

**HOPATCONG BOROUGH SCHOOL**  
**MIDDLE SCHOOL SCIENCE CURRICULUM**  
**GRADE 8**  
**AUGUST, 2009**

## PHYSICAL SCIENCE 2009

**COURSE DESCRIPTION:** The main focus of the eighth grade science curriculum is to familiarize the students with the many components of physical science and how it interacts with our daily living. Emphasis shall be placed on Matter (atoms, properties and changes in matter), Forces and Motion (force, mass, acceleration, Newton's laws, friction), Forms of Energy (heat, sound, light, transfer of energy). Furthermore, the eighth grade curriculum will provide a brief review of all standards covered in the sixth and seventh grade science curriculum. This course is designed to encourage students to develop and use problem-solving and decision-making skills along with collaborative research techniques through experimentation. Students will be formulating questions and hypotheses along with interpreting and analyzing data, drawing conclusions and communicating results.

All middle school science classes will cover problem solving and mathematics (problem solving in science, scientific procedures, mathematics in science), and history of science, technology and society (relationships between science, technology, and society, scientific measurement tools, observational strategies, technological advancements and space exploration).

Technology literacy will be addressed in the science classroom as students utilize computer applications to gather and organize data and solve problems.

By the discovery process, the students will develop an understanding of fundamental scientific principles and science-related skills.

The sequence of the course will be determined by the classroom teacher pending material availability.

## **CORE CURRICULUM CONTENT STANDARDS:**

**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, 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 5.5 (CHARACTERISTICS OF LIFE)** All students will gain an understanding of the structure, characteristics, and basic needs of organisms and will investigate the diversity of life.

**STANDARD 5.6 (CHEMISTRY)** All students will gain an understanding of the structure and behavior of matter.

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

**STANDARD 5.8 (EARTH SCIENCE)** All students will gain an understanding of the structure, dynamics, and geophysical systems of the earth.

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

**STANDARD 5.10 (ENVIRONMENTAL STUDIES)** All students will develop an understanding of the environment as a system of interdependent components affected by human activity and natural phenomena.

**STANDARD 8.1 (COMPUTER AND INFORMATIONAL LITERACY)** All students will use computer applications to gather and organize information and to solve problems.

**STANDARD 8.2 (TECHNOLOGY EDUCATION)** All students will develop an understanding of the nature and impact of technology, engineering, technological design, and the designed world as they relate to the individual society, and the environment.

## **CUMULATIVE PROGRESS INDICATORS**

**SUGGESTED ACTIVITIES THAT ADDRESS THESE STANDARDS WHICH MAY INCLUDE BUT ARE NOT LIMITED TO:**

## **5.1 Scientific Processes**

### **A. Habits of Mind**

1. What constitutes evidence?
2. When do you know you have enough and the right kind of evidence?
3. How can this result be best justified and explained to others?
  - Evaluate the strengths and weaknesses of data, claims, and arguments.
  - Communicate experimental findings to others.
  - Recognize that the results of scientific investigations are seldom exactly the same and that replication is often necessary.
  - Recognize that curiosity, skepticism, open-mindedness, and honesty are attributes of scientists.

### **B. Inquiry and Problem Solving**

1. What makes a question scientific?
  - Identify questions and make predictions that can be addressed by conducting investigations.
  - Design and conduct investigations incorporating the use of a control.
  - Collect, organize, and interpret the data that result from experiments.

