SCIENCE Grades: 6-8

These learning outcomes are organized into 3 sections: Earth & Space Science, Life Science and Physical Science. A school's curriculum may address each section in a separate year, or it may include parts of each for the 3 years. In addition to achieving these standards, a student is expected to have developed the skills necessary to do science, i.e. scientific inquiry, including designing and conducting experiments, and to have been given the opportunity to experience Technology/Engineering challenges.

As were the original guidelines released in 2006, these revised Diocesan Science Curriculum Guidelines reflect primarily content standards drawn from the *National Science Education Standards* (NSES), the *Benchmarks for Science Literacy* and the Massachusetts *Science and Technology/ Engineering Curriculum Framework*. The outcomes have been left in grade-bands to give a school maximum flexibility when designing its individual science curriculum: allowing it to take advantage of local assets and/or programs or activities already in place; or to seek out and exploit the links to its existing curricula. These guidelines are generally the same as the original with the addition of more strategies and/or resources. A school should also look to include the NSES "Science as Inquiry" standards as it designs its curriculum and develops its teaching/learning strategies. These inquiry standards should not be viewed as secondary to the content standards, but rather, collectively, as a primary goal of science education with the content being the context within which these skills are learned.

NSES: Abilities Necessary to Do Scientific Inquiry

Grades K–4

- Ask a question about objects, organisms, and events in the environment
- Plan and conduct a simple investigation
- Employ simple equipment and tools to gather data and extend the senses
- Use data to construct a reasonable explanation
- Communicate investigations and explanations

Grades 5–8

- Identify questions that can be answered through scientific investigations.
- Design and conduct a scientific investigation.
- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models using evidence.
- Think critically and logically to make relationships between evidence and explanations.
- Recognize and analyze alternative explanations and predictions.
- Communicate scientific procedures and explanations.
- Use mathematics in all aspects of scientific inquiry.

NSES Changing Emphases to Promote Inquiry

LESS EMPHASIS ON	MORE EMPHASIS ON
Activities that demonstrate and verify science content	Activities that investigate and analyze science questions
Investigations confined to one class period	Investigations over extended periods of time

Process skills out of context	Process skills in context
Emphasis on individual process skills such as observation or inference	Using multiple process skills— manipulation, cognitive, procedural
Getting an answer	Using evidence and strategies for developing or revising an explanation
Science as exploration and experiment	Science as argument and explanation
Providing answers to questions about science content	Communicating science explanations
Individuals and groups of students analyzing and synthesizing data without defending a conclusion	Groups of students often analyzing and synthesizing data after defending conclusions
Doing few investigations in order to leave time to cover large amounts of content	Doing more investigations in order to develop understanding, ability, values of inquiry and knowledge of science content
Concluding inquiries with the result of the experiment	Applying the results of experiments to scientific arguments and explanations
Management of materials and equipment	Management of ideas and information
Private communication of student ideas and conclusions to teacher	Public communication of student ideas and work to classmates

Although the Massachusetts Technology/Engineering standards are not explicitly included in the Diocesan outcomes, some are integrated within Suggested Teaching/Learning Strategies. Schools are encouraged to include as many of the Technology/Engineering standards as possible.

As has been more consistently recognized in subjects other than K-8 science, it is not possible to learn, beyond a mere recitation of facts and "factoids", without "doing." For example, no one would consider a mathematics class satisfactory if it consisted solely of students reading about other people "doing" math and watching the teacher "doing" math. We fully accept that students must be given the opportunity to "do" math. So too, it is with science. Students must be given the opportunity to "do" science. While gaining a better understanding of the workings of the world around them, students will be able to more fully appreciate the wonders of creation as well as their role as stewards.

EARTH & SPACE SCIENCE	
Learning Outcomes The student can:	**Teaching / Learning Strategies & Assessments**
I. Structure of the Earth System E-I.1. Construct and interpret various 2- and 3-dimensional models of the earth's common physical features, including contour maps. E-I.2. Describe the layers of the solid earth as the lithosphere; the hot, convecting mantle; and the dense, metallic core. E-I.3. Describe how the movement of the earth's crustal plates causes major geological events (e.g. earthquakes, volcanic eruptions and the formation of mountains and ocean basins.)	➢ Given a topographic map, especially of the local area, students find various landmarks, describe elevation changes, map the flattest route from one point to another, choose the best location for something like a ski resort or a baseball stadium and explain why it's the best based on the topography. (Coastal communities could include the local nautical chart to use as

