

FLINT RIVER ACADEMY SCIENCE STANDARDS

PHYSICS

1. Nature of Science

- a. Through narrative research of the history of science, examine the questions of what is science and how do we come to know things
- b. Discern the empirical and tentative nature of science
- c. Identify and evaluate the interaction between human nature and the scientific process
- d. Demonstrate an appreciation for the persistence required to gain scientific knowledge
- e. Analyze how science and society interact from a historical, political, economic and social perspective. Describe how these factors have affected developments in science
- f. Explain the progression of ideas and explanations that lead to science theories which are a part of the current scientific consensus or core knowledge
- g. Discuss how physics discoveries both theory and experimental result in advancements in communication, medicine, transportation, commerce, exploration and technology by identifying applications in everyday situations
- h. Define physics and rationalize the relationship between physics and philosophy

2 Mechanics with a Mathematical Emphasis

- a. Visualize data by:
 1. Interpreting the meaning of linear, parabolic and hyperbolic curves on graphs
 2. Recognizing and manipulate linear and direct relationships
 3. Recognizing and manipulate quadratic (parabolic) relationships
 4. Recognizing and manipulate inverse (hyperbolic) relationships
 5. Demonstrating the capacity to use the trigonometry of right triangles
- b. Build an understanding of linear motion
 1. Identify a frame of reference for measurement of position and identify the initial position of the object
 2. Develop the definition of velocity as the rate of change of position conceptually, mathematically and graphically
 3. Apply the equations developed to several applications where objects are moving with constant velocity
 4. Define vector and scalar, incorporating magnitude and direction
 5. Apply concepts of speed and velocity to solve conceptual and quantitative problems
 6. Distinguish between distance and displacement conceptually and mathematically
 7. Solve quantitative problems involving distance and displacement

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8. Clarify that a positive value for velocity indicates motion in one direction while a negative value indicates motion in the opposite direction
 9. Develop the definition for constant (uniform) acceleration as the rate of change of velocity conceptually, mathematically, and graphically
 10. Analyze visual representations of constant and changing velocity
 11. Use kinematics equations to solve for acceleration
 12. Apply concepts of constant (uniform) acceleration to objects in free fall and solve application problems
 13. Measure position vs. time of an object moving with constant velocity
 - Plot a position vs. time graph of the measurements
 - Recognize that the relationship is linear and construct a best-fit line
 - Identify the slope of the line as the change in position over time (velocity) and the y-intercept as the initial position for the give time interval
 - Using the slope y-intercept equation from the graphs, derive corresponding mathematical relationships
 - Identify change in position as displacement
 14. Measure position and time of an object moving with constant acceleration.
 - Plot a position vs. time graphs of the measurements
 - Recognize that the relationship is not linear but parabolic indicating that position is proportional to time squared
 - At various points on the curve, draw lines tangent to the curve and develop the concept of instantaneous velocity
 - Give several examples of and compare position vs. time, velocity vs. time and acceleration vs. time graphs
 - Recognize that the sloe of the line on an instantaneous velocity vs. time graph is the acceleration
 - Develop appropriate equations and solve problems involving objects experiencing constant acceleration as in rolling down an inclined plane or free falling toward earth
- c. Build an understanding of two-dimensional motion including circular motion.
1. Analyze and evaluate projectile motion in a defined frame of reference
 2. Resolve vectors into vertical and horizontal components
 3. Evaluate the motion of a projectile both horizontally and vertically
 4. Design and conduct investigations of two-dimensional motion of objects