### **C. Safety**

1. What does Safety First demand of us in each setting?
2. What rules are general and what are situation-specific?
  - Know when and how to use appropriate safety equipment with all classroom materials.
  - Understand and practice safety procedures for conducting science investigations

### *SUGGESTED ACTIVITIES:*

- Students will identify, interpret, and construct a graph from data obtained through experimentation.
- Review and discuss the various aspects of correct procedure for laboratory processes and reporting using models that students can follow.
- Review and discuss proper lab report format for use throughout year.
- Use video presentations to address the aspect of safety in a science classroom setting.
- Research and discuss lab safety procedures in science classroom and lab.
- Have students design inquiry based lab situations related to each unit of study. Prior to executing lab activity, students must run purpose, materials and procedure by teacher for approval based on relevance and safety.
- Using cooperative learning groups, students can present and communicate their experimental findings from lab work.
- Make comparative listings of similarities and differences found in the results of each cooperative learning lab group's work. Discuss these similarities and differences.
- Take field trips to area laboratories. (Mennen, Warner Lambert, Schering Plough, etc.)
- Use of the NJ ASK booklets and NJ ASK practice tests.

## **5.2 Science and Society**

### **A. Cultural Contributions**

1. What do we mean in science when we say that we stand on the shoulders of giants?
  - Recognize that scientific theories develop over time, depend on the contributions of many people, and reflect the social and political climate of their time.
  - Know that scientists are men and women of many cultures who often work together to solve scientific and technological problems.
  - Describe how different people in different cultures have made and continue to make contributions to science and technology.

### **B. Historical Perspectives**

1. How do science and technology influence each other?
  - Describe the impact of major events and people in the history of science and technology, in conjunction with other world events.
  - Describe the development and exponential growth of scientific knowledge and technological innovations.

#### *SUGGESTED ACTIVITIES:*

- Use video presentations of the lives of famous scientists from around the world to show the contributions that men and women from various cultures have made.
- Invite guest speakers to talk to students about contributions scientists around the world have made.
- Using Internet resources, have connections to NASA where students can communicate with astronauts from around the world.
- Using cooperative groups, have students research the life of a scientist from New Jersey, the USA, and other countries of the world. Have students search for the contributions that the scientist has made and how they have affected the world.
- Using video presentations about the biographies of famous scientists (Einstein, Edison, etc.) students will be able to compare the attributes of a scientist.
- Research and discuss STEM (science, engineering, technology, and mathematics) career opportunities.
- Brainstorm different world events that have been affected through the history of science.
- Use of the NJ ASK booklets.

## **5.3 Mathematical Applications**

### **A-D. Numerical Operations, Geometry and Measurement, Patterns and Algebra, Data Analysis and Probability**

1. How do we use mathematics to model objects, events and relationships in science?
  - Express quantities using appropriate number formats, such as decimals, percents, and scientific notation.

- Perform mathematical computations using labeled quantities and express answers in correctly derived units.
- Express physical relationships in terms of mathematical equations derived from collected data.
- Represent and describe mathematical relationships among variables using graphs and tables.
- Analyze experimental data sets using measures of central tendency such as mean, mode, and median.
- Construct and use a graph of experimental data to draw a line of best fit and identify a linear relationship between variables.
- Use computer spreadsheets, graphing and database applications to assist in quantitative analysis of data.

*SUGGESTED ACTIVITIES:*

- Introduce the units of measurement by lecture, visual, and physical handling of the required equipment (meter sticks, centimeter rulers, balances, graduates, protractors, and thermometers).
- Complete activities consisting of activity sheets dealing with symbol identifications of metric units and converting metric units from one form to another. (Ex. 1m to 100cm)
- Construct a metric collage of everyday items that illustrate metric units.
- Utilizing the triple beam balance and electronic balance, predict and measure a variety of items.
- Work with a variety of graduated cylinders and measure the volumes of different containers.
- Examine and use a Celsius/Fahrenheit thermometer and compare on the scales.
- Construct and interpret graphs from various sets of data.
- Integrate real-world mathematics problems into laboratory experiments and data collection.
- Use of NJ ASK booklets and NJ ASK practice tests.

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

### **A. Science and Technology**

1. How do science and technology influence each other?

- Compare and contrast science with technology, illustrating similarities and differences between these two human endeavors.

### **B. Nature of Technology**

1. Are there ways to circumvent physical and social constraints when using technology?

- Analyze a product or system to determine the problem it was designed to solve, the design constraints, trade-offs and risks involved in using the product or system, how the product or system might fail, and how the product or system might be improved.

