Summer 1997

A Model Fourth Grade Science Curriculum based on Multiple Intelligence Theory and Washington State's Essential Academic Learning Requirements for Science

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A MODEL FOURTH GRADE SCIENCE CURRICULUM BASED ON MULTIPLE INTELLIGENCE THEORY AND WASHINGTON STATE'S ESSENTIAL ACADEMIC LEARNING REQUIREMENTS FOR SCIENCE

A Project Report

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

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by

Kerry Lynn Ward

May, 1997

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BASED ON MULTIPLE INTELLIGENCE THEORY

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FOR SCIENCE

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The purpose of this project was to design and develop a model fourth grade science curriculum based on Howard Gardner's Theory of Multiple Intelligences and in line with Washington State's Essential Academic Learning Requirements for Science. Along with this, assessment criteria were to be designed for each learning activity. To accomplish this purpose, current research on Multiple Intelligence Theory, assessment, curriculum development and Washington State's Essential Academic Learning Requirements for Science were reviewed. Finally, student learning objectives, learning activities and corresponding assessment criteria were adapted and developed.

TABLE OF CONTENTS

CHAPTER I

BACKGROUND OF THE STUDY

Introduction

> The notion that we can place a child with reference to every other child as if there was a single scholastic hierarchy, is a tremendous arrogance (Anglin, 1993, p. 20).

Knowing that children posses unique talents and abilities, it would seem absurd to think that educators could develop a single measure by which to judge all students. However, this is exactly what intelligence tests are suppose to do. Gardner believes that intelligence tests actually measure only two types of intelligence, while overlooking several other intelligences. Gardner developed a Theory of Multiple Intelligences (MI Theory) and came up with seven distinct abilities he calls "intelligences". These abilities include linguistic and logical/mathematical (the two intelligences measured by standard intelligence tests), along with visual/spatial, bodily/kinesthetic, musical, interpersonal and intrapersonal abilities. Each of these abilities is separate and distinct, however, more than one intelligence is usually needed to accomplish even our simplest daily undertakings.

Need for the Study

Many educators have implemented certain aspects of MI theory in the classroom. A widely used technique is the development of learning centers or "flow areas", which allow the student to explore concepts through each of the seven intelligences (Campbell, 1992; Nelson, 1995; Bolanos, 1994). Another means of implementing MI theory is allowing project work in which students choose approaches which are best suited to their strengths and interests (Campbell, 1992; Wallach & Callahan, 1994). However, most science teaching focuses on the linguistic and logical/mathematical intelligences, causing difficulty for students whose strength may lie in other areas (Campbell & Burton, 1994).

As Washington state continues to implement curriculum reform as mandated by House Bill 1209, educators will need to find ways to make science meaningful to all students. According to the Essential Academic Learning Requirements for science, students must show mastery of science concepts and principles as early as the fourth grade (Washington State Commission on Student Learning-Science, Draft C). Therefore, elementary educators must not only work to bridge the understanding gap for many science students, they must also assess the students' understanding.

Purpose of the Study

The purpose of this project was to design and develop a model fourth grade science curriculum and assessment based on the theory of multiple intelligences and in line with Washington state's Essential Academic Learning

Requirements for Science (per House Bill 1209). To accomplish this purpose, current research and literature on multiple intelligences, elementary science curricula, assessment and the Essential Academic Learning Requirements for Science were reviewed. Finally, student learning objectives, learning activities and assessment rubrics were adapted and developed.

Definition of Terms

Significant terms used in the context of this study have been defined as follows:

1. Multiple Intelligence Theory: A theory that supports the existence of seven comprehensive abilities or "intelligences." These seven intelligences include verbal/linguistic; logical/mathematical; bodily/kinesthetic; visual/spatial; musical; interpersonal; and intrapersonal (Armstrong, 1994).
2. Curriculum Development: The process of analysis, design, implementation, and evaluation by which curriculum developers set goals, plan experiences, select content and assess outcomes of school programs (Wiles & Bondi, 1993).
3. Assessment: A means by which students, teachers, and school districts receive feedback on the learning of students, instructional practices and the effectiveness of school programs (National Science Education Standards, 1996).

4. Assessment Rubric: A way of specifying exactly what is expected of students at varying levels of achievement (Liu, 1995).

5. Washington State Essential Academic Learning Requirements for Science: Specific competencies which outline what a student should know, understand and be able to do in order to achieve a basic level of scientific literacy (Washington State Commission on Student Learning - Science, 4/9/96 - Draft C).

Overview

The following chapter is a review of literature related to Multiple Intelligence Theory, curriculum development, assessment and the Essential Academic Learning Requirements as they apply to the area of elementary science education. Chapter III outlines considerations which spurred the development of the project as well as the procedures and planned implementation of the project. Chapter IV is the project which includes four science units developed for a fourth grade classroom. Finally, Chapter V discusses conclusions and recommendations made based on the development of the project.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

The review of research and literature summarized in Chapter II has been organized to address:

1. Multiple Intelligence Theory--Background Information
2. Curriculum Development based on Multiple Intelligence Theory
3. Assessment Through the Multiple Intelligences
4. Information on Washington State's Essential Academic Learnings for Science
5. Summary

Research and literature was identified through an Educational Resource Information Centers (ERIC) computer search. Other information was gathered through government documents, specifically documents from Washington state's Commission on Student Learning.

Multiple Intelligences--Background Information

In 1900 the psychologist Alfred Binet was asked to devise some measurement technique which would predict the success and/or failure of primary grade students. Out of this request came the "intelligence test" which measured "IQ". Since that time the use of intelligence testing has led to "the categorization of individuals based upon their intelligence quotient (IQ) score" (Smerechansky-

Metzger, 1995, 12). However, according to Black (1994) "schools misuse tests when they use scores to slot kids into ability groups" (p. 25). Black states that IQ tests are good for one purpose only and that is predicting student success in *school* (p. 24). Howard Gardner states; "the notion that we can place a child with reference to every other child as if there was a single scholastic hierarchy, is a tremendous arrogance" (Anglin, 1993, 20). In fact, Gardner (1993) believes that "human cognitive competence is better described in terms of a set of abilities, talents, or mental skills, which we call 'intelligences'" (p. 15). He goes on to state that "an intelligence entails the ability to solve problems or fashion products that are of consequence in a particular cultural setting or community" (p. 15).

Gardner defined specific criteria by which a set of intelligences could be identified. "Each intelligence must have a developmental feature, be observable in special populations such as prodigies or "idiot savants", provide some evidence of localization in the brain, and support a symbolic or notational system" (Campbell, Campbell, Dickinson, 1992, p. xv). Along with this, accounts of cognition across cultures was also considered (Gardner, 1993, p. 16). With these criteria in mind, Gardner distinguished seven intelligences consisting of musical, linguistic, bodily/kinesthetic, visual/spatial, logical/mathematical, interpersonal, and intrapersonal abilities. Gardner (1993) states that while each of these "intelligences are to a significant extent independent,... nearly every cultural role of any degree of sophistication requires a combination of intelligences" (pp. 26-27).

Musical ability includes the ability to "manipulate pitch, melody and timbre and to participate with some skill in musical activities" (Campbell et al., 1992, p. 80). Gardner states that the ability to produce and perceive music has been shown to reside in the right hemisphere. While strict localization of musical skill has not been shown there is evidence of "amusia" or loss of musical ability. Along with this, music is a universal aspect of all cultures (Gardner, 1993, pp. 17-18). Therefore, music should be considered an intelligence.

Linguistic skill and ability have to do with language use, including oral and written communication. "Linguistic intelligence consists of the ability to think in words and to use language to express and appreciate complex meanings" (Campbell et al., 1992, p. xvi). Language skill has been shown to be localized in "Broca's Area", a specific area of the brain. Language and language development are universal across cultures. Even among deaf populations, language exists in a unique output channel (Gardner, 1993, p. 21).

Bodily/kinesthetic intelligence involves manipulation of materials and/or involving movement of a person's body. The control of bodily movements is localized in the motor cortex. Along with this, "body movement undergoes a clearly defined developmental schedule in children. And there is little question of its universality across cultures" (Gardner, 1993, pp. 18-19).

The visual/spatial intelligence includes the skills of "visual discrimination, recognition, projection, mental imagery, spatial reasoning, image manipulation, and the duplication of inner or external imagery" (Campbell, 1992, p. 42). The

evidence that visual/spatial ability is localized in the right hemisphere is clear, according to Gardner (1993). He states that damage to the right posterior region impairs a person's ability to recognize faces or scenes, notice fine details or find their way around a site. Gardner also states that visual/spatial skill had been documented in special populations such as autistic children (Gardner, 1993, p. 22).

"Logical/mathematical intelligence makes it possible to calculate, quantify, consider propositions and hypotheses, and carry out complex mathematical operations" (Campbell et al., p. xvi). The development of logical/mathematical skill had been carefully documented by Jean Piaget. Along with this, Gardner points out that there has been documentation of both idiot savants and child prodigies with enormous mathematical skill. He also states that "certain areas of the brain are more prominent in mathematical calculation than others" (Gardner, 1993, p. 20).