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- Select appropriate measurements for an investigation of projectile motion
 - Identify factors that may affect results
 - Predict and measure the path of the projectile including horizontal range, maximum height, and time in flight
5. Analyze and evaluate independence of vector components of projectile motion
 6. Evaluate, measure and analyze circular motion
 7. Analyze and evaluate the nature of centripetal forces
 8. Investigate, evaluate and analyze the relationship among centripetal force, centripetal acceleration, mass, velocity, and radius through manipulation and equations
- d. Understand forces and Newton's Laws of Motion.
1. Determine that an object will continue in its state of motion unless acted upon by a net outside force
 2. Define inertia
 3. Assess, measure and calculate the conditions required to maintain a body in a state of static equilibrium
 4. Describe forces as interactions between two objects, including contact and forces at a distance
 5. Describe the four fundamental forces and illustrate the environment in which each can be observed
 6. Define normal force
 7. Analyze force diagrams to calculate the net force on an object.
 8. Assess, measure, and calculate the relationship among the force acting on a body, the mass of the body, and the nature of the acceleration produced
 9. Apply proportional reasoning to the relationship $F = ma$
 10. Make appropriate calculations using the mathematical description of Newton's Second Law of Motion
 11. Analyze and mathematically describe forces as interactions between bodies
 12. Assess the independence of the vector components of forces.
 13. Resolve forces into components
 14. Apply Newton's Laws of Motion to the perpendicular components of force in the following examples:
 - Objects pulled or pushed along a horizontal surface by a force at an angle to the surface
 - Objects sliding down an inclined plane
 - Three concurrent force acting on an object in static equilibrium
 15. Investigate, and analyze the nature and magnitude of frictional forces

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16. Assess and calculate the nature and magnitude of gravitational forces
- e. Build an understanding of impulse and momentum.
 1. Assess the vector nature of momentum and its relations to the mass and velocity of an object
 2. Apply the momentum equation of $p = mv$
 3. Compare and contrast impulse and momentum
 4. Analyze the factors required to produce a change in momentum.
 5. Apply the impulse equation in various situations
 6. Analyze one dimensional interactions between objects and recognize that the total momentum is conserved in both collision and recoil situations
 7. Solve problems using conservation of momentum
 8. Identify the special case of an elastic collision (recoil) where the objects do not stick together and both momentum and kinetic energy are conserved
 9. Assess real world applications of impulse and momentum, including but not limited to, sports and transportation.
 10. Solve collision problems
 11. Distinguish between elastic and inelastic collisions. Display an ability to calculate the result of elastic collisions using the Laws of Conservation of Energy and Momentum

5. Thermodynamics

- a. Evaluation and investigation of temperature and heat
 1. Understand and describe that nature of thermal energy as explained by the kinetic theory
 2. Distinguish thermal energy from temperature
 3. Explain the process of equilibrium and its application to the measurement of temperature
 4. State the First Law of Thermodynamics; distinguish heat from work and both from thermal energy; relate all to the function of a heat engine, refrigerator and heat pump
 5. Explain that the total useful energy of an open system is constantly declining due to entropy
 6. Define and use the terms and/or symbols for: enthalpy, entropy, specific heat capacity, temperature, joule, endothermic reactions, exothermic reaction, and catalyst
 7. Interpret the following:
 - Heating and cooling curves (noting both significance of plateaus and the physical states of each segment)
 - Phases diagrams for water and carbon dioxide
 - Energy vs. reaction pathway diagrams for both positive and negative values of change in enthalpy

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8. Complete calculations of: heat, specific heat, heat of fusion, heat of vaporization, heat lost vs. heat gained, and phase changed for calorimetry work
- b. Evaluation of Entropy
1. Analyze the relationship between entropy and disorder in the universe
 2. Understand entropy as a measure of disorder
 3. Recognize that the entropy of the universe is increasing
 4. Explain that, along with a tendency for systems to proceed toward the lowest energy level, they also move in the direction of the greatest entropy
- 6. States of Matter**
- a. The Fluid and Solid States
1. Understand the origin of Pascal's and Archimedes' Principles and apply both to everyday applications such as hydraulic machines and determination of buoyant force
 2. Explain Bernoulli's Principle and its applications in producing lift; understand the difference between streamlined and turbulent flow
 3. Describe how cohesive and adhesive forces cause surface tension and capillary action, respectively
 4. Relate the origin of evaporation and condensation to the kinetic model
 5. Compare solids, liquids, gases, and plasmas at a microscopic level, and relate their properties to their structures
 6. Explain why solids expand and contract when the temperature changes
 7. Calculate the expansion of solid and discuss the problems caused by expansion
 8. Make calculations using Pascal's Principle and Archimedes' Principle
 9. Explain phenomenon applying the appropriate principle.
 - The flight of a curve ball
 - The flight of a golf ball
 - The factors that allow airplanes to fly
 - The fact that humans sink in water as they exhale

