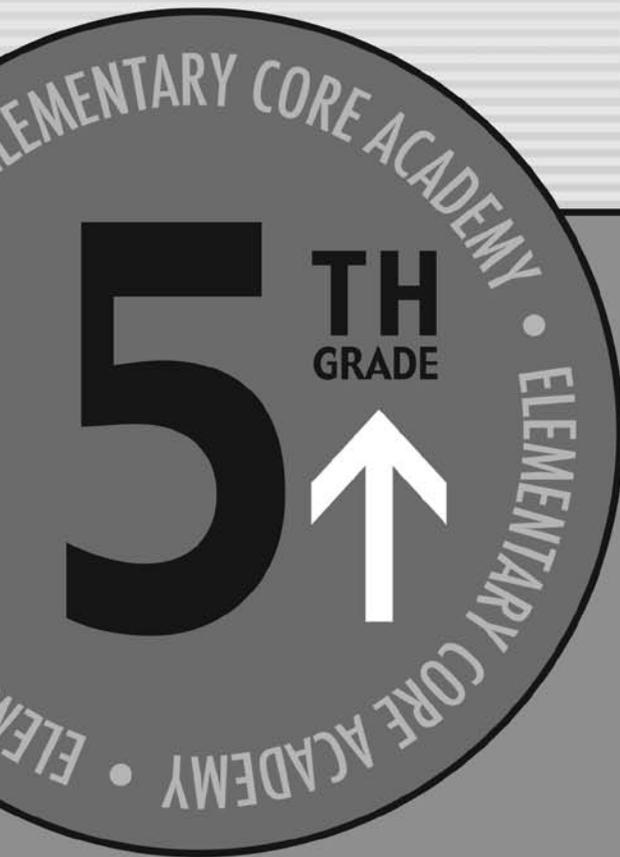




Participant Handbook



2006



ELEMENTARY CORE ACADEMY

6517 Old Main Hill
Logan, UT 84322-6517

435-797-0939
<http://coreacademy.usu.edu>

UtahState
UNIVERSITY

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These materials have been produced by and for the teachers of the State of Utah. Appreciation is expressed to the numerous individuals who provided input and effort into the creation of this curriculum. Delivery of the Elementary CORE Academy, including the development and delivery of content, coordination of sessions, distribution of materials, and participant interaction, has been a collaborative effort of many educational groups across Utah. The following organizations, Utah teachers, and educational leaders contributed ideas and activities as part of this professional development project:

Organizations:

Utah State Office of Education (USOE)
Utah State University (USU)
State Science Education Coordination Committee (SSECC)
State Mathematics Education Coordination Committee (SMECC)
Special Education Services Unit (USOE)
WestEd Eisenhower Regional Consortium

Individuals:

Academy Coordination Committee: Max Longhurst, Brett Moulding, Nicole Paulson, Velma Itamura, Janet Gibbs

Academy Director: Max Longhurst

Academy Coordinator: Megan Richards

Academy Facilitators: Robin Clement, Darrell Spendlove, Patti Spigarelli

Academy Presenters and Contributors: Rachel Belnap-Alberts, Jerolyn Call, Brandon Coates, Carri Jean Jones, Ruthanne Keller, Art Sussman

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UTAH STATE OFFICE OF EDUCATION

Leadership...Service...Accountability

Patti Harrington, Ed.D. State Superintendent of Public Instruction
Voice: (801) 538-7500 Fax: (801) 538-7521 TDD: (801) 538-7876
250 East Cesar E. Chavez Blvd. (500 South) P.O. Box 144200 Salt Lake City, Utah 84114-4200

Dear CORE Academy Teachers:

Thank you for your investment in children and in building your own expertise as you participate in the Elementary CORE Academy. I hope your involvement helps you to sustain a laser-like focus on student achievement.

Teachers in Utah are superb. By participating in the Academy, you join a host of teachers throughout the state who understand that teaching targeted on the core curricula, across a spectrum of subjects, will produce results of excellence. The research is quite clear—the closer the match of explicit instruction to core standards, the better the outcome on core assessments.

I personally appreciate your excellence and your desire to create wonderful classrooms of learning for students. Thank you for your dedication. I feel honored to associate with you and pledge my support to lead education in ways that benefit all of our children.

Sincerely,



Patti Harrington, Ed.D.
State Superintendent of Public Instruction

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Appreciation is expressed for the tremendous educational input and monetary commitment of several organizations for the successful delivery of the Elementary CORE Academy. This year's Elementary CORE Academy was developed and funded through a variety of sources. The Utah State Office of Education (USOE), in collaboration with Utah State University (USU) and local school districts of Utah, have supported kindergarten through sixth grade teachers with professional development experiences that will enhance the educational experience for Utah children.

Major funding for the Academy comes from the following sources:

Federal/State Funds:

- Utah State Office of Education
 - Staff Development Funds
 - Special Education Services Unit
- ESEA Title II
- Utah Math Science Partnership
- WestED Eisenhower Regional Consortium

District Funds:

Various sources including Quality Teacher Block, Federal ESEA Title II, and District Professional Development Funds

School Funds:

- Trust land, ESEA Title II, and other school funds
- Utah State Office of Education Special Education Services

The state and district funds are allocations from the state legislature. ESEA is part of the “No Child Left Behind” funding that comes to Utah.

Additionally, numerous school districts, individual schools, and principals in Utah have sponsored teachers to attend the Academy. Other educational groups such as the Utah Division of Water Resources, National Energy Foundation, Utah Energy Office, and the Utah Mining Association have assisted in the development and delivery of resources in the Academy.

Most important is the thousands of teachers who take time from their summer to attend these professional development workshops. It is these teachers who make this program possible.

Goals of the Elementary CORE Academy

Overall

The purpose of the Elementary CORE Academy is to create high quality teacher instruction and improve student achievement through the delivery of professional development opportunities and experiences for teachers across Utah.

The Academy will provide elementary teachers in Utah with:

1. Models of exemplary and innovative instructional strategies, tools, and resources to meet the Core Curriculum standards, objectives, and indicators.
2. Practical models and diverse methods of meeting the learning needs of all children, with instruction implementation aligned to the Core Curriculum.
3. Meaningful opportunities for collaboration, self-reflection, and peer discussion specific to innovative and effective instructional techniques, materials, teaching strategies, and professional practices in order to improve classroom instruction.

Learning a limited set of facts will no longer prepare a student for real experiences encountered in today's world. It is imperative that educators have continued opportunities to obtain instructional skills and strategies that provide methods of meeting the needs of all students. Participants of the Academy experience will be better equipped to meet the challenges faced in today's classrooms.

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**Fifth Grade
Science
Core Curriculum**

Utah Elementary Science Core Curriculum

Introduction

Science is a way of knowing, a process for gaining knowledge and understanding of the natural world. The Science Core Curriculum places emphasis on understanding and using skills. Students should be active learners. It is not enough for students to read about science; they must do science. They should observe, inquire, question, formulate and test hypotheses, analyze data, report, and evaluate findings. The students, as scientists, should have hands-on, active experiences throughout the instruction of the science curriculum.

The Elementary Science Core describes what students should know and be able to do at the end of each of the K–6 grade levels. It was developed, critiqued, piloted, and revised by a community of Utah science teachers, university science educators, State Office of Education specialists, scientists, expert national consultants, and an advisory committee representing a wide variety of people from the community. The Core reflects the current philosophy of science education that is expressed in national documents developed by the American Association for the Advancement of Science, the National Academies of Science. This Science Core has the endorsement of the Utah Science Teachers Association. The Core reflects high standards of achievement in science for all students.

Organization of the Elementary Science Core

The Core is designed to help teachers organize and deliver instruction.

The Science Core Curriculum’s organization:

- Each grade level begins with a brief course description.
- The INTENDED LEARNING OUTCOMES (ILOs) describe the goals for science skills and attitudes. They are found at the beginning of each grade, and are an integral part of the Core that should be included as part of instruction.
- The SCIENCE BENCHMARKS describe the science content students should know. Each grade level has three to five Science Benchmarks. The ILOs and Benchmarks intersect in the Standards, Objectives and Indicators.



- A STANDARD is a broad statement of what students are expected to understand. Several Objectives are listed under each Standard.
- An OBJECTIVE is a more focused description of what students need to know and be able to do at the completion of instruction. If students have mastered the Objectives associated with a given Standard, they are judged to have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- An INDICATOR is a measurable or observable student action that enables one to judge whether a student has mastered a particular Objective. Indicators are not meant to be classroom activities, but they can help guide classroom instruction.

Guidelines Used in Developing the Elementary Science Core

Reflects the Nature of Science

Science is a way of knowing, a process of gaining knowledge and understanding of the natural world. The Core is designed to produce an integrated set of Intended Learning Outcomes (ILOs) for students. Please see the Intended Learning Outcomes document for each grade level core.

As described in these ILOs, students will:

1. Use science process and thinking skills.
2. Manifest science interests and attitudes.
3. Understand important science concepts and principles.
4. Communicate effectively using science language and reasoning.
5. Demonstrate awareness of the social and historical aspects of science.
6. Understand the nature of science.

Coherent

The Core has been designed so that, wherever possible, the science ideas taught within a particular grade level have a logical and natural connection with each other and with those of earlier grades. Efforts have also been made to select topics and skills that integrate well with one another and with other subject areas appropriate to grade level. In addition, there is an upward articulation of science concepts, skills, and content. This spiraling is intended to prepare students to understand and use more complex science concepts and skills as they advance through their science learning.

Developmentally Appropriate

The Core takes into account the psychological and social readiness of students. It builds from concrete experiences to more abstract understandings. The Core describes science language students should use that is appropriate to each grade level. A more extensive vocabulary should not be emphasized. In the past, many educators may have mistakenly thought that students understood abstract concepts (such as the nature of the atom), because they repeated appropriate names and vocabulary (such as electron and neutron). The Core resists the temptation to tell about abstract concepts at inappropriate grade levels, but focuses on providing experiences with

The Core is:

- Coherent
- Developmentally Appropriate
- Encourages Good Teaching Practices
- Comprehensive
- Feasible
- Useful and Relevant
- Encourages Good Assessment Practices

concepts that students can explore and understand in depth to build a foundation for future science learning.

Encourages Good Teaching Practices

It is impossible to accomplish the full intent of the Core by lecturing and having students read from textbooks. The Elementary Science Core emphasizes student inquiry. Science process skills are central in each standard. Good science encourages students to gain knowledge by doing science: observing, questioning, exploring, making and testing hypotheses, comparing predictions, evaluating data, and communicating conclusions. The Core is designed to encourage instruction with students working in cooperative groups. Instruction should connect lessons with students' daily lives. The Core directs experiential science instruction for all students, not just those who have traditionally succeeded in science classes. The vignettes listed on the "Utah Science Home Page" at <http://www.usoe.k12.ut.us/curr/science> for each of the Core standards provide examples, based on actual practice, that demonstrate that excellent teaching of the Science Core is possible.

Comprehensive

The Elementary Science Core does not cover all topics that have traditionally been in the elementary science curriculum; however, it does provide a comprehensive background in science. By emphasizing depth rather than breadth, the Core seeks to empower students rather than intimidate them with a collection of isolated and eminently forgettable facts. Teachers are free to add related concepts and skills, but they are expected to teach all the standards and objectives specified in the Core for their grade level.

Feasible

Teachers and others who are familiar with Utah students, classrooms, teachers, and schools have designed the Core. It can be taught with easily obtained resources and materials. A Teacher Resource Book (TRB) is available for elementary grades and has sample lessons on each topic for each grade level. The TRB is a document that will grow as teachers add exemplary lessons aligned with the new Core. The middle grade levels have electronic textbooks available at the Utah State Office of Education's "Utah Science Home Page" at <http://www.usoe.k12.ut.us/curr/science>.

Useful and Relevant

This curriculum relates directly to student needs and interests. It is grounded in the natural world in which we live. Relevance of science

to other endeavors enables students to transfer skills gained from science instruction into their other school subjects and into their lives outside the classroom.

Encourages Good Assessment Practices

Student achievement of the standards and objectives in this Core are best assessed using a variety of assessment instruments. One's purpose should be clearly in mind as assessment is planned and implemented. Performance tests are particularly appropriate to evaluate student mastery of science processes and problem-solving skills. Teachers should use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform their instruction. Sample test items, keyed to each Core Standard, may be located on the Utah Science Home Page. Observation of students engaged in science activities is highly recommended as a way to assess students' skills as well as attitudes in science. The nature of the questions posed by students provides important evidence of students' understanding of science.

The Most Important Goal

Elementary school reaches the greatest number of students for a longer period of time during the most formative years of the school experience. Effective elementary science instruction engages students actively in enjoyable learning experiences. Science instruction should be as thrilling an experience for a child as seeing a rainbow, growing a flower, or holding a toad. Science is not just for those who have traditionally succeeded in the subject, and it is not just for those who will choose science-related careers. In a world of rapidly expanding knowledge and technology, all students must gain the skills they will need to understand and function responsibly and successfully in the world. The Core provides skills in a context that enables students to experience the joy of doing science.



Fifth Grade Science Core Curriculum

In the Fifth Grade, students begin to understand concepts of Change and Cause and Effect. Students will learn about the constantly changing Earth's surface. They will investigate physical and chemical changes in matter. They will begin to relate causes for changes with their effects. Students will have opportunity to investigate the effects of various forces, such as magnetism and electricity upon materials. They will begin to learn how traits passed from parent organisms to their offspring effect their survival.

Students should learn to value the scientific processes as means of obtaining knowledge. They should be encouraged to maintain an open and questioning mind and should be helped and encouraged to pose their own questions about objects, events, processes and results. Fifth graders should have the opportunity to plan and conduct their own experiments and come to their own conclusions as they read, observe, compare, describe, infer and draw conclusions.

Good science instruction requires hands-on science investigations in which student inquiry is an important goal. Teachers should provide opportunities for all students to explore many things. Fifth graders should have sufficient understanding of Earth Science to point out an interesting landform to others and hypothesize its origin; feel the success of connecting batteries and wire to make the lights come on; learn about chemical change as they mix baking soda and vinegar and test changes in acidity of liquids using the juice of red cabbage leaves. They should come to enjoy science as a process of learning about their world.

Science Core concepts should be integrated with concepts and skills from other curriculum areas. Reading, writing and mathematics skills should be emphasized as integral to the instruction of science. Technology issues and the nature of science are significant components of this Core. Personal relevance of science in students' lives is always an important part of helping students to value science and should be emphasized at this grade level.

This Core was designed using the American Association for the Advancement of Science's Project 2061: Benchmarks For Science Literacy and the National Academy of Science's National Science Education Standards as guides to determine appropriate content and skills.

- Value the scientific process
- Maintain an open and questioning mind
- Pose questions about objects, events, processes and results



The fifth grade Science Core has three online resources designed to help with classroom instruction; they include Teacher Resource Book—a set of lesson plans, assessment items and science information specific to fifth grade; Sci-ber Text—an electronic science textbook specific to the Utah Core, and the science test item pool. This pool includes multiple-choice questions, performance tasks, and interpretive items aligned to the standards and objectives of the fifth grade Science Core. These resources are all available on the Utah Science Home Page at: <http://www.usoe.k12.ut.us/curr/science>

Safety Precautions:

The hands-on nature of this science curriculum increases the need for teachers to use appropriate precautions in the classroom and field. Teachers must adhere to the published guidelines for the proper use of animals, equipment, and chemicals in the classroom. These guidelines are available on the Utah Science Home Page.

Intended Learning Outcomes for Fifth Grade Science

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant science experiences that lead to student understanding using the ILOs.

The main intent of science instruction in Utah is that students will value and use science as a process of obtaining knowledge based upon observable evidence.

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

1. Use Science Process and Thinking Skills
 - a. Observe simple objects, patterns, and events and report their observations.
 - b. Sort and sequence data according to criteria given.
 - c. Given the appropriate instrument, measure length, temperature, volume, and mass in metric units as specified.
 - d. Compare things, processes, and events.
 - e. Use classification systems.
 - f. Plan and conduct simple experiments.
 - g. Formulate simple research questions.
 - h. Predict results of investigations based on prior data.
 - i. Use data to construct a reasonable conclusion.
2. Manifest Scientific Attitudes and Interests
 - a. Demonstrate a sense of curiosity about nature.
 - b. Voluntarily read and look at books and other materials about science.
 - c. Pose science questions about objects, events, and processes.
 - d. Maintain an open and questioning mind toward new ideas and alternative points of view.
 - e. Seek and weigh evidence before drawing conclusions.
 - f. Accept and use scientific evidence to help resolve ecological problems.

- Use Science Process and Thinking Skills
- Manifest Scientific Attitudes and Interests
- Understand Science Concepts and Principles
- Communicate Effectively Using Science Language and Reasoning
- Demonstrate Awareness of Social and Historical Aspects of Science
- Understand the Nature of Science

3. Understand Science Concepts and Principles
 - a. Know and explain science information specified for the grade level.
 - b. Distinguish between examples and non-examples of concepts that have been taught.
 - c. Solve problems appropriate to grade level by applying science principles and procedures.
4. Communicate Effectively Using Science Language and Reasoning
 - a. Record data accurately when given the appropriate form (e.g., table, graph, chart).
 - b. Describe or explain observations carefully and report with pictures, sentences, and models.
 - c. Use scientific language in oral and written communication.
 - d. Use reference sources to obtain information and cite the source.
 - e. Use mathematical reasoning to communicate information.
5. Demonstrate Awareness of Social and Historical Aspects of Science
 - a. Cite examples of how science affects life.
 - b. Understand the cumulative nature of science knowledge.
6. Understand the Nature of Science
 - a. Science is a way of knowing that is used by many people not just scientists.
 - b. Understand that science investigations use a variety of methods and do not always use the same set of procedures; understand that there is not just one “scientific method.”
 - c. Science findings are based upon evidence.