Interpersonal intelligence is the ability to understand and interact effectively with other people. The frontal lobes seem to play an important role in interpersonal knowledge. Pick's disease, a form of presenile dementia, affects the frontal lobes and includes a rapid loss of social graces (Gardner, 1993, p. 23). Gardner also states that the study of prehistoric societies points to a cultural basis of an interpersonal intelligence. Without participation and cooperation, skills such as hunting and tracking, killing of game would have been next to impossible (1993, p. 24).

Intrapersonal intelligence has to do with a person's ability to develop an accurate perception of oneself and use this knowledge to make personal choices and plans. As with interpersonal intelligence, intrapersonal intelligence shows evidence that it is localized in the frontal lobes. Injury to the lower frontal lobe often produces irritability and euphoria, while injury to the upper regions of the frontal lobe produces indifference, listlessness and apathy (Gardner, 1993, p. 25). The lack of this intelligence is evident in autistic children who may not even be able to refer to him/herself.

Science Curriculum Development Based on Multiple Intelligence Theory

Implications of this research for education are tremendous. "Schools are typically organized around the linguistic and logical-mathematical intelligences" (Hoerr, 1994, p. 30). Therefore, students who do well in these two intelligences have a better chance of doing well in school. Unfortunately, not all students are strong in these areas and, therefore, school is a place where many students struggle. "To Gardner, much of what passes for serious academic learning in school is simply a barrier that keeps many individuals from putting their inherent intelligences to good use" (Black, 1994, p. 26).

Campbell and Burton (1994) state that "because the framework of science is built around the linguistic and logical/mathematical intelligences, students whose strengths lie in other areas may find science difficult" (p. 22). Along with

this, the National Science Education Standards (1996) states that "different students will achieve understanding in different ways, (therefore) teachers need to use many different strategies to develop the understandings and abilities described in the *Standards*" (p. 2). Gardner believes that teachers are "curriculum brokers" who must find and provide the most appropriate curriculum for each individual student. In an interview with Jacqueline Anglin (1993), Gardner states that "everybody should learn geometry or history...but it's hardly necessary for everybody to learn geometry and history in exactly the same way" (p. 19).

This is where MI Theory provides a framework for teachers to develop a curriculum through which all students can learn in the best way suited to them. According to Armstrong (1994) "MI Theory essentially encompasses what good teachers have always done in their teaching: reaching beyond the text and the blackboard to awaken students' minds" (pp. 49-50). The benefit of MI theory as an instructional framework is that it provides a template for teachers to begin developing instructional activities which allow for every student to utilize his or her strongest intelligences to acquire information and solve problems. "Essentially, MI theory offers a means of building daily lesson plans, weekly units, or monthly or year-long themes and programs in such a way that all students can have their strongest intelligences addressed at least some of the time" (Armstrong, 1994, 57).

Two effective strategies for incorporating MI Theory into curriculum development have surfaced in the literature. These strategies include: using stronger intelligences to build on weaker intelligences, known as academic "bridging" (Gray & Viens, 1994; Hoerr, 1994), and learning subject matter through each intelligence (Campbell et al., 1992; Armstrong, 1994). "By learning subject matter in different ways, each student has multiple chances of understanding and retaining academic information" (Campbell, 1992). These strategies are not mutually exclusive and can actually be applied simultaneously.

Armstrong (1994) outlines a seven step procedure that can be used to create curriculum units based on MI theory. First the instructor must focus on a specific objective or topic. Then, key MI questions must be asked which address how the objective or topic can be addressed by each intelligence. In other words, when considering the spatial intelligence the teacher must ask; "How can I use visual aids, visualization, color, art, or metaphor?" (p. 58). The third and fourth steps entail considering the possibilities and brainstorming for specific ideas. From the list of ideas generated appropriate activities are then selected and a sequential plan is developed. Finally, step seven is the implementation of the plan.

A similar framework for developing MI based instruction is given by Campbell and Burton (1994). Like Armstrong, Campbell and Burton begin the process of developing MI based curriculum by identifying a topic. Specifically they begin with a unit topic. They then develop a list of exploration activities

related to the topic for each intelligence. A brief introduction to the topic is given to the class and content-related words are introduced. At this time the students are allowed to pick which exploration activities they want to complete. Students are instructed that they must complete at least one activity from each intelligence category. In this way, students are able to learn about the topic through at least one area of strength. Along with this, the student will also expand other intelligences that may not be as strong.

Assessment

Inherent in the development of a curriculum based on the Theory of Multiple Intelligences is assessment of students through the multiple intelligences. "It would certainly be the height of hypocrisy to ask students to participate in a wide range of multispectrum experiences in all seven intelligences, and then require them to show what they've learned through standardized tests that focus narrowly on verbal or logical domains" (Armstrong, p. 115). Therefore, an underlying concept of a good program which implements MI Theory is the development of "multiple options for students to demonstrate what they have learned" (Campbell, et al, p. 200).

Along with this, assessment practices should be seen as an integral part of the instructional process. In fact, Stiggins (1994) states that sound assessment leads to effective instruction which in turn leads to maximum achievement (p.

41). Therefore, "assessment experiences and instructional experiences should begin to appear virtually indistinguishable" (Armstrong, p. 132).

An important aspect of good assessment is the clear communication of what is expected. Not only does this allow the student to know exactly what is expected of them, it also allows the teacher to state what it is that he or she values as the target outcome. Stiggins (1994) states that "sound assessment requires clear thinking and effective communication-not just the quantification of achievement" (p. 9). Therefore, educators must first think about and know what it is they want to assess, and then they must effectively communicate this to students. Campbell and Burton state that "students should understand clearly the learning and evaluation procedures of the unit" (p. 24). In order for this to happen, the criteria by which something is to be assessed must be clearly stated from the beginning.

An effective means of stating specific criteria by which something will be assessed is through rubrics. Rubrics state what a student must do to earn a certain number of points. As Stiggins (1994) states, "the symbols used as the basis of our communication about student achievement are only as meaningful and useful as the definitions of achievement that underpin them" (p. 9). Therefore, regardless of how we choose to assign value to our students' progress or achievement, we must first define what it is that we expect our students to achieve.

Rubrics help teachers and students focus on the specific concepts and ideas to be learned. However, often rubrics are written with the ideal achievement at the highest level and less is required of students at each lower level. Liu (1995) suggests that an alternative to this is to design additive rubrics. "With an additive rubric, students must learn more content in greater depth to achieve higher levels" (p. 49). Liu explains that additive rubrics begin with the minimum standard that all students are expected to achieve. The standard is based on the idea "that all students will, at a minimum, learn some concepts well, rather than many incompletely" (Liu, p. 49). From the minimum standard, higher levels are achieved through learning more content and/or showing application of learned material in novel situations.

Washington State's Essential Academic Learning Requirements for Science

Washington state's Essential Academic Learning Requirements for science and the accompanying benchmarks provide the minimum standards by which the base level of a competent science background can be assessed. "The purpose of the essential academic learning requirements in science is to identify what students should know, understand and be able to do in order to attain a fundamental level of scientific literacy" (Washington State Commission on Student Learning - Science, 4/9/96 - Draft C, p. 2).

Under the Engrossed Substitute House Bill (ESHB) 1209, essential academic learning requirements have been identified for science. By the 10th grade students must show mastery of the performance requirements which would result in the acquisition of a certificate of mastery. There are three benchmarks by which students' attainment levels would be monitored: lower level (benchmark #1 - K - 4th grades), middle level (benchmark #2 - 5th - 7th grades), and upper level (benchmark #3 - 8th - 10th grades).

The following are five essential academic learning requirements for science which have been outlined as a means of obtaining scientific literacy.

1. The student knows and understands scientific concepts and principles.
2. The student conducts scientific inquiry.
3. The student communicates scientific understanding.
4. The student understands how science knowledge and skills are connected with other subject areas and real-life situations.
5. The student applies science knowledge and skills to solve problems and meet challenges (Draft C, p. 5).

Each of these essential academic learning requirements is subdivided into Components which are organized around important learning elements.

Summary

The research and literature summarized in Chapter II supported the following themes:

1. Multiple Intelligence Theory assumes that people posses seven different areas of intelligence.
2. Engaging students in as many intelligences as possible will increase the potential for understanding concepts being taught.
3. In order for learning to be beneficial, assessment must be an integral and ongoing aspect of the learning experience.
4. Assessment criteria must be clearly stated prior to the inception of the activity to be assessed.
5. The state of Washington's Essential Academic Learning Requirements for Science clearly state the desired outcomes for the subject of science.

The following chapter takes into consideration all of the information gained through the review of literature and outlines considerations taken in developing the project. Along with this, procedures and planned implementation of the project is discussed.

