Archdiocese of Philadelphia

Science Guidelines

Grade 2

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									
3. Identifying: ability to describe and interpret sensory and qualitative aspects of learning									
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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.

P.S.S	CONTENT	STRATEGIES AND ASSESSMENTS
	Unit One – Solar System	
	I. Motions in the Solar System	
	A. Rotation – the ability of an object to spin on its axis.	**KINESTHETIC:** Have select students demonstrate the ability to rotate, revolve, and do both.
	1. Rotating causes day and night because only part of the planet is facing the Sun.	**OBSERVE:** Place a sticker on the globe at Philadelphia. Shine a light and count to 24 as the globe is turned. **DEMONSTRATION:** Spin a top.
	2. Earth's day takes 24 hours.	
	B. Revolution – the ability of an object to orbit around another object.	
	1. Revolution takes different amounts of time on different planets because of their distance from the Sun.	**VISUAL:** Use flashlights to demonstrate that students in the back of the classroom will see things later than students in the front.
	2. Earth's orbit takes 365 days which we call a year.	
	C. Gravity – the attraction between two objects keeps the planets in their orbits.	
	II. Sun and Planets	
	A. Sun – a large ball of gases visible in our day time sky; it is actually a star	
	1. It is so big that it could hold one million Earths.	
	2. It is so far away that light takes 8 minutes for for a ray of light to reach the Earth.	
	B. Planets – large round bodies that revolve around the Sun.	**IDENTIFY:** Use textbooks, trade books, reference books, or the Internet in order to identify characteristics that the planets have.

	1. Inner Planets – rocky bodies close to the Sun a. Mercury b. Venus c. Earth d. Mars	**CLASSIFY:** Organize the information about the planets in any way that makes sense to the students.
	2. Outer Planets – large gas bodies farther away from the Sun a. Jupiter b. Saturn c. Uranus d. Neptune	**MATH:** Make a bar graph of the sizes of the planets, or the distance from the sun, or how many moons each planet has.
	3. Pluto – smallest planet in the solar system seems to have more in common with inner planets than the gas giants	**READING:** Find out stories about the gods for whom the planets were named. **WRITING:** Write a travel commercial asking people to come to their chosen planet for vacation.
	III. <u>Moon</u> – Earth's only natural satellite, which means it travels around the Earth.	**OBSERVING:** Keep a moon journal for a month so that students can discuss what they see. If they have binoculars or a telescope, they will have even more data to discuss.
	A. The moon is visible in the night sky but it does not make its own light, it reflects the light of the Sun.	
	B. <u>Craters</u> are holes in the surface of the moon may have resulted from collisions with asteroids or other objects in space.	
	C. <u>Phases</u> are changes in the appearance of the moon as we view it from Earth.	**INQUIRY:** Use a Styrofoam ball and lamp to demonstrate the relationship between the Sun and the moon during various phases.
	D. Man landed on the moon in 1969 when Apollo 11 completed NASA's goal for the United States space program. Eventually five other Apollo missions continued this work.	**TECHNOLOGY:** NASA has a great website and teacher support to introduce students to its work.

	Unit Two – Energy	
	I. <u>Heat</u> – kind of energy that can change a matter's state. Heat always moves from warmer objects to colder objects.	**CRITICAL THINKING:** How could you stay warm on your way to school on a cold day?
	A. How can heat change matter?	**OBSERVE:** What happens when an ice cube, butter, and chocolate are placed in the Sun?
	1. Taking heat away can change a liquid to a solid. (Placing water in a freezer will produce ice.)	
	2. Adding heat to a liquid can change a liquid to a gas. (Boiling water will produce steam.)	
	3. Heat can change the physical properties of object.	
	B. What are some sources of heat?	
	1. Much of our heat comes from the Sun.	
	2. Fire gives off heat. To do this, it burns fuel. Wood, natural gas, and oil are fuels. <u>Fuel</u> is Something that gives off heat when it's burned.	**SAFETY FIRST!** If conditions permit, invite students to compare heat given off by a candle, an alcohol burner, a hot plate, and a desk lamp. Discuss.
	3. Heat can come from electricity. We can even use dams on rivers to make electricity.	
	4. You can rub two objects together to create heat. This is called <u>friction</u>. (Have students rub their hands together to prove this.)	**MEASURE:** What happens when you try to push something heavy over a rug? Try to push the same heavy object over tile or wood. Discuss the difference. **DEMONSTRATION:** Static Electricity

	C. Heat can move from one object to another.	
	1. Heat moves through metals quickly, this is why metals are called <u>conductors</u>. A cooking pan is an example of a conductor.	
	2. Heat moves less quickly through wood and rubber, that is why that are called <u>insulators</u>. We have rubber insulators around pan handles so we do not burn ourselves.	**INQUIRY:** What materials are the best insulators?
	D. How is heat measured?	
	1. Heat is measured by taking the temperature of an object. <u>Temperature</u> is how fast the particles of an object are moving.	**MATH:** Take the temperature everyday for a week both in the morning and in the afternoon. Graph the results and discuss.
	2. There are two temperature scales that are used in everyday life. **They are not the only scales used by scientists.** a. Celsius (metric/scientific) - ^{o}C 1) Freezing point of water - 0 ^{o}C 2) Boiling point of water - 100 ^{o}C b. Fahrenheit (customary/standard) – ^{o}F 1) Freezing point of water - 32 ^{o}F 2) Boiling point of water - 212 ^{o}F	
	3. One of the ways we read temperature is through the use of a <u>thermometer</u>. (Students should be able to read and record temperatures using thermometers.) In our homes, we use <u>thermostats</u>, to control the temperature.	

