SECTION III
NSES CONTENT STANDARD B

PHYSICAL SCIENCE

1. Structure of Atoms (3 – 12)
2. Structure and Properties of Matter
3. Chemical and Physical Changes
4. Math Aspects of Science
5. Motion and Forces
6. Energy and its Interaction with Matter

"Raise your eyes and look about."
Isaiah 60: 4

Physical Science
K – 1 – 2

NSES: Physical Science, Content Standard B

As a result of activities in grades K – 1 – 2, all students should develop an understanding of:

- the properties of objects and materials
- position and motion of objects
- light, heat, electricity and magnetism

NJCCCS:

Standard 5.8

- All students will gain an understanding of the structure and behavior of matter.

Standard 5.9

- All students will gain an understanding of natural laws as they apply to motion, forces and energy transformation.

DIOCESAN STANDARDS:

- All students will understand the structure and properties of matter.
- All students will demonstrate an understanding of the nature of energy and its interactions with matter.

OUTCOMES: By the end of second grade, students will be able to:

- observe and list properties of matter discernible by using the five senses
- understand that force can affect the position and motion of an object
- recognize the existence and polarity of magnetism
- recognize that energy exists in the forms of heat, light and electricity

Physical Science Key Areas and Content Topics
K – 1 – 2

1. **Structure of Atoms: not introduced**

2. **Structure and Properties of Matter**
   - observable physical properties

3. **Chemical and Physical Changes**
   - changing properties of matter
   - water cycle

4. **Math Aspects of Science**
   - metric measurement
   - tables, charts and graphs

5. **Motion and Forces**
   - gravity
   - effect of force
   - direction/location

6. **Energy and their Interaction with Matter**
   - heat
   - light
   - electricity
   - sound
   - magnetism

2. STRUCTURE AND PROPERTIES OF MATTER

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Observable physical properties	• Use the five senses to identify and list the properties of a type of matter • Create riddles about different types of matter 🕮 • Be able to classify a set of objects according to physical properties, e. g. , *sort buttons made of various materials according to size and/or color* △	• Observe and measure the properties of matter, e.g., *size, shape, weight, color, texture* △ • Look for similarities and differences △

Teacher Comments:

3. CHEMICAL AND PHYSICAL CHANGES

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Changing the properties of matter	• Draw a picture and label the ingredients of a simple recipe and the results 🕮 • Give examples of the ways in which matter in the home is changed • Describe different "mystery liquids", e.g., *corn syrup, cooking oil, water, vinegar*, by their properties 🕮	• Cook or bake to demonstrate the changing of matter. Discuss the ways in which the matter changed △ • Explore the different results of combining water and salt, water and cornstarch, water and cooking coil, water and corn syrup • Change the size and shape of matter by molding clay △
• The water cycle	• Create and act out stories about the water cycle 🕮 • Create a classroom display showing uses of water by plants and animals	• Collect pictures showing how water is used by plants and animals ☺

4. MATH ASPECTS OF SCIENCE

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Metric measurement	• Measure using standard and non-standard tools 🖷 • Measure in metric units	• Explore the concept of measurement by measuring objects using standard measuring tools such as rulers and non-standard tools such as straws and paper clips
• Tables, charts and graphs	• Make a class table of data collected • Chart the results of the table • Draw and label bar graphs and pictographs	• Collect objects and sort and chart by the physical properties

5. MOTION AND FORCES

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Gravity	• Predict what will happen if an object is dropped from different heights 🕮	• Drop various objects from different heights and record the results △
• Effect of force	• Predict how the application of force will affect something 🕮	• Use a push or a pull to demonstrate the way a force can change the position of an object (Push and pull a variety of wheeled toys with varying degrees of force). Discuss what happens
• Direction/location	• Group task: observe and explain how things move 🕮 • Describe the location of an object by giving clues to its position 🕮	• Roll different objects down inclines of various degrees • Bounce and throw balls • Push and pull a variety of wheeled toys with varying degrees of force • Use playground equipment, e.g., *swing,* to experiment with different amounts and directions of forces ☺ • Read Aesop's fable, "The Tortoise and the Hare" 🕮 • Play a game in which one student chooses an object in the classroom and gives clues as to its location 🕮