CHAPTER III

The purpose of this project was to develop a model fourth grade science curriculum and assessment based on multiple intelligence theory and in line with Washington state's Essential Academic Learning Requirements for Science. To accomplish this purpose current research and literature on multiple intelligences, elementary science curricula, assessment, and the Essential Academic Learning Requirements for Science were reviewed.

Chapter III contains background information describing:

1. Considerations for the project
2. Procedures
3. Planned implementation of the project

Considerations for the Study

The writer considered the following in the design of the project:

1. The writer's, three years of teaching experience resulted in the recognition of the instructional benefits of varied learning experiences for all students and she was investigating better ways to insure students' learning in the subject of science.
2. The writer's return to Washington state after a two year absence created the need to learn about the Essential Academic Learning Requirements which had begun development and implementation during her absence.

3. Current research findings supported student motivation and learning through teaching techniques which implemented Multiple Intelligence Theory.
4. The writer found a lack of curriculum which tied assessment and student learning goals together.
5 Undertaking this project coincided with graduate studies in Master Teacher at Central Washington University.

Upon discussion with various other educators and through personal reading and research, the writer began to see a need for a deeper level of science understanding at the elementary level. During three years of teaching, the writer engaged in kinesthetic, visual, and musical learning activities and noticed the deeper level of understanding that took place. The writer began researching Multiple Intelligence Theory and noticed that the concepts of the theory benefited students who may have difficulty in the subject of science. Awareness that the state of Washington, through the Commission on Student Learning, had established Essential Academic Learning Requirements in educational areas including science, caused the writer to include these in the study. Input from fellow educators and university professors influenced the writer's decision to proceed with the development of a model fourth grade science curriculum.

Procedures

To obtain background information essential for developing a science curriculum based on Multiple Intelligence Theory and appropriate assessment devices, an Educational Resources Information Center (ERIC) computer search was undertaken. Additionally, current educators and school personnel of Ellensburg elementary schools were contacted for information on the implementation of the state of Washington's Essential Academic Learning Requirements for Science.

Planned Implementation of the Study

Accordingly, the model fourth grade science curriculum is intended for use specifically at the fourth grade level of a Washington state school. With some revisions, however, it is a tool that can be used by any elementary educator. It is a resource that will be utilized by the writer upon returning to teaching.

CHAPTER IV

The Project

The model fourth grade science curriculum designed for use in any fourth grade classroom, which was the subject of this project, has been presented in Chapter IV, in four units.

UNIT I: Matter

UNIT II: Electricity

UNIT III: Ecosystems

UNIT IV: Circulatory and Respiratory Systems

Each unit includes a list of key terms and concepts and specific learning objectives. Along with this, there are seven Exploration Activities for each unit. Each Activity emphasizes one of the seven intelligences outlined in Howard Gardner's Theory of Multiple Intelligences. The Exploration Activities are not intended to be the sole means of instruction or learning for each unit. However, they are meant to provide students with an opportunity to explore science concepts from many different intelligences. Included with the Exploration Activities are assessment rubrics which outline how to assess students work. Finally, there is a matrix which outlines which Essential Academic Learning Requirements for Science are met through each unit.

A MODEL FOURTH GRADE SCIENCE CURRICULUM WHICH IMPLEMENTS PRINCIPLES OF MUTIPLE INTELLIGENCE THEORY

Kerry Lynn Ward, Instructor

TABLE OF CONTENTS

PAGE

Essential Academic Learning Requirements
SCIENCE

ESSENTIAL LEARNING 1: The student understands and uses scientific concepts and principle.

To meet this standard, students will:

COMPONENTS	Benchmark 1: K-4	MATTER	ELECTRICITY	ECOSYSTEM	CIRC./RESP
Use properties and characteristics to identify, describe and categorize substances, materials and objects	• (a) use properties to identify natural and manufactured materials • (b) use physical properties to describe the three states of matter • sort and order objects by physical properties (such as size, shape, color, texture, hardness, conductivity, weight, length, and volume)	musical	musical		
Identify, describe, and categorize living things based on their characteristics	• identify the principle characteristics that distinguish living organisms from non-living things • use characteristics to distinguish among different kinds of living organisms				
Measure properties and characteristics	• use tools and units of the English and metric systems to measure the properties of objects and materials including length, volume, weight, and temperature				

		Matter	Electricity	Ecosystem	Circ./Resp.
Measure properties and characteristics (Cont.)	• identify and correct sources of error in measurement • use basic time units such as seconds, minutes, hours, day, year • understand measuring involves choosing an appropriate standard unit for comparison, and then using a tool to compare the unknown to the standard unit				bodily
Recognize the components, structure, and organization of systems and the interconnections within and among them.	• describe the interdependence among animals, plants and decomposers in their environment • construct a complete electric circuit • recognize that a complete electric circuit is an electrical system • cite evidence that materials are composed of parts too small to be seen without magnification • observe and measure weather phenomena • recognize that reproduction is essential to the continuation of a species	bodily	logical visual	linguistic, logical, kinesthetic	

		Matter	Electricity	Ecosystem	Circ./Resp.
Recognize the components, structure, and organization of systems and the interconnections within and among them (Cont.)	• demonstrate how traits are passed from parent to offspring and recognize that those traits determine the species of an organism • identify the basic needs of plants and animals in their environment • identify examples of the relationship between form and function in everyday life • identify a simple system which has interactive and interdependent components				visual
Understand that interactions within and among systems cause changes in matter and energy	• recognize fossils are the remains of plants and animals that lived long ago • recognize some species of plant and animals (such as dinosaurs) have become extinct • recognize all organisms, including humans, cause changes in the environment • recognize how erosion, deposition, earthquake, and volcanism affect the surface of the earth • identify rocks by texture and mineral composition (resulting in different colors and density) • know rocks weather slowly to form soils			kinesthetic, interpersonal, intrapersonal	

		Matter	Electricity	Ecosystem	Circ./Resp.
Understand that interactions within and among systems cause changes in matter and energy (Cont.)	• know some changes in matter result in same type (melting, freezing, evaporating) and some changes in matter result in different kinds of matter (burning)	logical, visual, interpersonal			
	• describe the changes of state of common substances like water	logical, visual, interpersonal			
	• give examples of conduction and radiation of energy		interpersonal		
	• give examples of forms of energy and how people use them				
	• compare directions of motion, distances, relative speeds of familiar objects				
	• (a) identify factors that affect the motion of a particular object	bodily			
	• (b) know water is cycled from ocean to air to land, and back to the ocean	linguistic			
	• recognize examples of cyclical events such as life cycles and seasonal cycles	linguistic			visual
	• observe the cyclic patterns of the sun and moon				
	• explain cyclic events such as day, night, and seasons				
	• know the motion of the moon and the earth relative to each other and the sun				

		Matter	Electricity	Ecosystem	Circ./Resp.
Construct and use models to predict, test and understand scientific phenomena	• construct a physical model of a familiar object • interpret a physical model of a familiar object and/or system • describe how a model is similar to and different from the natural object and/or system				

ESSENTIAL LEARNING 2: The student conducts scientific investigations.

To meet this standard, the student will:

COMPONENTS	Benchmark 1: Grades K-4	Matter	Electricity	Ecosystems	Circ./Resp.
Conduct scientific investigations	• make simple accurate observations		logical	logical	logical, bodily
	• ask questions, define the problem, make predictions based on experience, and identify any conditions that should be considered		logical		
	• use tools and technologies, and information to conduct simple scientific investigation		logical		logical, bodily
	• plan and conduct a simple experiment				
	• work individually and/or with others in designing and carrying out an experiment				
	• record experimental data appropriately		logical	logical,	logical, bodily
	• use data to construct logical explanations		logical		logical, bodily
	• accurately report observations, methods, and results of simple experiments		logical	logical	logical, bodily
	• follow safety rules during investigations	interpersonal	logical		
	• develop questions and/or define a problem related to the physical world based on observation/ personal experiences			logical	

		Matter	Electricity	Ecosystems	Circ./Resp.
Think logically, analytically and creatively	• use imaginative and creative strategies to investigate the physical and human-designed world	interpersonal			
	• examine data to verify a conclusion in a simple investigation		logical		logical, bodily
	• compare, order, and categorize scientific information	logical	logical	logical	logical, bodily
	• explain how a conclusion was derived in a science investigation		logical		logical, bodily
Practice the principles of scientific inquiry	• record data accurately • identify and attribute a scientific discovery to the discoverer		logical, inter. Linguistic	logical	logical, bodily
	• interpret scientific data accurately even when the results are contrary to predictions		logical		logical
	• identify what is already known about a science problem	interpersonal			
	• know ideas in science change as new scientific evidence arises		linguistic		
	• recognize science is one way of knowing about the physical world	interpersonal, intrapersonal	interpersonal, intrapersonal, linguistic		

ESSENTIAL LEARNING 3: The student uses effective communication skills and tools to build and demonstrate understanding of science.