Fifth Grade Science Standards

Science Benchmark

The weight of an object is always equal to the sum of its parts, regardless of how it is assembled. In a chemical reaction or physical change matter is neither created nor destroyed. When two or more materials are combined, either a chemical reaction or physical change may occur. Chemical reactions are often indicated when materials give off heat or cool as they take in heat, give off light, give off gas, or change colors. In a chemical reaction, materials are changed into new substances. In a physical change a new substance is not formed.

Standard I: Students will understand that chemical and physical changes occur in matter.

Objective 1: Describe that matter is neither created nor destroyed even though it may undergo change.

- a. Compare the total weight of an object to the weight of its individual parts after being disassembled.
- b. Compare the weight of a specified quantity of matter before and after it undergoes melting or freezing.
- c. Investigate the results of the combined weights of a liquid and a solid after the solid has been dissolved and then recovered from the liquid (e.g., salt dissolved in water then water evaporated).
- d. Investigate chemical reactions in which the total weight of the materials before and after reaction is the same (e.g., cream and vinegar before and after mixing, borax and glue mixed to make a new substance).

Objective 2: Evaluate evidence that indicates a physical change has occurred.

- a. Identify the physical properties of matter (e.g., hard, soft, solid, liquid, gas).
- b. Compare changes in substances that indicate a physical change has occurred.
- c. Describe the appearance of a substance before and after a physical change.

Standard I:

Students will understand that chemical and physical changes occur in matter.



Objective 3: Investigate evidence for changes in matter that occur during a chemical reaction.

- a. Identify observable evidence of a chemical reaction (e.g., color change, heat or light given off, heat absorbed, gas given off).
- b. Explain why the measured weight of a remaining product is less than its reactants when a gas is produced.
- c. Cite examples of chemical reactions in daily life.
- d. Compare a physical change to a chemical change.
- e. Hypothesize how changing one of the materials in a chemical reaction will change the results.

Science language students should use:

heat, substance, chemical change, dissolve, physical change, matter, product, reactants, solid, liquid, weight

Science Benchmark

The Earth's surface is constantly changing. Some changes happen very slowly over long periods of time, such as weathering, erosion, and uplift. Other changes happen abruptly, such as landslides, volcanic eruptions, and earthquakes. All around us, we see the visible effects of the building up and breaking down of the Earth's surface.

Standard II: Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.

Objective 1: Describe how weathering and erosion change Earth's surface.

- a. Identify the objects, processes, or forces that weather and erode Earth's surface (e.g., ice, plants, animals, abrasion, gravity, water, wind).
- b. Describe how geological features (e.g., valleys, canyons, buttes, arches) are changed through erosion (e.g., waves, wind, glaciers, gravity, running water).
- c. Explain the relationship between time and specific geological changes.

Objective 2: Explain how volcanoes, earthquakes, and uplift affect Earth's surface.

- a. Identify specific geological features created by volcanoes, earthquakes, and uplift.
- b. Give examples of different landforms that are formed by volcanoes, earthquakes, and uplift (e.g., mountains, valleys, new lakes, canyons).
- c. Describe how volcanoes, earthquakes, and uplift change landforms.
- d. Cite examples of how technology is used to predict volcanoes and earthquakes.

Objective 3: Relate the building up and breaking down of Earth's surface over time to the various physical land features.

- a. Explain how layers of exposed rock, such as those observed in the Grand Canyon, are the result of natural processes acting over long periods of time.
- b. Describe the role of deposition in the processes that change Earth's surface.

Standard II:

Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth's surface.

- c. Use a time line to identify the sequence and time required for building and breaking down of geologic features on Earth.
- d. Describe and justify how the surface of Earth would appear if there were no mountain uplift, weathering, or erosion.

Science language students should use:

earthquakes, erode, erosion, faults, uplift, volcanoes, weathering, buttes, arches, glaciers, geological, deposition

Science Benchmark

Earth and some earth materials have magnetic properties. Without touching them, a magnet attracts things made of iron and either pushes or pulls on other magnets. Electricity is a form of energy. Current electricity can be generated and transmitted through pathways. Some materials are capable of carrying electricity more effectively than other materials. Static electricity is a result of objects being electrically charged. Without touching them, materials that are electrically charged may either push or pull other charged materials.

Standard III: Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and materials made of iron.

Objective 1: Investigate and compare the behavior of magnetism using magnets.

- a. Compare various types of magnets (e.g., permanent, temporary, and natural magnets) and their abilities to push or pull iron objects they are not touching.
- b. Investigate how magnets will both attract and repel other magnets.
- c. Compare permanent magnets and electromagnets.
- d. Research and report the use of magnets that is supported by sound scientific principles.

Objective 2: Describe how the magnetic field of Earth and a magnet are similar.

- a. Compare the magnetic fields of various types of magnets (e.g., bar magnet, disk magnet, horseshoe magnet).
- b. Compare Earth's magnetic field to the magnetic field of a magnet.
- c. Construct a compass and explain how it works.
- d. Investigate the effects of magnets on the needle of a compass and compare this to the effects of Earth's magnetic field on the needle of a compass (e.g., magnets effect the needle only at close distances, Earth's magnetic field affects the needle at great distances, magnets close to a compass overrides the Earth's effect on the needle).

Standard III:

Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and materials made of iron.



Standard IV:
Students will
understand features
of static and current
electricity.

Standard IV: Students will understand features of static and current electricity.

Objective 1: Describe the behavior of static electricity as observed in nature and everyday occurrences.

- a. List several occurrences of static electricity that happen in everyday life.
- b. Describe the relationship between static electricity and lightning.
- c. Describe the behavior of objects charged with static electricity in attracting or repelling without touching.
- d. Compare the amount of static charge produced by rubbing various materials together (e.g., rubbing fur on a glass rod produces a greater charge than rubbing the fur with a metal rod, the static charge produced when a balloon is rubbed on hair is greater than when a plastic bag is rubbed on hair).
- e. Investigate how various materials react differently to statically charged objects.

Objective 2: Analyze the behavior of current electricity.

- a. Draw and label the components of a complete electrical circuit that includes switches and loads (e.g., light bulb, bell, speaker, motor).
- b. Predict the effect of changing one or more of the components (e.g., battery, load, wires) in an electric circuit.
- c. Generalize the properties of materials that carry the flow of electricity using data by testing different materials.
- d. Investigate materials that prevent the flow of electricity.
- e. Make a working model of a complete circuit using a power source, switch, bell or light, and a conductor for a pathway.

Science language students should use:

battery, complete circuit, incomplete circuit, current, conductor, insulator, pathway, power source, attract, compass, electromagnetism, magnetic force, magnetic field, natural magnet, permanent magnet, properties, repel, static electricity, temporary magnet, switch, load

Science Benchmark

All living things inherit a set of characteristics or traits from their parents. Members of any given species transfer traits from one generation to the next. The passing of traits from parent to offspring is called heredity and causes the offspring to resemble the parent. Some traits differ among members of a population, and these variations may help a particular species to survive better in a given environment in getting food, finding shelter, protecting itself, and reproducing. These variations give the individual a survival advantage over other individuals of the same species.

Standard V: Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.

Objective 1: Using supporting evidence, show that traits are transferred from a parent organism to its offspring.

- a. Make a chart and collect data identifying various traits among a given population (e.g., the hand span of students in the classroom, the color and texture of different apples, the number of petals of a given flower).
- b. Identify similar physical traits of a parent organism and its offspring (e.g., trees and saplings, leopards and cubs, chickens and chicks).
- c. Compare various examples of offspring that do not initially resemble the parent organism but mature to become similar to the parent organism (e.g., mealworms and darkling beetles, tadpoles and frogs, seedlings and vegetables, caterpillars and butterflies).
- d. Contrast inherited traits with traits and behaviors that are not inherited but may be learned or induced by environmental factors (e.g., cat purring to cat meowing to be let out of the house; the round shape of a willow is inherited, while leaning away from the prevailing wind is induced).
- e. Investigate variations and similarities in plants grown from seeds of a parent plant (e.g., how seeds from the same plant species can produce different colored flowers or identical flowers).

Standard V:

Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.

Objective 2: Describe how some characteristics could give a species a survival advantage in a particular environment.

- a. Compare the traits of similar species for physical abilities, instinctual behaviors, and specialized body structures that increase the survival of one species in a specific environment over another species (e.g., difference between the feet of snowshoe hare and cottontail rabbit, differences in leaves of plants growing at different altitudes, differences between the feathers of an owl and a hummingbird, differences in parental behavior among various fish).
- b. Identify that some environments give one species a survival advantage over another (e.g., warm water favors fish such as carp, cold water favors fish such as trout, environments that burn regularly favor grasses, environments that do not often burn favor trees).
- c. Describe how a particular physical attribute may provide an advantage for survival in one environment but not in another (e.g., heavy fur in arctic climates keep animals warm whereas in hot desert climates it would cause overheating; flippers on such animals as sea lions and seals provide excellent swimming structures in the water but become clumsy and awkward on land; cacti retain the right amount of water in arid regions but would develop root rot in a more temperate region; fish gills have the ability to absorb oxygen in water but not on land).
- d. Research a specific plant or animal and report how specific physical attributes provide an advantage for survival in a specific environment.

Science language students should use:

inherited, environment, species, offspring, traits, variations, survival, instincts, population, specialized structure, organism, life cycle, parent organism, learned behavior

Facilitated Activities

Science I-2&3

Activities

Matter - Change

Science Detectives

Standard I:

Students will understand that chemical and physical changes occur in matter.

Objective 3:

Investigate evidence for changes in matter that occur during a chemical reaction..

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills
4. Communicate Effectively Using Science Language and Reasoning
5. Understand the Nature of Science

Content Connections:

Science “matter may undergo changes”

Mathematics “determine measurements using appropriate tools”

Language Arts “produce observation reports”

Science
Standard

I

Objective

3

Connections

Background Information

This lesson is intended to introduce students to the difference between physical and chemical changes in matter. When two or more materials are combined, either a chemical or physical change may occur. Chemical reactions are often indicated when materials: give off heat or cool as they take in heat, give off light, give off gas, or change colors. In a chemical reaction or change, materials are changed into new substances. In a physical change, a new substance is not formed. It is important for students to continually use observation skills during this investigation. The teacher should continually check for student observation.

This activity involves the use of Alka Seltzer tablets. Stomachs can become upset as a result of excessive acidity levels. Alka Seltzer tablets contain sodium bicarbonate and citric acid. When the tablet is dropped into water, sodium citrate and carbon dioxide are formed. Sodium citrate is a weak base and neutralizes stomach acid (mainly HCL) Bromphenol blue is an acid base indicator. It turns yellow in the presence of an acid, in this case vinegar, and blue in the presence of a base, in this case the sodium citrate created from the Alka Seltzer reaction. Sometimes it is easier to locate bromothymol blue. Bromothymol blue can be used in the place of bromphenol blue. The pH range of bromothymol blue is not as sensitive to bases as bromphenol blue. When substituting with bromothymol blue, it is necessary to add one Tablespoon of baking soda with the Alka Seltzer tablet to the water. This will make the solution a stronger base, allowing solution color to return to blue once the acid is neutralized.

The *Physical or Chemical Change?* checklist will be used for all of the lessons. It includes the indicators for physical and chemical changes as outlined in the Core Curriculum. To help students make real life connections and practice determining the difference between the two types of changes, it is helpful to keep a large copy of the checklist on display. It is also helpful to have a visible writing space reserved for keeping an ongoing list of various chemical and physical changes the students observe in and outside of the classroom. Encourage students to look for physical and chemical changes in their environments and discuss the changes as a class.

Research Basis

Burns, M. (Nov 2005). Looking at how students reason. *Educational leadership*, 63 (3), pp.2-6

This activity uses a lot of classroom discussion. In this article, “Looking at How Students Reason,” the author investigates the benefits of formative assessments such as small group discussions to provide insight into student thinking. She mentions specific strategies to get the most out of classroom and small group discussions. Among these strategies are: giving opportunity for whole group, small group and partner discussion and asking students to explain their responses. “Science Detectives” was designed to maximize the benefits of classroom discussion.

Leahy, S., Lyon, C., Thompson, M., & William D. (November 2005). Classroom assessment minute by minute, day by day. *Educational leadership* (63) (3), pp 21-22

This research-based article discusses the positive correlation between quality assessment and student learning. Specific strategies to integrate assessment and instruction are presented. Many of the assessments suggestions are formative in nature and require teacher flexibility. In other words, a teacher must be willing to shift gears mid instruction to meet the needs of his or her students. “To gauge understanding of the whole class, the teacher needs to get responses from the students in real time.” One of the strategies used to check for student understanding in real time involves having each student write their individual responses to teacher’s questions on small student whiteboards. The activity Science Detectives introduces what can be a difficult concept – the difference between physical and chemical changes in matter. It is important that the teacher continually gauges student understanding and modifies instruction accordingly throughout the activity. For this reason, the use of student whiteboard responses is used throughout the activity.

Marzano, R., Pickering, D., Pollock, J., (2001) *Classroom instruction that works*, Alexandria, VA.ASCD

This text covers multiple research based strategies for increasing

student learning and achievement. Explicitly teaching similarities and differences in relation to what students are learning “enhances their learning and ability to use knowledge.” As encouraged in this text, this activity was designed to include both teacher and student directed opportunities to identify similarities and differences in chemical and physical changes. Research indicated that classifying is a “highly effective” form of comparing similarities and differences. Students use the Physical or Chemical Change? checklist to help guide them through the comparison process and eventually classify the reactions they observe.

Invitation to Learn

Read the scenario below to the students. Encourage them to take notes to determine if the incident was an accident or deliberate act.

Your class returned from lunch recess to find their teacher’s favorite glass bell broken and shattered on the floor. You wonder if the broken bell was the result of an accident or a deliberate act. You decide to use careful observation and a review of the facts to determine if the bell was broken by way of an accident or on purpose.

This is what you know:

Two of your classmates have been not been getting along since the beginning of the school year. Violet thinks that Matilda is always trying to copy her. Violet is currently very upset with Matilda. One week before the teacher’s birthday, Violet had told Matilda that she was planning on buying the teacher a glass bell for her birthday. The next day, Matilda told Violet that she had gone to the store and bought the glass bell as a birthday present for the teacher. Matilda gave the teacher a glass bell for her birthday. The teacher’s birthday was two weeks ago. Since that time, Violet got in trouble for hiding Matilda’s Science Fair Project on the day it was due.

The following events took place on the day the bell was broken:

Violet announced that she forgot her lunch money in the classroom. The teacher gave her permission to leave the lunch line and return to the portable classroom, alone, for her lunch money.

A group of third graders got in trouble at recess for playing wall ball on the side of your portable classroom – the side of the classroom where the shelf hangs. The glass bell had sat at the end of the shelf, the end of the shelf that was tilting down.

The morning of the accident, Melvin wanted the model airplane he had brought for Show and Tell to be kept safe. He asked the



Materials

- Alka-Seltzer tablet
- 100 ml of water
- 100-200 ml graduated cylinder
- Vinegar
- Bromphenol blue indicator
- Pipettes
- Physical or Chemical Change?*
- Small plastic baggies
- Safety goggles
- Metric rulers (optional)
- Student white boards and markers

teacher if she would put it on the wall shelf. As the teacher lifted the model airplane onto the shelf and set it next to the bell, she said to Melvin, “Your plane is much heavier than it looks.”

This is what you observe:

The wall shelf where the bell once stood has a loose screw and is slanting down. The end of the shelf where the bell once stood is lower than the rest of the shelf.

Melvin’s model airplane is teetering on the end of the shelf where the bell once stood.

Aside from the glass shards on the floor, there are two pieces of glass from the bell on top of the file cabinet that sits just below the shelf.

Give students time to think about the information and ask clarifying questions before asking them if they think the described accident was an accident or a deliberate act. Discuss their conclusions.

Relate their responses to scientific observations. Scientists use observations and knowledge to make the best possible conclusions. This will be valuable when helping students as they determine whether observed changes are chemical or physical. Sometimes a reaction or change can have characteristics of a physical and chemical reaction, leaving scientists to weigh the evidence.

Instructional Procedures

1. Discuss how scientists are often much like detectives. They must make frequent and careful observations. They use these observations as a way to collect information and make informed hypothesis and conclusions. Explain that we are going to use observation/detective skills to make some decisions involving changes in matter.
2. Give one Alka-Seltzer tablet to every two students. They will use their journals to record as many observations as they can about the physical characteristics of the tablet such as size, shape, marking and or chipping. Provide students with a metric ruler. Allow two to three minutes to make and record observations.
3. Collect the tablets from all of the groups. Mix them up and set them out on a table. Students must use their detailed observations to identify and retrieve their tablets.

4. Once groups locate their tablet, discuss some of the observation and location techniques that were used. Emphasize that they use observation of the physical characteristics of the tablets.
5. Instruct students to place their tablets in a small plastic bag. Using a heavier object such as the corner of a textbook, have them strike the tablet once. Record the observations, focusing on changes in appearance (size and shape—a physical change).
6. Explain to students that they will use their observations skills to observe the tablets (tablet pieces) as they react with other substances. Emphasize that they will need to be extra observant, because some of the reactions will happen quickly.
 - a. Each group of two to three students will add seven drops of bromphenol blue indicator to about 100ml of room temperature water. The water should turn blue. Ask the students, “Was this an expected color change?” Students will record any observations up to this point in their journal, under the heading “Step 1.”
 - b. Each group will add a dropper full of vinegar to the bromphenol blue/water solution and record observations in their journal under the heading “Step 2” (the water should turn yellow). Ask the students, “Was this an expected color change?”
 - c. Each group will place their “Alka-Seltzer” tablets in the bromphenol blue/water and vinegar solution and record observations in their journal under the heading “Step 3” (as the Alka-Seltzer starts to fizz, the color changes back to blue/purple as the acid is neutralized). Ask the students, “Was this an expected color change?”
7. Share observations and discuss any discrepancies that arise between the observations. Ask the students to think about and discuss whether visual observations are always 100 percent accurate. It is important as you prepare to introduce the difference between chemical and physical changes that students understand that we do our best to make accurate observations, but won’t always arrive at absolutes. In other words, sometimes a color change can indicate a physical or chemical change, as can the production of a gas.
8. Introduce the *Physical or Chemical Change?* activity sheet. Because this sheet will be used for all of the investigations, it is important that students have a clear understanding of how to

use it. Using the observations recorded in their journals, ask students to replay steps one to three in their minds to check all of the observations that apply on the checklist.

