WRHS Science Curriculum
Syllabus

Course Name: Freshman Physics **Grade Level: 9**

Course Description:

Freshman Physics is a physical science course specifically for ninth grade students beginning their high school science curriculum. The course will expand the students' understanding of motion, properties of matter, sound, light, electricity and magnetism, all presented without requiring extensive mathematical background. All topics will incorporate basic scientific practices and methods. Projects, both individual and group, laboratory experiments, research, and other group activities will all be an integral part of the program. This program will provide a good foundation for future science courses.

Links to Student Expectations:

- All students will develop skills to utilize technology to gather, to evaluate, to assimilate, and to present information.
- All students will utilize critical thinking skills to identify and to provide resources to solve a problem.
- All students will be able to make decisions and solve problems using logical processes (e.g., scientific method, induction, deduction, syllogism, etc.).
- All students will develop skills to promote a sense of confidence in tackling the rigors of standardized tests such as the required MCAS and optional AP, SAT.

Interdisciplinary Connections:

Freshman Physics is a physical science course that teaches knowledge and skills that are the fundamental basis of future science courses. In addition it teaches and strengthens mathematical concepts, laboratory skills, critical thinking, and technical writing. Students will generate written lab reports and apply algebra skills to physical problems. Students will understand the underlying forces that form the basis of chemical and biological processes.

I. Essential Questions for Course

- How can the scientific method be applied to physics applications?
- How do distance, speed, velocity, and acceleration relate to each other?
- How can Newton's first, second, and third laws of motion be interpreted and applied to practical situations?
- How can the laws of conservation of momentum and conservation of energy be used to predict and describe the movement of objects?
- What are work, energy, and power, and how do they relate to each other?

- What are temperature and heat, and how are they related?
- What happens when a substance changes phase?
- What are the characteristics of harmonic motion and wave motion?
- What are the relationships and differences among electrostatics, electricity, and magnetism?

II. Student Objectives

- To interpret and apply Newton's laws of motion.
  - To distinguish between vector quantities and scalar quantities.
  - To solve problems and interpret graphs involving velocity, speed, and acceleration.
  - To interpret and apply Newton's first, second, and third laws of motion.
  - To draw force diagrams that are appropriate to various types of problems.
  - To identify and use appropriate standard international units of measurement for force, mass, distance, speed, acceleration, and time.
- To use the laws of conservation of momentum and conservation of energy to predict and describe the movement of objects.
  - To describe the relationship between impulse and momentum, both conceptually and quantitatively.
  - To interpret the law of conservation of momentum and provide examples which illustrate it.
  - To describe the relationship among work, energy, and power, both conceptually and quantitatively.
  - To interpret the law of conservation of energy and provide examples which illustrate it.
  - To provide examples of how energy can be transformed from kinetic to potential and vice versa, demonstrating the concept of energy conservation.
  - To identify and use appropriate standard international units of measurement for impulse, momentum, energy, work, and power.
- To understand the concepts of temperature, heat, and heat transfer.
  - To relate thermal energy to molecular motion.
  - To explain the relationships among the heat added to the substance and the substance's temperature change, mass, and specific heat.
  - To relate the concept of conservation of energy to heat transfer.
  - To recognize that matter exists in four phases, and explain what happens during a phase change.
  - To distinguish among the types of heat transfer: convection, conduction, and radiation.
  - To identify and use appropriate standard international units of measurement for temperature, heat, and specific heat.
- To describe and distinguish among waves and wave motion.
  - To differentiate between harmonic and non-harmonic motion.

    - To recognize the measurable properties of waves, such as velocity, frequency, and wavelength, and explain the relationships among them.
    - To distinguish between transverse and longitudinal waves.
    - To distinguish between mechanical and electromagnetic waves.
    - To recognize the effects of wave interactions.
    - To describe the electromagnetic spectrum in terms of wavelength and energy and be able to identify specific regions of the spectrum.
    - To identify and use appropriate standard international units of measurement for wavelength and frequency.
- To develop a basic understanding of electrostatics, electricity, and magnetism.
    - To recognize characteristics of static charge, and explain how a static charge is generated.
    - To interpret and apply Coulomb's law.
    - To apply a quantitative and qualitative understanding of current, voltage, resistance, and the connection among them.
    - To analyze the voltage and current in series and parallel circuits.
    - To identify and use appropriate standard international units of measurement for charge, current, voltage, and resistance.

III. Suggestions for Instruction

- Lectures
- Discussions
- Textbook readings (*Conceptual Physics*, 3rd Edition, by Paul Hewitt)
- Conceptual questions & quantitative problem solving
- Worksheets
- Small-group laboratory experiments
- Teacher conducted demonstrations
- Individual and group projects
- Utilization of the Cambridge Physics equipment
- Videos

IV. Suggestion for Assessment

- Conceptual questions & quantitative problem solving
- Quizzes utilizing a mixture of conceptual, quantitative, and interpretive questions
- Tests utilizing a mixture of conceptual, quantitative, and interpretive questions
- Formal and informal lab reports
- Performance- and process-based projects graded according to rubric standards
- Out of class assignments, graded for effort and/or accuracy

V. Curriculum

- Scientific method
- Standard units of measurement
- Unit conversions
- Problem solving techniques
- Linear motion: distance, time, speed, velocity, acceleration
- Free fall
- Graphs of motion
- Relationship between mass and inertia
- Newton's 1st law: Force, net force, equilibrium
- Vector addition of forces (graphically)
- Newton's 2nd law: Force, mass, and acceleration
- Friction
- Pressure
- Air resistance and terminal speed
- Newton's 3rd law: Forces and interactions between two objects
- Momentum & Impulse
- Collisions and conservation of momentum
- Mechanical energy: Work, power, kinetic energy, potential energy
- Conservation of energy
- Temperature & kinetic energy (thermal energy and molecular motion)
- Thermal equilibrium
- Specific heat
- Thermal expansion
- Change of phase: Evaporation, condensation, boiling, freezing, melting
- Heat transfer: Conduction, convection, radiation
- Simple harmonic motion
- Properties of waves (velocity, frequency, wavelength)
- Transverse and longitudinal waves
- Wave interaction (destructive and constructive interference)
- Electromagnetic spectrum
- Electrical forces & charges
- Coulomb's law
- Circuits: Current, voltage, resistance
- Ohm's law

VI. Lesson Extensions

- Honors level
  - Extend the calculations, data collection, and analysis for various laboratory investigations.
  - Solve more sophisticated problems that involve the use of basic trigonometry.

    - Perform an independent investigative research project.
- Academic Enrichment level
    - Increase emphasis on conceptual understanding rather than quantitative analysis of topics.