To meet this standard, the student will:

COMPONENTS	Benchmark 1: Grades K-4	Matter	Electricity	Ecosystems	Circ./Resp.
Use listening, observing, and reading kills to obtain scientific information	• obtain science information by listening and attending a science presentation • read and comprehend developmentally appropriate science information	linguistic	interpersonal linguistic		linguistic
Use writing and speaking skills to organize and express science ideas	• write clear science explanations using developmentally appropriate vocabulary and writing skills • recognize and use everyday science terms associated with the students' environment	logical, musical, interpersonal, intrapersonal logical, musical, interpersonal, intra., visual	logical, interpersonal interpersonal, intrapersonal	linguistic linguistic, musical	linguistic
Use effective communication strategies and tools to prepare and present science information	• use common computer programs to prepare a science report • operate developmentally appropriate science software programs • plan and present science information using strategies such as drawings, media technology, models, role playing, verbal and written explanations, pictures, lists, data tables, etc.	visual, bodily	bodily, visual, interpersonal, musical	linguistic, visual logical, musical, bodily, interpersonal, intrapersonal	musical, visual, bodily, logical

ESSENTIAL LEARNING 4: The student understands how science knowledge and skills are connected to other subject areas and real-life situations.

To meet this standard, the student will:

COMPONENTS	Benchmark 1: Grades K-4	Matter	Electricity	Ecosystems	Circ./Resp.
Identify the connections between science and mathematics	• recognize and describe pattern				bodily
	• collect and organize numerical data from a scientific investigation				logical, bodily
	• use estimation skills and judgment to make a prediction		logical	kinesthetic	logical, bodily
	• use numbers, shapes, symbols, and graphs to describe situations in the physical world		visual		
Identify the connections between science and technology	• explain how people have invented tools and techniques to solve problems		linguistic, interpersonal		
	• identify ways in which tools help scientists make better observations and measurements				
Describe the connection between science and history	• describe significant scientific contributions by individuals from the past		linguistic		
Describe the connection between science and society	• investigate how science and technology influence everyday life	intrapersonal	interpersonal, intrapersonal	interpersonal	
	• describe how natural resources are used by people		intrapersonal, interpersonal		
	• describe how personal decisions can impact the environment			intrapersonal	intrapersonal

Describe the connection between science and society (Cont.)	• describe how science and technology information can influence personal decisions	**Matter**	**Electricity** interpersonal, intrapersonal	**Ecosystems** intrapersonal, interpersonal	**Circ./Resp.** interpersonal, intrapersonal
Investigate the need for scientific knowledge and skills in his/her careers of interest	• investigate how the knowledge and skills of science and mathematics are used in familiar workplace occupations		interpersonal		interpersonal

ESSENTIAL LEARNING 5: The student applies knowledge and skills to solve problems or meet challenges.

To meet this standard, the student should:

COMPONENTS	Benchmark 1: Grades K-4	Matter	Electricity	Ecosystems	Circ./Resp.
Identify problems and challenges in which science knowledge and skills can be applied	• identify a problem in which science/technology can be used to design a solution • define the parts of the problem and the factors that would determine a desirable solution			interpersonal	
Research, design, and test a variety of ways to address problems and/or challenges	• research, design, and test a solution to meet a science/technology challenge • identify the difficulties that exist in designing a solution				
Evaluate solutions and consequences	• evaluate a solution based on how well it meets the criteria				
Implement a proposed solution and communicate the approach used	• work alone or with a group to implement a solution • verbally describe the problem or challenge and the process used to design and select a solution				

UNIT I

TABLE OF CONTENTS

MATTER

Unit on Matter

Key Terms and Concepts:

Solid - an object having length, width, and breadth

Liquid - a substance that flows readily but does not expand indefinitely

Gas - substance which expands indefinitely

Molecules - the smallest part of something that retains it's characteristics

Physical Change - a change in substance which does not alter the molecular makeup of the substance

Chemical Change - a change in a substance which alters the molecular makeup of the substance

Evaporation - the process of changing (a solid or a liquid) into a vapor

Condensation - the process of changing to a denser form (a gas to a liquid)

Water Cycle - the process of evaporation and condensation which recycles the water in the environment

Objectives:	Exploration
1. The student will know the states of matter (solid, liquid and gas) and define properties that distinguish each state of matter.	Musical, Linguistic
2. The student will be able to describe the proximity and motion of molecules in each state of matter.	Bodily
3. The student will be able to describe and produce both physical and chemical changes in various forms of matter.	Logical, Visual Interpersonal
4. The student will be able to describe the water cycle and relate each state of matter to the water cycle.	Linguistic
5. The student will be able to describe how the states of matter are evident in his/her daily life and why it is necessary to know and/or learn about them.	Intrapersonal

Linguistic Activity for Matter Unit

Read the book The Magic School Bus: Wet All Over by Joanna Cole (1996). While you are reading the book pay special attention to the different states of matter that are described. One of the states of matter is *not* talked about in the book, and yet it does occur in nature.

Once you have read the story and know which state of matter is missing, you will write a story similar to the one by Joanna Cole. However, your story must include an explanation of **all three** states of matter which can be evidenced in the water cycle and a description of how one state of matter can be changed to another. You must use appropriate vocabulary. Be as creative as possible but be sure that your story is scientifically accurate.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Linguistic Activity		
Exemplary	4 points	**Good** + the student's story includes a description and explanation of other changes in matter that can be evidenced in nature (i.e. forest fire).
Good	3 points	**Satisfactory** + the story describes how to change each different state of water to each of its other states.
Satisfactory	2 points	The student writes a story which accurately describes the three states of matter as evidenced in the water cycle. The story includes a description of how to change one state of water to each of it's other states.
Inadequate	1 point	The student's story has more than two inaccuracies or does not include a description of all three states of matter and how to change one state of matter to each of its other states.
No Response	0 points	

Logical/Mathematical Activity for Matter Unit
(adapted from Kleinheider, 1996)

In this activity you will create physical and chemical changes in various forms of matter. As you do the activity you should be thinking of other changes that you could create.

Given the items below, create as many physical and chemical changes in matter as you can think of. Record what you do and explain whether it is a chemical or physical change. Also include an explanation of the difference between a physical and chemical change.

hair dryer	hammer	hard candy	peanut
ice cubes	baking soda	vinegar	margarine

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Logical/Mathematical Activity		
Exemplary	4 points	**Good** + the student actually carries out the changes described and accurately writes about what he she did and the type of change that was produced.
Good	3 points	**Satisfactory** + the student thinks of and describes at least 2 more physical changes and 2 more chemical changes that he/she could make with the objects given or with any other objects he/she can think of.
Satisfactory	2 points	The student is able to produce six changes in the matter that is given and accurately describes what they did and properly categorizes the change as a physical or chemical change. There is an appropriate explanation of the difference between a physical and chemical change in matter.
Inadequate	1 point	The student produces less than 6 changes or does not give an explanation about the difference between a physical and chemical change in matter.
No Response	0 points	

Bodily/Kinesthetic Activity for Matter Unit

In groups of 6 act out how molecules behave in each state of matter. Your skit should include examples of how close or far apart molecules are in each state of matter and how the molecules move in each state of matter.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Bodily/Kinesthetic Activity		
Exemplary	4 points	**Good** + the skit accurately depicts factors that would effect the movement of molecules and lead to changes in states of matter.
Good	3 points	**Satisfactory** + the skit shows the total movement of the molecules in each state of matter and depicts factors that may influence the movement (gas in a beaker).
Satisfactory	2 points	The skit accurately shows the proximity of molecules to each other in each state of matter and how fast or slow the molecules move in each state of matter.
Inadequate	1 point	The skit has more than two inaccuracies.
No Response	0 points	

Visual/Spatial Activity for Matter Unit

After you have completed the Interpersonal Activity in which you made Rice Crispy Treats, make a flow chart which accurately shows the process of making the treats and relates this process to the process of changing states of matter.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Visual/Spatial Activity		
Exemplary	4 points	**Good** + the student creates another flow chart of his/her choice which accurately depicts the process of changing states of matter (i.e. water cycle).
Good	3 points	**Satisfactory** + the student includes an accurate description of whether the changes in states of matter were physical or chemical.
Satisfactory	2 points	The flow chart accurately shows the process of making Rice Crispy treats and relates this process to the process of changing states of matter.
Inadequate	1 point	The flow chart is inaccurate or unreadable.
No Response	0 points	

Musical Activity for Matter Unit

By yourself or with a partner write a song about the properties of each state of matter.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Musical Activity		
Exemplary	4 points	**Good** + all of the extra concepts relate to the properties of one of the states of matter.
Good	3 points	**Satisfactory** + the song includes at least four other concepts about matter.
Satisfactory	2 points	The song gives two properties of each state of matter.
Inadequate	1 point	The song has less than two properties for each state of matter.
No Response	0 points	

Interpersonal Activity for Matter Unit

In groups of four read the recipe for making Rice Crispy treats. Together discuss the different parts of the recipe which may cause a change in a state of matter. Under the supervision and guidance of an adult (the teacher or parent) make the Rice Crispy treats. As the treats cool work as a group to write what you learned about the states of matter and the process of changing states of matter to different states.