9. We categorize the way matter can change into two major categories—physical and chemical. There are general indicators or clues that can help us determine if a change is physical or chemical in nature. Review the clues/indicators on the checklist. Like the glass bell scenario, we use these clues or indicators in conjunction with observations to make educated conclusions.
10. Instruct students to look at the items they checked on the list for the Alka-Seltzer investigation to determine if the changes in each step were chemical or physical. Make sure students include changing the size and of the tablets when they crushed them and when the tablets dissolved in water as two of the changes (physical). Make sure students understand that the checklist includes many, but not all of the indicators of physical and chemical changes. We compare the checkmarks on both sides of the list to help determine if a change is physical or chemical. It may be necessary to repeat the experiment as a teacher demonstration, because the reactions happen so quickly.

Assessment Suggestions

- After introducing the difference between physical and chemical changes, students will use individual whiteboards and markers to answer teacher questions. Questions might include, “Was the production of a gas in this experiment a physical or chemical change?, or are the color changes in this activity chemical or physical?” Scanning student whiteboard responses will help the teacher gauge understanding and determine pacing. The whiteboard responses can also be used at the end of the lesson to determine how much extra support students will need before moving onto other physical and chemical change investigations. This can be done using questions that relate to physical or chemical changes not observed in the activity. For example: vinegar and baking soda reacting to produce a gas, toasting bread, making ice cubes, melting ice cream.
- Recorded observations and checklist.
- A concept card sort can be used as a cumulative form of assessment. Using examples from the class generated list and learning activities, the teacher creates a set of 10-20 cards for

each group of two students. Each card has an example of a physical or chemical change. Students first sort the cards into two categories, Physical Changes and Chemical Changes. Students will then sort the cards into more specific categories based on the indicators found on the *Physical or Chemical Change?* checklist

- Classroom and small group discussions: When students are sharing solutions strategies throughout the activity using questions such as “Who has a different way to think about this?” For example: “mixing vinegar and baking soda produces a gas” would be sorted into a chemical change and more specifically, a change that produces a gas. Students glue the cards on a journal page and label sorting categories accordingly.

Curriculum Extensions/Adaptations/Integration

- For students needing extra support, repeat the investigation as a teacher demonstration to give them another opportunity to make observations.
- Challenge students to try other types of acids and bases, observe and compare the reaction to the ones they have already observed.
- Challenge students to design an experiment, using water temperature as a variable.
- Ask the students to think of or observe a physical or chemical change to share with the class on the following day

Family Connections

- Send a copy of the *Physical or Chemical Change?* checklist home with the students. This will allow them to practice observation skills and classify changes in matter.
- Test your family member’s observation skills by using peanuts instead of Alka-Seltzer tablets. Observe as many physical characteristics of the peanut before mixing them together in a bowl and challenging family members to find their individual peanuts in the bowl.

Additional Resources

Books

Kitchen Chemistry, by John B. Bath, Ph.D. and Sally C. Mayberry, Ed.D. ISBN 4-4222-1137-6

Simple Science Experiments With Everyday Materials, by Muriel Mandell ISBN 0-8069-5764-6

Hands-On Physical Science Activities, by Marvin N. Tolman ISBN 0-13-230178-4

Science Experiments You Can Eat, by Vicki Cobb ISBN 0-06-446002-9

Chemistry Matters, AIMS Education Foundation, ISBN 1-3203-03-6

Crime Scene Investigations, Real Life Science Activities for the Elementary Grades, by Pam Walker and Elaine Wood, Jossey-Bass ISBN 23812-48502

Videos

Chemical Reaction, part of the Bill Nye The Science Guy Classroom Edition, by Disney <http://dep.disney.go.com/educational/index> Item #77AO7VLLOO

Web sites

<http://www.uen.org>

<http://www.homeschooling.gomilpitas.com/explore/chemistry.htm>

http://www.alkaseltzer.com/as/experiment/student_experiment.htm

<http://www.usoe.k12.ut.us/curr/Science/core/5th/sciber5/index.htm>

www.flinsci.com (Flinn Scientific)

Organizations

The Children's Museum Of Utah, 840 N. 300 W. SLC, UT, 801-322-5268,
www.childmuseum.org, contact Leah Zumbrunnen Outreach Manager
lzumbrunner@childmuseum.org

The Chem Shop, 1134 W. 850 N. Centerville, UT 801-295-9591

Flinn Scientific Inc. www.flinsci.com (Item #B0065 Bromphenol Blue)

Physical or Chemical Change?

PHYSICAL CHANGE

Expected color change_____

Explain:

A new substance is _____

Explain:

A change in size, but not substance_____

Explain:

A change in shape, but not substance_____

Explain:

Reversible_____

Explain:

Change in state (liquid, solid, gas), but not in composition_____

Explain:

I think_____

is a PHYSICAL CHANGE because:

CHEMICAL CHANGE

Unexpected or surprise color change_____

Explain:

A new substance is formed_____

Explain:

A gas is produced_____

Explain:

Change in temperature_____

a. heat is absorbed

beginning temperature_____

temperature during reaction_____

temperature after reaction_____

b. heat is give off_____

beginning temperature_____

temperature during reaction_____

temperature after reaction_____

Explain:

Irreversible or only reversible through another chemical change_____

Explain:

I think_____

is a CHEMICAL CHANGE because:

Nothing New – A Physical Change

Science Standard

I

Objective

2

Connections

Standard I:

Students will understand that chemical and physical changes occur in matter.

Objective 2:

Evaluate evidence that indicates a physical change has occurred.

Intended Learning Outcomes:

1. Use Science Processes and Thinking Skills
5. Understand the Nature of Science

Content Connections:

Language Arts: write an observation report
 Science: understand that matter is neither created or destroyed

Background Information

Often students have the misconception that making a solution such as salt water produces a chemical change. It is important to discuss reversibility of a physical change and that chemical changes produce a new substance, physical changes do not. At the conclusion of this experiment, it is important for students to observe the same amount of salt is left in the bowl that was used to make the solution—no matter was destroyed. The amount of water also remains the same, but that some of the water underwent a phase change to a vapor.

It is also important to activate student prior knowledge of the Water Cycle. The Water Cycle has multiple examples of physical changes.

Research Basis

Shepard, L.A. (Nov 2005). Linking formative assessment to scaffolding. *Educational leadership*, 63.3 p.3

To help scaffold student understanding of physical changes, this activity builds on students' prior knowledge of the Water Cycle to understand physical changes. This article, "Linking Formative Assessment to Scaffolding," discusses the importance of eliciting prior knowledge to help students build new understanding by making sense of new experiences in light of what they already know. "Teachers should not think of prior knowledge assessment as a discrete pretest to use from time to time. Rather it should be common in classroom practice. Knowledge activation routines help develop students' metacognitive abilities while providing relevant knowledge connections for specific units of study."

Materials

- Large clear plastic or glass bowl
- Short clear plastic or glass bowl
- Masking Tape
- Plastic wrap
- Small rock
- Water
- Salt
- Stirring spoon
- Pitcher or two-liter bottle
- Tablespoon
- Physical or Chemical Change?*



Marzano, R., Pickering, D., Pollock, J., (2001) *Classroom Instruction That Works*, Alexandria, VA. ASCD

This text covers multiple research based instruction strategies that when implemented, improve student achievement. “The more learners use linguistic and non-linguistic representations of knowledge, the better they are able to think and recall knowledge.” One research based method that enhances the development of non linguistic representations in the classroom is making physical models—concrete representation of the knowledge being learned. Nothing New—A Physical Change was designed to give students the opportunity to use and create a nonlinguistic representation of a physical change. Students will create and observing a working solar still. Another strategy presented in this book was Generalization/Principle Patterns. The *Physical or Chemical Change?* checklist will be used to help students make generalizations when determining the types of changes occurring in matter.

Invitation to Learn

Ask students to imagine that while on a field trip, the class is stranded on a deserted island in the ocean. There is plenty of undrinkable salt water, but no fresh water. Explain that we have the following materials with us to make fresh drinkable water from salt water: large and small, bowl, plastic wrap, rocks, their knowledge of the Water Cycle, and the energy from the sun.

Instructional Procedures

1. Allow each group of three students to experiment with the materials and their knowledge of the Water Cycle to think of ways they could get fresh water from salt water. It is helpful to review the stages of the Water Cycle before students start the experiment, especially condensation and evaporation. Discuss whether the changes water goes through during the cycle are physical or chemical.
2. Allow groups to share their methods. Before introducing the design for the solar still, be sure to validate student ideas and draw similarities between their designs with the design that will be used. When possible incorporate their ideas into the design. They will have the opportunity to design and test their own stills.
3. Each group will make their own solar still by:

- a. Making a salt water solution by mixing three to four tablespoons of table salt with one one to two liters (depending on the size of the bowl) of tap water. It is important for students to make the solution, rather than the teacher. Making a saltwater solution provides experience with a physical change. A two-liter bottle can be used instead of a pitcher to make the solution. The students stir or shake the salt and water to make a salt-water solution. This solution represents the salt water of the ocean. Ask students to hypothesize whether making salt water is a physical or chemical change.
 - b. Pour the saltwater into the large bowl.
 - c. Place the small empty glass in the center of the large bowl. The top of the glass should be shorter than the top of the bowl, but taller than the salt water line. It is best to use a glass that doesn't have a lip top.
 - d. Put plastic wrap over the top of the bowl. Use masking tape to make sure the seal is tight
 - e. Put the rock in the center of plastic wrap, over the empty glass. The rock should not exceed the width of the cup. This will weigh the plastic down and help with water collection.
4. Take the solar stills outside to an area with plenty of exposure to the sun. Let it stand for a minimum of 24 hours. The longer you leave it out, the more fresh water you will collect.
 5. Discuss and record predictions in student science journals.
 6. Observe the stills two to three times a day. After a minimum of 24 hours, take off the plastic wrap and look at the water in the cup. Ask students if they think it is salty or fresh. Students can taste the water or simply observe to see if the salt and freshwater were separated.
 7. Discuss what happened (distillation) to get fresh water from salt water.
 8. Use *Physical or Chemical Change?* checklist to help determine if the changes observed were physical or chemical. Is mixing salt and water a physical or chemical change? An optional step is to repeat the process by taking the separated salt from the still and mixing it again with the fresh water. This allows students to see that physical changes can often be repeated, reversed and new substances are not formed. Ask, "is the amount of salt still the same? Has the water disappeared or simply undergone a phase change?"

Assessment Suggestions

- Test other solutions to see if they can be separated using distillation or evaporation.
- Teacher observation and student journals.
- *Physical or Chemical Change?* checklist.

Curriculum Extensions/Adaptations/Integration

- A simple way to illustrate that making a salt water solution is a physical change is to leave a cup of salt water in the sun and wait for the water to completely evaporate. Is the amount of salt still the same? Has the water disappeared or undergone a phase change?
- Design a new type of solar still.
- Could a solar still be used to determine the amount of water content in foods such as applesauce?
- Over the years, scientists proposed and tried various methods for converting freshwater to saltwater. Research the geographical and social implications of being able to efficiently find a way to convert abundant amounts of ocean saltwater to freshwater. Develop your own theory or method.

Family Connections

Make a solar still at home. Experiment with other solutions such as food coloring and water and various types of juices.

Additional Resources

Books

Kitchen Chemistry, by John B. Bath, Ph D. and Sally C. Mayberry, Ed.D. ISBN 4-4222-1137-6

Simple Science Experiments With Everyday Materials, by Muriel Mandell ISBN 0-8069-5764-6

Chemistry Matters, AIMS Education Foundation, ISBN 1-3203-03-6

Hands–On Physical Science Activities, by Marvin N. Tolman ISBN 0-13-230178-4

Science Experiments You Can Eat, by Vicki Cobb ISBN 0-06-446002-9

Web sites

<http://www.uen.org>

<http://www.usoe.k12.ut.us/curr/Science/core/5th/sciber5/index.htm>

ChromaCool!

Science Standard

I

Objective

2

Connections

Standard I:

Students will understand that physical and chemical changes occur in matter.

Objective 2:

Evaluate evidence that indicates a physical change has occurred.

Intended Learning Outcomes:

1. Use Science Processes and Thinking Skills
5. Understand the Nature of Science

Content Connections:

Science: “matter may undergo changes”, “matter is neither created or destroyed”

Language Arts: “develop oral communication”, “produce observation reports”

Mathematics: “effectively use measurement tools”

Background Information

The purpose of conducting these activities together is to give students the opportunity to compare a physical and chemical change that both involve a change in color. Students often generalize that a color change is always an indicator of a chemical change. It is helpful to introduce them to the concept of “expected” and “unexpected” color changes. In other words, when red coloring is mixed with water, you expect the water to turn red, when you use a blue marker on paper, you expect the mark on the paper to be blue. These expected changes in color usually indicate a physical change. Unexpected changes in color such as red cabbage juice and ammonia turning green or bromphenol blue turning yellow in the presence of an acid are usually chemical in nature. It is important to reinforce that physical changes are reversible and new substances are not formed. Chemical changes in matter involve the formation of a new substance.

Students will use the *Physical or Chemical Change?* checklist as they conduct each investigation. It is helpful to make two copies of the checklist so they can compare observations from the two investigations.

In the first activity students mix colors and then use a process called chromatography to separate colors. Color particles (molecules) separate according to size and solubility. Mixing and separating colors is a physical change.

In the second activity, red cabbage juice is used as an indicator to determine if certain substances are acids or bases. The red cabbage juice acts as an acid/base indicator. Red cabbage juice turns different colors in the presence of acids and bases, creating a chemical color change.

Research Basis

Hackling, M.W. (Mar2000). Using open investigation for improving scientific literacy. *Professional development*, 16.1, pp. 2-4.

One of the assessments in this activity involves a student conducting open investigation. In open investigations, it is the student who plans and conducts the investigation. The teacher sets the context and introduces the problem, but the students work in small groups to plan and conduct their own investigations. Open investigations can be scaffolded for students using questions, prompts, and/or report sheets. Report sheets, such as an Experiment Design sheet used in this activity help guide students through the decision making steps of an investigation and elicit from students information about their thinking and doing at each phase of the investigation. Open investigations are useful in gaining insight into students thinking and reasoning.

Marzano, R., Pickering, D., Pollock, J., (2001) *Classroom instruction that works*, Alexandria, VA.ASCD

This text covers multiple research based strategies for increasing student learning and achievement. Explicitly teaching similarities and differences in relation to what students are learning “enhances their learning and ability to use knowledge.” As encouraged in this text, these activities were designed to include both teacher and student directed opportunities to identify similarities and differences in chemical and physical changes. Research indicated that classifying is a “highly effective” form of comparing similarities and differences. Students use the *Physical or Chemical Change?* checklist to help guide them through the comparison process and eventually classify the reactions they observe.

Invitation to Learn

Show students an uncapped dry erase marker and ask them what color of mark it will leave on the whiteboard. Make a mark on the whiteboard and point out that the color they expected appeared on the whiteboard. Repeat the same type of questioning using nail polish. Refer to or repeat the Alka-Seltzer bromphenol blue activity. Was the bromphenol blue and water solution turning yellow in the presence of an acid an *expected* or *unexpected* (surprise) color change?

Instructional Procedures

Activity 1

1. Make a crease about three centimeters from the end of a coffee filter strip (about two point five centimeters wide), by folding

Materials

- Coffee filter paper
- Blue and green food coloring
- Clear plastic cups
- Water
- Pencil
- Colored pencils
- Physical or Chemical Change?*
- Plastic plates
- Toothpicks



the strip. Students will skim the creased section of the strip through a drop of blue food coloring. It is important that students avoid getting too much food coloring on the strip. A color spot can be used in place of a color stripe by using a toothpick to make a color dot on the filter. Hang the strip of filter paper from a pencil over a glass of water (about one-fourth full) Hang the coffee strip from a pencil so that the colored line is about five centimeters above the water line. When hanging the filter strip from the pencil, put the color strip or dot end of the strip furthest from the pencil. Hang the strip of filter paper into a cup of water (about one-fourth full). The bottom of the filter should be in the water, but the ink should not go below the surface of the water. Allow the strip to dry.

2. Illustrate observations in student journals. Repeat the process using yellow food coloring. Allow the strip to dry.
3. On a plastic plate, instruct students to use a toothpick to mix one drop of blue and one drop of yellow food coloring.
4. Discuss how and if it is possible to separate or unmix the colors. (Repeating the same process used in Steps 1 and 2 with the droplet made from blue and yellow food coloring). How will we use the results to determine if mixing dyes to create a new color is a physical or chemical change? (if the colors separate into blue and yellow, we can conclude that mixing color dyes is a physical change.) Allow adequate time for the strip to dry.
5. Students make and record predictions in their science journals. Students will illustrate their observations in their science journals using colored pencils.
6. Using the *Physical or Chemical Change?* checklist and discussion, determine if mixing colors is a physical or chemical change.

Materials

- Red cabbage juice indicator
- Lemon juice
- Clear plastic cups
- Baking soda
- Safety goggles
- Toothpicks
- Sharpie markers
- Pipettes
- Alka Seltzer tablets (optional)
- Physical or Chemical Change?*
- Experimental Design Sheet*
- 100ml or 200ml graduated cylinder



Activity 2

1. Each group of two to three students will pour 30 milliliters of red cabbage juice into a cup labeled “A” and 30 milliliters of red cabbage juice indicator into a cup labeled “B”.
2. Fill a separate cup with 30 milliliters cup of water labeled “C”
3. Place two Alka Seltzer tablet or into cup “C” or two and a half tablespoons of baking soda and wait for it to dissolve.
4. Use a pipette to place five drops of Alka Seltzer solution from cup “C” into cup “A”. Swirl if necessary. Record observations on *Physical or Chemical Change?* checklist.

