Mississippi Science

High School: Physics

Adopted 2018

High School - Physics

1. **One-Dimensional Motion** PHY.1

   1A. Students will investigate and understand how to analyze and interpret data. PHY.1A

   1. Investigate and analyze evidence gained through observation or experimental design regarding the one-dimensional (1-D) motion of objects. Design and conduct experiments to generate and interpret graphical evidence of distance, velocity, and acceleration through motion. PHY.1A.1
   2. Interpret and predict 1-D motion based on displacement vs. time, velocity vs. time, or acceleration vs. time graphs (e.g., free-falling objects). PHY.1A.2
   3. Use mathematical and computational analysis to solve problems using kinematic equations. PHY.1A.3
   4. Use graphical analysis to derive kinematic equations. PHY.1A.4
   5. Differentiate and give examples of motion concepts such as distance-displacement, speed-velocity, and acceleration. PHY.1A.5
   6. Design and mathematically/graphically analyze quantitative data to explore displacement, velocity, and acceleration of various objects. Use probe systems, video analysis, graphical analysis software, digital spreadsheets, and/or online simulations. PHY.1A.6
   7. Design different scenarios, and predict graph shapes for distance/time, velocity/time, and acceleration/time graphs. PHY.1A.7
   8. Given a 1D motion graph students should replicate the motion predicted by the graph. PHY.1A.8

2. Newton's Laws PHY.2

2A. Students will develop an understanding of concepts related to Newtonian dynamics. PHY.2A

1. Identify forces acting on a system by applying Newton's laws mathematically and graphically (e.g., vector and scalar quantities). PHY.2A.1
2. Use models such as free-body diagrams to explain and predict the motion of an object according to Newton's law of motion, including circular motion. PHY.2A.2
3. Use mathematical and graphical techniques to solve vector problems and find net forces acting on a body using free-body diagrams and/or online simulations. PHY.2A.3
4. Use vectors and mathematical analysis to explore the 2D motion of objects. (i.e. projectile and circular motion). PHY.2A.4
5. Use mathematical and computational analysis to derive simple equations of motion for various systems using Newton's second law (e.g. net force equations). PHY.2A.5
6. Use mathematical and computational analysis to explore forces (e.g., friction, force applied, normal, and tension). PHY.2A.6
7. Analyze real-world applications to draw conclusions about Newton's three laws of motion using online simulations, probe systems, and/or laboratory experiences. PHY.2A.7
8. Design an experiment to determine the forces acting on a stationary object on an inclined plane. Test your conclusions. PHY.2A.8
9. Draw diagrams of forces applied to an object, and predict the angle of incline that will result in unbalanced forces acting on the object. PHY.2A.9
10. Apply the effects of the universal gravitation law to generate a digital/physical graph, and interpret the forces between two masses, acceleration due to gravity, and planetary motion (e.g., situations where g is constant, as in falling bodies). PHY.2A.10
11. Explain centripetal acceleration while undergoing uniform circular motion to explore Kepler's third law using online simulations, models, and/or probe systems. PHY.2A.11

3. **Work and Energy** PHY.3

   3A. Students will develop an understanding of concepts related to work and energy. PHY.3A

   1. Use mathematical and computational analysis to qualitatively and quantitatively analyze the concept of work, energy, and power to explain and apply the conservation of energy. PHY.3A.1
   2. Use mathematical and computational analysis to explore conservation of momentum and impulse. PHY.3A.2
   3. Through real-world applications, draw conclusions about mechanical potential energy and kinetic energy using online simulations and/or laboratory experiences. PHY.3A.3
   4. Design and conduct investigations to compare conservation of momentum and conservation of kinetic energy in perfectly inelastic and elastic collisions using probe systems, online simulations, and/or laboratory experiences. PHY.3A.4
   5. Investigate, collect data, and summarize the principles of thermodynamics by exploring how heat energy is transferred from higher temperature to lower temperature until equilibrium is reached. PHY.3A.5
   6. Enrichment: Design, conduct, and communicate investigations that explore how temperature and thermal energy relate to molecular motion and states of matter. PHY.3A.6
   7. Enrichment: Use mathematical and computational analysis to analyze problems involving specific heat and heat capacity. PHY.3A.7
   8. Enrichment: Research to compare the first and second laws of thermodynamics as related to heat engines, refrigerators, and thermal efficiency. PHY.3A.8
   9. Explore the kinetic theory in terms of kinetic energy of ideal gases using digital resources. PHY.3A.9
   10. Enrichment: Research the efficiency of everyday machines (e.g., automobiles, hair dryers, refrigerators, and washing machines). PHY.3A.10
   11. Enrichment: Use an engineering design process to design and build a themed Rube Goldberg-type machine that has six or more steps and complete a desired task (e.g., pop a balloon, fill a bottle, shoot a projectile, or raise an object 35 cm) within an allotted time. Include a poster that demonstrates the calculations of the energy transformation or efficiency of the machine. PHY.3A.11

