MEDFORD HIGH SCHOOL
COURSE SYLLABUS

Department: Science

Course Title: Physics

Level and/or Grade: Honors; Grades 11-12

Prerequisite: A grade of "B" or better in Honors Chemistry, Honors Geometry and Honors Algebra 2 or "A-" or better in Standard levels of the courses named or teacher and department recommendation

Course Description:

This course is designed for students who started their science course sequence with Biology and Chemistry. Standards are the same as, but will be addressed in more depth and with greater sophistication than in Standard Physics 11-12. The course will give students a coherent modern view of Physics with a strong foundation in Newtonian mechanics and wave kinematics. Emphasis is placed on understanding the basic laws and concepts of Physics. The major topics of the course are motions and forces, energy, momentum, mechanics, electricity/magnetism, waves and optics. Experimentation, classroom demonstrations and problem-solving applications are used to accomplish the goals outlined above.

Learning Standards: *Through inquiry, experimentation, labs, use of tools, discussion, presentation, and composition, students will be able to…..*

Motion and Forces:

- Distinguish between vector quantities and scalar quantities; understand how to add vectors using scale drawings and trigonometry; solve relative motion problems with vector addition.
- Distinguish between, and solve problems involving velocity, speed (constant and average), and constant acceleration.
- Solve problems, in one or two dimensions, involving displacement and distance. •

Distinguish the difference between mass and weight; calculate weight.

- Create, interpret, and solve problems involving graphs of motion; describe relationships among time, distance, and speed and among position, velocity, acceleration, and time.
- Understand, interpret, and apply Newton's three Laws of Motion: Inertia; Force and Acceleration; Action and Reaction; measure and calculate the magnitude of frictional forces and Newton's three Laws of Motion.
- Understand the existence of normal forces and calculate them.
- Qualitatively and quantitatively distinguish between static and kinetic friction, what they depend on and their effects on the motion of objects.
- Understand Newton's Law of Universal Gravitation; solve problems involving this law; measure and calculate the magnitude of gravitational forces.
- Qualitatively understand centripetal acceleration and centripetal forces.
- Solve 2-dimensional trajectory, 2-dimensional vector, and 2-dimensional static and non-static problems. •

Understand the effects of local gravity.

Conservation of Energy and Momentum:

- Define work, power, mechanical energy, potential energy, and kinetic energy; understand, interpret, and provide examples for the law of conservation of energy.

- Apply quantitatively the law of conservation of mechanical energy to simple systems; solve problems involving conservation of energy in simple systems with various sources of potential energy.
- Describe the relationship among energy, work, and power both conceptually and quantitatively; analyze the relationship between temperature, internal energy, and work done in a physical system; analyze and measure power.
- Define momentum; understand, interpret, and provide examples that illustrate the law of conservation of momentum.
- Define impulse; understand its relationship to momentum; solve impulse/momentum problems.
- Use formulas to calculate kinetic energy ($E = \frac{1}{2} mv^2$), changes in gravitational potential energy near Earth (change in potential energy = mgh), and momentum.
- Measure and calculate the vector nature of momentum; solve problems involving collisions in one dimension using the principles of conservation of momentum.

Waves and Optics:

- Describe the properties and characteristics of waves; describe wave motion.
- Distinguish between transverse waves and longitudinal waves; identify these waves in mechanical media and on earth.
- Describe factors that affect the speed of a wave; explain the relationship between the speed of a wave and the medium it travels through.
- Identify characteristic properties of waves and determine the behavior of waves: constructive and destructive interference (beats) for one and two dimensions, diffraction, refraction, reflection, Doppler effect, and superposition of harmonics.
- Solve problems involving wavelength, frequency, and wave speed.
- Understand, qualitatively and quantitatively, standing waves on a string and in a column of air. • Understand that speed of light depends on the medium. • Understand reflection and refraction of light.
- Understand and solve, graphically and through the thin lens equation, thin lens problems for real and virtual images; distinguish between real and virtual images.

Electromagnetism:

- Recognize the characteristics of static charge, and explain how a static charge is generated.
- Develop a qualitative and quantitative understanding of current, voltage, resistance, and the connection between them; predict the voltage and current in DC (series and parallel) electric circuits; use a formula to calculate power in any resistive circuit element; determine equivalent resistances in series and parallel circuits.
- Solve problems involving Ohm's Law.
- Interpret and apply Coulomb's Law conceptually and quantitatively.
- Understand that magnetic materials and electric currents are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources; determine the direction of a magnetic field.
- Understand conceptually what electric and magnetic fields are; understand that they contain energy and act as vector force fields.
- Understand that electric currents create magnetic fields and how to determine the magnitude and direction of fields created by a long straight wire, a coil of wire, and a solenoid.
- Understand that a moving charge or a current carrying a wire in a magnetic field will feel a force; understand how to determine the magnitude and direction of the force(s).
- Understand how a D.C. motor operates.
- Understand that the relative motion of a wire through a magnetic field can induce a voltage. • Understand and apply Faraday and Lenz' Laws. • Understand how electricity is generated.

- Know that the force on a charged particle in an electric field is qE; calculate the electric field resulting from a point charge; understand how to draw the electric field for a positive or negative charge.
- Understand and calculate electrical potential energy, electrical potential, potential difference, and voltage.
- Distinguish between mechanical and electromagnetic waves; explain the processes that result in the production and energy transfer of electromagnetic waves; understand that a changing magnetic field creates a changing electric field and can result in an electromagnetic wave.

Electromagnetic Radiation:

- Recognize that electromagnetic waves are transverse waves and travel at the speed of light through a vacuum.
- Describe the electromagnetic spectrum for wavelength and energy; be able to identify specific regions such as visible light; recognize ways in which direction of visible light can be changed.
- Explain how the various wavelengths in the electromagnetic spectrum have many useful applications such as radio, TV, microwaves, and cellular phones.

Course Alignment with High School Expectations for Student Learning:

Students will…

1. Analyze, interpret, evaluate and use logical reasoning to solve problems using a variety of resources and strategies.
   - Make observations, raise questions, and formulate hypotheses.
   - Read, interpret, and examine the credibility and validity of scientific claims in different sources of information.
   - Design and conduct scientific investigations - identify purpose, select appropriate tools and conditions; identify variables; write clear procedures; measure accurately and collect data in organized ways; follow safety guidelines.
   - Analyze and interpret results of scientific investigations.
2. Communicate effectively to a variety of audiences.
   - Communicate orally and in writing, and apply the results of scientific investigations.
   - Explain diagrams and charts and prepare lab reports,
   - Use language and vocabulary appropriately, speak clearly, and use appropriate technology.
3. Create works using a variety of communication forms.
   - Present arguments through writing; solve problems through projects, homework, tests, and lab experiences; use technology; make oral presentations.
4. Develop skills and knowledge to reach personal and career goals.
   - Develop 'habits of mind': work beyond center of competence; gain attitude of persistence; seek feedback; develop confidence.
   - Become familiar with careers related to science.
5. Work cooperatively to achieve objectives.
   - Work in pairs, small groups, and part of the whole class to solve problems. •

   Analyze and evaluate the mathematical thinking and strategies of others.

Assessment:

- See grading policy attached.