6. ENERGY AND ITS INTERACTION WITH MATTER

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Heat, light, electricity	• Create a collage showing different types of energy 🕮 • Graph the resulting temperature changes when moving from an area in the sun to an area in the shade △ • Create a class book of different heat sources 🕮	• Move from a lighted to a shaded area to observe and record temperature △ • Demonstrate heat caused by friction (rubbing hands) • Observe drops of food coloring in warm and cool water
• Sound	• Create simple instruments (oatmeal box drum, stretched rubber band)	• Demonstrate how sound travels through vibration
• Magnetism	• Identify a magnet from a variety of metal objects • Classify objects as magnetic or non-magnetic and explain why they are different 🔑	• Explore various types of magnets

Physical Science
3 – 4 – 5

NSES: Physical Science, Content Standard B

As a result of activities in grades 3 – 4 – 5, all students should develop an understanding of:

- the properties of objects and materials
- position and motion of objects
- light, heat, electricity and magnetism

NJCCCS:

Standard 5.8

- All students will gain an understanding of the structure and behavior of matter.

Standard 5.9

- All students will gain an understanding of natural laws as they apply to motion, forces and energy transformation.

DIOCESAN STANDARDS:

- All students will understand the structure and properties of matter.
- All students will demonstrate an understanding of the nature of energy and its interactions with matter.

OUTCOMES: By the end of fifth grade, students will be able to:

- understand that energy can be transformed from one form to another
- identify the simple machines: lever, inclined plane, pulley, wheel and axle, screw and wedge
- recognize that simple machines can be combined
- recognize the interaction of forces, gravity and friction in doing work
- recognize that matter is composed of small particles and has physical and chemical properties

Physical Science Key Areas and Content Topics

3 – 4 – 5

1. **Structure of Atoms**
   - parts of the atom
2. **Structure and Properties of Matter**
   - physical properties
   - states of matter
3. **Chemical and Physical Changes**
   - changes in state
   - water cycle
4. **Math Aspects of Science**
   - metric measurement
   - tables, charts and graphs
   - calculations of mass, weight, volume and density
5. **Motion and Forces**
   - gravity
   - effect of force
   - work and energy
   - machines
6. **Energy an its Interaction with Matter**
   - solar energy
   - heat, light
   - sound
   - magnetism
   - electricity

1. STRUCTURE OF ATOMS

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Parts of an atom	• Draw and label a diagram of an atom 🕮 • Express some common compounds using chemical symbols, e.g., *water as H_2O* • Role play the interaction of atomic particles 🕮	• Research the structure of atoms using videos, encyclopedias and software △🕮 • Make models of atoms using everyday objects • Use paper clips to model the structure of a molecule (N.J.S.C.F. indicator 6 on p. 148) • Explore static electricity

2. STRUCTURE AND PROPERTIES OF MATTER

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Physical properties	• List the properties of different types of given matter	• Demonstrate physical changes in matter (add food coloring to water, tear paper, etc.)
• States of matter	• Draw and label a diagram of the arrangement of particles in a solid, a liquid and a gas	• Blow bubbles and describe the state of matter of the container, the solution and the bubbles

3. CHEMICAL AND PHYSICAL CHANGES

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Changes in state of matter	• Give examples of physical and chemical changes and explain why they are different	• Observe evaporation and condensation and discuss what happens in each process • Record in a journal the results of timing the evaporation of different liquids, e.g., *alcohol, water, vinegar, soda* 🕮
• Water cycle	• Design a system to purify water ☺ • Create a graph of the amount of water used for different purposes by the class △	• Observe water and other moisture in the environment and record the findings • Record in a log, the amount of water used by a student's family for one week 🕮

4. MATH ASPECT OF SCIENCE

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Metric measurement	• Demonstrate the ability to use a graduated cylinder, a balance, a thermometer and a centimeter ruler • Demonstrate the ability to calculate the amount of work done by using the formula Work = Effort x Distance	• Explore and practice using a graduated cylinder • Estimate and weigh a variety of objects on a balance • Observe and record the temperatures of different materials under different conditions, e.g., *different colored liquids or solids in and out of the sun* 🕮 • Measure distance, length, width and height in metric units • Move objects of different weights up an inclined plane and measure the force needed by using a spring scale. Experiment to find the result of changing the height of the inclined plane
• Tables, charts and graphs	• Demonstrate the ability to communicate the results of an investigation using tables, charts and graphs 🕮	• Make a table comparing the densities of various objects based on their buoyancy • Make a chart of the simple machines found in an assortment of complex machines 🕮 • Fill containers that are insulated in different ways with hot water. Make a graph of the resulting temperatures as heat is lost at different rates

