VALWOOD

GO BEYOND

Honors Physics Curriculum

Honors Physics Overview

Course Description	Topics at a Glance
Physics is a quantitative and qualitative study of the interactions of forces and energy A problem-solving approach is employed to investigate Newtonian mechanics, fluids, heat, waves, light, sound, electricity, and magnetism. Real world applications are employed, and laboratory experiments will play a significant role in helping students develop their understanding of each concept. Students will be expected to analyze complex problems and create formal lab reports.	• Waves and Sound • 1-D and 2-D Kinematics • Electrostatics and DC Circuits • Forces and Gravitation • Magnetism • Work, Energy and Momentum • Optics • Fluids • Thermodynamics • Rotational motion and torque • Atomic and sub-atomic physics
Assessments	
• Assessments Adopted from course materials • Teacher-created assessments	
Standard	**Big Ideas In Physics**
Physical Science	1. 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 2. Apply an understanding of atomic structure to predict outcomes of nuclear reactions 3. Apply an understanding that energy exists in various forms, and its transformation and conservation occur in processes that are predictable and measurable 4. 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. 5. Analyze the properties and applications of waves. 6. Evaluate relationships between electrical and magnetic forces.

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
- Evaluate and analye relationships between electricl and magnetic forces
- 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 - Honors Physics

Standard: 1. Physical Science

Valwood Graduates:

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.

Grade Level Expectation

Concepts and skills students master:

1. Scientists design and conduct scientific investigations; identify major sources of error or uncertainty within an investigation (e.g., particular measuring devices and experimental procedures); and communicate and evaluate scientific thinking that leads to particular conclusions

Evidence Outcomes	**21st Century Skills and Readiness Competencies**
Students can: a. Create and defend a written plan of action for a controlled experiment b. Identify the independent and dependent variables in a scientific investigation c. Attempt to keep all conditions other than the independent variable constant, while monitoring variables that cannot be held constant d. Select and use the appropriate observation or measurement technique e. Select and use appropriate technologies to gather, process, and analyze data f. Record qualitative and quantitative observations g. Describe how different types of technologies are used in scientific investigations h. Identify when error has been introduced into a scientific investigation because certain variables are not controlled or more than one variable is changed i. Describe ways of minimizing experimental errors in a scientific investigation j. Distinguish between error, uncertainty, and mistakes k. Calculate percent error l. Summarize data effectively using graphs and tables m. Identify and use evidence to support a particular conclusion n. Write a conclusion that links the question being investigated to the evidence collected during the investigation o. Identify and explain whether or not a conclusion is	**Inquiry Questions:** 1. What elements of design are critical in conducting a scientific investigation? 2. How do we know whether scientific data are accurate? 3. How do we know whether the conclusions of a scientific investigation are valid? **Relevance and Application:** 1. Most great discoveries and advancements in science have been made through conducting proper investigations; for instance the discovery of the structure of the atom and the discovery of Kepler's Laws. 2. Human beings, whether scientists or not, are often engaged in trying to understand a problem or puzzle for which they can employ the principles of scientific investigations. **Nature of Discipline:** 1. Use an inquiry approach to answer a testable question about an application of Newton's laws of motion. 2. Share experimental data, respectfully discuss conflicting results, and analyze ways to minimize error and uncertainty in measurement. 3. Differentiate between the use of the terms "law" and "theory" as they are defined and used in science compared to how they are used in other disciplines or common use. 4. Use technology to perform calculations and to organize, analyze and report data.

aligned with the testable question and the scientific investigation that was conducted p. Explain how conclusions and models from previous scientific investigations might be revised based on new evidence	

Content Area: Science - Honors Physics

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: Physics

Concepts and skills students master:

2. Newton's laws of motion describe and explain the motion of objects – but have limitations

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. States Newton's 1st and 3rd laws and gives examples from the real world illustrating them b. Understands the concept of force as a vector and identifies all the forces acting on a chosen body c. Writes and solves Newton's 2nd law to describe the motion of bodies in one and two dimensions	**Inquiry Questions:** 1. How do forces explain motion? 2. How do Newton's three laws work together and not independently?
	Relevance and Application: 1. Newton's laws are used in a variety of design processes such as vehicle safety, aerospace, bridge design and interplanetary probes. 2. An understanding of forces leads to safer building designs such as earthquake-safe buildings.
	Nature of Discipline: 1. Use an inquiry approach to answer a testable question about an application of Newton's laws of motion. 2. Share experimental data, respectfully discuss conflicting results, and analyze ways to minimize error and uncertainty in measurement. 3. Differentiate between the use of the terms "law" and "theory" as they are defined and used in science compared to how they are used in other disciplines or common use. 4. Use technology to perform calculations and to organize, analyze and report data.