5. Place a dropper full of lemon juice into the indicator in cup “B”. Record observations on Physical or Chemical Change? checklist.
6. Read the ingredients from the Alka Seltzer box to the students. Sodium bicarbonate (baking soda) is a base and citric acid is an acid found in fruits such as lemon and oranges. Think about the way Alka Seltzer works in your stomach. Citric acid and sodium bicarbonate form a weak base to ease the discomfort in your stomach caused by excess acid.

Assessment Suggestions

- Design an experiment to demonstrate how Alka Seltzer neutralizes acids in the stomach. Challenge students to design and carry out an experiment in a separate cups “D” and “E” to try various combination amounts of lemon juice (representative of the citric acid in Alka Seltzer) and baking soda (representative of sodium bicarbonate found in Alka Seltzer) to produce a weak base. When added to red cabbage juice indicator, the base (color) should resemble the base formed by Alka Seltzer. Refer to cup “A” as a model to measure by. Students must plan their experiments before conducting them, following the steps of the Scientific Method. This can be done in their science journals. They will use the *Experiment Design Sheet* to record each trial. Lemon juice amounts will be measured in drops and baking soda amounts by toothpick scoops. While you won’t explicitly point this out to students that the goal is to use lemon juice and baking soda to produce the color of the solution in cup “A”.
- Design an experiment after completing Activity 1, and change the variables (e.g., colors, temperatures of water, using pure water vs. salt water). Students must note, follow, and use each step of the Scientific Method in their journals when designing and conducting the experiments.
- Compare the checklist used for Activity 1 to the checklist used for Activity 2. Then write or verbally explain how you could help another student understand the difference between a change in color as a result of a physical change and a change in color as the result of a chemical change.
- Use *Experiment Design Sheets*.

Curriculum Extensions/Adaptations/ Integration

- Markers can be used in place of food coloring for a quick way to offer more practice for students struggling with the concept of a physical change that involves a color change and can be reversed.
- Challenge students to experiment with other solutions and determine if they are acids or bases.
- Design an experiment to compare different brands of (washable/non washable) markers to see which separate through chromatography.
- Paper or cloth tie-dyeing is a great way to observe the physical change of mixing colors and dye use.
- For extra practice with chromatography and physical changes, the following investigation can be used:

Explain to students that will try to separate the colors that make up the candy shells. Ask, “Do you think candy makers use a chemical or physical reaction to color candy shells?” If a prompt is necessary, you can ask them to think of a time they may have touched candy with wet hands and what happened? The only materials required for this activity that were not used in Activity 1 are Skittles and table salt.

1. Each group will:
 - a. Cut the coffee filter paper into a eight centimeters by eight centimeters square.
 - b. Draw a pencil line about 1 cm from the edge of the paper.
 - c. Make six dots with the pencil equally spaced along the line, leaving about 0.5 centimeters between the first and last dots and the edge of the paper.
 - d. Below the line, use the pencil to label each dot for the different colors of candy that you have. For example, “Y” for yellow.
2. Each group will make solutions of the colors in each candy with these steps.
 - a. Take a 20 centimeters by 10 centimeters piece of aluminum foil and laying flat on the desk.
 - b. Using pipettes, place six drops of water spaced evenly along the foil. Place one color of candy on each drop. Wait about

- a minute for the color to come off the candy and dissolve in the water.
- c. Remove and dispose of the candy
 - d. After all of the color spots on the filter paper have dried, go back and repeat the same process with the toothpicks to get more color on each spot. Do this three times, waiting for the spots to dry each time.
 - e. When the paper is dry, fold it in half so that it stands up on its own, with the fold standing vertically with the dots on the bottom.
3. Stop and discuss, using the *Physical or Chemical Change? Checklist*, if the color dissolving on the paper a physical or chemical change? Why?
 4. Next we will make a developing solution.
 - a. Measure a teaspoon of salt (1 cm³) and a liter of water and put them in a well rinsed two-liter bottle. Screw on the cap and shake the contents until all of the salt is dissolved in the water. This will make a one percent salt solution. Refer to the Solar Still activity and ask, “Is mixing salt and water to make a solution a chemical or physical change?”
 - b. Pour the salt solution into a tall clear glass to a depth of about 0.5 centimeters. The level of the solution should be low enough so that when you put the filter paper in, the dots will initially be above the water level.
 - c. Have the students predict what they think will happen when the filter paper with the dots at the bottom is set in the salt solution. Test predictions. When the salt solution is about one centimeter from the top edge of the paper, remove the paper from the solution. Lay the paper on a flat surface to dry.
 - d. Record predictions and observations in journals. Allow students to use colored pencils to make diagrams of their observations. Compare the spots from the different candies, noting the similarities and differences.

Family Connections

- Use chromatography to separate the colors in products like food coloring and Kool-Aid.
- Look at a variety of recipes that call for baking soda and a type of acid-based ingredient. Think about the chemical reaction

of Alka-Seltzer to explain why a recipe would call for both ingredients.

- Make a red cabbage juice indicator and with the help of an adult test various household items to determine if they are acidic or basic.

Additional Resources

Books

Kitchen Chemistry, by John B. Bath, Ph D. and Sally C. Mayberry, Ed.D. ISBN 4-4222-1137-6

Chemistry Matters, AIMS Education Foundation, ISBN 1-3203-03-06

Simple Science Experiments With Everyday Materials, by Muriel Mandell ISBN 0-8069-5764-6

Hands-On Physical Science Activities, by Marvin N. Tolman ISBN 0-13-230178-4

Science Experiments You Can Eat, by Vicki Cobb ISBN 0-06-446002-9

Videos

Chemical Reaction, part of the Bill Nye The Science Guy Classroom Edition, by Disney
<http://dep.disney.go.com/educational/index> Item #77AO7VLLOO

Web sites

<http://www.uen.org>

<http://www.homeschooling.gomilpitas.com/explore/chemistry.htm>

http://www.alkaseltzer.com/as/experiment/student_experiment.htm

<http://www.usoe.k12.ut.us/curr/Science/core/5th/sciber5/index.htm>

Organizations

The Children's Museum Of Utah, 840 N. 300 W. SLC, UT, 801-322-5268,
www.childmuseum.org, contact Leah Zumbrunnen Outreach Manager
lzumbrunner@childmuseum.org

Experiment Design Sheet

Trial 1

Prediction:

Amount of lemon juice used:

Amount of baking soda used:

Observations:

Trial 2

What will you do differently for this trial?

Why?

Prediction:

Amount of lemon juice used:

Amount of baking soda used:

Observations:

Trial 3

What will you do differently for this trial?

Why?

Prediction:

Amount of lemon juice used:

Amount of baking soda used:

Observations:

All Activities

What's the BIG Idea?

Meet the Book and DVD

Standard I:
Students will understand that chemical and physical changes occur in matter.
Objective 3:
Investigate evidence for changes in matter that occur during a chemical reaction.
Standard III:
Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and materials made of iron.
Objective 1:
Investigate and compare the behavior of magnetism using magnets.
Standard IV:
Students will understand features of static and current electricity.
Objective 1:
Describe the behavior of static electricity as observed in nature and everyday occurrences.
Standard V:
Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.
Objective 2:
Describe how some characteristics could give a species a survival advantage in a particular environment.
Intended Learning Outcomes:
1. Understand Science Concepts and Principles

*Science
Standard
All
Objective
All*

Connections

Background Information

For any science topic to be taught, accomplished teachers have acquired pedagogical content knowledge. They know the science content at a deeper level than basic understanding of the standards and objectives. For example, students learn that electricity and magnetism share some common features (e.g., attraction and repulsion), whereas teachers should know that electricity and magnetism are both part of the same force, called electromagnetism. One important feature of electromagnetism is that when wires and magnets move relative to each other, this motion causes electricity to flow in the wires. High voltage electricity is produced in power stations in exactly this way.

Perhaps one of the biggest ideas of science is that all of science works together to explain reality. Deep pedagogical content knowledge also includes an ability to recognize the big ideas

associated with a topic, and to make meaningful connections across different topics and fields of science. The more students experience the connections in science, the greater the likelihood that they will understand, remember, and enjoy what they have been taught.

Teachers also understand the difficulties that students experience in mastering the science content, and they use a variety of tools to effectively explain the content in ways that match the needs of different students. This pedagogical content knowledge also includes skills in increasing students' abilities to learn when they read science texts. At a basic level, this generally involves assigning literacy strategies for students to use before, during, and/or after they read. At a more advanced level, this involves fostering metacognition, helping students to become aware of what is going in their minds as they read and try to make sense of a text. Successful readers monitor their understanding, become aware of difficulties they may be having, and seamlessly apply literacy strategies to comprehend what they are reading.

Materials

- Dr. Art's Guide to Science: Connecting Atoms, Galaxies, and Everything in Between*
- Dr. Art Does Science*
- Who Knows What?*
- Levels of Knowledge*
- Guiding Questions*
- Wooden stand with cow magnet
- Steel paper clip
- Thread
- Transparent and masking tape
- Flat objects made of different materials (e.g., plastic ruler, wood ruler, index card, metal butter knife, plastic butter knife)
- D-cell battery
- 20 gauge stranded wire with insulation stripped
- Four ceramic disc magnets
- Two blank overhead transparency sheets
- Three rubber bands
- 60 meters of #30 magnet wire
- Two mini alligator clips
- Light-emitting diode (LED)



Research Basis

Heller, J.I. Daehler, K.R., Shinohara, M., & Kaskowitz, S.R. (April 20, 2004). *Fostering pedagogical content knowledge about electrical circuits through case-based professional development*. Paper presented at the annual meeting of the National Association for Research on Science Teaching, from <http://www.wested.org/cs/we/print/docs/sc/narst.html>

Pedagogical content knowledge refers to understanding what makes the learning of specific topics difficult to learn, and knowledge about ways to make that subject matter comprehensible to learners. This paper focuses on teachers' knowledge of electrical circuits.

Craig, M.T., & Yore, L.D. (1992). Middle school students' metacognitive knowledge about science reading and science text: An interview study. *ERIC Source* (ED356135). Retrieved from <http://www.eric.ed.gov>

The simplest definition of "metacognition" is thinking about thinking, and being aware of one's own thinking processes. Many reading strategies ultimately aim at fostering metacognition. Skillful readers effectively utilize metacognition, monitoring and improving their understanding as they read.

Invitation to Learn

What should you know when you have symptoms of a disease?
What should a doctor know about your symptoms?

Instructional Procedures

1. Invitation to learn (“Who Knows What?” and “Levels of Knowledge”) leads into discussion of different levels of knowledge by students, teachers, citizens, and experts.
2. Working in groups, explore different sections of *Dr. Art’s Guide to Science: Connecting Atoms, Galaxies, and Everything in Between*.
3. Discuss issues related to different levels of understanding the associated standards, and to effectively teaching these standards.
4. Make a shaker-generator to take back to the classroom.

Curriculum Extensions/Adaptations/Integration

- Read the book *Dr. Art’s Guide to Science*, and note Big Ideas and connections that enrich your understanding and that can inform your teaching of the Grade 5 Core Curriculum. Distinguish between material appropriate for teachers and that for Grade 5 students.
- Watch the DVD *Dr. Art Does Science*, and note experimentation and content ideas that can inform your teaching of the Grade 5 Core Curriculum. Distinguish between material appropriate for teachers and that for Grade 5 students.
- Ask students to become aware of their thoughts as they read a challenging, interesting science text that includes graphic elements. Have them take notes about their thoughts, and about any strategies (what they do) as they read to help them understand the text.

Family Connections

- Provide a challenging and interesting science reading for students to take home and share with family members. Have them ask the family member to jot down notes about their thoughts as they read, and about any strategies (what they do) as they read to help them understand the text. Have the family discuss reading strategies.
- Examine a flashlight that works by motion, and discuss what must be happening inside the device.

Additional Resources

Books

Dr. Art's Guide to Science: Connecting Atoms, Galaxies, and Everything in Between, by Art Sussman; ISBN 0-7879-8326-8

Square Wheels and Other Easy-To-Build, Hands-On Science Activities, by Don Rathjern and Paul Doherty; ISBN 0-943451-55-8

Teaching Reading in Science, by Mary Lee Barton and Deborah L. Jordan, ISBN 1-893476-03-0

Videos

Dr. Art Does Science, by Art Sussman (WestEd, 415-615-3144, www.WestEd.org); MS-06-02

Web sites

<http://www.guidetoscience.net>

Who Knows What?

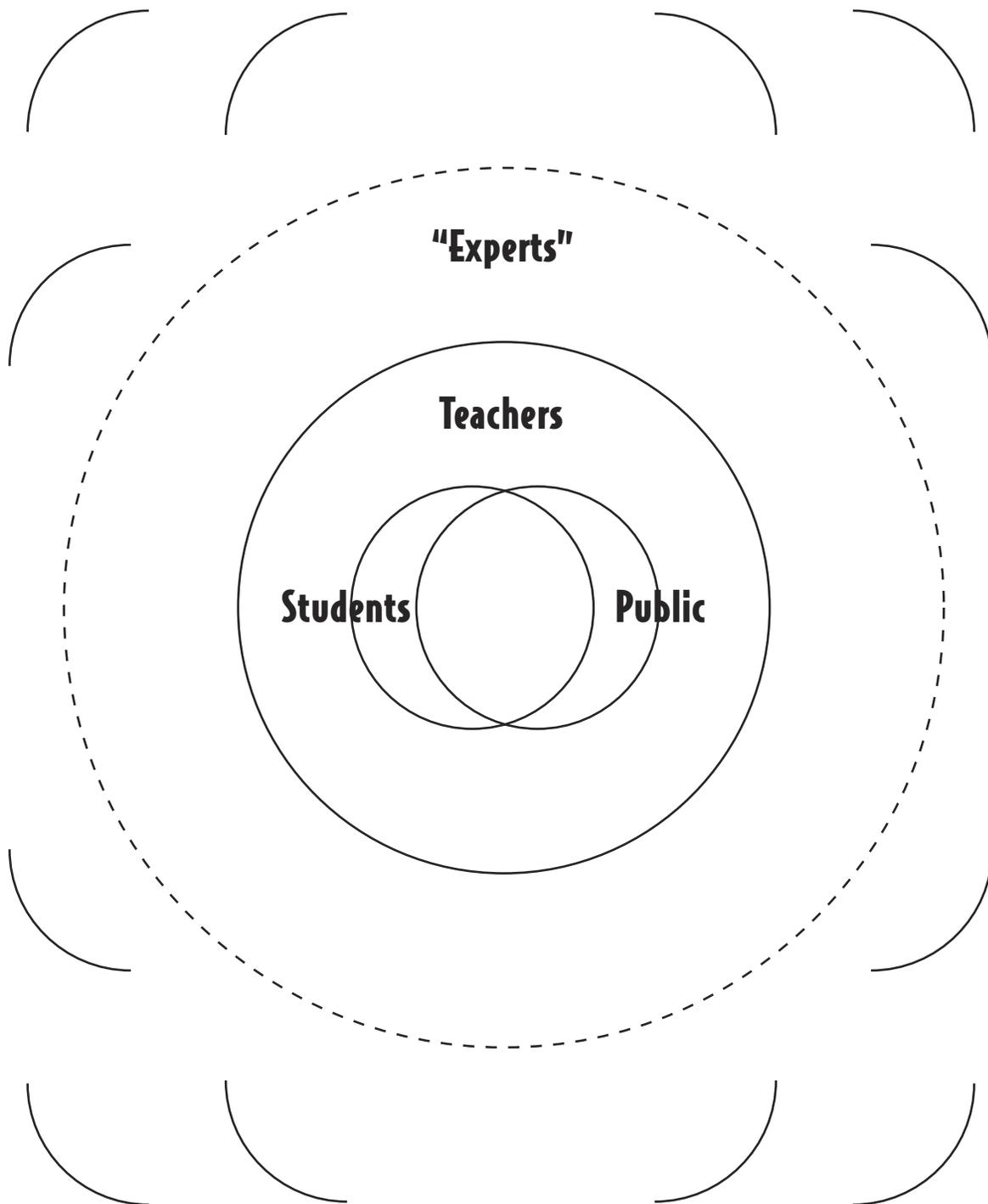
When you go to a doctor because you have symptoms, which of the letters below corresponds to the knowledge that you should have? Which letter corresponds to the knowledge that your doctor should have?

- a. The knowledge of the recommended treatment for your symptoms
- b. The knowledge and health information skills of a health literate citizen
- c. Understanding of the relationships among your symptoms, likely causes of those symptoms, and choices of treatments plus the skills and knowledge to know when and how to access more technical information
- d. Knowledge of the most advanced medical literature about the symptoms, causes, and treatments

Considering an area of science such as physical science, which statement below corresponds to the level of knowledge we aim for our students? Which statement below corresponds to the level of knowledge that teachers should have?

- a. Knowledge of some science topics, vocabulary words, and process skills
- b. The knowledge and science information skills of a science literate citizen
- c. Understanding of major science concepts and how they connect with each other, plus the skills and knowledge to know when and how to access more technical information, plus the skills and knowledge to help others become science literate
- d. Knowledge of the most advanced science literature in many areas of science

Levels of Knowledge



Guiding Questions

You will work in five groups, with each group having its own assignment. Each group will answer the same set of questions, and then share their responses with the whole group.

Assignments

Group A Chemical and Physical Changes: Read page 52 second paragraph through end of page 57. [Extra credit: read page 58 and the first three lines of page 59]

Group B Static and Current Electricity: Read page 67 “Stronger Than Gravity” through end of page 70. Then watch DVD Static Electricity section (in Physical Science).