Recipe: taken from Safeway Brand Crispy Rice Cereal Box

¼ cup margarine 40 large marshmallows 5 cups crispy rice cereal

1. Butter a 13 x 9 x 2-inch baking pan.
2. Melt the margarine in a large saucepan over low heat.
3. Add marshmallows and stir constantly until they are melted.
4. Remove from heat.
5. Quickly add cereal and stir until all pieces ore evenly coated.
6. Press into the prepared pan with the back of a buttered spoon.
7. Let cool and then cut into squares.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Interpersonal Activity		
Exemplary	4 points	**Good** + the paragraph describes the properties that they recognize in each state of matter.
Good	3 points	**Satisfactory** + the paragraph states at least 4 specific things that they learned about matter that relates to the process of making Rice Crispy treats (i.e. when heat is applied to butter it will change from a solid to a liquid).
Satisfactory	2 points	The group's paragraph describes at least 4 things that they learned about matter and changing states of matter to another state.
Inadequate	1 point	There are less than 4 things described.
No Response	0 points	

Intrapersonal Activity for Matter Unit

Write a reflective paragraph which describes evidence of the three states of matter in your daily life **and** explains why you think it's important for you to know about matter and the changing states of matter.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Intrapersonal Activity		
Exemplary	4 points	**Good** + the student's paragraph includes at least one other aspect about matter (i.e. a description of properties of the examples).
Good	3 points	**Satisfactory** + at least 1 of the examples is a natural cycle of changing states of matter and at least 1 of the examples is a man-induced way of changing states of matter.
Satisfactory	2 points	The student gives 3 examples of each of the three states of matter from his/her daily life and writes an explanation about why he/she thinks it's important to know about matter.
Inadequate	1 point	The student has less than three examples of each state of matter or does not explain why matter is important.
No Response	0 points	

UNIT II

TABLE OF CONTENTS

ELECTRICITY

Unit On Electricity

Key Terms and Concepts:

Closed Circuit - a continuous connection which allows electrical energy to flow from the source of energy to an outlet of energy

Open Circuit - a break or gap prevents the continuos flow of electrical energy from the source to outlet

Switch - serves to open or close a circuit

Series Circuit - all of the usable electricity flows through each bulb or appliance

Parallel Circuit - electricity flows through a main wire and through branching wires connected to the main wire

Voltage - pressure behind the flow of electricity

Conductor - any substance that permits an easy flow of electricity

Insulator - poor conductors, inhibit the easy flow of electricity

Fuse - safety device, narrow metal strip that melts at a low temperature, shutting off the current which may cause fire

Objectives:	**Exploration**
1. The student will demonstrate that electricity can only flow through a closed circuit and that a gap or a break in a circuit creates an open circuit which electricity cannot flow through.	Bodily
2. The student will be able to create a series circuit and a parallel circuit and explain how they are different from each other.	Logical
3. The student will be able to list conductors and insulators of electricity and list properties of each.	Musical
4. The student will be able to explain that static electricity is created when a negative electric charge is built up in an object. The student will be able to explain that the negative charge is created through the loss of protons *or* through the addition of electrons.	Visual
5. The student will be able to explain that current electricity is most efficiently created through mechanical energy - the energy of motion. This is done through changing the energy in fuels and/or falling water into electricity.	Interpersonal
6. The student will be able to describe and explain a minimum of three ways to be safe with and/or around electricity.	Intrapersonal
7. The student will be able to describe at least one person's contributions to the development of electricity.	Linguistic

Linguistic Activity for Electricity Unit

In this activity you will do a short report on someone's contribution to the development of electricity. You must use at least two books. Your report must be clear and easy to read.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Linguistic Activity		
Exemplary	4 points	**Good** + the student discusses the changes and advancements of electricity since this person's contribution.
Good	3 points	**Satisfactory** + the student discusses the significance of this contribution to our present day world.
Satisfactory	2 points	The student's report clearly states one person's contributions to the development of electricity. The student has used at least two books in his/her report.
Inadequate	1 point	The student's report does not clearly state someone's contribution to the development of electricity or the student uses less than two books.
No Response	0 points	

Mathematical/Logical Activity for Electricity Unit
(adapted from Gega, 1986)

In this activity you will be making a series circuit and a parallel circuit.

At the conclusion of the activity you will need to hand in:

* Your observations of how energy flows through a series circuit.
* Your observations of how energy flows through a parallel circuit.
* Some description of how series circuits differ from parallel circuits.

Before beginning your activity you should read the scoring rubric for this activity.

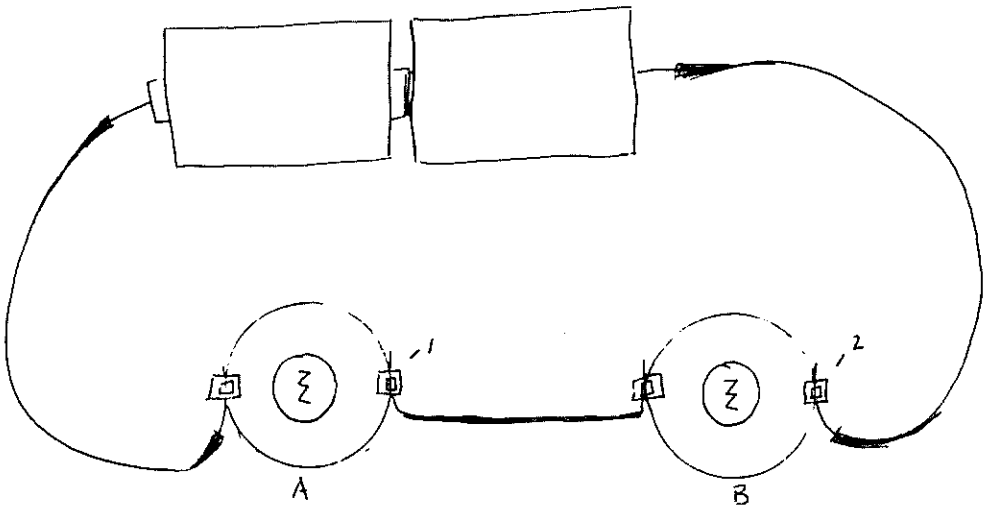
Scoring Rubric for Mathematical/Logical Activity		
Exemplary	4 points	**Good** + the student gives possible circumstances when a series circuit may be preferred over a parallel circuit and when a parallel circuit may be preferred over a series circuit.
Good	3 points	**Satisfactory** + the student uses charts, tables or graphs to present the information.
Satisfactory	2 points	The student makes and records observations about how energy flows in a series and parallel circuit. The student also gives a description of how the two types of circuits are different.
Inadequate	1 point	The student's records are incomplete or there is no description about how the two types of circuits are different.
No Response	0 points	

Exploration Activity for Series Circuits
(adapted from Gega, 1986)

You Will Need:

three flashlight bulbs	four wires
three bulb holders	two D-size batteries

Explore:
Use two bulbs and two bulb holders, two batteries, and three wires. Set up the circuit as shown below.



Questions:

What happens to light B if you remove light A? What happens to light A if you remove light B?

What happens to light A if you disconnect the wire at place 1? Light B?

What happens to light A if you disconnect the wire at place 2? Light B?

What happens if you used one more wire, bulb and bulb holder and connected another bulb to the series circuit?

On a separate sheet of paper clearly record what you observe.

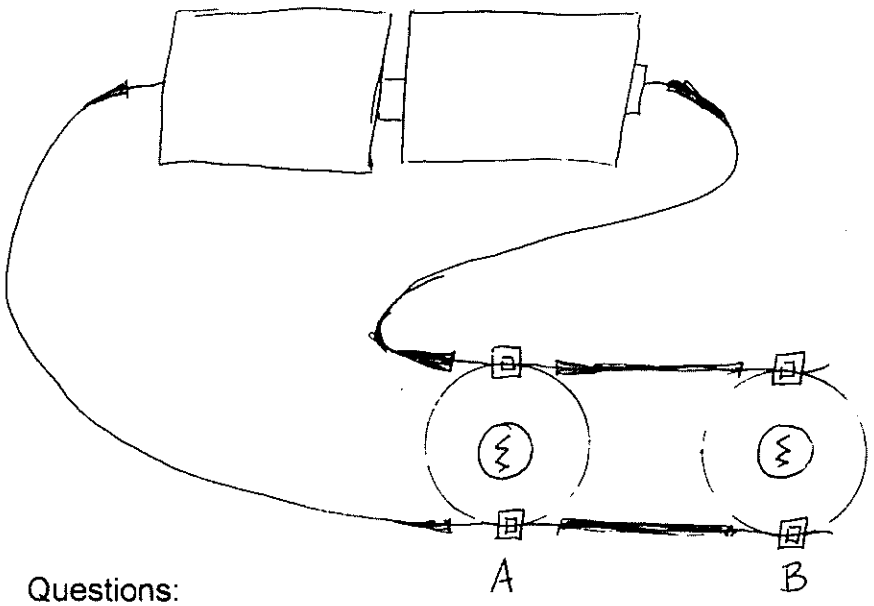
Write a description of how electricity seems to flow in a series circuit.

