADE LEVEL EXPECTATION

Concepts and skills students master:

8. The physical characteristics and changes of solid, liquid, and gas states can be explained using the particulate model

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Explain how the arrangement and motion of particles in a substance, such as water, determine its state • Describe and identify the properties of solids, liquids, and gases • Describe the arrangement, motion, and energy of particles in different states b. Distinguish between changes in temperature and changes of state using the particle model of matter • Identify the names and processes of changes in state • Predict how changes in temperature affect behavior of particles • Use the particulate model to explain the changes in energy and molecular motion in transitions between solids, liquids, and gases • Measure temperature using a thermometer and appropriate units c. Extension: Explore additional states of matter, such as plasma, Bose-Einstein Condensate, etc. d. Extension: Investigate Ideal Gas Law and use mathematical expressions to predict changes in pressure, volume, and temperature. e. Extension: Interpret phase diagrams for different types of matter f. Extension: Design experiments to test hypotheses about changes in state for different types of matter	**Inquiry Questions:** 1. What determines whether matter is in the form of a solid, liquid, or gas? 2. What is the kinetic molecular theory, and how does temperature affect the behavior of particles in a gas? **Relevance and Application:** 1. Solids, liquids, and gasses all have unique properties that make them useful in different situations. For example, solids are useful building materials. **Nature of Discipline:** 1. Use models and technology tools to help visualize what is happening at the molecular level during phase changes. 2. Understand and apply the difference between scientific laws, theories and hypotheses. 3. Work in groups using the writing process to communicate an understanding how the particle model of matter explains various states of matter.

Content Area: Science

Standard: 1. Physical Science

Valwood Graduates:

Apply an understanding of atomic and molecular structure to explain the properties of matter, and predict outcomes of chemical and nuclear reactions

GRADE LEVEL EXPECTATION

Concepts and skills students master:

9. Distinguish among, explain, and apply the relationships among mass, weight, volume, and density

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Explain that the mass of an object does not change, but its weight changes based on the gravitational forces acting upon it • Define mass, volume, weight, density, and gravity • Distinguish between mass and weight b. Predict how changes in acceleration due to gravity will affect the mass and weight of an object c. Predict how mass, weight, and volume affect density d. Measure mass and volume, and use these quantities to calculate density • Use appropriate units for listed quantities • Predict how relative density affects the ability of a sample to float or sink in a liquid of known density e. Use tools to gather, view, analyze, and report results for scientific investigations about the relationships among mass, weight, volume, and density • Use a balance, graduated cylinder, scale, and metric ruler f. Extension: Calculate force of gravity on objects using acceleration and mass g. Extension: Explore Newton's Law of Universal Gravitation and explain how mass and distance affect gravitational pull between two objects h. Extension: Describe inertia and how inertia relates to mass	**Inquiry Questions:** 1. Which of the following is the best recommendation for a person trying to lose weight and why? o Reduce the number of calories he or she eats. o Exercise more. o Go to the Moon. 2. If weight and mass are not the same thing, why might people use the words interchangeably? 3. Describe a situation in which mass would be the most useful information to know about an object? Do the same for weight, volume, and density. **Relevance and Application:** 1. Mass, weight, and gravitational forces are critical for space travel, future visits to outer space, and possibly the colonization of places like the Moon or Mars. **Nature of Discipline:** 1. Calculate the density of a sample, predict its ability to float or sink in a liquid of known density, design and perform the experiment, and justify discrepancies in the experimental outcome. 2. Ask testable questions, make a falsifiable hypothesis about density and design an inquiry based method to find an answer. 3. Select proper tools to measure the mass and volume of an object and use appropriate units.