Group C Magnetism: Examine chart on page 73. Read from top of page 81 through end of page 83. Set up a suspended paper clip and test different materials for their effect on the force field between the paper clip and the suspended cow magnet.

Group D Electromagnetism: Do the activity on last paragraph page 73 and first paragraph page 74. [Observe how a bare wire connected to two ends of a D-cell battery interacts with magnets.] Read about the Stripped Down Generator (rest of page 74 until new section bottom of page 75). Experiment with the provided Stripped Down Generator and explain different observations with a single red LED compared with dual green-red LED. Read the section “Electromagnetism Is the Glue Of Matter.”

Group E Traits and Survival Advantage: Read pages 194-199.

Guiding Questions for Each Group:

What stood out for you as one or more Big Ideas?

What do students need to know about this topic according to the CORE, and is that covered?

Do these materials go beyond required student knowledge?

What teacher knowledge do these materials provide or reinforce?

What skills/strategies did you use in making sense of the reading?

Why do we want students to know this topic (besides the fact that it is in the Core)?

What problems do students have in understanding this topic?

How do you address the problems that students encounter with this topic?

Do you have any questions?

Group Report For Guiding Questions

Group Letter and Topic:

What stood out for you as one or more Big Ideas?

What do students need to know about this topic according to the CORE, and is that covered?

Do these materials go beyond required student knowledge?

What teacher knowledge do these materials provide or reinforce?

What skills/strategies did you use in making sense of the reading?

Why do we want students to know this topic (besides the fact that it is in the Core)?

What problems do students have in understanding this topic?

How do you address the problems that students encounter with this topic?

Do you have any questions?

Make a Shaker-Generator

1. Place two transparency sheets one on top of the other, and roll them into a long tube. Close each end of the tube with an empty film canister (with lid on, top facing out). Tighten the tube so it fits snugly against the canisters at both ends. Tape the tube at the ends and the middle, maintaining the diameter of the canisters. Also tape along the sideways seam for added strength. You should be able to easily remove and reinsert the canisters.
2. Double up two rubber bands and place them around the middle about 2.5 cm apart. You will wrap the coils of wire between these rubber bands.
3. Wrap the magnet wire around the tube between the two rubber bands. Leave about 30 cm of wire free at the starting end, and begin wrapping as close as to can to the inside of one of the rubber bands. Proceed toward the other rubber band. Wrap tightly without squashing the tube. When you reach the second rubber band, proceed back toward the original rubber band. KEEP WRAPPING IN THE SAME DIRECTION (CLOCKWISE OR COUNTERCLOCKWISE). Reversing directions will cancel the effect. Keep wrapping until you have 400 to 500 wraps. Be careful not to scrape the insulation off the wire as you wrap it.
4. Leave at least 30 cm of wire free at the finishing end. Tape the base of each free wire end to the tube near the coil. Have the ends lie against the tube facing in the same direction. Cut both of these wires so they extend about 8 cm from the coil.
5. Use sandpaper to THOROUGHLY remove about 4 cm of insulation from each of the two ends of wire. Connect each end with an alligator clip by putting the stripped end through the hole in the shank of the alligator clip, and tightly winding the wire around the shank. Make sure you have good contact between each wire and its alligator clip.
6. Clip each alligator clip to one of the LED legs. The alligator clips should be lying next to each other, along the side of the tube, but not touching each other. Double up the third rubber band, and use it to hold the alligator clips and LED in place.
7. Put the donut magnets together to form a stack. Remove on the film canisters, insert the magnets into the tube, and close the end with the film canister. Secure the film canisters in place with masking tape. Shaking the magnets side to side should make the LED bulb light up with each pass.

This activity is adapted from “Stripped Down Generator” with permission from the Exploratorium, from the book *Square Wheels and Other Easy-to-Build Hands-On Science Activities*. ©2002 Exploratorium, www.exploratorium.edu

Science I-1

Activities

Matter

What a Reaction

Standard I:

Students will understand that chemical and physical changes occur in matter.

Objective 1:

Describe that matter is neither created nor destroyed even though it may undergo change.

Intended Learning Outcomes:

2. Manifest Scientific Attitudes and Interests.

Content Connections:

Determine measurements using appropriate tools and formulas. Develop language through listening, writing, and speaking. Recognize and use informational text.

*Science
Standard*

I

Objective

1

Connections

Background Information

Everything in and on Earth is made of matter. The amount of matter on Earth does not change. Matter is only changed from one form to another. Matter changes physically and chemically all the time; however, the total amount of matter always remains the same. This is known as the Law of Conservation of Matter. Matter can neither be created nor destroyed. It can only change from one substance to another.

When seltzer tablets and water are mixed together they create a chemical reaction. These two substances create carbon dioxide. In this activity students will understand that matter is neither created nor destroyed. It has changed from one substance to another.

This is the reason for using the scales to measure the matter. The weight should be the same before and after the experiment. The chemical change is known as the Law of Conservation of Matter. Matter can neither be created nor destroyed. It can only change from one substance to another.

Measuring all substances before and after the reaction will help students confirm predictions and draw conclusions about the “Law of Conservation of Matter.”

In the second part of this activity you will be using plaster of Paris, which originated in Montmartre Paris. Plaster of Paris is formed from gypsum. The gypsum is heated to 150 degrees Celsius and becomes a dry powder. When this powder is mixed with water it re-forms into a paste and eventually hardens into a solid. The powder mixed with water is held together by hydrogen bonds in the water molecules. This

is a weak bond that is easily broken. That is why Plaster of Paris is quite soft.

When Plaster of Paris and water are mixed together they undergo a chemical change. The particles rearrange to make a completely new substance. When plaster of Paris and water are mixed together the mixture becomes warm releasing energy in the form of heat therefore undergoing a chemical change.

Warning: Plaster of Paris should never be dumped down a sink or toilet. It always hardens and will cause major problems with plumbing.

Research Basis

Corcoran, Carol A.; (May-Jun 2004). A teacher's guide to alternative assessment: Taking the first steps. *Clearing house*, Volume #77 (Issue #5), Page #213.

Moon, Tonya R., Brighton, Catherine M., Callahan, Carolyn M., & Robinson, Ann; (Winter/Spring2005). Development of authentic assessments for the middle school classroom. *Journal of secondary gifted education*, Volume #16 (Issue #2/3), Page 119-133, 15p

DeGeorge, Barbara; Santoro, Anne Marie C.C. (Nov-Dec 2004). Manipulatives: A hands-on approach to math. *Principal* v84 n2 p28-28 (Ej693871). January 31, 2006 from <http://www.eric.ed.gov>

Renwick, Lucille C.C. (Jan-Feb 2004). Hands-on learning. Instructor Vol. 113.5 pp.9-9, 1/2p, 1c (12403496). January 31, 2006 from <http://www.eric.ed.gov>

Hands-on learning is critical to students' understanding of science concepts. Research shows that hands-on projects actually help children learn better. Hands-on learning helps students more readily understand concepts and boosts their self-confidence.

Performance Assessment is the collection and evaluation of evidence of student learning, focusing on indicators of meaningful and valuable student progress. This type of assessment asks students to perform, create, produce, or do something. Performance assessment moves the students into higher-level thinking and problem-solving skills. It uses tasks that represent meaningful instructional activities involving real world applications and using human judgment to do the scoring.

Invitation to Learn

Predict what you think will happen when vinegar and baking soda are mixed together in a bottle with a balloon attached to the top. Do you think that the mass of the objects will be the same or different after performing the experiment? Does this experiment support the "Law of Conservation of Matter?"

Instructional Procedures-Part One

1. Predict what will happen when the seltzer tablet and water are mixed together. Record answers on large paper for class to see. Students should record their own predictions on their worksheet.
2. Discuss what the mass will be before and after the experiment. Record these answers along with the first question.
3. Have all of the materials assembled before hand to perform this experiment: scales, metric weights, seltzer tablets, water, balloons, vials, lids, and vial holders.
4. Model how you want the experiment to be preformed. Show students how to do everything you want the students to do except pouring the water into the balloons. You want the students to experience this sensation as they perform the experiment.
5. Break your seltzer tablet into four small pieces. Place these pieces in your balloon. Place the balloon on the balance scale along with your piece of string and record the weight.
6. Place your vial and lid on the balance scale. Record their weight.
 Pour water into the vial and place lid on the vial. (three-fourths full of water). Place the vial onto the scales and record the weight.
 Subtract the weight of the vial and lid from the weight of the vial with water and lid to get the weight of the water.
 Model this next step for students without pouring the water in the balloon. This would give the prediction away.
 Demonstrate how to carefully remove the lid from the vial and pour the water into the balloon making sure that the balloon does not let any gas escape.
 Show student how to tie the balloon closed and watch what happens.
7. Record observations.
8. Add the weight of the water to the weight of the balloon, string, and seltzer tablet.
9. The weight should be the same before and after the experiment.
10. Do the results match predictions or do predictions need to be modified.

Materials

- Balloons
- String for tying around balloons
- Seltzer tablets
- Water
- Vials, vial holders, lids for vials,
- Scales
- Safety goggles
- Metric weights
- What a Reaction*



11. Check to see if the mass is the same or different from the first measurement taken.
12. Explain measurement on *What a Reaction* worksheet.
13. Now experiment has been modeled for students so have students collect materials and perform the experiments in groups.
14. Write on worksheet what happened with experiment.
15. Explain what this experiment has to do with the “Law of Conservation of matter?”

Instructional Procedures-Part Two

Materials

- Plaster of Paris
- Water
- Mixing bowl
- Ziploc baggies
- Thermometers
- Popsicle stick
- Spoons
- Scales



1. Get materials ready.
2. Hand out the graphic organizer to each student.
3. Hold up a baggie with the white powder in it and a cup with water.
4. This part is the invitation to learn. Have each student predict on their graphic organizer what they think will happen when the powder and water are mixed together.
5. Hand out the materials to perform the activity. This activity may be done in groups or individually. If done in groups each student should be responsible for their own graphic organizer.
6. Because of the “Law of Conservation of Matter” all materials need to be weighed before and after the experiment.
7. Read through the worksheet with the students before they perform the activity. Check for understanding and clarify any misunderstanding and answer any questions.
8. Guide the students through the activity step by step.
9. Record the weight of all the individual ingredients. Add all individual weights for a total.
10. Record a temperature reading of the powder before mixing.
11. Mix the ingredients in a bowl for about three minutes. Record a temperature reading of the mixture. Pour the mixture into a baggie. Press to remove all of the air and seal the baggie. Mold into desired shape by pressing on the bag. (You will need to wait about 20 minutes before the change starts to occur and the shape can be molded.)

12. After twenty minutes you should start to feel the temperature changing. Tape the thermometer to the baggie. Record a temperature reading every two minutes for 14 minutes.
13. Record the temperature and their observations about what is taking place every two minutes.
14. When the temperature stops rising or starts going down remove the thermometer from the baggie, weigh all materials and compare beginning weight with ending weight.

Assessment Suggestions

- Check student’s worksheet for clear understanding of the “Law of Conservation of Matter” along with correct terminology.
- Have students explain to one another what has taken place and listen for correct terminology and explanations. Record findings.
- When doing the curriculum extension tell students that they will need to explain what happened when baking soda and vinegar are mixed together. Students will explain what gas is made and why the bubbles seemed to be suspended in mid-air. They will need to tie this to the “Law of Conservation of Mater.”
- After students have preformed the experiment they should be able to write a reflection paper. They should include in their paper something about heat as an indicator that a “Chemical Reaction” has taken place. The student should conclude something about when the temperature stopped rising and the substance started getting hard the chemical reaction had stopped or was over and that a new substance was formed.

Curriculum Extensions/Adaptations/Integration

- Use an aquarium to mix baking soda and vinegar to produce carbon dioxide. Students will not be able to see the gas; however, carbon dioxide is produced.
- Blow bubbles into the aquarium and watch what happens. The bubbles will float on top of the gas proving that the gas is really there. Students are fascinated by this experiment.
- Make another mixture of Plaster of Paris and water in a clear bowl. With the mixture in the bottom pour a cup of water on the top of this mixture. This will show the students that

the change did not occur because water evaporated, rather the change occurred because it was a chemical change.

- Pour one cup of Plaster of Paris, one and a half cups of vermiculite and one cup of water into bowl. Stir this mixture until it is ready to be sculpted. When this mixture no longer sticks to the sides of the bowl it is ready to be sculpted. This would be a great activity to have students do to demonstrate their knowledge of landforms.

Family Connections

- Tie a string to the middle of a ruler and attach a blown up balloon to one side and a balloon without being blown up on the other side. Lift the ruler by the attached string. Explain what happened. The ruler should drop down on the side of the blown-up balloon. Teaching that air is matter and has weight.
- Students and family members could perform this same experiment with aquarium, baking soda, and vinegar at home.
- This same Plaster of Paris recipe could be used at home to create a fictional character. When finished it could be painted and used to write a story about the character.
- There are many molds that can be purchased at craft stores. Students could use a mold and the Plaster of Paris recipe to create something that they are interested in.
- When students do one of the connections at home they should explain what is happening with the Plaster of Paris. This will help cement their learning of the “Law of Conservation of Matter.”

Additional Resources

Books

Surprising Science, by Nancy De Waard, John De E. John ISBN 0673363120BT

Web sites

http://en.wikipedia.org/wiki/Plaster_of_Paris

What a Reaction

Predict what you think will happen when a seltzer tablet and water are combined in a balloon? Do you think the combined mass of the objects will be the same or different? Explain your prediction. Will this experiment support the “Law of Conservation of Matter?”

Collect the items from the table that you will need to perform this experiment: one balloon, string, one seltzer tablet, one vial with lid, a small cup of water, and a balance scale. Return with these items to your group and perform the out-lined activity.

To begin your experiment you will first need to get the weight of the seltzer tablet, balloon, string, water, and vial with lid.

1. Make sure that your balance is working correctly.	Weight
2. Break your seltzer tablet into four small pieces. Place these pieces in your balloon. Place the balloon on the balance scale along with your piece of string and record the weight.	2.
3. Place your vial and lid on the balance scale. Record their weight.	3.
4. Fill the vial with water to the mark indicated and weigh it again. Subtract the weight of the vial and lid from the weight of the vial with water and lid to get the weight of the water. Place this weight in column four.	Weight of vial, lid and water minus the weight of vial and lid. Place the difference on line four. _____ - _____ = _____ Lid, vial, and water – vial and lid 4.
5. Now pour the water from the vial into the balloon. Hold the balloon tightly around the vial while a partner ties the string around the balloon. Remove the vial. Watch and feel what happens to the balloon and record your observations in column five.	

6. Place the balloon on the scale and measure the weight of the balloon.	Place the weight of the balloon on six. 6.
7. Add the weight of the water to the weight of the balloon, string and seltzer tablet. Record this on line seven	$\underline{\hspace{2cm}} + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$ Total of line two + line four 7. Total of line two, and four. _____
8. Does your balloon weigh the same as the sum of numbers two and four? Yes or No. Explain your answer in column eight.	8.
9. What might explain any changes in weight? Record your answer in column nine.	9.
10. What law was demonstrated with this experiment?	10.

11. Did you prediction match the outcome of your experiment? Explain

12. What is the “Law of Conservation of Matter” and how did your experiment prove this law.

13. Reflection, tell about what you did and what you learned from this experiment.

Hot Shapes Activity Sheet

Predict what you think will happen when this mysterious powder and water are mixed together?

Record the weight of all the individual ingredients. Add all individual weights for a total.

- 1 cup of mystery powder in baggie
- ½ cup water
- bowl for mixing

Weigh mystery powder and baggie _____
 Weigh bowl with ½ cup water _____
 Total _____

Make and record observation of what the mysterious powder looks like and take a temperature reading.

Students Will:	Record Temperature	Observations
Record temperature of powder		
Mix water with mysterious powder in bowl for at least 3 minutes or until mixture becomes thick. Wait about 20 minutes		
Pour mixture in baggie, mold into desired shape tape thermometer on baggie		
Record temperature and write observations every 2 minutes		
2 minutes (4 minutes total)		
2 minutes (6 minutes total)		
2 minutes (8 minutes total)		
2 minutes (10 minutes total)		
2 minutes (12 minutes total)		
2 minutes (14 minutes total)		

Graph the time and temperature on graph paper. (Time on X axis and temperature on Y axis)

Put the “Hot Sculpture” with the bowl back in the scales and weigh. Compare your beginning weight and you ending weight. Did it change or was it about the same? Explain your answer.

Tell what the temperature did. Relate the temperature to the hardness of the mixture.

What kind of a change do you have? Physical or Chemical? Explain you reasoning.

Blobber

Standard I:

Students will understand that chemical and physical changes occur in matter.

Objective 1:

Describe that matter is neither created nor destroyed even though it may undergo change.

Intended Learning Outcomes:

2. Manifest Scientific Attitudes and Interests.

Content Connections:

Measurement, Prediction, and Data Collection.

Science Standard

I

Objective

1

Connections

Background Information

White glue is made up of millions of polymers. When polymers are dissolved like they are in glue they slide around each other letting the glue flow. However, they are so long, that when they flow they get in each others way making the glue more viscous. Viscous means that glue flows more slowly than water. When you add a borax solution to the glue the polymers change. The borax makes them cross link or connect to each other like a net. The more tangled the polymers get the more water they trap creating a jelly like feel. Tangled molecules change and are even more difficult to pour. This makes the solution even more viscous than glue. The change that takes place to the polymers by adding the borax solution is a chemical change.

Indicators of a chemical change can be color, a new odor, light or change in heat is given off. When making Blobber two liquids are mixed together forming a precipitate. A precipitate is also an indication that a chemical change has taken place.

Super Science talks about a mistake that paid off, “Try as he might, the chemist James Wright was never able to create rubber in the laboratory. But one of the mistakes did become a very popular toy. When he added boric acid to silicone oil he created a bouncing solid that oozed like a liquid. You probably know it as Silly Putty!” (pg. 152).