Exploration Activity for Parallel Circuits
(adapted from Gega, 1986)

You Will Need:

three flashlight bulbs	six wires
three bulb holders	two D-size batteries

Explore:
Use two bulbs and two bulb holders, two batteries, and four wires. Set up the circuit as shown below.



Questions:
If you remove light A what happens to light B? If you remove light B what happens to light A?

What happens to light A if you disconnect the wire at place 1? Light B?

What happens to light A if you disconnect the wire at place 2? Light B?

If you use two more wires, a bulb, and a bulb holder to add another bulb to the circuit, what, if anything, will happen to the brightness of the lights?

On a separate sheet of clearly record what you observe.

Write a description of how electricity seems to flow in a parallel circuit.

Bodily/Kinesthetic Activity

In groups of six create a simple skit which correctly shows the difference between an open and closed circuit.

Before beginning refer to the scoring rubric for this activity.

Scoring Rubric for Kinesthetic/Bodily Activity		
Exemplary	4 points	**Good** + the skit depicts a more complicated type of circuit (i.e. rheostat switch).
Good	3 points	**Satisfactory** + the skit clearly shows *how* to make an open circuit a closed circuit and a closed circuit an open circuit.
Satisfactory	2 points	The skit clearly shows the difference between an open and closed circuit.
Inadequate	1 point	The skit does not show the difference between an open or closed circuit.
No Response	0 points	

Visual/Spatial Activity for Electricity Unit

On paper create a visual representation of a neutral atom, a positively charged atom, and a negatively charged atom.

On a separate sheet of paper visually show how a neutral atom can become either negatively or positively charged and explain how this creates static electricity.

Before beginning you should look at the scoring rubric for the activity.

Scoring Rubric for Visual/Spatial Activity		
Exemplary	4 points	**Good** + the student relates the depiction to an event he/she may encounter in his/her life.
Good	3 points	**Satisfactory** + the student depicts and/or explains *how* an atom may gain or lose electrons.
Satisfactory	2 points	The student has clearly depicted a neutral atom, positively charged atom, and a negatively charged atom. The student has clearly depicted that atoms become either positively or negatively charged by gaining or losing electrons respectively and there is an explanation about how this creates static electricity.
Inadequate	1 point	There are more than two inaccuracies in the student's depiction.
No Response	0 points	

Musical Activity for Electricity Unit

Write a song which explains what a conductor of electricity is and what an insulator of electricity is. Your song should include a description of some of the properties of both conductors and insulators.

If you have a difficult time getting started, you should start by making a list of materials that conduct the flow of electricity and materials that insulate the flow of electricity. For each list develop another list of common properties. Using your lists as a resource begin to write your song. If you can't think of how to begin your song start with a familiar song and change the words. For example, put your words to the tune of "Old MacDonald", "Mary Had a Little Lamb", or another familiar song.

Before beginning the activity you should look at the scoring rubric for this activity.

Scoring Rubric for Musical Activity		
Exemplary	4 points	**Good** + the song clearly explains how some poor conductors of electricity (insulators) may become good conductors of electricity.
Good	3 points	**Satisfactory** + the song clearly explains the concept of resistance.
Satisfactory	2 points	The students' song clearly explains what a conductor of electricity is and what an insulator of electricity is. The song includes properties of both electrical conductors and electrical insulators.
Inadequate	1 point	The student's explanations are not clear or understandable or the song does not include some properties of both electrical conductors and insulators.
No Response	0 points	

Interpersonal Activity for Electricity Unit

In person or over the phone interview an employee of the power company. Before your interview you must make a list of questions that you will ask so that you are prepared. In your interview you must ask for an explanation of where electricity comes from and how it gets to our houses. If during your interview there is anything that you do not understand you must ask for further information.

After your interview you must organize and present the information you obtained in a clear way to the class. Your presentation can include a written report, a clearly drawn picture, an oral presentation, or any other way that you can think of. Regardless of how you present the information it must be easy to understand by anyone who reads, sees, or hears it.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Interpersonal Activity		
Exemplary	4 points	**Good** + the student has done extra research on his/her own.
Good	3 points	**Satisfactory** + the student uses more than one way to present the information. For example, the student does an oral presentation but has visual aids such as drawings.
Satisfactory	2 points	The student has interviewed an employee of the power company and has clearly presented the information gathered about where electricity comes from and how it gets to our houses.
Inadequate	1 point	The student does not present the information or the presentation is not clear.
No Response	0 points	

Intrapersonal Activity for Electricity Unit

Create a poster which emphasizes ways that **you** can be safe with electricity. Your poster should show a personal perspective of electrical safety which has come about as a matter of self reflection.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Intrapersonal Activity		
Exemplary	4 points	**Good** + the poster looks professional.
Good	3 points	**Satisfactory** + the poster has an appropriate and "catchy" slogan.
Satisfactory	2 points	The student's poster depicts one way to be safe with electricity and shows self reflection.
Inadequate	1 point	The meaning of the poster is unclear or it does not show self reflection.
No Response	0 points	

UNIT III

TABLE OF CONTENTS

ECOSYSTEMS

Unit on Ecosystems

Key Terms and Concepts:

Ecosystem - the interdependent life in an area

Producer - A living thing that makes food. Green plants are producers.

Consumer - Any organism that uses, rather than produces food.

Decomposer - An organism that breaks down the substance of dead organisms. Mushrooms and bacteria are decomposers.

Herbivores - A plant-eating animal or insect.

Carnivore - A meat-eating animal.

Omnivore - An animal which eats both plants and other animals.

Habitat - The physical place where an organism lives.

Niche - The specific role of an organism.

Food Chains - A transfer of food energy from one organism to another. Producer/Consumer/Decomposer

Food Web - A group of interlinked food chains.

Objectives:	**Exploration**
1. The student will be able to show knowledge that an ecosystem is a collection of interdependent parts that function as a unit. The major parts of an ecosystem are producers, consumers, decomposers and nonliving parts.	Linguistic
2. The student will be able to give appropriate examples of producers, consumers, decomposers, and the nonliving parts that make up a specific ecosystem.	Linguistic
3. The student will be able to explain that a habitat is where particular plants or animals live (i.e. desert, forest, etc.) and explain that a niche is the role or occupation of a species in a community (i.e. spiders eat insects).	Linguistic
4. The student will know what a food chain is and what a food web is and will know the difference between the two.	Logical, Visual
5. The student will be able to predict outcomes when one of the components is removed from the ecosystem. What would happen if the decomposers were removed from the ecosystem?	Bodily
6. The student will cite specific examples of how what they do influences and effects the world they live in.	Intrapersonal, Interpersonal
7. The student will show awareness of environmental and/or ecological issues in the pop and news media.	Musical

Linguistic Activity for Ecosystem Unit

Suppose you were from another planet and you were sent to study earth. In order to blend in, your leaders thought you should come to earth as some life form, however, they did not want you to choose the human life form for fear that you would reveal yourself as an alien. What would you choose to be? Write a report for your leaders that reveals what life form you chose and why.

Include in your report:

1. Your understanding of your habitat.
2. A description of your niche in that habitat.
3. The other components that make up the specific habitat that you live in (i.e. what are the decomposers, consumers, producers).

Remember that your leaders know very little about earth and the report should be very thorough.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Linguistic Activity		
Exemplary	4 points	**Good** + the student makes predictions about how changes in the ecosystem they describe may cause changes in other ecosystems.
Good	3 points	**Satisfactory** + the student clearly explains the inter-relatedness of any given ecosystem.
Satisfactory	2 points	The student accurately explains what habitat and niche are and explains and gives example of decomposers, producers, and consumers in his/her specific ecosystem and no more than one piece of information is inaccurate.
Inadequate	1 point	One or more pieces of information are missing or two or more pieces of information are inaccurate.
No Response	0 points	

Logical/Mathematical Activity for Ecosystem Unit

In this activity you will work in groups of four to create a mold garden. The activity is taken from the book Science Crafts for Kids by Gwen Diehn and Terry Krautwurst (1994). You will need to keep an accurate daily record of what occurs in your garden.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Logical/Mathematical Activity		
Exemplary	4 points	**Good** + the student includes pictures and diagrams.
Good	3 points	**Satisfactory** + the student explains what is happening in terms of a decomposing food chain.
Satisfactory	2 points	The student keeps an accurate daily record of a mold garden.
Inadequate	1 point	The daily record is incomplete.
No Response	0 points	

Mold Garden
(taken from the book Science Crafts for Kids
by Gwen Diehn and Terry Krautwurst, 1994)

What You Will Need

- A plastic aluminum, or ceramic container at least 2 inches deep and 6 inches square
- A trowel or a large spoon
- Some rich garden soil or compost
- Orange peels, bread cheese, any other foods that you might have seen growing interesting-looking furry coats in the past (except meats)
- A spray bottle full of water or a watering can
- Plastic wrap to cover the container completely
- A large rubber band or string to fit around the container
- A magnifying glass
- Tweezers
- A piece of white paper
- A piece of black paper

What to Do

1. Fill the pan about 1 inch deep with soil.
2. Lay the bread, cheese, orange peels and other food on top of the soil.
3. Lightly water the garden.
4. Cover the garden with plastic wrap. Hold the wrap firmly in place with the rubber band or string.
5. Put the garden in a warm dark place. Watch the garden and keep a daily record of what you see or don't see happening in it.
6. When the garden blooms, carefully remove the cover. Be prepared for a smell! Use tweezers to pick up small bits of the mold. Put light mold down on the black paper and dark mold on the white paper. Use the magnifying glass to get a better look at your mold. Record what you see.
7. When you're finished with the mold garden, throw it into a compost heap or bury it in the garden. Throw away the plastic wrap and rubber band. You can wash and reuse the container.

