Archdiocese of Philadelphia

Science Guidelines

Grade 3

2006

GENERAL SCIENCE OBJECTIVES – Grades 1 to 8

At the conclusion of the science program prescribed for the elementary school in the Archdiocese of Philadelphia, students should have achieved the skills enumerated in the following six categories of objectives:

Knowledge

To read and state the meaning of certain scientific facts and concepts. When a problem situation is stated requiring application of some scientific principles, a child has learned that he/she should be able to apply the principle.

Instrumental Skills

To manipulate basic science equipment, interpret and prepare maps, graphs, charts, and tables appropriate to problems.

Problem-Solving Skills

To demonstrate problem-solving skills such as observing, inferring, sensing and defining problems, making hypotheses, outlining scientific procedures to test hypotheses, carrying out an investigation, controlling and manipulating variables, formulating models, making valid conclusions, recognizing and using space and time relationships, recognizing and using number relationships, classifying, measuring, communicating, and making operational definitions.

Scientific Attitudes

To demonstrate such scientific attitudes as open-mindedness by being willing to consider new facts in making judgments, withholding conclusions until all available facts are in, using controls, generalizing with sufficient evidence.

Appreciation

To describe the uses, benefits, and limitations of science to society.

Interest

To demonstrate interest in science by reading, collecting, studying, or becoming involved in some scientific activity as a leisure time pursuit.

SCIENTIFIC PROCESS SKILLS

Science education involves process as well as content. The content learned helps the students understand and interpret their environment. The process involves using diverse skills to solve different problems. This leads to effective ways of working and provides experience in thinking critically and creatively. The process skills with expectations for each grade are found below. It is hoped that teachers will develop these skills through hands-on experiences.

Introduce, Reinforce, Master	**K**	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1. Observing: ability to identify properties, structures, etc. through use of all the senses	I	R	R	M					
2. Classifying: ability to group, match, compare by commonality	I	R	R	M					
3. Identifying: ability to describe and interpret sensory and qualitative aspects of learning		I	R	R	R	M			
4. Questioning: ability to ask pertinent questions regarding experiences		I	R	R	R	M			
5. Measuring: ability to find quantitative differences, to estimate, calculate, etc. (metric)	I	R	R	R	R	M			
6. Recording: ability to collect, record, and tabulate data meaningfully				I	R	R	R	M	
7. Predicting: ability to guess outcomes on basis of previous experiences				I	R	R	R	M	
8. Formulating Models: ability to represent cognitive data graphically					I	R	R	M	
9. Formulating a Hypothesis: to predict and generalize from experiences/data; to make an educated assumption as to the possible outcomes of an experiment					I	R	R	M	
10. Interpreting: ability to analyze data validly (similarities, dissimilarities, cause/effect)						I	R	R	M

11. Designing Investigations: ability to control variables, record and interpret data, summarize data, graph						I	R	R	M
12. Inferring: ability to make conclusions referring to causes, effects, etc.				I	R	R	M		
13. Generalizing: ability to sum up experiences into some kind of conclusion						I	R	R	M
14. Experimenting: to try something out to see whether or not it works			I	R	R	R	M		
15. Manipulating Variables: to identify and selectively change experimental conditions such as time, intervals, temperature, distance					I	R	R	R	M
16. Handling Equipment: to know the purpose for and manner of using lab resources and equipment for the purpose of experimentation			I	R	R	R	M		
17. Using Space-Time Relationships: ability to consider position and motions from vantage points other than the child's own						I	R	R	M
18. Communication: ability to verbally relate experiences, information, and procedures with clarity	I	R	R	R	M				
19. Recognizing Problem Areas: ability to be aware of areas where alternative solutions are possibilities					I	R	R	R	M
20. Researching: ability to seek additional information, sources, conditions, personnel, events			I	R	R	R	M		
21. Interdisciplinary Skills: to be able to identify those areas of science which are interrelated to other disciplines such as math, English, and social studies	I	R	R	R	M				

SCIENTIFIC PROCESS SKILLS

Science education involves process as well as content. The content learned helps the students understand and interpret their environment. The process involves using diverse skills to solve different problems. This leads to effective ways of working and provides experience in thinking critically and creatively. A blank process skills chart has been provided for teachers to use as a work in progress: identify which skills your students should have mastered, record dates of when skills were introduced or used. Feel free to duplicate this form.