Research Basis

Corcoran, Carol A.; (May-Jun 2004). A teacher’s guide to alternative assessment: Taking the first steps. *Clearing house*, Volume 77.5, p.213.

Moon, Tonya R., Brighton, Catherine M., Callahan, Carolyn M., & Robinson, Ann; (Winter/Spring 2005). *Development of authentic assessments for the middle school classroom journal of secondary gifted education*, Volume 16.2/3, pp. 119-133, 15p

Materials

- One tablespoon white glue
- ½ teaspoon borax
- ½ cup water
- Food coloring (Optional)
- Two paper cups
- Tablespoons, teaspoons, and stirring sticks
- Scales to measure weight



DeGeorge, Barbara; Santoro, Anne Marie C.C. (Nov-Dec 2004). Manipulative: A hands-on approach to math. *Principal volume* 84 n2 pp.28-28 (Ej693871). January 31, 2006 from <http://www.eric.ed.gov>

Renwick, Lucille C.C. (Jan-Feb 2004). *Hands-on learning*. Instructor Vol. 113.5 p.9-9, 1/2p, 1c (12403496). January 31, 2006 from <http://www.eric.ed.gov>

Hands-on learning is critical to students' understanding of science concepts. Research shows that hands-on projects actually help children learn better. Hands-on learning helps students more readily understand concepts and boosts their self-confidence.

Performance Assessment is the collection and evaluation of evidence of student learning, focusing on indicators of meaningful and valuable student progress. This type of assessment asks students to perform, create, produce or do something. It taps into higher-level thinking and problem-solving skills. It uses tasks that represent meaningful instructional activities involving real world applications and using human judgment to do the scoring.

Invitation to Learn

What happens when you mix glue, and a mixture of borax and water together? Can you bend it, bounce it, even blow it up like a balloon. Why is it so moldable and flexible?

Instructional Procedures

1. Weigh all ingredients before mixing together.
2. Dissolve the borax in water.
3. Pour the white glue into another cup (optional: food coloring).
4. Add one tablespoon of the borax solution to the glue and stir with a stick or spoon
5. Take the mixture out of the cup and knead it with your hands for several minutes. You've got Blobber.
6. Prepare worksheet and worksheet cards for different recipes. See worksheets provided.
7. On the worksheet, predict, gather data about the Blobber, and draw conclusions as to what happened when the ingredients were combined.

Assessment Suggestions

- Were students able to mix the solution together properly and make Blobber? Were students able to follow worksheet and

complete answers drawing the correct conclusions? Look for evidence that the students understand what glue, water, and borax are and what they become when mixed together.

- Were students able to mix different solution of Blobber together, make predictions, gather data, and draw conclusions using their first mixture of Blobber?

Curriculum Extensions/Adaptations/Integration

- Have students conduct three different Blobber tests using different recipes varying the amount of borax.
- Have students complete worksheet *Comparing Different Recipes*. Predict, gather data about the Blobber, and draw conclusions as to what happened when the borax amount is changed in each recipe and which recipe is the best..
- Red Blobber. Use same recipe however change the amount of borax added to the water. This time add one teaspoon of borax to the one-half cup of water.
- Yellow Blobber. Use same recipe as above.
- Blue Blobber. Use the same recipe, however, change the amount of borax added to the water to one-fourth teaspoon borax.

Family Connections

- This is a fun activity for families to do at home. Ingredients are available in most homes and if not the school can provide borax and glue.
- Warning: Small children should be supervised when using this product. If swallowed, a child could choke on the Blobber.

Additional Resources

Books

Super Science Concoctions, by Jill Frankel Hauser; ISBN 1-885593-02-3

Aims Chemistry Matters, ISBN 1-932093-03-6

What Can My Blobber Do?

1. Use a meter stick and see how high your Blobber bounces when dropped from different heights. Record your data.

Drop Blobber from 150 cm	Drop Blobber from 100 cm	Drop Blobber from 50 cm

2. Roll your Blobber into a ball and set it on you desk. Watch what happens to your Blobber over a four minutes period.

1 minute	2 minutes	3 minutes	4 minutes

3. Does your Blobber keep its shape or does it start to flatten out? What do you think is happening?

4. Roll your Blobber into a ball again. Use a paperclip to make an imprint in it. How long does your imprint last? What happened and why?

5. Roll your Blobber into a rope and stretch it until it breaks. Record how long your Blobber was when it broke.

10 cm	20cm	30cm	40cm

6. What conclusions can you draw from the stretch test?

7. Write a secret message on a white piece of paper with a number two pencil. Write over this message once more to make it dark. Press your Blobber over the message and see what happens. Why do you think this happens?

Recipes for Extensions

Yellow Blobber

- 1 tablespoon white glue
- $\frac{1}{2}$ teaspoon borax
- $\frac{1}{2}$ cup water
- Food coloring optional
- 2 paper cups
- tablespoons, teaspoons, and stirring sticks
- scales to measure weight

Dissolve the borax in water. Pour the white glue into another cup. (optional: food coloring) Add 1 tablespoon of the borax solution to the glue and stir with a stick or spoon. Take the mixture out of the cup and knead it with your hands for several minutes. You've got Blobber.

Red Blobber

Use same recipe however change the amount of borax added to the water. This time add 1 teaspoon of borax to the $\frac{1}{2}$ cup of water.

- 1 tablespoon white glue
- 1 teaspoon borax
- $\frac{1}{2}$ cup water
- Food coloring Optional
- 2 paper cups
- tablespoons, teaspoons, and stirring sticks

Dissolve the borax in water.

Pour the white glue into another cup. (optional: food coloring) Add 1 tablespoon of the borax solution to the glue and stir with a stick or spoon. Take the mixture out of the cup and knead it with your hands for several minutes. You've got Blobber.

Blue Blobber

Use the same recipe, however, change the amount of borax added to the water to $\frac{1}{4}$ teaspoon borax.

- 1 tablespoon white glue
- $\frac{1}{2}$ teaspoon borax
- $\frac{1}{4}$ cup water
- Food coloring Optional
- 2 paper cups
- tablespoons, teaspoons, and stirring sticks

Dissolve the borax in water. Pour the white glue into another cup. (optional: food coloring) Add 1 tablespoon of the borax solution to the glue and stir with a stick or spoon. Take the mixture out of the cup and knead it with your hands for several minutes. You've got Blobber.

Comparing Different Recipes

Collect and record your data from each recipe.	Yellow Recipe	Red Recipe	Blue Recipe
Bounce Test			
Roll Blobber into a ball. How long does it stay in a ball?			
Roll Blobber into a ball again. This time press a paper clip into the ball. How long does the imprint last?			
Which Blobber stretches the best?			
Print transfer test with secret message.			

Which recipe would you use for your product? Why?

Blobber Ad

**Design a newspaper or magazine ad that you would use to sell your product.
Use the properties of Blobber in your ad to get the audience excited about buying your product.**

Blobber Ad

**Design a newspaper or magazine ad that you would use to sell your product.
Use the properties of Blobber in your ad to get the audience excited about buying your product.**

Science II

Activities

Changing Earth

Virtual Field Trip

Standard II:
Students will understand that volcanoes, earthquakes, uplift, weathering, and erosion reshape Earth’s surface.
Objective 1:
Describe how weathering and erosion change Earth’s surface.
Objective 2:
Explain how volcanoes, earthquakes, and uplift affect Earth’s surface.
Objective 3:
Relate the building up and breaking down of Earth’s surface over time to the various physical land features.
Intended Learning Outcomes:
1. Use Science Process and Thinking Skills.
2. Manifest Scientific Attitudes and Interests.
4. Communicate Effectively Using Science Language and Reasoning.
Content Connections:
Language Arts I-I;VIII-5

Science Standard II

Objective 1,2,&3

Connections

Background

Students should have been previously exposed to the concepts that are being presented. This is an additional learning experience for them. There will be a brief background before you start each activity for each location.

Summary: Students will use this activity to reinforce knowledge that they have learned in previous classes. The virtual tour is a time where the students are able to meet with groups and have fun with one another while seeing small experiments showing how landforms are changed and made in their home area. Students will have the chance to learn more about their home area without even leaving the school boundaries. These activities can also be used as class presentations, to teach the various landform objectives.

Research Basis

Anderson, R. (1984). “Role of reader’s schema in comprehension, learning, and memory.” In R. Anderson, J. Osbourne, & R. Tierney, (Eds.), *Learning to read in american schools*. Hillsdale, NJ: Lawrence Erlbaum Assoc.

Atwell, N. (1987, 1999). *In the middle: Writing, reading and learning with adolescents*. Portsmouth, NH: Heinemann.

Minsky, M. (1975.) A framework for representing knowledge. *In the psychology of computer vision*, Winston, P.H. (Ed.). New York, NY: McGraw-Hill.

Murray, D.M. (1984.) *Write to learn*. New York, NY: Holt, Rhinehart and Winston.

Materials

- Virtual Field Trip Journals
- Pictures of different landforms in your area
- Poster presentation boards
- Separate materials will be listed for each individual activity.



Owen, D. (1987). Math discovery. *In plain talk: About learning and writing across the curriculum*. Self, J (Ed.) Virginia Department of Education

Journaling is a great tool in the learning process; being able to write about what you have learned increases retention immensely. That is why scientists and mathematicians take such in depth notes. Building on prior knowledge is another great way to help students learn the things more quickly that you would like them to. If the students don't have any background information about the new material you are presenting, then they will have nothing to relate it with. Therefore building on prior knowledge is also a great tool.

Instructional Procedures

Students will be put into groups of about four to six, depending on your class size. This will take place either in the gym or out on a large part of the playground where other students will not disrupt your class. Students will rotate from each station every 10-15 minutes. There are 8 stations for the virtual tour. Have parents, teacher aides, or college students volunteering at each station. You could easily set up more or fewer stations as needed. Students should have a field trip journal to be used at each location; pictures, drawings, and an explanation will be expected from each student.

It may be a good idea to join with the other teachers in your grade level. This way you will be able to use the teachers at your school to help instead of having to find as many volunteers.

Location #1 - Chemical Weathering

1. Put a couple of drops of lemon juice on each of the rocks.
2. Put a couple drops of vinegar on each of the rocks. Don't put the drops on the same rock you will need at least two of the same kind of rock; one for the lemon juice and one for the vinegar.
3. Watch and listen to see what happens when you add either the lemon juice or the vinegar.

What should happen:

Both lemon juice (citric acid) and vinegar (acetic acid) are weak acids. Explain to the students that water often contains weak acids (approximately $\text{pH}=5.8$) that dissolve rocks that contain calcium carbonate. You should have heard fizzing and saw bubbling from the limestone, marble, chalk, and calcite. The quartz and granite would not have been affected because they don't contain calcium carbonate.

Materials

- Lemon juice
- Vinegar
- Medicine droppers
- Small chunks (two or three each) limestone, marble, quartz, calcite, and chalk
- Magnifying glass
- Paper towels



Location #2 - Candy Bar Crunch

1. Give each student a candy bar.
2. Tell the students to carefully unwrap the candy bar. When they have it unwrapped tell them to use their fingernail to put cracks in the middle portion of the bar. This represents the Earth's crust.
3. Have the students hold the edges of the bar and pull it apart into two pieces. The chocolate should separate exposing the caramel which represents magma.
4. Now have the students push the candy bar back together. When the chocolate collides it may crumble or form mountains just as the earth does.
5. Once the students realize what is going on with the plates have them pull the bar totally apart. Notice that there has been no weathering or erosion yet, so the chocolate is rugged on the edges where it has been broken.
6. The students are now able to eat the candy if that is what the teacher instructs them to do.

Questions to think about:

1. Describe what you observed when you pulled the candy bar apart. What might you expect to see on Earth when you see two plates moving apart?
2. What happened when the stretched candy bar was pushed together? What might you expect to see when two plates on the Earth are being pushed together?
3. What happens along boundaries between plates?

Locations #3 - Abrasion

1. Rub the file back and forth across the ridges on the pencil.
2. Observe the surface of the pencil.

What should happen:

The ridges of the pencil should be cut down. The file has a rough, grainy surface. Tiny pieces are cut from the pencil as the file moves back and forth across it. Surfaces can be pitted and polished by sand grains carried by wind. The grains of sand act like the file as they strike and weather surfaces. The wind carries the particles cut away from the surface to other areas. This type of erosion is called abrasion.



Materials

- One small Milky Way Candy Bar
- Towels for clean up



Materials

- Fingernail file
- Six-sided pencil

Materials

- Two crayons
- 25 cm piece of string
- A beaker, 50-100 ml.
- Scissors
- 300 ml paper cup
- Plaster of paris
- Hot plate
- Spoon
- Pan
- Water
- Tongs
- Safety glasses



Location #4 - Volcanoes and Magma

Part 1 (Complete prior to the activity)

1. Remove the paper from the crayons. Break one into pieces and put the pieces in the beaker. Put on the safety glasses and warm the beaker on the hot plate until the crayon melts.
2. Hold the string at one end and use the spoon to push it onto the melted wax until it is completely coated. Then remove the string and let cool. (You may remove your glasses when this is done.)
3. Break the other crayons into three or four pieces and bundle the pieces together using the wax-covered string. Leave at least five centimeters of string extending from the bundle.
4. Mix the plaster of paris and water in the paper cup. The mixture should be about the consistency of soft ice cream and should fill $1/2 - 1/3$ of the cup.
5. Use the spoon to push the crayon bundle into the plaster of paris mixture. The bundle should be completely covered and should not be touching the bottom or sides of the cup. Loop the string around a pencil or straw to support the bundle and keep it from sinking to the bottom of the cup.
6. Holding the pencil or straw, tap the cup so that the bundle does not hit the bottom; tap the cup on the table to make any air bubbles rise to the top.
7. Clean your work area and let the plaster of paris harden overnight. To remove wax from the beaker, melt it with hot water, pour out water, and wipe out the beaker before the wax hardens again.

Part 2

8. After the plaster has hardened and you are ready to erupt the volcano, tear away the paper cup from around the hardened plaster.
9. Cut off the string close to the surface of the plaster.
10. Put on your safety glasses and wear them throughout the rest of the activity. Use tongs to place the plaster in a pan of boiling water with the string end up. For the best results, the surface of the plaster should be about 1.5 centimeters above the surface of the water.
11. Observe and consider what happens as the wax “magma” inside the plaster “volcano” melts.

12. When the “eruption” is completed, turn off the burner and allow the water to stop boiling before attempting to remove the volcano. Once the water has stopped boiling, use the tongs to carefully remove the volcano from the pan. Discard the volcano, empty the remaining water from the pan, and clean any remaining wax from the pan, tongs, and burner. Make sure the burner has had enough time to cool before attempting to clean it.

Questions to think about

1. Why did the wax from the crayons inside the model volcano rise to the surface when the volcano was placed in the pan of boiling water?
2. What causes magma to rise to Earth’s surface in a real volcano? How effective are the wax crayons in the plaster-of-paris model in portraying the action of real magma?
3. When the volcano model was prepared, air bubbles were removed from the plaster. What would have happened if there had been air spaces still in the plaster-surrounding bundle of wax crayons?
4. What might have happened if there had been no waxed string (no opening to the surface) in the plaster to relieve the pressure from the expanding crayon? Is this situation (the absence of a vent for magma and steam pressure) possible in a real volcano? What would be the result?

Location #5 - Tilting

1. Use a pencil to make a hole through the side of each paper cup near the bottom edge. The hole must be small enough that the straw will fit tightly.
2. Insert about one-half inch of one end of the straw into each hole and seal with the clay.
3. Set the pan on a table and place two connected cups in the center of the pan.
4. Fill both cups half full with water.
5. Lift one end of the pan so that it is about two inches above the table. Observe the contents of each cup.

What should happen:

Raising the pan causes the amount of water to decrease in the elevated cup and increase in the lower cup.

Materials

- Pencil
- Two five-ounce paper cups
- Drinking straw
- Modeling clay
- Shallow baking pan
- Tap water



The cups are a model of a voltmeter (an instrument that measures the tilting of the ground). Volcanologists (scientists who study volcanoes) place the tiltmeter on a volcano with one end pointing toward the swelling in the volcano. The swelling is detected when the water content in the end pointing toward the cone decreases. An unusually large swelling in a short period of time tells scientists that an eruption is most likely on the way.

Materials

- Pencil
- Half-empty tube of toothpaste



Location #6 - Shield Volcano

1. Use the point of a pencil to make a hole in the tube near the cap.
2. Hold the toothpaste tube in you hands.
3. With the cap screwed on tight, push against the tube to force the toothpaste toward the capped end.

What should happen:

The toothpaste slowly emerges from the hole and flows down the side of the tube. The pressure from your fingers forces the liquid toothpaste out the opening. Tremendous pressure within the Earth forces magma out of cracks or weak spots in the Earth's surface. The liquid rock is called magma when it is within the Earth, but it is called lava once it reaches the surface. The lava cools and hardens on the surface, forming a mound of rock around the opening. A new layer is added to the mound with each eruption. This layered mound of lava is called a shield volcano.

Location #7- Quick Water

1. Use the pencil to make a hole in the side of the paper cup near the bottom.
2. Cut the straw in half and insert one of the pieces into the hole in the cup. Seal around the hole with clay.
3. Lay the cookie sheet on the ground and raise one end about two inches by putting soil under it.
4. Cover the sheet with a thin layer of soil. Set the cup on the sheet as shown.
5. Hold your finger over the end of the straw as you fill the cup with water.
6. Release the end of the straw and observe the movement of the water.
7. Repeat steps four through six, raising the end of the sheet about six inches.

Materials

- Pencil
- Paper cup
- Scissors
- Drinking straw
- Modeling clay
- Cookie sheet
- Ruler
- One-gallon plastic jug, filled with tap water



What should happen:

More soil is washed away when the slope of the cookie sheet is increased. As the slope increases, the water flows more quickly. The faster the water moves, the more energy it has, and thus the more soil it pushes forward. The process of being worn away by water is called erosion.

