

# **Physics**

**Grade 11 and 12**

**Hopatcong Board of Education**

**August 2006**

# Physics

## Revised August 2006

**COURSE DESCRIPTION:** (The course description sets the parameters, scope and sequence for the course:

In Physics, students conduct field and laboratory investigations, use scientific methods during investigations, and make informed decisions using critical thinking and scientific problems solving. Students study a variety of topics that include: laws of motion; change within a physical systems and conservation of energy and momentum; forces; thermodynamics; characteristics and behavior of waves; and electricity. This course provides students with a conceptual framework, and factual knowledge, and analytical and scientific skills.

**CORE CURRICULUM CONTENT STANDARDS:** (Quoted from state Document)

**STANDARD 5.1 (SCIENTIFIC PROCESSES)** All students will develop problem-solving, decision-making and inquiry skills, reflected by formulating usable questions and hypotheses, planning experiments, conducting systematic observations, interpreting and analyzing data, drawing conclusions, and communicating results.

**STANDARD 5.2 (SCIENCE AND SOCIETY)** All students will develop an understanding of how people of various cultures have contributed to the advancement of science and technology, and how major discoveries and events have advanced science and technology.

**STANDARD 5.3 (MATHEMATICAL APPLICATIONS)** All students will integrate mathematics as a tool for problem-solving in science, and as a means of expressing and/or modeling scientific theories.

**STANDARD 5.4 (NATURE AND PROCESS OF TECHNOLOGY)** All students will understand the interrelationships between science and technology and develop a conceptual understanding of the nature and process of technology.

**STANDARD 5.7 (PHYSICS)** All students will gain an understanding of natural laws as they apply to motion, forces, and energy transformations.

**STANDARD 5.9 (ASTRONOMY and SPACE SCIENCE)** All students will gain an understanding of the origin, evolution, and structure of the universe.

## **CUMULATIVE PROGRESS INDICATORS** (Quoted from state document)

### **5.1 (Scientific Processes)**

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

- A. Habits of Mind
  1. When making decisions, evaluate conclusions, weigh evidence, and recognize that arguments may not have equal merit.
  2. Assess the risks and benefits associated with alternative solutions.
  3. Engage in collaboration, peer review, and accurate reporting of findings.
  4. Explore cases that demonstrate the interdisciplinary nature of the scientific enterprise.
- B. Inquiry and Problem Solving
  1. Select and use appropriate instrumentation to design and conduct investigations.
  2. Show that experimental results can lead to new questions and further investigations.
- C. Safety
  1. Understand, evaluate and practice safe procedures for conducting science investigations.

### **5.2 (Science and Society)**

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

- A. Cultural Contributions
  1. Recognize the role of the scientific community in responding to changing social and political conditions and how scientific and technological achievement affect historical events.
- B. Historical Perspectives
  1. Examine the lives and contributions of important scientists who effected major breakthroughs in our understanding of the natural and designed world.
  2. Discuss significant technological achievements in which science has played an important part as well as technological advances that have contributed directly to the advancement of scientific knowledge.
  3. Describe the historical origin of important scientific developments such as atomic theory, genetics, plate tectonics, etc., showing how scientific theories develop, are tested, and can be replaced or modified in light of new information and improved investigative techniques.

### **5.3 (Mathematical Applications)**

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

- A. Numerical Operations
  - 1. Reinforce indicators from previous grade level.
- B. Geometry and Measurement
  - 1. When performing mathematical operations with measured quantities, express answers to reflect the degree of precision and accuracy of the input data.
- C. Patterns and Algebra
  - 1. Apply mathematical models that describe physical phenomena to predict real world events.
- D. Data Analysis and Probability
  - 1. Construct and interpret graphs of data to represent inverse and non-linear relationships, and statistical distributions.

### **5.4 (Nature and Process of Technology)**

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

- A. Science and Technology
  - 1. Know that scientific inquiry is driven by the desire to understand the natural world and seeks to answer questions that may or may not directly influence humans, while technology is driven by the need to meet human needs and solve human problems.
- B. Nature of Technology
  - 1. Assess the impacts of introducing a new technology in terms of alternative solutions, costs, tradeoffs, risks, benefits and environmental impact.
- C. Technological Design
  - 1. Plan, develop, and implement a proposal to solve an authentic, technological problem.

### **5.7 (Physics)**

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

- A. Motion and Forces
  - 1. Apply the mathematical relationship between the mass of an object, the net force exerted on it, and the resulting acceleration.
  - 2. Explain that whenever one object exerts a force on another, an equal and opposite force is exerted on the first object.
  - 3. Recognize gravity as a universal force of attraction between masses and that the force is proportional to the masses and inversely proportional to the square of the distance between them.

4. Recognize that electrically charged bodies can attract or repel each other with a force that depends upon the size and nature of the charges and the distance between them and know that electric forces play an important role in explaining the structure and properties of matter.
  5. Know that there are strong forces that hold the nucleus of an atom together and that significant amounts of energy can be released in nuclear reactions (fission, fusion, and nuclear decay) when these binding forces are disrupted.
  6. Explain how electromagnetic, gravitational, and nuclear forces can be used to produce energy by causing chemical, physical, or nuclear changes and relate the amount of energy produced to the nature and relative strength of the force.
  7. Demonstrate that moving electric charges can produce magnetic forces and moving magnets can produce electric forces.
  8. Recognize that magnetic and electrical forces are different aspects of a single electromagnetic force.
- B. Energy Transformations
1. Explain how the various forms of energy (heat, electricity, sound, light) move through materials and identify the factors that affect that movement.
  2. Explain that while energy can be transformed from one form to another, the total energy of a closed system is constant.
  3. Recognize that whenever mechanical energy is transformed, some heat is dissipated and is therefore unavailable for use.
  4. Explain the nature of electromagnetic radiation and compare the components of the electromagnetic spectrum from radio waves to gamma rays.