Introduce, Reinforce, Master									
1. Observing: ability to identify properties, structures, etc. through use of all the senses									
2. Classifying: ability to group, match, compare by commonality									
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SCIENTIFIC METHOD

(Expectations by Grade Level)

Primary – Observe and Inquire: Grades One to Three

1. Ask questions and make observations.
2. State the problem.
3. Identify the materials.
4. Follow the procedures to conduct the investigation.
5. Tell what was learned as a result of the investigation.

Elementary – Hypothesize and Experiment: Grades Four to Six

1. Ask questions and make observations.
2. Recognize and state the problem.
3. Formulate a hypothesis based on content, research and previous experience.
4. Identify the materials.
5. Follow the procedures to conduct the investigation.
6. Collect data and record the results.
7. State a conclusion based on the data collected; include applications to everyday life.

Middle School – Analyze and Extend: Grades Seven and Eight

1. Ask questions and make observations.
2. Recognize and state the problem.
3. Formulate a hypothesis based on content, research and previous experience.
4. Identify the materials.
5. Follow and/or design the procedures to conduct the investigation.
6. Collect data and record the results making use of maps, charts, and graphs as well as tables and drawings.
7. State a conclusion based on the data collected; include applications to everyday life as well as suggestions for extended investigations.

PSS	CONTENT	SUGGESTED STRATEGIES AND ASSESSMENT
	Unit One: Geology	
3.5.4.A.	**I. Rocks and Minerals**	**LANGUAGE ARTS:** Write a story from the point of view of a rock.
	A. How do rocks form?	**OBSERVE:** Use a chocolate chip cookie (with nuts) as an example of a rock.
	1. Rocks are natural, solid, nonliving materials found in the earth a. color b. what minerals they contain – sometimes so small they aren't easy to see c. texture – size of the bits of minerals (grains) that make up the rock; examples: smooth, rough, bumpy	**CLASSIFY:** Students should classify rocks using a hand lens and by creating their own classification system (before the lesson) **MATH:** Venn Diagram: compare and contrast rocks by their characteristics; **WRITING:** summarize rock information or create a class Book of Rocks.
	2. Rocks are made of one or more minerals	**CRITICAL THINKING:** How can you tell that a rock sample is made of more than one mineral?
	3. Rocks are always changing and undergoing various processes during the rock cycle	**KINESTHETIC:** Create a game that allows the players to "cycle" through the rock formation. **CRITICAL THINKING:** Discuss how recycling is like the rock cycle.
	4. Rock Groups (included are the basic definitions of the three types of rocks – you may explore specific examples of each type if you have the time and inclination	**MODEL:** Rock layers using various types of bread (no crust) that has been compacted under a pile of books. **TECHNOLOGY:** research famous buildings and what type of rock they're build from.

	a. Igneous rocks form from a red-hot mixture of melted rock material (magma or lava) and gases that cool and harden. Igneous means “from fire” b. Sedimentary rocks form when small pieces of rocky matter (sediments) are pressed or cemented together. c. Metamorphic rocks form when great heat and pressure inside the Earth change existing rock. The rock does not actually melt (if it did it would be an igneous) but instead the minerals either change their identity or separate into layers of different densities.	**KINESTHETIC:** act out what happens for rocks to turn from one type to another.
	B. What are minerals?	**MATH:** Survey: Find items around the house that are made from minerals.
	1. A mineral is a natural solid material that forms from nonliving things. a. Minerals are the most common solid material found on Earth.	**INQUIRY:** Growing Crystals: students this age are fascinated by being able to grow crystals: get a kit or research on the internet some suggestions for easy, inexpensive crystal growing activities **INQUIRY:** Mining: mine the chips out of chocolate chip cookies (hard, store-bought cookies work better than soft, homemade cookies); cross curricular activities could have the students graphing the amount of chips based on the size of the cookie.

	b. Minerals can form in a number of ways. 1) When magma cools and crystals form. 2) When rocks are put under great pressure and heat and are then brought near the surface. 3) When hot water cools and minerals settle out and crystallize. 4) When water evaporates and minerals, that were dissolved, form crystals. c. An ore is a mineral that contains a useful substance. Ores contain enough useful substance to make them valuable to mine: aluminum, iron, copper d. A gem is a mineral that is valued for being rare and beautiful: diamond, ruby, sapphire	
	2. Minerals can be identified by their physical properties. (Included are some of the physical properties because they are easy enough to work with for students of this age – feel free to investigate other properties if you have the time and inclination). a. Color – easy to notice; however, some minerals come in a variety of colors and some colors are common to many minerals b. Luster – light bounces off a mineral; for example, shiny, glassy, or dull c. Streak – color in its powder form; even if a mineral comes in a variety of colors, its streak will always be the same color	