Location #8 - Weathering

1. Place three tablespoons of dirt in the bowl.
2. Stir in enough glue to make a stiff mixture.
3. Shape the mixture into two balls of equal size.
4. Wipe the glass bowl clean with a paper towel and place the balls of dirt inside the bowl.
5. Place the glass bowl in a sunny area and allow the dirt balls to harden for several days.
6. Fill each plastic bowl half full with water.
7. Add one teaspoon of gravel to one of the plastic bowls.
8. Place one dirt ball in each bowl and secure the lid.
9. Shake each bowl vigorously 10 times.
10. Open the lids and observe the shape of each dirt ball.
11. Close the lid. Shake and observe three more times.

What should happen:

The shape of both balls changes, but the ball in the bowl with the gravel changes faster. Land can be worn down by moving water. This change in the land is called weathering (the breaking down of rocks and other land features). The dirt balls (homemade rocks) in the bowls were weathered by the water and the bowl hitting against them. The gravel sped up the weathering process by scraping against the surface of the dirt ball.

Assessment Suggestions

- The main assessment that will be of value is the journal that the students have to take with them on the field trip. You will be able to see if they were able to understand and grasp the concepts that you were trying to reinforce. Pictures that have been drawn and questions that have been answered should easily tell you if they understand different processes happening with the land around us.

Materials

- Dirt
- Small glass bowl
- Spoon
- White glue
- Paper towel
- Two plastic bowls of equal size with lids
- Tap water
- Aquarium gravel



Curriculum Extensions/Adaptations/Integration

- If you know that you have students that are advanced learners you may choose to pair them with other students who are struggling. By doing this the advanced learners will be able to solidify their knowledge and provide alternative explanations for their peers.
- Have the students give examples that they know of where weathering and erosion area taking place.
- An adaptation may be to create a packet that has already been made to assist those that have difficulty with writing.
- You may have advanced students who would benefit from being a “teachers assistant” at any one of the locations on the virtual field trip. They can have an alternate journaling activity that is associated with their individual teaching assignment.
- A great extension of this activity would be a group scrapbook. If your class is able to take a landforms fieldtrip, it would be a good idea to divide your class into small groups. Each group would be provided with a disposable camera to take pictures of various landforms and examples of weathering and erosion. In the classroom, the students can use their developed pictures to create a landform scrapbook. This would incorporate concepts from the Language Arts, Visual Arts, and Science Core curriculum.

Family Connections

- The next time they get a Milky Way candy bar or a candy bar that is similar, challenge the students to explain to a family member how an earthquake changes Earth’s surface.
- Students can easily walk around their neighborhood and come back with examples of weathering and erosion. Remember most weathering and erosion starts out small and later becomes very noticeable.

Additional Resources

Books

201 Awesome, Magical, Bizarre, and Incredible Experiments, by Janice VanCleave;
ISBN 0-471-26593-4

202 Oozing Bubbling, Dripping, and Bouncing Experiments, by Janice VanCleave; ISBN 0-471-26594-2

Simple Earth Science Experiments with Everyday Material, by Louis V. Loischnig ISBN 0-8069-0365-1

Project Earth Science GEOLOGY, by National Science Teachers Association; ISBN 0-87355-131-1

Web sites

<http://www.earthsciweek.org>

<http://www.specificurl.com>

Organizations

American Geological Institute, 4220 King Street Alexandria, VA. 22302,(703) 379-2480
www.agiweb.org

Science V

Activities

Inherited Traits

Trait Variations for Survival

Standard V:

Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.

Objective 2:

Describe how some characteristics could give a species a survival advantage in a particular environment.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills

Content Connections:

Science V, Inherited Traits; Language Arts VIII-1, Organizing Information; Language Arts VIII-6, Write in different forms and genres

Science
Standard

V

Objective

2

Connections

Background Information

Members of a species are alike in many ways. However, individuals within a species show small differences. Variations are differences in appearance of an inherited trait among the members of a species. Variations can be observed in traits related to size, shape, behavior, function, and body parts. Most variations are minor and include differences in hair color, texture and length of fur, and flower color. Others may be major and quite apparent, like a cat with six toes on each paw or an albino deer. All of these variations are inherited and can be passed down to the offspring from the parent organism.

Variations in species may affect their ability to survive in a changing environment. During the course of many generations, a variation that provides a survival advantage can become widespread in a population because individuals with it have a higher probability of reproducing and surviving. If a species is unable to adapt to its changing environment, it can become extinct. Dinosaurs are an example of this.

Plant breeders take advantage of variations to produce improved crops. For example, United States potato farmers spend millions each year on pesticides, but insects become resistant to these pesticides. In Bolivia, a species of wild potato has hairs on its leaves that release a sticky chemical when touched. The hairs act like flypaper and trap pests that feed on the leaves of the potato plant. However, these potatoes are very small. Through plant breeding, scientists have been able to combine the trait of large size of the U.S. potatoes with the insect-resistance trait of the Bolivian potatoes to develop a high-yielding, large, insect-resistant variety of potatoes.

Research Basis

Lambert, M. & Carpenter, M., (2005). Visual learning: Using images to focus attention, evoke emotions, and enrich learning. *MultiMedia & Internet@Schools*, 12.5, pp. 20-24.

McCoy, J. D., & Ketterlin-Geller, R., (2004). Rethinking instructional delivery for diverse student populations: Serving all learners with concept-based instruction. *Intervention in School & Clinic*, 40.2, pp. 88-95.

Using graphic organizers can help students on all levels understand content concepts more clearly as they help the students organize the material. This can be especially true for students reading below grade level as the organizers can help them with reading comprehension. It is also helpful with gifted learners as it helps them bridge and categorize their expansive thinking.

Invitation to Learn

Show students a picture of a klipspringer antelope and a picture of a mountain goat. Ask them to think about the physical characteristics of each as you explain them to them. The information about these two antelopes is located on the *Mountain Goat and Klipspringer Animal Cards* overhead transparency. While both antelope live in the mountains on small ledges, the klipspringer has an amazing variation that allows it to leap from rock to rock without falling. Its rubbery hoofs allow it to grip the rocks as it jumps from one to another on the rocky slopes of the African mountains. The students will participate in an activity that will test their jumping ability.

Divide the students into pairs. Give each pair of students four square sheets of paper measuring 8" x 8", 6" x 6", 4" x 4", and 2" x 2". Lay the sheets of paper on the ground approximately one to one and one half feet apart from one another. One student at a time will try to jump from paper to paper without falling off any of them. This will help them make the connection that the klipspringer's hoof variation truly does help it survive in its environment and how important species variations are to the species' survival.

Instructional Procedures

Students will work in pairs to study related organisms that live in different environments. To teach the students how to do this activity, you will model it using the klipspringer and mountain goat.

1. Begin by passing out a copy of the *Klipspringer Card* to each student in the class. (Since you will also need a classroom set of the *Mountain Goat Card*, to save paper, you may want to copy the two animal cards front to back.)



2. Display an overhead transparency of the *Klipspringer Card*.
3. As a class, read the *Klipspringer Card* together. After each paragraph is read with students, pick out the word or words that convey the main idea of it. Have the students to write the word or words that give the main idea in the margin. Model this on the overhead as well. This strategy is called *Margin Magnets, as the words written in the margins are magnets that attract the information or what the paragraph was about. Follow this procedure for each paragraph on the card.
4. Fill out the overhead of the *Animal Variations Chart* together as a class using the information on the *Klipspringer Card*. You will be filling out the same chart on the overhead projector.
5. Repeat steps two through four using the *Mountain Goat Card*.
6. Fill out the *Venn Diagram for Comparing and Contrasting Animals* using the information written on the *Animal Variations Charts*.
7. Discuss the information on the two *Animals Variations Charts* noting how these variations give each organism a survival advantage in its unique environment.
8. Now you will write a class diamante poem using the information from the two *Animal Variations Charts* and the *Venn Diagram*. This diamante is a modified version to suit the purposes of this animal comparison study. The first three lines describe one of the animals, and the next lines describes both animals, and the last three lines describe the other animal. The format is as follows:

Line 1: Noun (one of the animals)

Line 2: Two adjectives describing first animal

Line 3: Phrase beginning with an “ing” word (participle) that describes what the noun does and where

Line 4: Three participles describing both animals

Line 5: Phrase beginning with an “ing” word (participle) that describes what the noun (other animal) does and where

Line 6: Two adjectives describing the other animal
Adjective, adjective

Line 7: Noun (the other animal)

Example:

Klipspringer
Spiky-horned, brown

Materials

- Paper squares 8” x 8”, 6” x 6”, 4” x 4”, and 2” x 2”
- Klipspringer and Mountain Goat Animal Cards* (Overhead)
- Klipspringer and Mountain Goat Animal Cards*
- Animal Variations Chart* (2 Overheads)
- Venn Diagram for Comparing and Contrasting Animals*
- Venn Diagram for Comparing and Contrasting Animals* (Overhead)
- Animal Fact Cards* (small)

Landing on narrow, rocky mountain ledges in Africa
Jumping, gripping, traveling
Rock climbing to dizzying mountain heights in Alaska
Bearded, white
Mountain Goat

9. The students will divide into pairs to study two different animals and will write their own poems.
10. Provide the student pairs with *Animal Fact Cards* that contain pictures and facts about related animals and birds living in different environments.
11. Now have students follow steps three through seven using new cards.
12. When they have written their own poems, have the students copy them onto the diamond outline and draw a picture of both animals to complete the assignment.

*The Margin Magnets reading strategy came from Dr. Carol Santa of the Montana Academy. She can be reached at carol@montanaacademy.com or to read more <http://www.projectcriss.com>

Assessment Suggestions

- The *Animal Variations Charts*, *Venn Diagram for Comparing and Contrasting Animals*, and both poems can be used as assessments.
- Students could write a paragraph or story detailing a situation in which their animal's variation would help it survive.

Curriculum Extensions/Adaptations/Integration

Instead of writing diamante poems, student pairs could write Poems for Two Voices and share them with the class. To write these poems, students are grouped in pairs. You can stipulate how many stanzas you want the poems to have. A stanza consists of three lines that do not need to rhyme. You could list the points from the lesson that you would like covered in the poems and they could include the information covered on their Animal Variations Charts. An example of a poem about klipspringers and mountain goats follows:

Animal Variations Poem for Two Voices Klipspringer and Mountain Goat

I am a klipspringer
I am a mountain goat
We are both antelopes

I live in Africa
I live in North America
We both live on mountain cliffs and ledges

I jump from rock to rock on small mountain ledges
I climb on rocks on the steep mountain slopes
We both have spongy, springy hoofs

I have a long brownish-gray bristly coat
I have a long, hairy white coat
Both of our coats protect us in our environments

I eat fruits, flowers, moss, and succulents
I eat grass, sedges, and lichens
We both have to search in treacherous circumstances for our food

I stay with one mate throughout my life
I live in herds of up to ten mountain goats
We both have one or two offspring a year

Students may choose to present the poems in a variety of ways including:

1. Having the first person read the first line, the second person reads the second line and both read the third line together.

or

2. Having both people read all three lines together.

If you choose to have your students follow choice number one, the pairs of students can write their poems on overhead transparencies using three different colors of markers; a separate color for each student and another for the line they read together. The students then present their poem to the class by displaying on the overhead projector and reading it together. You may want to have the students illustrate their poems with accurate drawings of the animals they researched.

- Group students with special needs with students who will have a good model to help them.

- Students who have a difficult time copying information from an overhead could be given a personal copy of the information to have at their desks so they do not have to look from the overhead to their paper in order to copy the information.

Family Connections

- While visiting Hogle Zoo in Salt Lake City, read the information about the animals at each display.
- Find the animals at the zoo that you researched for your variations comparisons.

Additional Resources

Books

Macmillan Illustrated Animal Encyclopedia: A Visual "Who's Who" of all the World's Creatures, edited Dr. Phillip Whitfield, ISBN 0-02-627680-1

The Kingfisher Illustrated Animal Encyclopedia, David Burnie, ISBN 0-7534-5283-9

Videos

Eyewitness DK Survival; writer: Paul Thomas; director: Richard Simkin; 1997;
<http://www.dk.com>

Web sites

Source for animal card clipart:

<http://office.microsoft.com/clipart/default.aspx?lc=en-us>

<http://jechevry.free.fr/n.html>

More information about animals can be found at:

<http://www.animalsearch.net>

<http://www.awesomelibrary.org/Classroom/Science/Animals/Animals.html>

<http://www.buschgardens.org/>

<http://classroomclipart.com/cgi-bin/kids/imageFolio.cgi?direct=Animals>

<http://www.hoglezoo.org/>

http://www.nationalgeographic.com/kids/creature_feature/archive/

<http://www.projectwild.org/>

<http://yahooligans.yahoo.com/content/animals/>

<http://www.zoobooks.com>

Name _____

Animal Variations Chart

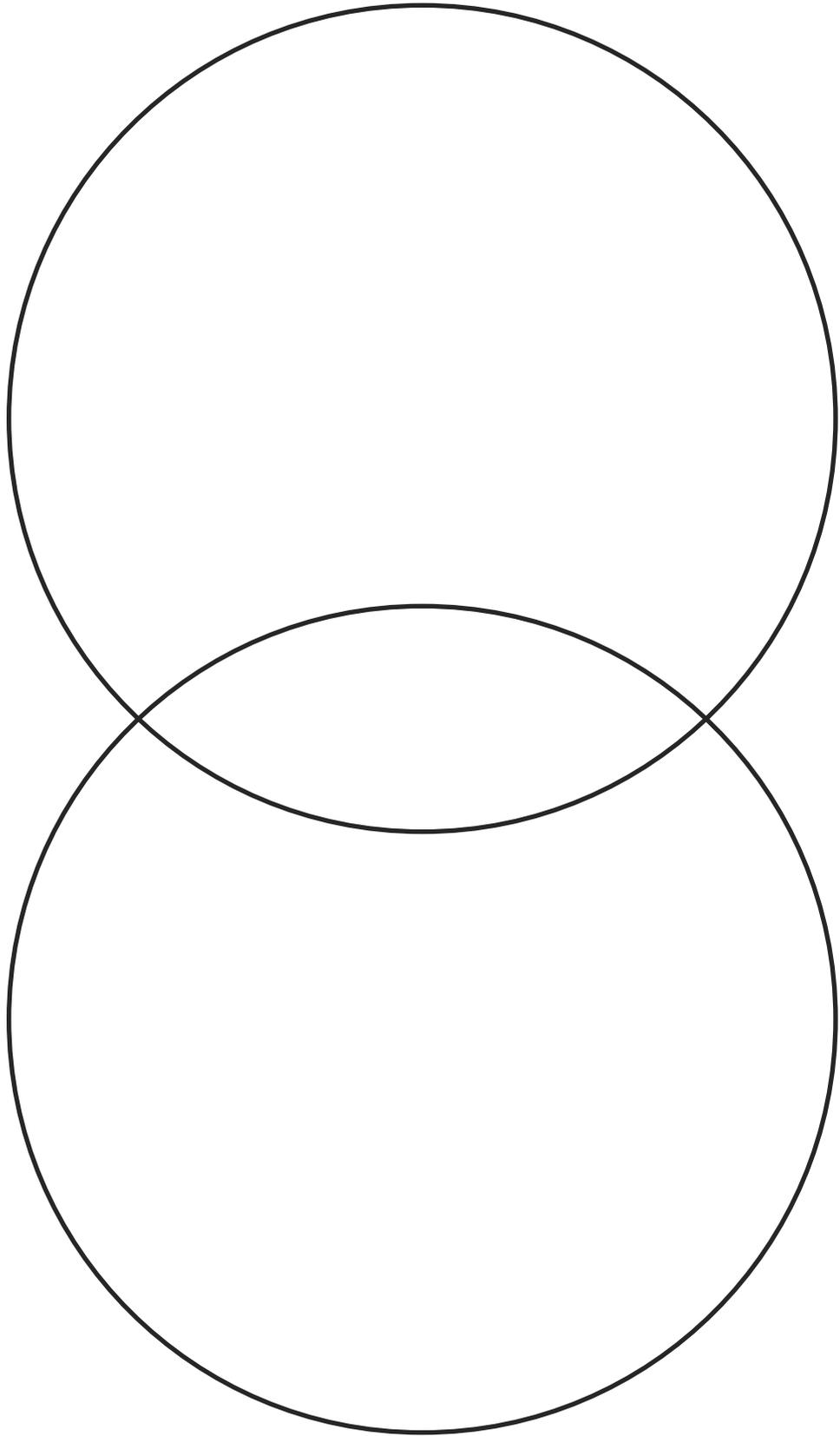
Animal Name	Range (Where it lives)	Habitat
Size	Food Source	Outstanding physical features that allow this animal to survive in its environment.
Societal Group		

Name _____

Venn Diagram for Comparing and Contrasting Animals

Animal #1

Animal #2



Observing Mealworms and Earthworms

Standard V:

Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.

Objective 1:

Using supporting evidence, show that traits are transferred from a parent organism to its offspring.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills

Content Connections:

Science V, Inherited Traits; Language Arts VIII-1, Organizing Information
Math IV-2, Measurement

Science
Standard

V

Objective

1

Connections

Background Information

All organisms have life cycles. Sometimes offspring do not look like the parent organism at first, but as they go through their life cycle, they begin to look more like the parents. Some organisms show direct development. This means they are born looking like the parent organisms, only smaller. As they develop, they change only by increasing in size until they are to the adult stage and look just like their parents. Spiders and earthworms go through direct development. Other organisms go through incomplete metamorphosis, which means they progress through three stages of development: egg, nymph, and adult. At each stage, they look different than they looked in the previous stage. Cockroaches and grasshoppers are two insects that develop through incomplete metamorphosis. A third type of life cycle is called complete metamorphosis. The insects' bodies change dramatically as they go through four stages: egg, larva, pupa, and adult. Mealworms and butterflies develop by going through complete metamorphosis.