### **C. Technological Design**

1. How is the overarching concept of systems related to design and technology?

- Recognize how feedback loops are used to control systems.

*SUGGESTED ACTIVITIES:*

- Use of Internet websites.
- Compare/contrast the technology design process with the scientific method.
- Brainstorm similarities and differences of science with technology in either a whole group setting or in cooperative learning groups. If in cooperative learning groups, upon completion have each group report back to the class as a whole and then compare and contrast the outcomes of each group.
- Identify examples of how demands for scientific knowledge lead to development of new technology in the fields of physics and chemistry (ex. need for precision die cutting led to the use of a laser beam in metal shops).
- Using the technology design process, instruct students to create a new form of technology, either realistic or fictional.
- Individualize class projects having students analyze a product or system to determine the problem that the system was designed to solve, the design constraints, trade offs, and the risks that are involved in using the product or system. Have students also report how the product or system might fail and how it might be improved.
  - Invite district technology personnel as guest speakers.
  - Possible field trips to a technology lab.
  - Video presentations.
  - Use of the NJ ASK booklets and NJ ASK practice tests.

## **5.5 Characteristics of Life**

### **A. Matter, Energy and Organization in Living Systems**

1. How is matter transformed, and energy transferred/transformed?
  - Explain how the products respiration and photosynthesis are recycled.
  - Recognize that complex multicellular organisms, including humans, are composed of and are defined by interactions of cells, tissues, organs, and systems.

### **B. Diversity and Biological Evolution**

1. How are organisms of the same kind different from each other?
2. How does this help them reproduce and survive?
  - Compare and contrast kinds of organisms using their internal and external characteristics.
  - Discuss how changing environmental conditions can result in evolution or extinction of a species.
  - Recognize that individual organisms with certain traits are more likely to survive and have offspring.

### **C. Reproduction and Heredity**

1. How does the understanding of manipulation of genetics, reproduction, development and evolution affect quality of human life?
  - Describe how the sorting and recombining of genetic material results in the potential for variation among offspring of humans and other species.

*SUGGESTED ACTIVITIES:*

- This will be a review of material learned in previous grade levels.
- Use of NJ ASK booklets and NJ ASK practice tests.

## **5.6 Physical Science – Chemistry**

### **A. Structure and Properties of Matter**

1. How do properties of materials determine their use?

- Know that all matter is composed of atoms that may join together to form molecules.
- Recognize that the phase of matter is determined by the arrangement and motion of atoms and molecules and that the motion of these particles is related to the energy of the system.
- Know that there are groupings of elements that have similar properties, including highly reactive metals, less reactive metals, highly reactive non-metals, and some almost completely non-reactive gases.
- Recognize that a mixture often can be separated into the original substances using one or more of their characteristic physical properties.

### **B. Chemical Reactions**

1. What determines the type and extent of a chemical reaction?

- Show how substances can chemically react with each other to form new substances having properties different from those of the original substances.
- Show that in most chemical reactions energy is transferred into or out of a system.
- Demonstrate that regardless how substances within a simple closed system interact the total mass of the system remains the same.
- Illustrate how atoms are rearranged when substances react, but that the total number of atoms and the total mass of the products remain the same as the original substances.

*SUGGESTED ACTIVITIES:*

- Have students guess what object is inside a container based on the description given by another student. Relate to physical properties of matter.
- Have students work individually or in cooperative learning groups to examine a variety of common objects and list their properties. Compare lists with those of the rest of the class and discuss.
- Do the activity, “Observing Viscosity,” to have the students make the inference that the least viscous substance will flow the quickest.
- Combine vinegar and baking soda and observe and analyze the chemical change that results.
- Complete the activity, “Name that Element” to reinforce the students’ ability to identify elements and chemical symbols.
- Do the activity, “Growing Crystals,” to observe the formation of ionic bonds and the resulting salt crystals.
- Use video presentations on matter.