Content Area: Science - Honors Physics

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:

3. Linear and two-dimensional motion, including projectile motion, can be described mathematically

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Define and demonstrate an understanding of position, velocity, and acceleration in one dimension b. Construct velocity versus time graphs depicting real motions, and interpret acceleration versus time graphs and position versus time graphs c. Write and solve the equations of one-dimensional motion with constant accelerations d. Compare and contrast scalar and vector quantities: speed & velocity and distance & displacement e. Use vector diagrams to analyze problems involving vector quantities f. Be able to solve projectile motion problems g. Extension: Understand vector problems involving relative velocity	**Inquiry Questions:** 1. How can we describe patterns of motion? 2. What is the difference between velocity and acceleration? 3. When and how do we use two-dimensional vectors? **Relevance and Application:** 1. The design and operation of factory assembly lines involves application of motion concepts. 2. Vehicle flow systems rely on employment of motion equations. 3. Ballistic trajectory applications rely on a knowledge of projectile motion. **Nature of Discipline:**

Content Area: Science - Honors Physics

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:

4. Newton's laws of motion and gravitation apply to circular motion. These laws describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Write and solve the universal law of gravitation. b. Define and describe uniform circular motion intuitively and mathematically c. Understand the forces present that cause objects to move in a circular motion	**Inquiry Questions:** 1. How do we describe patterns of motion using centripetal forces? 2. How can we describe the patterns of circular motion?
	Relevance and Application: 1. Newton's laws are used in a variety of design processes such as vehicle safety, aerospace, bridge design and interplanetary probes. 2. An understanding of forces leads to our understanding of the Universe and space exploration. 3. Satellites and their orbits are important to communication and GPS.
	Nature of Discipline: 1. Use an inquiry approach to answer a testable question about an application of circular motion. 2. Share experimental data, respectfully discuss conflicting results, and analyze ways to minimize error and uncertainty in measurement. 3. Use technology to perform calculations and to organize, analyze and report data.

Content Area: Science - Honors Physics

Standard: 1. Physical Science

Valwood Graduates:

Evaluate and analyze the relationships between electrical and magnetic forces.

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:

5. The right hand rule can be used to describe magnetic phenomena

The Earth's magnetic field effects a compass needle in a predictable pattern

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Use the right hand rule to describe magnetic field and magnetic force b. Explain how the magnetic force causes motors to spin c. Describe why generators create AC current using magnetic principles d. Extension: Understand the reasons for using AC power in our homes, and the importance of transformers for transmitting electrical power	**Inquiry Questions:** 1. How are electric forces and magnetic forces similar? 2. How are electric forces and magnetic forces different? **Relevance and Application:** 1. Generators use magnetic flux to create alternating current. 2. The Earth's magnetic field is important for the movement of charged particles from the Sun as well as navigation. **Nature of Discipline:** 1. Use an inquiry approach to answer a testable question about an application of the motion of charged particles in a magnetic field. 2. Discuss the difference between a field and a force. 3. Use technology to perform calculations and to organize, analyze and report data.

Content Area: Science - Honors Physics

Standard: 1. Physical Science

Valwood Graduates:

Evaluate and analyze the relationships between electrical and magnetic forces.

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

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:

6. Coulomb's law describes the forces between charged particles given their position and charge

Ohm's law applied to parallel and series circuits can be used to describe the voltage and current of individual components

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Explain the basic phenomena of "static electricity" using the principles of attraction and repulsion of charged particles b. Define and show an understanding of electric force and electric potential for stationary point charges c. Describe and define the potential difference mathematically and using gravitational parallels d. Use Ohm's law to describe DC circuits with combinations of resistors in series and parallel e. Extension: Find the energy and speed of a charged particle which has fallen through a potential difference	**Inquiry Questions:** 1. How does Coulomb's law resemble Newton's law of Gravity? 2. What is the difference between series and parallel combinations? What is the difference in voltage and current in each combination? **Relevance and Application:** 1. Electric devices are powered using the understanding of electricity. 2. Transfer of energy through power lines is currently how our buildings gain energy from power plants. 3. Combination of components in AC and DC circuits can be used to create many different practical electronic devices. **Nature of Discipline:** 1. Use an inquiry approach to answer a testable question about an application of circuit laws for both electric potential and current. 2. Share experimental data, respectfully discuss conflicting results, and analyze ways to minimize error and uncertainty in measurement. 3. Use technology to perform calculations and to organize, analyze and report data.