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7. The Gas Law

1. Behavior of gases
2. List the assumptions of the kinetic theory and the definition of an ideal gas
3. Demonstrate an understanding of the concept of pressure and the definition of the pascal and other pressure units; understand the microscopic cause of gas pressure
4. State Boyle's Law and demonstrate an ability to use it in solving problems while understanding the microscopic basis of the law
5. State Charles' Law and demonstrate an ability to use it in solving problems as well as relating it to absolute zero
6. Understand the formulation of the ideal gas law and be able to solve applicable problems
7. Distinguish between real and ideal gases and relate the limitations of the ideal gas law

Investigation and Experimentation

1. Make observations, raise questions and formulate hypotheses.
 - a. Observe the world from a scientific perspective
 - b. Pose questions and form hypotheses based on personal observations, scientific articles, experiments and knowledge
 - c. Read, interpret, and examine credibility and validity of scientific claims in different sources of information, such as scientific articles, advertisements, or media stories
 - d. Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted
2. Design and conduct scientific investigations.
 - a. Articulate and explain the major concepts being investigated and the purpose of an investigation
 - b. Select required materials, equipment, and conditions for conducting an experiment
 - c. Identify independent and dependent variables
 - d. Write procedures that are clear and replicable
 - e. Employ appropriate methods for accurately and consistently making observations, making and recording measurements at appropriate levels of precision and collecting evidence or data in an organized way
 - f. Properly use instruments, equipment, and materials (scales, balances, meter sticks, probeware, microscopes, computers, etc...) including set up, calibration, technique, maintenance, and storage
 - g. Follow safety guidelines
3. Analyze and interpret results of scientific investigations.
 - a. Present relationships between and among variables in appropriate forms using charts, graphs, appropriate technology (graphing software) and other tools

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- b. Use mathematical operations to analyze and interpret data results
 - c. Assess the reliability of data and identify reasons for inconsistent results, such as sources of error or uncontrollable conditions
 - d. Recognize, analyze, and evaluate alternative explanations for the same set of observations
 - e. Use results of an experiment to develop a conclusion to an investigation that addresses the initial questions and supports or refutes the stated hypothesis
 - f. State questions raised by an experiment that may require further investigation
4. Communicate and apply the results of scientific investigations.
- a. Develop descriptions of explanations for scientific concepts that were a focus of one or more investigations
 - b. Review information, explain statistical analysis and summarize data collected and analyzed as the result of the investigation
 - c. Explain diagrams and charts that represent relationships between variables
 - d. Construct a reasoned argument and respond appropriately to critical comments and questions
 - e. Use language and vocabulary appropriately, speak clearly and logically, and use appropriate technology and other tools to present findings
 - f. Use and refine scientific models that stimulate physical processes or phenomena

Application of Mathematical Skills

- a. Construct and use tables and graphs to interpret data sets
- b. Solve simple algebraic expressions
- c. Perform basic statistical procedures to analyze the center and spread of data
- d. Measure with accuracy and precision (length, volume, mass, temperature, time)
- e. Convert within a unit
- f. Use common prefixes such as milli, centi, and kilo
- g. Use scientific notation, where appropriate
- h. Use ratio and proportions to solve problems
- i. Translate data into the correct units and dimensions using conversion factors and scientific notation
- j. Determine the correct number of significant figures
- k. Determine percent error from experimental and accepted values
- l. Use appropriate metric/standard international (SI) units of measurement
- m. Use the Celsius and Kelvin scales

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Flint River Academy
Physics

Year Curriculum Map

Year Curriculum Map										
1st Nine Weeks			2nd Nine Weeks				3rd Nine Weeks		4th Nine Weeks	
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8	Unit 9	Unit 10	Unit 11
Nature of Science	Physics and Philosophy	Visualize Data Through Graphing	Mechanics Linear Motion	Mechanics Forces	Laws of Motion	Two Dimensional and Circular Motion	Mechanics Impulse and Momentum	Thermodynamics and Entropy	States of Matter	Gas Laws
2 weeks	3 weeks	3 weeks	3 weeks	3 weeks	2 weeks	3 weeks	3 weeks	7 weeks	4 weeks	3 weeks