4. MATH ASPECT OF SCIENCE (cont'd)

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Calculations of mass, volume and density	• Accurately measure mass with a balance • Accurately measure volume with a graduated cylinder • Be able to use mass and volume to calculate density	• Practice the use of a balance to measure mass • Practice using a graduated cylinder to measure volume of regular and irregular objects and liquids • Place an object in a graduated cylinder containing a fixed amount of water that will allow the student to calculate the amount of water displaced by the object. Weigh the object to determine its density by comparing grams per cubic centimeter

5. MOTION AND FORCES

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Effect of force	• Design a "Rube Goldberg" device △ 🕮 • Give examples of the effects of force used in the home ☺	• Introduce and explore the work of Rube Goldberg (Pulitzer Prize winning cartoonist) 🔑△ • Demonstrate how pushing down on a lever can move an object • Experiment with dropping a ball from different heights: graph the results △ 🕮
• Work and energy	• Describe how potential and kinetic energy differ 🕮 • Design a flow chart showing how energy can be converted to work △ • Design and demonstrate an experiment to show the effect of either friction or gravity on the amount of force necessary to do work ☺	• Demonstrate how an electrical pencil sharpener converts electrical energy to mechanical energy 🕮 • Explore how changing the amount of friction or gravity affects the force necessary to do work, e.g., *compare the amount of force needed to push an object up an inclined plane of various heights* △
• Machines	• Bring in and demonstrate examples of simple machines 🕮 • Label the simple machines in a bicycle	• Locate examples of simple machines in the classroom and on the playground ☺ • Explore different combinations of simple machines, e.g., *manual pencil sharpener*

6. ENERGY AND ITS INTERACTIONS WITH MATTER

CORE CONTENT	ASSESSMENT STRATEGIES	INSTRUCTIONAL STRATEGIES
• Solar energy	• Design a device to measure solar energy △🕮 • Plan a self-contained terrarium ☺	• Research solar energy 🔑△ • Investigate the greenhouse effect ☺
• Heat, light	• Prepare an oral or graphic explanation of the production of heat from some other form of energy △🕮 • Demonstrate conduction and convection 🕮 • Design and construct a periscope	• Observe heat generated by a light bulb • Explore reflection and refraction through use of mirrors and prisms
• Sound	• Predict the pitch of lengths of elastic bands from highest to lowest • Demonstrate and explain the solution to designing a string telephone that will work around a corner 🕮	• Fill bottles with varying levels of water and play a tune by blowing into them. Discuss why the pitches are different • Build a string telephone
• Magnetism	• Predict if a magnet will attract an object • Use unlabelled magnets and determine their polarity	• Make a compass using a needle in a cork and a dish of water △
• Electricity	• Create a complete circuit using a battery, wire and a bulb ☯	• In cooperative groups, design an electromagnet

Physical Science

6 – 7 – 8 (cont'd)

OUTCOMES: By the end of eighth grade, students will be able to:

- compare and contrast the parts of an atom
- understand that all matter is made up of atoms
- define what an element is and identify the types of elements in a periodic table
- demonstrate that matter is composed of moving particles
- describe the physical and chemical properties of matter
- compare a physical and chemical change that matter undergoes
- demonstrate the different kinds of chemical reactions
- use the metric system in measurements and calculations
- understand mathematical relationships among variables
- understand Newton's Laws of Motion
- demonstrate how inertia affects the motion of an object and how the force of friction acts to retard motion
- understand how simple machines work
- describe the Law of Conservation of Energy

Physical Science Key Areas and Content Topics
6 – 7 – 8

1. Structure of Atoms
- atomic structure and theory
- discovery of subatomic particles
- fission, fusion

2. Structure and Properties of Matter
- Law of Conservation of Mass
- physical properties of matter
- states of matter
- mass, volume, density, buoyancy
- periodic table of elements

3. Chemical and Physical Changes
- physical changes, chemical changes
- boiling point, melting point, solubility
- chemical reactions – exothermic, endothermic
- variables affecting pressure
- atmospheric pressure, cohesion, adhesion
- kinetic molecular theory
- qualitative description of gases: gas laws

Science Key Areas and Content Topics

6 – 7 – 8 (cont'd)

4. Math Aspects of Science

- quantities
- mathematical relationships using tables, charts and graphs
- measurements
- introduction to balancing equations
- scientific notation
- metric system

5. Motion and Forces (Introduction)

- Universal Law of Gravitation
- speed – velocity, acceleration, deceleration, terminal velocity, momentum
- equilibrium, friction
- Newton's Laws of Motion (i, ii, iii)
- simple machines
- effort force, resistance force, mechanical advantage
- Bernoulli's Principle