Content Area: Science - Honors Physics

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

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:

7. Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined

   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

   Momentum is conserved, and is transferred by impulse

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Define and describe basic forms of energy such as kinetic energy, gravitational potential energy, thermal energy, elastic potential energy, and work b. Identify the forms of energy within a simple closed system c. Extension: Understand the behavior of ideal springs and how springs cause Simple Harmonic Motion d. Write and solve the equation of energy conservation for a simple closed system e. Understand the relationship between force, time, impulse, and momentum f. Write and solve the equations for conservation of linear momentum within a closed system in one and two dimensions g. Extension: Find the center of mass of a body or system and describe the motion of the center of mass	**Inquiry Questions:** 1. How is energy used in modern machines? 2. How can we maximize efficiency when changing from one type of energy to a different type? **Relevance and Application:** 1. Changes in forms of energy are utilized in many mechanical devices. The type of energy used depends on the design of the device. 2. Conservation of momentum in collisions is important to improving safety in modern transportation. **Nature of Discipline:** 1. Use an inquiry approach to answer a testable question about an application of conservation of energy and momentum. 2. Share experimental data, respectfully discuss conflicting results, and analyze ways to minimize error and uncertainty in measurement. 3. Use technology to perform calculations and to organize, analyze and report data.

Content Area: Science - Honors Physics

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:

8. A wave is a disturbance that travels through space and time, which can be described mathematically and which is usually accompanied by the transfer of energy

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Define and relate, using equations and graphs, velocity, frequency, amplitude, period and wavelength of a periodic wave b. Demonstrate that standing waves are a one-dimensional interference pattern based on the principle of superposition c. Compare and contrast longitudinal and transverse waves and give examples of each d. Explain concepts such as echolocation, beats, Doppler effect, and shock waves e. Extension: Demonstrate understanding of the factors that affect sound quality f. Extension: Explain how intensity of wave energy is dependent on amplitude and frequency	**Inquiry Questions:** 1. How do we describe the behavior of waves? **Relevance and Application:** 1. An understanding of waves leads to safer building designs such as earthquake-safe buildings. 2. Knowledge of waves is important for understanding music theory and musical instruments. 3. Weather forecasting and certain astronomical applications are based on the Doppler Effect. **Nature of Discipline:**

Content Area: Science - Honors Physics

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

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

Grade Level Expectation

Concepts and skills students master:

9. The ray model can be used to explain the nature of electromagnetic waves and the characteristics of light

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Write and solve Snell's Law to model the behavior of light passing from one medium to another b. Find real and virtual images formed by a converging lens using ray drawings c. Find real and virtual images formed by mirrors and lenses using the mirror/lens formula d. Describe the electromagnetic wave model of light e. Understand the electromagnetic spectrum, and explain the origin of these broad types of radiation: radio waves, visible light, x-rays, and gamma rays f. Explain and solve problems involving total internal reflection g. Extension: Draw ray diagrams and solve problems involving combination of lenses h. Extension: Understand Huygens' Principle and how it explains diffraction and refraction i. Extension: Solve problems involving interference in Young's Double-Slit experiment j. Extension: Understand thin film interference and polarization	**Inquiry Questions:** 1. How can we use the particle model to understand how light is transmitted through and reflected from various media? **2. Extension: How does the wave model of light differ from the particle model and what phenomena can be explained with this model?** **Relevance and Application:** 1. In medicine, surgery is performed using flexible scopes which work on the principle of total internal reflection. 2. Optical devices such as microscopes and telescopes have led to momentous discoveries that impact our lives daily. 3. Eyeglasses, contacts, and laser eye surgery are applications of geometric optics that help people to overcome vision defects. **Nature of Discipline:**

Content Area: Science – Honors Physics

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

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

Grade Level Expectation

Concepts and skills students master:

10. Extension: Quantum physics and the Special Theory of Relativity can be used to explain the behavior and motion of objects that are very small (subatomic scale) or which are moving very fast (approaching the speed of light)

Evidence Outcomes	21st Century Skills and Readiness Competencies
Students can: a. Extension: Explain and solve problems involving the Special Theory of Relativity b. Extension: Understand quantum topics such as the Double-Slit Experiment, the Uncertainty Principle, and Plank's Quantum Hypothesis c. Extension: Describe the principles of nuclear decay, fission, fusion, and particle physics	**Inquiry Questions:** **1. Extension: What principles of physics can be used to solve problems dealing with objects that are moving very fast (approaching the speed of light) and objects that are very small (subatomic scale)?** **Relevance and Application:** **1. Extension: GPS satellite systems use special relativity corrections to keep clocks adjusted correctly.** **2. Extension: Quantum effects are important in such practical devices as lasers, transistors, and MRI imagers.** **3. Extension: Nuclear physics is the basis for nuclear power plants, which are an important source of electrical generation in many countries.** **Nature of Discipline:**