4. **Waves** PHY.4

4A. Students will investigate and explore wave properties. PHY.4A

1. Analyze the characteristics and properties of simple harmonic motions, sound, and light. PHY.4A.1
2. Describe and model through digital or physical means the characteristics and properties of mechanical waves by simulating and investigating properties of simple harmonic motion. PHY.4A.2
3. Use mathematical and computational analysis to explore wave characteristics (e.g., velocity, period, frequency, amplitude, phase, and wavelength). PHY.4A.3
4. Investigate and communicate the relationship between the energy of a wave in terms of amplitude and frequency using probe systems, online simulations, and/or laboratory experiences. PHY.4A.4
5. Design, investigate, and collect data on standing waves and waves in specific media (e.g., stretched string, water surface, and air) using online simulations, probe systems, and/or laboratory experiences. PHY.4A.5
6. Explore and explain the Doppler effect as it relates to a moving source and to a moving observer using online simulations, probe systems, and/or real-world experiences. PHY.4A.6
7. Explain the laws of reflection and refraction, and apply Snell's law to describe the relationship between the angles of incidence and refraction. PHY.4A.7
8. Use ray diagrams and the thin lens equations to solve real-world problems involving object distance from lenses, using a lens bench, online simulations, and/or laboratory experiences. PHY.4A.8
9. Research the different bands of electromagnetic radiation, including characteristics, properties, and similarities/differences. PHY.4A.9
10. Enrichment: Research the ways absorption and emission spectra are used to study astronomy and the formation of the universe. PHY.4A.10
11. Enrichment: Research digital nonfictional text to defend the wave-particle duality of light (i.e., wave model of light and particle model of light). PHY.4A.11
12. Enrichment: Research uses of the electromagnetic spectrum or photoelectric effect. PHY.4A.12

5. **Electricity and Magnetism** PHY.5

   5A. Students will investigate the key components of electricity and magnetism. PHY.5A

      1. Analyze and explain electricity and the relationship between electricity and magnetism. PHY.5A.1
      2. Explore the characteristics of static charge and how a static charge is generated using simulations. PHY.5A.2
      3. Use mathematical and computational analysis to analyze problems dealing with electric field, electric potential, current, voltage, and resistance as related to Ohm's law. PHY.5A.3
      4. Develop and use models (e.g., circuit drawing and mathematical representation) to explain how electric circuits work by tracing the path of electrons, including concepts of energy transformation, transfer, conservation of energy, electric charge, and resistance using online simulations, probe systems, and/or laboratory experiences. PHY.5A.4
      5. Design and conduct an investigation of magnetic poles, magnetic flux and magnetic field using online simulations, probe systems, and/or laboratory experiences. PHY.5A.5
      6. Use schematic diagrams to analyze the current flow in series and parallel electric circuits, given the component resistances and the imposed electric potential. PHY.5A.6
      7. Analyze and communicate the relationship between magnetic fields and electrical current by induction, generators, and electric motors (e.g., microphones, speakers, generators, and motors) using Ampere's and Faraday's laws. PHY.5A.7
      8. Enrichment: Design and construct a simple motor to develop an explanation of how the motor transforms electrical energy into mechanical energy and work. PHY.5A.8
      9. Enrichment: Design and draw a schematic of a circuit that will turn on/off a light from two locations in a room like those found in most homes. PHY.5A.9

6. **Nuclear Energy** PHY.6

   6A. Students will demonstrate an understanding of the basic principles of nuclear energy. PHY.6A

      1. Analyze and explain the concepts of nuclear physics. PHY.6A.1
      2. Explore the mass number and atomic number of the nucleus of an isotope of a given chemical element. PHY.6A.2
      3. Investigate the conservation of mass and the conservation of charge by writing and balancing nuclear decay equations for alpha and beta decay. PHY.6A.3
      4. Simulate the process of nuclear decay using online simulations and/or laboratory experiences and using mathematical computations determine the half-life of radioactive isotopes. PHY.6A.4