	d. Hardness – ability to resist being scratched; this property cannot be judged by sight, the mineral must be tested	
	3. Many everyday items come from minerals.	
	4. Chemicals found in some minerals keep our bodies healthy.	
3.5.4.A.	**II. Soil Formation** – **<u>Soil</u>** is the thin layer of loose material that covers most of Earth's land.	
	A. What is soil important?	
	1. Soil forms over hundreds of years from nonliving and once living materials. a. Living things in soil break down the remains of plants and animals in a process called <u>decay</u>. b. Decay releases nitrogen that plants need in order to grow. (Decayed plants and animals in the humus produce <u>nutrients</u>).	
	2. Soil is involved in the water cycle (see III).	
	B. Parts of Soil – soil is organized in layers. Different places have layers of different thickness and color.	**INVESTIGATE:** How much water can soil hold? **MODEL:** Use colored clay to show the layers of soil.

		ASSESS: Use a straw to extract a core sample of the clay model soil and label it.
	1. Topsoil is the top layer that includes rock particles mixed with the dark products of decay. a. The decayed parts of plant and animal remains are called humus. b. Humus contains much of what plants need to grow.	
	2. Subsoil is under the topsoil. It is lighter in color, has less humus, and includes tree roots and broken pieces of rock. Water from precipitation may be found in this layer.	
	3. Bedrock, below the subsoil, provides raw material for making new soil because the rock breaks down here.	
	C. Types of Soil – Soil type depends in part on the types of rock particles found in the soil.	
	1. All soil has the same four ingredients: weathered rock, humus, air, and water.	
	2. Three main types of soil a. Sand – large particles that allow water to pass easily b. Silt – medium particles more closely packed together so it holds more water than sand	**INVESTIGATE:** Use strainers of different gauges to sort particles of different samples of soil. **EXPERIMENT:** How much water does a particular type of soil hold? How much water does it drain?

	c. Clay – small particles that are closely packed so that the soil holds water and will remain wet for a long time	
	3. Loam is a mixture of sand, silt, and clay that is good for growing plants. In addition, it contains humus, which has many minerals and nutrients.	**TESTING VARIABLES:** Experiment with growing plants in different types of soil or with different amounts of water.
4.6.4.B.	**III. Water Cycle**	
	A. Why is water important?	**DISCOVERY**: make a collage that shows the various uses of water
	1. Living things need water to stay alive. a. Inside the human body, water helps digestion and movement of materials to body parts. b. Water is also important to help stabilize and regulate body temperature.	
	2. People use water in transportation, in industry, for enjoyment, and to make electricity.	
	B. Three-fourths of Earth's surface is covered with water, most of which is salt water.	**MATH:** Create a circle graph of water usages.
	1. Water is found as water, ice, and water vapor. a. A small amount of water is found in the air as an invisible gas called water vapor. b. Water vapor rises from oceans and lakes and becomes part of the air.	**INQUIRY:** Place ice cubes in clear plastic cups and cover the top with clear plastic wrap secured with a rubber band. Place the cup in a warm sunny spot. Collect observations.

	3. Fresh water is found as groundwater and in streams, rivers, and lakes, as well as in wetlands. a. Water that seeps down slowly through the soil and collects in spaces between underground rocks is called <u>groundwater</u>. b. Places with wet or water-covered ground at least part of the year are called <u>wetlands</u>	**INQUIRY:** How can you make fresh water from salt water?
	C. Water moves in a cycle from Earth's surface to the air and back again.	**READ:** Read or watch <u>Magic School Bus</u> (water cycle)
	1. Water changes form as it moves through the water cycle: evaporation, condensation, and precipitation. 2. Water that falls to Earth as part of the water cycle is precipitation: rain, snow, sleet, hail.	**ART:** Create a diagram using magazine pictures. **MODEL:** Create a plastic bag water cycle by taping a sealed plastic bag of water to a window. Record observations. It will be more visual if the water has been colored.