Bodily/Kinesthetic Activity for Ecosystem Unit

In groups of four to five, create and act out skits that accurately depict what would happen if one of the components were removed from an ecosystem. For example, create a skit that shows what would happen if the decomposers were removed from the ecosystem. Be creative but apply what you know about ecosystems.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Kinesthetic/Bodily Activity		
Exemplary	4 points	**Good** + the skit makes suggestions about ways to avoid extinguishing parts of an ecosystem.
Good	3 points	**Satisfactory** + the skit offers possible reasons that parts of an ecosystem may vanish.
Satisfactory	2 points	The skit clearly depicts possible outcomes of removing one of the components of an ecosystem.
Inadequate	1 point	The skit is imprecise or not clearly presented.
No Response	0 points	

Visual/Spatial Activity for Ecosystem Unit

In this activity you will create a three dimensional model which clearly and accurately represents the food web of a specific habitat.

Guidelines for this activity:

- You may work alone or with a partner.
- You must be specific about the habitat and food web you choose to represent. For example, you may wish to choose a desert habitat and should list specific plants and animals specific to that habitat.
- You will need to be prepared to present and explain your model to the class.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Visual/Spatial Activity		
Exemplary	4 points	The model depicts the interconnectedness of both a grazing food web and a decomposer food web (including specific examples of producers, consumers, and decomposers).
Good	3 points	The model accurately depicts the interconnectedness of a food web with examples of producers and consumers (including herbivores, omnivores, and carnivores).
Satisfactory	2 points	The model would actually be classified as a food chain instead of a food web (the components are connected by only one or two lines).
Inadequate	1 point	The model does not have an example of a producer and/or a consumer.
No Response	0 points	

Musical Activity for Ecosystem Unit

With a partner prepare a musical collage which emphasizes current ecological issues.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Musical Activity		
Exemplary	4 points	**Good** + the student adds sound effects which emphasize possible positive and negative aspects of the ecological issues expressed in the collage.
Good	3 points	**Satisfactory** + the student adds personal comments in the collage about relevant ecological issues expressed.
Satisfactory	2 points	There are parts of at least four different songs used to create the collage and each song makes some statement about ecological issues.
Inadequate	1 point	Fewer than four songs are used to create the collage, or one or more of the songs does not make a statement about ecological issues.
No Response	o points	

Interpersonal Activity for Ecosystem Unit

In person or over the phone interview an ecologist about what he or she considers the most important thing that you, as a fourth grade student, can do to take care of the ecosystems in our area. Be prepared to share what you find out with the class.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Interpersonal Activity		
Exemplary	4 points	**Good** + the student researched and reported on how to implement the ideas that the ecologist gave.
Good	3 points	**Satisfactory** + The student got specific ideas about what they could do to help local ecosystems.
Satisfactory	2 points	The student asked and recorded specific questions and answers about ecology that related to what has been studied in class.
Inadequate	1 point	The student called an ecologist but did not write down any specific questions or answers and briefly summarized the conversation from memory.
No Response	0 point	

Intrapersonal Activity for Ecosystem Unit

Reflect on what you know about ecosystems. Remember that they are interdependent parts that function as a unit. In other words each part effects other parts. Make a list of at least ten things that you do that positively affect an ecosystem. Then make a list of ten things that you do that negatively affect an ecosystem. Write at least one paragraph describing what you learn about yourself.

Begin by reading the scoring rubric for this activity.

Scoring Rubric for Intrapersonal Activity		
Exemplary	4 points	**Good** + in the paragraph the student writes about how he or she can work to improve the negative things they do.
Good	3 points	**Satisfactory** + the paragraph shows that the student is reflective about themselves and how what they do effects ecosystems.
Satisfactory	2 points	The student lists ten positive and ten negative things they do that effect ecosystems.
Inadequate	1 point	Less than ten positives or negatives are listed.
No Response	0 points	

UNIT IV

TABLE OF CONTENTS

CIRCULATORY AND RESPIRATORY SYSTEMS

Unit on the Circulatory and Respiratory Systems

Key Terms and Concepts:

Circulatory System -

Heart - A powerful muscle which pumps the blood throughout the body

- Left and Right Atriums (Auricles)
- Left and Right Ventricles
- Inferior Vena Cava
- Superior Vena Cava
- Pulmonary Artery
- Pulmonary Vein
- Pulmonary Valve
- Aorta
- Mitral Valve
- Aortic Valve
- Tricuspid Valve

Arteries - carry oxygen-rich blood from the heart to the body

Veins - carry carbon dioxide back to the heart to be disposed of through the lungs

Capillaries - the means through which food and oxygen are passed to the cells and carbon dioxide is picked up from the cells

Blood - vehicle that transports food, chemicals, and oxygen to all parts of the body; blood is made up of:

Plasma - a clear, yellowish substance which is the liquid part of blood
Red Blood Cells - carry oxygen from the lungs to the body's cells, and carbon dioxide from the cells back to the lungs; give blood the characteristic color
White Blood Cells - cells that fight disease
Platelets - help to make the blood clot

Respiratory System - the system by which carbon dioxide and water vapor in our blood is replaced with oxygen

Bronchi - two tubes that branch off from the windpipe and are attached to each lung

Bronchioles - smaller branches of tubes which split off from the bronchi

Alveoli - tiny air sacs surrounded by capillaries where oxygen is passed to the blood and carbon dioxide and water vapor are removed from the blood

Trachea - the windpipe, a tube that passes oxygen from the mouth and/or nasal passages to the bronchi

Exhale - the process of releasing carbon dioxide and water vapor from the lungs

Inhale - the process of taking in oxygen to the lungs

Objectives:	Exploration
1. The student will know that the heart is a muscle that pumps blood throughout the body and correctly label a diagram of the heart.	Visual
2. The student will be able to name the components that make up blood and explain the function of each component.	Musical
3. The student will be able to explain that blood is carried away from the heart by arteries and to the heart by veins and trace the flow of blood through the heart, lungs and body.	Visual
4. The student will be able to correctly label a diagram of the respiratory system with trachea, lungs, bronchi, bronchioles, and alveoli.	Visual
5. The student will be able to explain how the respiratory and circulatory systems are interconnected.	Visual
6. The student will be able to give an explanation of one form of heart or lung disease.	Linguistic
7. The student will be able to relate how what they do positively or negatively effects their circulatory and respiratory systems.	Logical, Bodily Interpersonal, Intrapersonal

Linguistic Activity for
Circulatory and Respiratory Systems Unit

Write a report on either heart disease or lung disease.

Your report should include:

- A specific disease that you will research and write about.
- An explanation of the cause of the disease.
- An explanation of possible treatment for the disease.

You must use at least one source from the Internet and at least one other source.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Linguistic Activity		
Exemplary	4 points	**Good** + the student makes predictions about how science and technology may be used in the future to treat the disease even better.
Good	3 points	**Satisfactory** + the student includes visual aids such as drawings, charts or graphs which clarify information in the report.
Satisfactory	2 points	The student's report discusses causes of the disease he/she is writing about and discusses treatment of the disease. The student has used one source from the Internet and at least one other source.
Inadequate	1 point	The student's report does not discuss the cause of the disease or does not discuss the treatment of the disease. Or, the student did not use as Internet source.
No Response	0 points	

Logical Activity for
Circulatory and Respiratory Systems Unit

Do the activity on the "Volume of Air you Breathe" (adapted from Gega, 1984). Complete the attached worksheet.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric Logical Activity		
Exemplary	4 points	**Good** + the student tests to see if his/her prediction is correct.
Good	3 points	**Satisfactory** + the student collects data from other people about their lung capacity and graphs the data. The student uses the graph to predict possibilities.
Satisfactory	2 points	The student accurately performs the activity and answers the questions on the worksheet.
Inadequate	1 point	The student does not completely finish the worksheet.
No Response	0 points	

The Volume of Air You Breathe (adapted from Gega, 1984)

How much air do you breathe in a single breath? How big a container do you think you would need to hold it?