- Use Internet website access.
- Complete the activity, “Mystery Substance,” to apply students knowledge of heat and phase changes. Discuss.
- Carry out activity, “Changing the Boiling Point,” to discover that adding salt increases the boiling point of water.
- Invite high school chemistry teacher or a chemist in as a guest speaker.
- Complete the activity, “The Mystery Element,” to reinforce the students’ understanding of atomic number, isotopes, and atomic mass.
- Complete the activity, “A Balancing Act,” to reinforce the students’ understanding of how to balance a chemical equation.
- Have students create atoms and molecules depicting various states of matter using a variety of manipulatives.
- Instruct students to research physical and chemical changes and create a lab situation which depicts one of those changes. Lab must be approved by teacher for safety and procedural concerns. Students shall communicate results to peers via presentation and/or demonstration.
- Use Smart board software to manipulate atoms while balancing equations.
- Make mixtures using various materials, and then have the students determine how to separate the mixtures they have made.
- Illustrate Law of Conservation of Matter and Energy through use of visual aids.
- Differentiate between exothermic reactions and endothermic reactions through lab demonstrations and/or discussions.
- Use of NJ ASK booklets and NJ ASK practice tests.

## **5.7 Physics**

### **A. Motion and Forces**

1. How would the universe be different if one or more of the laws of motion were suspended?
  - Use quantitative data to show that when more than one force acts on an object at the same time, the forces can reinforce or cancel each other producing a net (unbalanced) force that will change speed and/or direction of the object.
  - Recognize that every object exerts a gravitational force on every other object, and that the force depends on how much mass the objects have and how far apart they are.

### **B. Energy Transformations**

1. How do we know that things have energy?
  - Recognize that the sun is a major source of the Earth’s energy and that the solar energy includes visible, infrared and ultraviolet radiation.
  - Describe the nature of various forms of energy, including heat, light, sound, chemical, mechanical, and electrical and trace energy transformations from one form to another.

- Describe how heat can be conducted through materials or transferred across space by radiation and know that if the material is fluid, convection currents may aid the transfer of heat.
- Show that light is reflected, refracted, or absorbed when it interacts with matter and that colors may appear as a result of this interaction.

*SUGGESTED ACTIVITIES:*

- Participate in a variety of games such as: Symbols and Sayings, What Moved?
- Solve a variety of word problems using the formula: momentum equals mass times velocity.
- Complete the lab on Marble Motion or Speed Lab to calculate the average speed based on the students' observations.
- Record the information data obtained from the Marble Motion or Speed Lab and put this information into a data table and then make a distance/time graph.
- Solve the practice problems in the text and use the acceleration formula to solve addition problems.
- Perform an experiment using a penny that is slid across the table to hit a quarter and then discuss how momentum was transferred to the quarter and how momentum was conserved or substitute a five ball pendulum apparatus as a demonstration of this same theory.
- Relate roller coaster and other theme park rides to the laws of motion and gravity. Instruct students to build or illustrate a ride showing the different forces at work.
- Collect photographs, illustrations, and headlines that depict motion and discuss which examples show acceleration or deceleration. Possibly make collages out of the pictures.
- Study the electromagnetic spectrum. Have students research and explain the various applications of radio waves through gamma rays.
- Utilizing visual and auditory resources, explain sound waves, how they travel, and the Doppler effect. Relate to SONAR and RADAR.
- Complete the activity, "Heat Loss," to discover examples of heat loss due to convection, conduction, and radiation.
- Carry out a calorie lab (marshmallow).
- Use of Internet websites.
- Use of video presentations.
- Consider the difference between two beakers of water, one filled with 500 ml of hot water and one filled with 1000ml of hot water. Brainstorm and list the differences and discuss.
- Have students observe the heating of a strip of foil-backed wrapping paper and have students make inferences about the function of the bimetallic strip in a thermostat.
- Have students work in cooperative groups to build the best insulator possible given a Styrofoam cup, a thermometer, hot water and various materials for insulation.
- Use of the NJ ASK booklets and NJ ASK practice tests.