	Unit Two: Force and Motion	
3.4.4.C.	**I. Forces and Motion**	
	A. Motion – change in position 1. Position – location of an object 2. Distance – length between two places 3. Speed – distance divided by time; for example, a cheetah moves at 60 miles per hour	**GRAPH:** The speeds of objects over a specific distance for a specific time
	B. Forces – push or pull on an object; happens in pairs (Heavier objects need a greater force to make them move)	**INQUIRY:** Create an experience that allows the students to demonstrate that the heavier an object the harder it is to move.
	C. Types of Force 1. Gravity – pulling force between an object and the Earth a. gravity exists everywhere on Earth b. weight – how much pull the Earth has on an object 2. Friction – force created when an object rubs against another object a. friction causes heat b. lubricants to reduce friction 3. Magnetic force – anything that attracts metal has the property of magnetism a. poles – where the pull of the magnet is strongest 1) magnets have two poles 2) like poles repel 3) unlike poles attract b. magnetic field – the area around a magnet where its force pulls c. Earth is a magnet; therefore, it has a magnetic field.	**DISCUSS (before the lesson):** Will two objects fall at the same or different rates? Discuss the weight of objects and height to see whether the opinions change. **INVESTIGATE:** Does weight affect how fast an object falls? **OBSERVE AND EXPERIMENT:** Allow students to play with various types of magnets to create their own conclusions about positive and negative poles.

	D. Types of Motion 1. Linear – movement in a line 2. Wave – patterned movement 4. Random – no pattern to the movement	
	E. Work – when force changes the motion of an object; what happens when force moves mass over a distance	**CRITICAL THINKING:** What do machines have to do with work?
	F. Energy – ability to do work 1. Energy is needed to do work. 2. There are different types of energy.	
	G. Simple Machines – tools that make work easier; when using a simple machine less energy is required. 1. lever – stiff bar that rests on a fulcrum which moves or lifts loads a. fulcrum – support for the lever b. three classes according to the placement of the fulcrum 2. pulleys – use grooved wheels and a rope to raise or lower a load 3. wheel and axle – a wheel with a rod through the center (axle) which moves loads 4. inclined plane – slanting surface connecting a higher surface with a lower surface 5. screw – an inclined plane wrapped around a pole which holds objects together or lifts objects 6. wedge – two inclined planes	**WRITING:** Write a friendly letter describing how a simple machine improved your life. **SOCIAL STUDIES:** How did simple machines help build some of the great structures of the world like the pyramids and great cathedrals? **CRITICAL THINKING:** How is a staircase an inclined plane? **READING:** Create a cause-effect chart to describe how simple machines have improved life.

	Unit Three: Human Body	
3.3.4.B.	**I. Cells, Tissues, and Organs**	**DRAMA:** Write and perform a skit to show how the cells make tissues, which make organs, which make systems.
	A. Cells – basic unit of all living things 1. Each kind of cell has a particular function. 2. Cells work together to perform basic life processes. 3. Cell Structure a. Cell membrane holds the parts of the cell together and separates the cell from its surroundings. b. Nucleus determines the cell's activities such as reproduction.	
	B. Tissue – similar cells that work together perform a function 1. muscle tissue contracts when it receives a signal from the brain 2. nervous tissue sends signals from the brain: senses, brain, spinal cord 3. connective tissue includes the tissue in bones, cartilage, tendons, and blood. 4. epithelial tissue includes the body covering of an animal as well as the lining of most internal organs	**MODEL:** Compare tissues and organs to the parts of a familiar vehicle like a bicycle, skateboard or skates. The parts of the vehicle are the tissues and together they make an organ.
	C. Organs – tissues that work together; organs perform major functions that keep the animal alive; for example, heart is an organ that pumps blood throughout the animal's body	

	D. System – organs that work together to perform a function; human beings have ten major body systems; systems are dependent upon one another	
3.3.4.B.	**II. Skeletal System**	
	A. Bones and muscles work together to support and move your body.	**MODEL:** Create a model of a backbone using wheel pasta and soft jelly rings.
	B. Skeleton provides support for your body and protects your internal organs. 1. Bones – made up on connective tissue: outer protective layer, layer of hard material, and a soft center containing bone marrow. a. Bone marrow – connective tissue that produces red and white blood cells b. There are three main types of bones: long bones, flat bones, and short bones c. A human skeleton has 206 bones d. Joints are points at which bones meet, but all joints do not allow movement. 1) hinge joints – allow back and forth movement 2) ball-and-socket joints – allow circular movement 3) immovable joints – do not allow movement 2. Tendons – tough bands of connective tissue join muscles to bones at the joints 3. Ligaments – attach bones to each other in order to hold the skeleton together	**INQUIRY:** Create rectangular and circular tubes and see how many books can be balanced. Infer how this relates to the shape of bones in our body. **MATH:** Divide the bones fractionally according to the body position of the bones. **MODEL:** Use balls and cardboard tubes to model various types of joints.