Exploratory Problem

How can you find out how much air you breathe?

Needed

large bowl
1 gallon plastic bottle with cap
rubber tube
paper sheet
pencil
masking tape
string
ruler

Try This

1. Stick a strip of tape down the side of the glass bottle.
2. Mark the strip into 10 equal parts.
3. Partly fill a large bowl with water.
4. Fill the bottle with water and cap it.
5. Put the bottle, upside down, into the bowl.
6. Remove the cap while the bottle neck is under water.
7. Put one end of the tube into the bottle. (You may have to tip the bottle a little.)
8. Wrap some paper around the other end of the tube. This is for personal hygiene.
9. Take a regular breath. Then, blow out the air through the tube. Quickly pinch the tube shut when you finish blowing. Observe how much water is forced out of the bottle. This tells you how much air you blow out.
10. Refill the bottle each time you do a breath test.

Worksheet for Logical Activity

1. By what tape mark is the water level for a regular breath? _____

2. How much air can you hold when you breath deeply? _____

3. How much more air can you hold when you breath deeply? _____

4. How much air can other persons blow out in one breath?

Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____
Name:_____	Lung Capacity:_____

5. What can you determine from the information you have gathered?

_____

_____

_____

_____

_____

_____

Bodily/Kinesthetic Activity for
Circulatory and Respiratory Systems Unit

Do the activity on taking and recording your pulse rate (adapted from Gega, 1984). Do at least three of the discovery problems related to taking your pulse rate. Make a graph that shows the results of one of the discovery activities.

Before beginning you should read the scoring rubric for the activity.

Scoring Rubric for Bodily/Kinesthetic Activity		
Exemplary	4 points	**Good** + the student makes a prediction about another activity or circumstance that might effect pulse rate and does some experimenting to test his/her prediction.
Good	3 points	**Satisfactory** + the student makes several graphs about the data collected and draws conclusions about how different variables effect pulse rate.
Satisfactory	2 points	The student has accurately recorded his/her pulse rate. The student has done three of the discovery problems related to taking pulse rates. The student has made a graph that accurately depicts the data from one of the discovery problems.
Inadequate	1 point	The student did not do one of the discovery problems or the student did not make a graph.
No Response	0 points	

People's Pulse Beats (taken from Gega, 1984)

Your heat pumps blood through arteries. Your arteries are very elastic. They stretch, then shrink, slightly each time the heart pumps more blood through them. These tiny movements are called *pulse* beats. You can tell how fast your heart pumps by feeling your pulse beats.

Exploratory Problem

How can you feel and measure how fast your pulse beats?

Needed

watch or clock with second hand paper and pencil

Try This

1. Press on the inside part of your wrist with four fingers.
2. Find where you can best feel your pulse.
3. Count how often your pulse beats in one minute while sitting. The number of pulse beats in one minute is your pulse rate.
4. Record your pulse rate on paper.

Discovery Problems

A How does what you do change your pulse rate? For example, how does standing affect it? Lying down? Exercise?

B How do the pulse rates of boys and girls compare?

C How do adults and children compare?

D How do young and old adults compare?

E Does how tall a person is make a difference in pulse rates?

F Does how heavy a person is make a difference?

Visual/Spatial Activity for
Circulatory and Respiratory Systems Unit

For this activity you will make a diagram of the lungs and heart. Below are guidelines that should be followed when doing this activity.

- Your diagram should be done on a 10" x 13" piece of paper.
- The diagram must show where the heart is in relation to the lungs.
- The heart must be correctly labeled with left and right atriums, left and right ventricles, mitral valve, aortic valve, tricuspid valve, pulmonary valve, aorta, inferior and superior vena cavas, pulmonary artery, and pulmonary vein.
- The lungs must be correctly labeled with trachea, bronchi, bronchioles, alveoli.
- The diagram must show the flow of oxygen into and through the body, and carbon dioxide through and out of the body.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Visual/Spatial Activity		
Exemplary	4 points	**Good** + the student also does "close up" drawings to show fine details of the process (i.e. the drawing of an alveolus surrounded by capillaries).
Good	3 points	**Satisfactory** + the student somehow delineates the oxygen poor and oxygen rich blood.
Satisfactory	2 points	The student accurately draws the lungs and heart and correctly labels the diagram. The student correctly shows the flow of oxygen into and through the body and the flow of carbon dioxide through and out of the body.
Inadequate	1 point	The drawing is not accurate or there are two or more labeling mistakes or two or more mistakes in the flow of oxygen and carbon dioxide.
No Response	0 points	

Musical Activity for
Circulatory and Respiratory Systems Unit

For this activity you will write a song about blood.

Your song must:

* Include a description of what makes up blood including plasma, red blood cells, white blood cells, and platelets.
* Include an explanation of the purpose of each of the components that make up blood.

Hint: The rhythm of your song could be based on the rhythm of your heart.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Musical Activity		
Exemplary	4 points	**Good** + the student relates the song to the circulatory system.
Good	3 points	**Satisfactory** + the song includes one other concept about blood that the student learns.
Satisfactory	2 points	The student's song has a description and an explanation of purpose of each of the components that make up blood.
Inadequate	1 point	The student's song leaves out one or more of the components that make up blood
No Response	0 points	

Interpersonal Activity for
Circulatory and Respiratory Systems Unit

Record what you eat for one week.

Once you have recorded a weekly diet for yourself, interview a nurse or nutritionist about how your diet may effect your circulatory and respiratory systems. Prepare questions to ask prior to your interview and record the information you obtain.

After you have completed the interview, work with a partner to evaluate your weekly diet. Your evaluation should include an explanation of how your diet may have effected your circulatory and respiratory systems.

You will need to turn in:

- Your recorded diet for one week.
- Your interview questions and information obtained from the interview.
- An evaluation of your diet for one week.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for Interpersonal Activity		
Exemplary	4 points	**Good** + the student presents what he/she learns to the class.
Good	3 points	**Satisfactory** + the student has researched on his/her own or with a partner for further information on how diet and/or nutrition may effect his/her respiratory and circulatory systems.
Satisfactory	2 points	The student has turned in a recorded diet for one week, written interview questions, written information gained from the interview, and an evaluation of his/her weekly diet.
Inadequate	1point	Anyone of the criteria in the **Satisfactory** column is missing or incomplete.
No Response	0 points	

Intrapersonal Activity for
Circulatory and Respiratory Systems Unit

Keep a personal journal of your exercise for two weeks.

Evaluate your exercise in terms of its benefit to your circulatory and respiratory systems.

Before beginning you should read the scoring rubric for this activity.

Scoring Rubric for the Intrapersonal Activity		
Exemplary	4 points	**Good** + the student discusses how the exercise benefits him/her both now and in the future.
Good	3 points	**Satisfactory** + the student discusses how exercise relates to both his/her circulatory *and* respiratory systems.
Satisfactory	2 points	The student keeps an accurate exercise journal for two weeks and discusses how this relates to either his/her circulatory or respiratory system.
Inadequate	1 point	The student is missing three or more days in his/her journal or he/she does not relate the exercise to either the circulatory or respiratory systems.
No Response	0 points	

PROJECT REFERENCES

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CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this project was to design and develop a model fourth grade science curriculum that included at least one activity which focused on each of the seven multiple intelligences. Along with this, the project was to include assessment for each of the seven activities. To accomplish this purpose, current research and literature on multiple intelligences, assessment, and Washington State's Essential Academic Learning Requirements for science were reviewed. Additionally, student learning objectives, learning activities, and assessment rubrics were adapted and developed.

Conclusions

Conclusions reached as a result of this project were:

1. Engaging students in as many of the seven intelligences as possible will increase the potential for understanding science concepts being taught.
2. Assessment criteria which is clearly stated at the inception of an activity to be assessed will increase both the quality of student work and the quality of student learning.
3. Assessment is an integral and ongoing aspect of the learning experience.

Recommendations

As a result of this project, the following recommendations have been suggested:

1. Teachers wishing to best meet the needs of all of their students should investigate multiple intelligences.
2. Concepts to be learned by students should be experienced from a variety of the intelligences.
3. The state of Washington's Essential Academic Learning Requirements for Science should be investigated when developing a science curriculum to be implemented in the state of Washington.
4. Other teachers wishing to develop a science curriculum based on multiple intelligences may wish to adapt the model curriculum which was the subject of this project, or undertake further research in the area of multiple intelligences.

Washington State Commission on Student Learning. (4/9/96-Draft C). Essential Academic Learning Requirement for Science.

Wiles, J. & Bondi, J. (1993). Curriculum development: A guide to practice. New York, NY: Macmillan Publishing Company.