**5.8 Earth Science**

### **A. Earth's Properties and Materials**

1. How does understanding the properties of Earth materials and the physical laws that govern behavior lead to prediction of Earth events?

- Reinforce indicators from previous grade level.

### **B. Atmosphere and Weather**

1. How do changes in one part of an Earth system affect other parts of the system?

- Describe conditions in the atmosphere that lead to weather systems and how these systems are represented on weather maps.

### **C. Processes that Shape the Earth**

1. How do geologic events occurring today provide insight into Earth's past?

- Explain how Earth's landforms and materials are created through constructive and destructive processes.
- Show how successive layers of sedimentary rock and the fossils contained in them can be used to confirm the age, history, changing life forms, and geology of Earth.

### **D. How We Study the Earth**

1. How does technology extend human senses and understanding of Earth?

- Utilize data gathered from emerging technologies (e.g., geographic information systems (GIS) and global positioning systems (GPS)) to create representations and describe processes of change on the Earth's surface.
- Explain how technology designed to investigate features of the Earth's surface impacts how scientists study the Earth.

### *SUGGESTED ACTIVITIES:*

- This will be a review of material learned in previous grade levels.
- Use of NJ ASK booklets and NJ ASK practice tests.

## **5.9 Astronomy and Space Science**

### **A. Earth, Moon, Sun System**

1. What predictable, observable patterns occur as a result of the interaction between Earth, Moon, and Sun?

2. What causes these patterns?

- Investigate the Earth, moon, and sun as a system and explain how the motion of these bodies results in the phases of the moon and eclipses.
- Explain how the regular and predictable motions of the Earth and moon produce tides.
- Explain how the tilt, rotation, and orbital pattern of the Earth relative to the sun produce seasons and weather patterns.

### **B. Solar System**

1. How are planets and other objects in the Solar System similar to and different from Earth?
2. What implication does this have for the existence and sustaining of life?
  - Describe the physical characteristics of the planets and other objects within the solar system and compare Earth to the rest of the planets.

### **C. Stars**

1. What characteristic does our Sun share with other stars?

Understand that the sun is a star and that it shares characteristics with other stars.

### **D. Galaxies and Universe**

1. Is there order to the Universe?
  - Know that the universe consists of many billions of galaxies, each including billions of stars.

#### *SUGGESTED ACTIVITIES:*

- This will be a review of material learned in previous grade levels.
- Use of NJ ASK booklets and NJ ASK practice tests.

## **5.10 Environmental Studies**

### **A. Natural systems and Interactions**

1. How can change in one part of an ecosystem affect change in other parts of the ecosystem?
  - Investigate the impact of catastrophic events such as forest fires, floods, and hurricanes on the environment of New Jersey.

### **B. Human Interactions and Impact**

1. How do humans impact the diversity and stability of ecosystems?
  - Compare and contrast practices that affect the use and management of natural resources.

#### *SUGGESTED ACTIVITIES:*

- This will be a review of material learned in previous grade levels.
- Use of NJ ASK booklets and NJ ASK practice tests.

## **8.1 Computer and Information Literacy**

### **A. Basic Computer Skills and Tools**

1. In a world of constant technological change, what skills should we learn?
2. How do I choose which technological tools to use and when it is appropriate to use them?
  - Input and access data and text efficiently and accurately through proficient use of other input devices, such as the mouse.
  - Create documents with advanced text-formatting and graphics using word processing.
  - Construct a simple spreadsheet, enter data, and interpret the information.
  - Design and produce a basic multimedia project.
  - Use network resources for storing and retrieving data.