	II. **<u>Sound</u>** – kind of energy made when something vibrates or moves back and forth. When the object vibrates, it moves air. The vibrating air moves to your ear. It makes part of your ear vibrate, then you hear. When you speak, your vocal chords vibrate.	**OBSERVE:** Turn on a radio or CD player and listen. Take turns touching the radio as the music is playing.
	A. Sound travels in waves. Sound waves move through the air like a ripple in a pond.	**PREDICT:** After introducing students to the tuning fork, ask them to predict what will happen if it is struck and placed in water.
	B. What makes loud and soft sounds?	**ART:** Play music that will introduce students to the various orchestra instruments. Have them draw pictures of what they think the different instruments look like based on sounds.
	1. Big vibrations make loud sounds. For example, heavy steps make big vibrations; hitting a pot will create big vibrations.	
	2. Small vibrations make soft sounds. For example, soft steps make small vibrations; tapping a pot lightly will create small vibrations.	
	C. What makes sounds high or low? <u>Pitch</u> is how high or low a sound is.	**ART:** Make musical instruments from various odds and ends. Discuss the pitch and volume of the sound produced by each instrument.
	1. Fast vibrations have high pitches. The small end of a xylophone produces a high pitch.	**CLASSIFY:** Students should come up their own system and classify all the instruments.

	2. Slow vibrations have low pitches. The large end of a xylophone produces a low pitch.	**OBSERVE:** Transmit sound through a paper cup "telephone."
	D. What can sound move through?	
	1. Sounds can move through solids, liquids, and gases. Most sounds you hear move through the air, which is made up of gases.	**EXPLORE:** Create Bottle Chimes by filling 3 bottles with different amounts of water. Tap on each. Then blow into each. Discuss.
	2. Sounds move differently through water than air. The sounds make the water vibrate.	
	III. Light – the kind of energy that lets us see.	**DISCUSS:** Why do some houses and building use solar panels?
	A. Light travels in waves. Light waves travel like ocean waves.	**INQUIRY:** Use a slinky or jump rope to demonstrate the movement of waves.
	B. Some sources of light are the Sun, light bulbs, and fire. Most of the Earth's light is from the Sun. Without the Sun, the Earth would be in darkness and nothing would be able to live or grow.	
	C. Light can reflect and refract.	**IDENTIFY:** Try various means of shining light so that students can identify when it is reflected and when it is refracted. For instance, a straw in a glass of what should look bent.
	1. Reflect means that the light bounces off another object. For example, mirrors and ponds reflect light.	**WRITING:** Describe why the windows of a treehouse should not be made out of cardboard. Offer a substitute material.

	2. Refract means that the light bends. For example, a hand lens, water or a glass can refract light.	**EXPLORE:** Make rainbows by shining light through a glass of water onto paper.
	D. When light is blocked, a shadow is created.	**MEASURE:** Using chalk, measure some of the student shadows in the morning. That those same students out in the afternoon and measure again. Discuss what the students noticed.
		ART: Make shadow puppets.
	Unit Three– Animals	
	(Growth, change, and life cycle of animals are the topics outlined for this unit in the 2004 Scope and Sequence. Considering the vastness of this topic, feel free to explore animals in whatever way you feel best meets the needs of your students.)	*(Inquiry and investigation with living creatures is not advised. A classroom pet, stories about animals, a trip to the zoo are all possible ways to become familiar with the lives of animals.)*
	I. Some animals have backbones.	
	A. Mammals	
	1. Warm-blooded – body temperature stays the same.	
	2. Most have hair or fur on their bodies.	
	3. Give birth to live young. (Platypus and echidna lay eggs.)	
	4. Feed their young milk.	
	5. Mammals have special characteristics for living in their environment, finding food, and interacting with other animals in their habitat.	
	6. Almost 4000 species of mammals have been identified.	
	B. Reptiles	
	1. Cold-blooded – depend on the Sun and other heat sources to stay warm.	

	2. Most have scales or scutes to cover and protect their tough skin.	
	3. Give birth to eggs with thick shells. a. Turtle hatchlings are on their own. b. Crocodiles are quite protective of their hatchlings for the first few months.	
	4. Some reptiles live on land near the water, some live in deserts.	
	5. Reptile diet is as varied as the habitats.	
	6. 6500 species of reptiles are currently alive.	
	II. Some animals do not have backbones.	
	A. <u>Insects</u> – arthropods that have a hard body case that covers the whole body	
	1. Three body parts: head, thorax, abdomen	
	2. Thorax usually carries 3 pairs of legs and possibly 2 pairs of wings.	
	3. Sting organs, if there are any, are contained in the abdomen.	
	4. Antennae and other body parts such as legs and wings are used to “hear” and “see”.	
	5. Insects usually give birth to eggs with varying degrees of motherly attention.	
	6. Insects play an important role in creating new plants. On the other hand, insects can be “pests” that cause crop and plant damage.	
	7. There are approximately 65000 identified species of insects.	
	B. <u>Spiders</u> – arthropods with jointed legs and a hard body case	
	1. Body has 2 parts separated by a waist; they usually have many eyes.	
	2. Arachnids have 8 legs instead of 6 and no	

	wings or antennae.	
	3. Powerful jaws can deliver a poisonous bite. However, about only 500 can penetrate human skins.	
	4. Lay large numbers of eggs with protective tools such as camouflage sacs or by carrying the eggs wherever they go.	
	5. All spiders are predators.	
	6. About 35,000 species of spiders have been identified.	

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.