3.3.4.B.	**III. Muscular System**	
	A. Voluntary muscles – move bones and hold skeleton upright: made up of groups of muscle tissue bound together by connective tissue. They are generally attached to two or more bones, either directly or through tendons.	
	B. Smooth muscles – contract slowly and move substances through the organs they surround. They run in bands around the walls of blood vessels and digestive organs.	
	C. Cardiac muscles – make up the walls of the heart; Their function is to pump blood. Some cardiac muscles work together to set the heart rate.	**KINESTHETIC:** Use a stopwatch to track your pulse and then run in place and track your pulse again. Research how much your heart muscle should be working during exercise.

4.7.4	**Unit Four: Living Things**	
4.7.4.A.	**I. Ecosystems** – community and its physical environment together	**PERSUADE:** Why should people protect the environment?
	A. Community – all populations of organisms living together in an environment 1. population – individuals of the same kind living in the same environment 3. individual – single organism in an environment	**MODEL:** Create a marine environment.
	B. Habitat – every population has a place where it lives in an ecosystem.	**DESCRIBE:** Write a description of your neighbor as a habitat.
	C. Niche – role of an organism in an environment	**INQUIRY:** Grow and transfer mold from a strawberry to a piece of bread.
4.7.4.A.	**II. Food Chains**	**RESPOND:** How do living things interact?
	A. Cells get energy they need from food.	
	B. The sun provides the energy for almost every ecosystem on Earth. 1. producers (plants) – use sunlight to make the food they need from carbon dioxide and water 2. consumers (animals) – organism that must eat in order to get the energy it needs	
	C. Food Web – shows the interaction among many different food chains in a single ecosystem 1. food chain – ways in which the organisms in an ecosystem interact with one another according to what they eat	**CONCLUDE:** What happens when a food chain is broken? **ART:** Design a poster that shows a plant being eaten by an animal that humans use.

	2. Food chains have several layers: a. producer (usually plants) – base of every food chain b. herbivores (plant eaters) – first level consumers eat the producers c. carnivores (meat eaters) – second level consumers eat first level consumers 3. decomposers – break down the tissues of dead organisms; whatever the organism does not use becomes part of the soil and nutrient rich soil helps grow producers.	**GAME:** Have students create a game that shows how living things interact. **INQUIRY:** How can a change in the environment affect plant growth? Investigate how change in soil, sun, or water affects a plant.
4.7.4.B.	**III. Adaptations** – trait or traits that help an animal meet its needs in the place where it lives; adaptations are inherited, passed on to future generations.	**EXPOSITORY WRITING:** Write a news story about the extinction of dinosaurs.
	A. Getting Food – some animals have adaptations for getting food; such as feet that are good for digging holding on tightly to their prey	**QUESTION:** What would happen if there were too many plants (or animals) in the same habitat?
	B. Protection – the way an animal looks and acts can help it survive 1. camouflage – blending in with its surroundings 2. armor – special body parts to protect animals from danger 3. poison 4. mimicry – ability to look or act like a dangerous or poisonous animal	**ART:** Create an animal that exhibits all the means of protection. **ACTIVITY:** Spread a cloth on the floor or grass; scatter candies of various colors across the cloth (be sure that the cloth is similar in color to some of the candy); allow students to find the candy. Discuss why some candy was more difficult to find. **INVESTIGATE:** How do pillbugs react when they are threatened?

ROLE OF THE SCHOOL SCIENCE COORDINATOR

In order to provide for articulation in the science curriculum and to make science an important and functional learning situation, the principal should appoint a science coordinator. This coordinator should be an experienced teacher (if possible), but above all one who is interested in science and is familiar with the latest books and programs. The coordinator must be aware of innovations and new methods and be willing to implement them.

Responsibilities of the Science Coordinator

1. To work with the principal and teachers to define the curriculum for each grade level and to make sure that the archdiocesan curriculum guidelines are adapted for the school.

2. To be responsible for keeping the texts or programs up to date and to prepare orders for additional texts and workbooks to be used for the next school year.

3. To consult with the principal about providing equipment and materials so that investigative science can be performed in the school.

4. To inform teachers of the availability of materials and equipment for their level.

5. To hold periodic meetings with the teachers to discuss the implementation of the science program and to provide for a sharing of ideas and methods.

6. To assist the teacher whenever needed and to encourage science experimentation.

7. To acquaint new staff members with curriculum guidelines and to see that the teachers have a copy; to offer any help needed by teachers in the implementation of the science program.

8. To present interesting articles and new ideas in the field of science through periodicals, books, workshops, etc.

9. To attend workshops or meetings provided by the archdiocese or any other seminars provided by professionals.

10. To plan and organize a science fair.

11. To keep the principal informed of meetings and any new developments in classroom science.