## **5.9 (Astronomy and Space Science)**

Building upon knowledge and skills gained in preceding grades, by the end of Grade 12, students will:

- A. Earth, Moon, Sun System
  1. Reinforce indicators from previous grade level.
- B. Solar System
  1. Explain that our solar system coalesced from a nebular cloud of gas and dust left from exploding stars.
- C. Stars
  1. Describe the physical characteristics, stages of development, and the apparent motions of stars.
- D. Galaxies and Universe
  1. Describe data gathering and observation technologies and explain how they are used to explore the solar system and beyond.
  2. Cite evidence to describe the scientific theory of the origin of the universe and the current explanations of its evolution.

**SUGGESTED ACTIVITIES THAT ADDRESS THESE STANDARDS MAY INCLUDE BUT ARE NOT LIMITED TO: (Arranged by standard)**

**Standard 5.1 (Scientific Processes)**

Lab- Introduction to the Scientific Method

Lab Manual- Lab 1 Measurement of Length page 5-8

Lab Manual – Lab 2 Measurement of Density page 9-12

Pocket Lab- Falling page 5

Egg Drop Challenge

**5.2 (Science and Society)**

Students will read the information in the text and discuss or write reaction papers on the science and society issue.

Research Dollar – page 8

Assessing Risk – page 70

Energy from Tides – page 266

You Can't Take it with you – page 356

Research Paper on famous Physicist

**5.3 (Mathematical Applications)**

Students will use various physics equations throughout the year to solve algebraic problems.

Worksheets

Problems in textbook throughout chapter and end of chapter

Lab

Graphing Experimental Data – page 13

Design your own Physics Lab Mystery Plot- Page 32

Problem Solving Strategies

Estimates- Page 17

Factor Label Method- page 20

Plotting Line Graphs – page 31

#### **5.4 (Nature and Process of Technology)**

Students will read the information in the text and discuss or write reaction papers on the science and technology issue.

The Zero Gravity Trainer – page 95

Looping Roller Coaster – page 167

Global Positioning Systems – Page 178

High Tech Tennis Rackets - page 202

#### **5.7 (Physics)**

Students will use various physics equations throughout the year to solve algebraic problems to understand the outcomes of physical events.

Worksheets

Problems in textbook throughout chapter and end of chapter

Labs

Graphical Analysis of Motion- page 21

Graphical Analysis of Motion: Uniform Acceleration- page 25

Force and Acceleration – Page 27

Centripetal Force – page 51

Conservation of Energy: The Inclined Plane – page 75

The Conservation of Thermal Energy – page 79

Wave Properties- Page 103

Static Electricity- page 153

Magnetic Fields Around Magnets- page 185

Half Life Simulation – page 233

#### **5.9 (Astronomy and Space Science)**

Students will use various physics equations throughout the year to solve algebraic problems to understand the outcomes of physical events.

Worksheets

Problems in textbook throughout chapter and end of chapter

Labs

Keplers Law of Equal Areas- Page 59

The Orbit- page 179 in textbook

Going Further- Design Sports Events on another planet- page 197

## **INSTRUCTIONAL STRATEGIES:**

### **Standard 5.1 (Scientific Processes)**

- The teacher will explain the steps used in the scientific method.
- Perform various laboratory investigations

### **5.2 (Science and Society)**

- The teacher will present students with examples of contributions of scientists who contributed to the area of physics.
- The teacher will describe the historical origin of important scientific breakthroughs.
- The student will perform research on a scientist and their importance to science.

### **5.3 (Mathematical Applications)**

- The teacher will demonstrate the methods of solving various physics problems.
- The teacher will demonstrate the methods of constructing and interpreting graphs.
- The students will solve various physics problems.
- The students will construct and interpret an number of graphs.

### **5.4 (Nature and Process of Technology)**

- The teacher will explain the need for technology to meet human needs and solve human problems.
- The teacher will describe how to plan, develop and implement a proposal to solve a technological problem.

### **5.7 (Physics)**

- The teacher will demonstrate the methods of solving various physics problems.
- The students will solve various physics problems.
- The teacher will explain the importance of conservation laws in physics: energy and momentum.
- The teacher will explain the relationship between various forces and the motion of objects.
- The teacher will explain the difference between fission and fusion reactions and how they relate to them.

### **5.9 (Astronomy and Space Science)**

- The teacher will explain how stars are formed and their life cycle.
- The teacher will describe the theories on how the universe was formed.

## **EVALUATION/ASSESSMENT OF STUDENTS:**

### **Students will be evaluated/assessed on the following criteria:**

Laboratory Reports

Daily Assignments

Tests

Quizzes

Independent Project

## **EVALUATION/ASSESSMENT OF CURRICULUM:**

This course of study will be evaluated/assessed by instructional staff during the first year of implementation for the purpose of necessary revision at the end of the first year. In addition, this course of study will be reviewed according to the Five-Year Curriculum Review schedule (see attached).

### **Resources/Bibliography:**

Physics: Principles and Problems – Glencoe

Physics: Principles and Problems Lab Manual