E-I.4. Explain how landforms are the result of both constructive and destructive forces. E-I.5. Explain the relationship among the energy provided by the sun, the global patterns of atmospheric movement, and the temperature differences among water, land, and atmosphere. E-I.6. Define & explain how radiation, conduction and convection are the mechanisms to transfer heat in the earth's systems.	well as to compare it to other types of maps) ➢ Given a portion of a topographic map showing a physical feature such as a mountain and a set of the contour lines for the feature (each line drawn separately), cut out the shapes and stack them with a spacer (like a small piece of foamboard or a piece of clay) between them to construct the physical feature in 3 dimensions. ➢ Given a world map showing longitude & latitude: students plot the locations of volcanoes and/or earthquakes and then compare this to a map of the crustal plate boundaries.
II. Earth's History E-II.1. Describe how processes we can still see today, such as erosion, movement of lithospheric plates, and changes in atmospheric composition, have caused changes to the earth over geologic time. E-II.2. Explain and give examples of how physical evidence, including fossils, demonstrates that the earth has evolved over time. E-II.3. Predict possible effects of a catastrophic event such as the impact of an asteroid or comet on the earth's geology and/or ecology.	➢ Given continent/tectonic plate outlines, students manipulate cut-cuts and hypothesize past super-continent arrangement(s). They then use fossil finds of the same organisms in what are now separate continents to evaluate the accuracy of their predictions. ➢ Design & conduct an experiment that determines how one factor affects the formation of fossils (e.g., how smooth and/or soft the substrate is, how much pressure is applied) ➢ Map locations of various fossil finds that show climate changes, for example, fossils of ocean creatures in what is now the middle of the continent, fossils of tropical plants/animals in areas that are no longer tropical… ➢ Design & conduct an experiment that determines how one factor affects the size of an impact crater (size or mass of falling object, height from which it's dropped (its speed), angle of impact)
III. Earth in the Solar System E-III.1. Describe gravity as a force that pulls all things on or near the surface toward the center. E-III.2. Briefly explain the relationship between differences in gravity on the moon and/or various planets and an object's weight E-III.3. Explain the role of gravity on the formation of the solar system and the movements of its components.	

E-III.4. Explain how gravity and the relative positions of the sun, moon and earth cause ocean tides E-III.5. Explain how the relative positions of the earth, moon, and sun cause lunar and solar eclipses.	➢ Students use a light source (like a lamp) representing the sun, and large and small spheres, representing the earth and moon, to demonstrate how lunar and solar eclipses occur.

Resources

digital-topo-maps.com nasa.gov/offices/education/about/index.html
NSTA Middle School Resources: http://www.nsta.org/middleschool/?lid=hp
Building a topographic map: http://www.explorelearning.com/index.cfm?method=cResource.dspExpGuide&ResourceID=493
Weathering activity: http://www.k5geosource.org/activities/invest/rock/q3/print.html
Elementary Science Links (all levels): http://interconnect.tamucc.edu/elementaryscience/

LIFE SCIENCE	
Learning Outcomes The student can:	**Teaching / Learning Strategies & Assessments**
[The Diocesan Health Curriculum Guidelines contain a significant number of related learning outcomes. These outcomes will be included unless they are addressed in other courses.]	
I. Structure and Function in Living Systems	
L-I.1. Explain the development of the Cell Theory emphasizing how the body of science builds over time.	➢ Create a rubric that guides students to write & perform a skit about a meeting of scientists that have been studying cells. Have their characters describe what they have seen, the equipment they have used and any conclusions they have come to.
L-I.2. Describe the interrelationship between science and technology through the study of the evolution of the microscope and/or other technologies.	
L-I.3. Create and interpret diagrams or models of plant and animal cells, identifying the major organelles and the function of each (nucleus, cytoplasm, cell membrane, cell wall.)	➢ Students prepare, examine and draw plant and animal cells. ✓ Demonstrate proper use of a microscope ✓ Label model of an animal and a plant cell.
L-I.4. Arrange and give examples of the five levels of organization within a multicellular organism (cell, tissue, organ, system, organism).	
L-I.5. Classify living organisms by similarities in structure according to the currently accepted classification system.	✓ Use a dichotomous key.
L-I.6. Describe the relationship between cellular respiration and photosynthesis.	
II. Population Diversity and Ecosystems	
L-II.1. Illustrate how producers, consumers and decomposers interact with each other to cause	➢ Distribute organism cards to students and

energy, beginning with sunlight via photosynthesis, to be transferred through a food web. L-II.2. Analyze the interrelationships between organisms including competitive, mutually beneficial, predator-prey and parasite/host relationships. L-II.3. Predict how populations respond to changes in conditions and/or interactions among organisms (including the actions of humans). L-II.4. Relate genetic variation to a species' survival. L-II.5. Explain the theory of evolution using data from the fossil record and other evidence.	have them create food webs ➢ Students participate in a population simulation
III. Reproduction and Heredity L-III.1. Recognize the structure, function and replication of DNA. L-III.2. Explain the fundamental connections among heredity, DNA, genes, and chromosomes. L-III.3. Design an investigation to study genetic variation within the classroom population (such as tongue rolling, attached earlobes, etc.) L-III.4. Construct a family tree (of actual or hypothetical people) to demonstrate the inheritance of a specific trait. L-III.5. Explain the differences between sexual and asexual reproduction. L-III.6. Debate some of the pros and cons of genetically engineered food. L-III.7. Describe the history of genetics.	✓ Using reference materials, students construct model of DNA ➢ Discuss individual differences and lead students to design an experiment where they measure human anatomy (ex. Height, foot length) and discuss the observed differences. ✓ Lab report on self-designed experiment
IV. Regulation and Behavior L-IV.1. Describe the difference between innate and learned behavior. L-IV.2. Explain, using examples, how behavioral changes help organisms survive changes in the environment. L-IV.3. Link behavioral changes to evolutionary adaptations L-IV.4. Analyze the advantages and disadvantages of social behaviors. L-IV.5. Give examples of how organisms maintain internal conditions while being exposed to changing external environments (maintain homeostasis.)	
V. The Human Body L-V.1. List and give the function of the different human body systems. L-V.2. Explain the importance of interactions between systems. L-V.3. Relate diseases to the malfunction of organ systems. L-V.4. Explain the importance of a healthy lifestyle to the prevention of disease. (topics could	Online drag & drop Body Parts game: http://www.bbc.co.uk/northernireland/schools/4_11/tykids/flash/bodyparts.html