## **B. Application of Productivity Tools**

1. How can I transfer what I know to new technological situations/experiences?
2. What are my responsibilities for using technology? What constitutes misuse and how can it best be prevented?
  - Describe and practice safe Internet usage.
  - Describe and practice “etiquette” when using the Internet and electronic mail.
  - Choose appropriate tools and information resources to support research and solve real world problems, including but not limited to on-line resources, databases, search engines, and subject directories.
  - Evaluate the accuracy, relevance and appropriateness of print and non-print electronic information sources.
  - Determine when technology tools are appropriate to solve a problem and make a decision.

### *SUGGESTED ACTIVITIES:*

- Utilize the above skills and tools while teaching science content as applicable.

## **8.2 Technology Education**

### **A. Nature and Impact of Technology**

1. Can we control the pace at which technology is created? Should we, even if we can?
  - Describe the nature of technology and the consequences of technological activity.
  - Describe how components of a technological product, system, or environment interact.
  - Describe how one technological innovation can be applied to solve another human problem that enhance human life or extends human capability.

### **B. Design Process and Impact Assessment**

1. How does technology extend human capabilities? What are the positive and negative consequences of technology? Should technologies that produce negative impact continue to be used?
2. When are the most sophisticated tool required and when and the simplest tools best?
  - Demonstrate and explain how the design process is not linear.
  - Use hands on activities to analyze products and systems to determine how the design process was applied to create the solution.
  - Identify a technological problem and use the design process to create an appropriate solution.
  - Describe how variations in resources can affect solutions to a technological problem.
  - Select and safely use appropriate tools and materials in analyzing, designing, modeling or making a technological product, system or environment.

### **C. Systems in the Designed World**

1. Can a system continue to operate with a missing or malfunctioning component?
2. Is it always beneficial to use the most economical material/materials for production of a technological product?
  - Explain technological advances in medical, agricultural, energy and power, information and communication, transportation, manufacturing, and construction technologies.

- Explain reasons why human-designed systems, products, and environments need to be monitored, maintained, and improved to ensure safety, quality, cost efficiency, and sustainability.

*SUGGESTED ACTIVITIES:*

- See Science Standard 5.4

**Instructional Strategies (may include but are not limited to):**

Lectures  
Modeling Lab Procedure  
Student Driven Labs and Experiments  
Guest speakers/Video Conferencing  
Overhead presentations, PowerPoint presentation, and/or Smart board lessons  
WebQuests  
Podcasts  
Wikis, Blogs, Nings, Voicethreads, Twitter, etc.  
Brainstorming  
Video presentations, United Streaming Clips  
Use of NJASK materials  
Quizzes/tests  
Field trips  
Individual class projects  
Student oral presentations  
Cooperative learning groups  
Instructional and Review Games  
Problem solving activities  
Internet research  
Text, magazine and internet readings  
Activity sheets  
Utilization of rubrics

**Evaluation/Assessment of Students (may include but are not limited to):**

Observation  
Class participation  
Notebooks and packets  
Student projects  
Lab reports  
Homework  
Writing Activities (stories, compare/contrast, poems, response to prompts)  
Activity Sheets (Worksheets, graphs, tables, charts, etc.)  
Research Projects  
Quizzes/tests  
Power Points  
Communication platforms (Voicethreads, Wikis, Blogs, Nings, etc.)

**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:**

Science Explorer/Physical Science (Prentice -Hall, Inc. 2001)  
Sciencesaurus: A student handbook (Houghton Mifflin Company)  
Measuring Up on the New Jersey NJASK book (The Peoples Publishing Group, Inc.)  
Measuring Up on the New Jersey ASK Diagnostic Practice Test 1 – 3 (The Peoples  
Publishing Group, Inc.)  
Preparing for the New Jersey ASK (Amsco School Publishing, Inc.)  
New Jersey ASK Student Preparation Booklet (New Jersey Department of Education)  
Internet  
Library and Technology Labs  
Science-based journals and magazines  
Non-fiction trade books  
Lab Equipment  
Teacher-created resources