Physical Science Key Areas and Content Topics

6 – 7 – 8 (cont'd)

6. **Energy and its Interaction with Matter** (Introduction)
    - Law of Conservation of Energy
    - types of energy
        - kinetic
        - potential
    - forms of energy
        - solar, nuclear, mechanical, electrical, chemical, radiant (heat, light)
        - heat and conduction
    - characteristics of waves
        - sound waves
        - light waves
            - reflection
            - refraction
    - electricity, magnetism

1. STRUCTURE OF THE ATOM

CORE CONTENT: Topics should include, but not be limited to:

- atomic structure and theory
- discovery of subatomic particles
- fission, fusion

ASSESSMENT STRATEGIES:

- Research time periods in which major advances regarding knowledge of the atom took place. What world events took place during the same time periods? 🔑 📖
- State today's modern atomic theory. Explain how it differs from the earlier theories. 🔑
- Hypothesize how the modern atomic theory might change as scientists make new observations. ☺
- In cooperative groups of three, have students build a model of the atom using different colors of gumdrops, a wire coat hanger, thread, toothpicks and index cards. Assign an element (1 – 18) to each group. Determine if all parts of the Atom are assembled and labeled correctly (correct number of protons, neutrons and electrons).
- Present a play to younger students about the accomplishments of Pierre and Marie Curie. The whole class can be involved in writing a scientifically accurate skit and in gathering simple props and costumes. 🔑 📖
- Research the Manhattan Project and present an oral report. On a poster board, distinguish between fission and fusion, using colorful diagrams. Display posters in the classroom. 🔑 📖

INSTRUCTIONAL STRATEGIES:

- Describe matter in terms of atoms that are joined to form molecules that can be found in any one of the three states of matter.

- Present the history of the discovery of the parts of the atom. Explain how the technology of the time aided scientists In their discovery, e.g. *1911 – Ernest Rutherford, aided by newly discovered x-rays found that electrons surround the atom's core, the nucleus.*

- Discuss why Marie Curie's research was harmful to her.

- Explain how bonds, which hold the protons and neutrons of an atom's nucleus together, contain energy.

2. STRUCTURE AND PROPERTIES OF MATTER

CORE CONTENT: Topics should include, but not be limited to:

- Law of Conservation of Mass
- physical properties of matter
- states of matter
- mass, volume, density, buoyancy
- periodic table of elements

ASSESSMENT STRATEGIES:

- Define the term matter and identify its three states.
- Explain why water is important and how it is helpful and harmful in each of its three states. ☺
- Using a variety of objects, describe and measure the physical properties of mass, volume, and density, using proper lab equipment. On a sheet of paper, rank them in order from least to greatest for each physical property. △
- Using a periodic table, explain how elements with similar properties are displayed.
- Working in cooperative groups, prepare and give an oral presentation (e.g. broadcast) explaining the value of the periodic table. 🕮

INSTRUCTIONAL STRATEGIES:

- Play the "Matter Guessing Game". Call on individual students to describe the physical properties of a mystery object while the other students try to guess the object being described.

- Provide the class with O*obleck* (a colloid mixture of cornstarch and water). Allow the class to handle the substance and record their observations. List the physical properties discovered while examining the "oobleck". Read *Bartholomew and the Oobleck* by Dr. Seuss. 🕮

- Using a variety of materials (e.g. coal, cork, stone, silver dollar, stick), and a balance, graduated cylinder, water and a ruler, have students figure out the density of each item, and explain each step to the class. Record all-important information.

- Provide students with Jell-o, water, cream cheese, Cool Whip, cherries in juice, mixer, bowls, whisk, clear cups, spoon, and a recipe to make "Density Dessert." Have them draw a diagram of the layers that form after the dessert is refrigerated. Ask them to explain why the ingredients layered in a certain way and then enjoy the dessert.

- Present the story of Archimedes and his Principle. 🔑 🕮 ☯

- Brainstorm to identify examples of buoyancy in everyday life. Provide students with cups of water and corks. Have students push the cork to the bottom of the cup and then let the cork go. Describe what happens to the cork. Explain what causes the cork to rise to the top of the water.

- Hypothesize what would happen if students swam in the Dead Sea or the Great Salt Lake. Why would it be different from swimming in a lake or pond? 🔑 ☯

- Explain the characteristics used to order the elements in the periodic table.

- Work cooperatively to discover the properties of different elements.

- Show students the two groups of "rare earth" elements on the periodic table. Discuss why they are named "rare earth" elements.