include exercise, nutrition, drugs/alcohol, environmental health.)	
Resources	
Microscopes & slides, etc. NSTA Middle School Resources: http://www.nsta.org/middleschool/?lid=hp Virtual Peppered Moth: http://www6.district125.k12.il.us/~nfischer/Moth/default.htm Elementary Science Links (all levels): http://interconnect.tamucc.edu/elementaryscience	
PHYSICAL SCIENCE	
Learning Outcomes The student can:	**Teaching / Learning Strategies & Assessments**
I. Properties and Changes of Properties in Matter P-I.1. Use appropriate equipment to measure mass, volume, distance and temperature using the metric system. P-I.2. Differentiate between mass and weight. P-I.3. Define and calculate density using appropriate units. P-I.4. Use the physical properties of a given substance to distinguish it from others P-I.5. Differentiate between elements, compounds and mixtures. P-I.6. Given the Periodic Table, briefly describe how it is arranged and read basic information about atoms/elements from it. P-I.7. Recognize that all substances consist of one or more of the 100+ known elements. P-I.8. Compare and contrast physical and chemical changes. P-I.9. Explain the conservation of mass in chemical reactions (for example, when an Alka-seltzer dissolves and the gas is collected.)	✓ Performance assessment: students move from station to station, making the measurement(s) asked for at each station. ➢ Lab: Distinguish among white powders
II. Motion and Forces P-II.1. Describe the forces acting on an object in motion and one at rest. P-II.2. Explain inertia. P-II.3. State Newton's Laws of motion and give examples. P-II.4. Describe an object's motion in terms of its position, direction and speed. P-II.5. Predict how a change in at least one of the forces acting on an object will affect its motion.	➢ NASA Engineering Design Challenges (//edc.nasa.gov/challenge.html) One example: Spacecraft Structures: Design, construct (from common materials) and test a thrust launcher capable of transferring the force of a falling sandbag to "launch" a water-filled soda bottle.

P-II.6. Assemble simple machines and explain the relationship between the distance an object moves and the force needed to move it. P-II.7. Construct and interpret graphs of distance vs. time.	➢ Marble Roll: By rolling a marble down an inclined plane, students determine how factors such as the angle of incline or where on the incline the marble is released affect how far the marble travels. Students then apply this knowledge by making the adjustments necessary to cause the marble to travel a given target distance.
III. Transfer of Energy P-III.1. Give examples of the change of energy from one form to another (for example: heat to light, electricity, mechanical motion, sound, nuclei, and chemical.) P-III.2. Describe situations where kinetic energy is transformed into potential energy and vice versa. P-III.3. Explain what happens to particles during a phase change. P-III.4. Predict how heat will move by conduction, convection and/or radiation until equilibrium is reached and relate this to temperature.	➢ Students will list at least 5 energy transfers that routinely occur in their houses. The list should include at least 4 types of energy. [For example: chemical energy in batteries is converted to light in a flashlight.] ➢ Given a roller coaster (diagram, model, or build a marble coaster): Explain the source of energy and energy conversions taking place and label the points of maximum & minimum kinetic and potential energy. ➢ Students will design and conduct an experiment that tests one factor affecting heat transfer (For example: measure the change in temperature of a quantity of hot water in a metal can while it's in a water bath vs that while in air only; metal can vs plastic cup; etc.)

Resources

Balances, Graduated cylinders, Thermometers, Copies of Periodic Table (download & games: http://education.jlab.org/itselemental/)
Element videos: http://www.periodicvideos.com/# NSTA Middle School Resources: http://www.nsta.org/middleschool/?lid=hp
Mystery Powder activity: http://alex.state.al.us/lesson_view.php?id=12894
Elementary Science Links (all levels): http://interconnect.tamucc.edu/elementaryscience

Suppliers to consider: hatchearlychildhood.com lakeshorelearning.com deltaeducation.com scientificsonline.com YoungExplorers.com basicsciencesupplies.com enasco.com/science etacuisenaire.com insectlore.com flinnsci.com