Every organism responds to its environment or the surroundings in which the organism lives. Some behaviors are inherited or instinctual, while others can be learned.

The life cycle of mealworms will be observed and a journal will be kept to record their metamorphosis to adulthood as they become darkling beetles. Caterpillars' life cycles may also be observed and recorded as they change into painted lady butterflies.

Caring for Mealworms:

Mealworms can be kept in a covered plastic shoebox with holes drilled in the lid. Similar containers will work just as well, just so the

mealworms have air holes for breathing. Bran or oatmeal can be used to line the bottom of the box and will serve as the mealworms food source. They will need a slice of apple or potato for moisture. Apples seem to last longer than potatoes. The mealworm habitat must be checked every day because the apple and potato slices tend to mold after a few days.

Mealworms need to be kept in a warm, but not hot, area. Do not place the container in direct sunlight. Mealworms move more slowly when the temperature is below 58° F. If you want to slow their growth process, they can be kept in the refrigerator for a short while. They will mature at a faster rate if they are kept in a warm area of 75° - 85°F.

Mealworms also like to hide under things. A small bowl, similar to the aluminum tins that individual potpies are cooked in, tipped upside down in the habitat works well as a mealworm hiding place.

An additional habitat option is to use empty Cool Whip containers with holes punched in the lid. Inside the habitat would be the same as with the shoe boxes. Groups of students can have their own group habitats that they can observe.

Before beginning the Invitation to Learn and the investigations, discuss the differences of instinctual and learned behaviors. At the end of the investigations you will go over this again. Your discussion might include the following points:

- Every organism responds to its environment. Some behaviors (how the organism acts) are “built in” or *instinctual*. These are inherited from the parent organism.
- Other behaviors are *learned* because the organism learns them during its life. They can learn them from the parent or through experience.

Research Basis

Haury, D. L. & Rillero, P. (1994). Perspectives of hands-on science teaching. *The ERIC clearinghouse for science, mathematics, and environmental education*. Retrieved January 14, 2006, from <http://www.ncrel.org/sdrs/areas/issues/content/entareas/science/eric/eric-2.htm>

Lopez, R. E. & Tuomi, J. (1995). Student-centered inquiry. *Educational Leadership*, 52(8), 78.

Research has shown that hands-on learning in science will help students remember the material better because they are part of the learning process and not just spectators. While this is true for all learners, it can have a profound impact on students with difficulties such as second language barriers and learning and behavior disabilities.

Invitation to Learn

In this activity, the students will be introduced to the mealworms and earthworms. They will study, sketch, measure, observe, record findings, and read about the worms. The students will be divided into pairs. Each pair of students will be given two heavy paper plates. One to three live mealworms will be placed on the first plate and one live earthworm will be placed on the second plate. If lightweight plates are used, make sure to put multiple plates together for sturdiness. Students may pair up to work together.

Next, give each student a copy of the *Mealworm and Earthworm Behaviors* worksheet. Allow the students to observe the worms as they move around on the plates. Have the students follow the directions on the sheet by observing, sketching, coloring, measuring and recording how each worm moves about on the plate and the sounds it makes as it moves. Encourage the students to gently pick up the mealworms and earthworms, then describe and record how they feel in their hands.

The students will now read information about mealworms and earthworms located on the *Mealworms-Background Information* and *Earthworms-Background* information sheets.

Upon completion of the Invitation to Learn activity, the students will participate in multiple investigations with the mealworms and earthworms by going from station to station using the *Mealworm and Earthworm Behaviors* sheet. If time is short, the investigations may be conducted on another day.

Instructional Procedures

To complete the investigations, continue using the *Mealworm and Earthworm Behaviors* worksheet. Direct the students to conduct the investigations using the instructions included on the sheet as they move from station to station. Using the information the students read in the background information during the invitation to learn segment, students will determine whether the behavior they observe in the worms is learned or instinctual. At the end of the investigations, discuss with the class what they discovered and lead them to realize that because the worms are lower life forms, their behavior is largely instinctual. Their instinctual behavior was passed to them from their parent organisms (darkling beetles). Also, point out that the mealworms (larva) look entirely different from the adult beetles, while baby earthworms look like the adult worms.

The teacher must set up the time limits for each station. Five to seven minutes should be plenty of time for students to make and

Materials

- Earthworms
- Meal worms
- Black paper
- White paper
- Chenille stem
- Flashlight
- Pipettes
- Frozen gel pack



record observations. It is also advised to go through the stations with the students before letting them begin the investigations.

**Station 1: Black/White using a mealworm &
Station 2: Black/White using an earthworm**

1. Students will use a half sheet of white construction paper taped to a half sheet of black construction paper at this station.
2. Students will predict whether the worms will prefer the black surface or the white surface. They must justify their prediction based on the mealworm and earthworm background information they read during the Invitation to Learn activity.

**Station 3: Light and Touch Response using a mealworm &
Station 4: Light and Touch Response using an earthworm**

1. At this station, students will predict the worms' response to light from a flashlight and to being gently touched with a chenille stem. They must justify their answers, again based on what they have learned so far about the worms.
2. Students will put the worms in the shoebox. Make sure to do this one type of worm at a time.
3. Shine the flashlight into the box. Observe and record the worms' behavior.
4. When this has been repeated with both kinds of worms, have the students put the worms back on the plate and lightly touch them with a chenille stem.
5. Record how the worms reacted to the chenille stem touching them.

**Station 5: Barrier Response using a mealworm &
Station 6: Barrier Response using an earthworm**

1. Give each group of students two paper plates and several items to act as barriers such as clothespin, piece of wood, a pencil, crumpled up pieces of paper, etc.
2. Have the students predict the worms' responses to these barriers. They can answer questions such as: Will the worms go around the barriers? Crawl over them? Burrow beneath them? Try to go through them? Will the mealworms react differently than the earthworms? Students must justify their answers based on what they previously read in the *Mealworms-Background Information* and *Earthworms-Background Information* sheets in the Invitation to Learn activity.

3. Have the students arrange the two or three barriers on the plate.
4. Depending on whether the students are at Station Five or Station Six, have them place either mealworms or an earthworm on their plate with the barriers and observe and record the behavior of the worms.
5. Students must record the reasons for the worms' behaviors regarding the barriers.

Station 7: Moisture Response using a mealworm & Station 8: Moisture Response using an earthworm

1. Have students predict whether the worms will prefer a moist surface or a dry surface and justify their predictions.
2. Have a moist rag or paper towels lying right next to a dry rag or paper towels, so they are touching.
3. Students will straddle the worm across the line separating the moist and dry towels and will then observe and record the worms' actions.
4. Supply both stations with one water dropper or pipette each and a small container of water. Instead of using a small container of water, another option is to set these stations up by a sink.
5. Now have the students place the worm on the moist side and gently place one drop of water on the worm, recording its reaction. Students will explain what they think the reasons are for the worm's reactions.

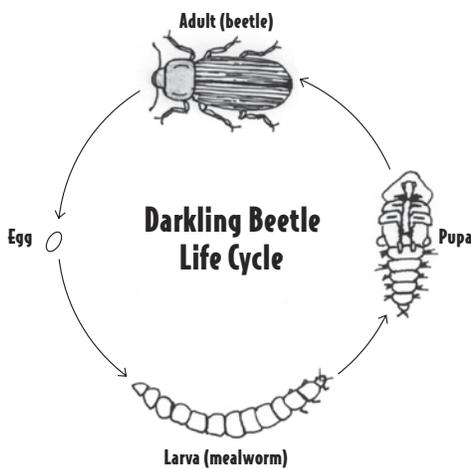
Station 9: Temperature Stimulus using a mealworm & Station 10: Temperature Stimulus using an earthworm

1. The day before doing this activity, place gel packs or several slightly damp paper towels in the freezer. Place layers of waxed paper in between the paper towels for easy separation. Retrieve them from the freezer just before commencing with this activity.
2. Just before this activity, place the rice or corn sacks or the damp paper towels in the microwave to heat. If using heating pads, turn them to warm.
3. To set up this station, place the hot and cold items next to each other with a hand towel or paper towels over the frozen gel pack and heated corn/rice packs or heating pad. This is to protect the worms. If using paper towels, you may want to do the same thing only with additional paper towels.

4. Have the students predict whether the worms will prefer the hot or cold areas.
5. Now have them place the worms on the areas and record their observations.

Discussion after the Investigations

1. As a class, list examples of instinctual behavior in the mealworms and earthworms. Bring up the fact that most, if not all, of the behaviors are instinctual because they are lower life forms.
2. List examples of instinctual and learned behaviors in other organisms and humans. Some examples of instinctual behaviors may include wolves living in a pack, moths and other insects flying toward lights, birds and salmon migration. Some examples of learned behaviors may include riding a bike, dogs whining or scratching to go out of doors, and cats meowing to be fed.
3. Discuss the role that instinctual and learned behaviors might play in providing an organism with a survival advantage or disadvantage in a particular environment.



Observing and Journaling Mealworms' Life Cycle Stages

1. Construct a mealworm habitat and observe mealworm larva undergo metamorphoses to become adults. See *Caring for Mealworms in the Background* section.
2. Have students record their observations in a science journal or spiral bound notebook. They will be comparing and contrasting the four stages the mealworm's experience as they become darkling beetles. They will be writing about and drawing what they observe.

Assessment Suggestions

- The completeness and accuracy of the *Mealworm and Earthworm Behaviors* worksheet can be used as an assessment.
- Observe the students as they work at the stations, noting the ease or difficulty they have at following the procedures and understanding the content at each station can also be an assessment method.

Curriculum Extensions/Adaptations/ Integration

Additional mealworm and earthworm investigations:

Food Stimulus Station

1. The day before this activity put mealworms and earthworms in a container with no food for 24 hours.
2. Have students predict how hungry mealworms and earthworms will react when they are placed at one end of a paper plate (or tray) and a food source is placed at the other end. Consider these questions in the predictions: Will they follow a direct route to the food? Will they meander around until they find it? Will they simply ignore it?
3. Give each pair of students a paper plate with a small pile of bran flakes or oatmeal at one end.
4. Place several mealworms on the opposite end of the food source on the paper plate.
5. Allow five minutes for students to observe the mealworms' behavior. Have the students record their observations with an explanation for the mealworms' behavior.
6. Repeat the process using carrot tops or celery leaves as the food source for the earthworms.

Training a Mealworm

1. Pose the following question to the students: Can mealworms be trained to follow a certain pathway to food?
2. Construct a “T” maze in a shallow box (the lid from a case of copy paper would be ideal).
3. Release several mealworms at the bottom of the “T” and record how many turn left at the “T” and how many turn right at the “T”.
4. Repeat this experiment again and place bran flakes or oatmeal at the far side of the left-hand turn. Release the mealworms again and count how many turn left toward the food source.
5. Repeat the process for two more cycles.
6. On the fourth cycle, DO NOT place any food in the maze. Release the hungry mealworms and count how many turn left at the top of the “T”.

Painted Lady Butterflies

Observing the metamorphosis of the Painted Lady Butterflies is also a fun extension. Two useful websites are listed in the web sites section for buying and caring for the caterpillars.

Mealworm and earthworm cinquain poems can be written as language arts connection. A cinquain is a simple, five-line verse that follows a specific pattern. The pattern is:

Line 1 - one word of two syllables (usually a noun that names the subject of the poem)

Line 2 - four syllables (two-syllable adjectives describing the noun in line one)

Line 3 - six syllable (showing action)

Line 4 - eight syllables (expressing a feeling or observation about the subject)

Line 5 - two syllables (describing or renaming the subject)

Examples:

Mealworm
Yellow larva
Eating, growing, changing
Will become a darkling beetle
Insect

Earthworm
Humus-maker
Wiggling, squirming, struggling
Trying to escape from the hook
Fish bait

Family Connections

- Look for insects in the yard and garden that go through complete metamorphosis.

Additional Resources

Mealworms can be purchased at your local pet store. They are inexpensive and most are sold in amounts of 50, 100, or 200. The large mealworms cost more, but are more lively, making them easier for students to observe. The large mealworms are often treated with hormones to prevent them from becoming beetles. Inquiring whether the mealworms have been treated with hormones may be a good idea. The smaller and untreated mealworms will change into beetles in four to six weeks. Mealworms are also available from Carolina Science and Math at 1-800-334-5551 or <http://www.carolina.com>. Larvae are \$6.70 for a pack of 50. Petco Store sells untreated mealworms \$2.57 for 50 and four to five dollars for 100. Petsmart sells three different sizes of mealworms: 50 regular-sized or 35 giant or 25 super mealworms for \$2.99 per type.

Earthworms can be purchased from stores that sell fishing tackle.

Books

For an alternative to mealworms and earthworms you could observe pillbugs. Pillbug investigations can be found in:

A Pillbug Project: A Guide to Investigation, Robin Burnett; ISBN 10: 0-87355-109-5

Videos

Eyewitness Butterfly & Moth; director: Derek Hall; producer: Richard Thomson; writer: Brian Meel; <http://www.dk.com>

Web sites

Both of these websites have information about obtaining and caring for Painted Lady butterfly larva:

<http://www.insectlore.com>

<http://www.worsleyschool.net/science/files/painted/lady.html>

Name _____

Mealworm and Earthworm Behaviors

<p>Sketch and color the MEALWORM.</p> <p>Describe the mealworms, please include:</p> <ul style="list-style-type: none">• Physical traits• How it feels when you touch them• Length in mm• The noise they make as they move across the plate <p>With your partner, read the information sheet about the mealworms.</p>	<p>Sketch and color the EARTHWORM.</p> <p>Describe the earthworm, please include:</p> <ul style="list-style-type: none">• Physical traits• How it feels when you touch it• Its length in mm• The noise it makes as it moves across the plate <p>With your partner, read the information sheet about the earthworms.</p>
<p style="text-align: center;">STATION 1: Black/White</p> <p>Predict whether the mealworms will prefer the black or white surface. After reading the mealworm information sheet, why do you think this?</p> <p>Straddle the mealworms across the line of the two papers and observe if it has a side that it prefers. Record your observations.</p> <p>Is this behavior learned or instinctual? (<i>Circle one</i>)</p>	<p style="text-align: center;">STATION 2: Black/White</p> <p>Predict whether the earthworm will prefer the black or white surface. After reading the earthworm information sheet, why do you think this?</p> <p>Straddle the earthworm across the line of the two papers and observe if it has a side that it prefers. Record your observations.</p> <p>Is this behavior learned or instinctual? (<i>Circle one</i>)</p>

STATION 3: Light and Touch Response

Predict how you think the mealworms will respond to light stimulus and to being touched with the chenille stem. Why do you think this?

Shine the flashlight into the box. See if the mealworm will stay in the light or to the dark part of the box. Record your observations.

Now touch the mealworms with the rounded end of the chenille stem. How did the mealworms react? Record your observations.

How do you know which end of the mealworm is its head? Record how you know.

Is this behavior learned or instinctual? (*Circle one*)

STATION 4: Light and Touch Response

Predict how you think the earthworm will respond to light stimulus and to being touched with the chenille stem. Why do you think this?

Shine the flashlight into the box. See if the earthworm will stay in the light or to the dark part of the box. Record your observations.

Now touch the earthworm with the rounded end of the chenille stem. How did the earthworms react? Record your observations.

How do you know which end of the earthworm is its head? Record how you know.

Is this behavior learned or instinctual? (*Circle one*)

<p>STATION 5: Barrier Response</p> <p>Predict how the mealworms will respond to a barrier in its way. Write why you think this.</p> <p>Place the mealworms on the plate. Record your observations about how the worm responds to the barriers placed in its way.</p> <p>Is this behavior learned or instinctual? <i>(Circle one)</i></p>	<p>STATION 6: Barrier Response</p> <p>Predict how the earthworm will respond to a barrier in its way. Write why you think this.</p> <p>Place the earthworm on the plate. Record your observations about how the worm responds to the barriers placed in its way.</p> <p>Is this behavior learned or instinctual? <i>(Circle one)</i></p>
<p>STATION 7: Barrier Response</p> <p>Predict whether the mealworms will prefer a dry surface or a moist surface. Write why you think this.</p> <p>Place the mealworms straddling the line between the dry and moist towels. Record your observations as to which side the mealworms prefer.</p> <p>Now, place the mealworm on the moist towel and gently place one drop of water on it. How did it react to the water? Why? Record your observations here.</p> <p>Is this behavior learned or instinctual? <i>(Circle one)</i></p>	<p>STATION 7: Barrier Response</p> <p>Predict whether the earthworm will prefer a dry surface or a moist surface. Write why you think this.</p> <p>Place the earthworm straddling the line between the dry and moist towels. Record your observations as to which side the mealworm prefers.</p> <p>Now, place the earthworm on the moist towel and gently place one drop of water on it. How did it react to the water? Why? Record your observations here.</p> <p>Is this behavior learned or instinctual? <i>(Circle one)</i></p>

<p>STATION 9: Temperature Stimulus Predict whether the mealworms will prefer a cold or hot temperature. Write why you think this.</p> <p>Place the mealworms on the warm area. Record your observations.</p> <p>Now place it on the cold side. Again, record your observations.</p> <p>Which temperature did the mealworm prefer?</p> <p>Why do you think this is so?</p> <p>Is this behavior learned or instinctual? (<i>Circle one</i>)</p>	<p>STATION 10: Temperature Stimulus Predict whether the earthworm will prefer a cold or hot temperature. Write why you think this.</p> <p>Place the earthworm on the warm area. Record your observations.</p> <p>Now place it on the cold side. Again, record your observations.</p> <p>Which temperature did the earthworm prefer?</p> <p>Why do you think this is so?</p> <p>Is this behavior learned or instinctual? (<i>Circle one</i>)</p>
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Mealworm and Earthworm Investigations

Black/White Mealworm	Black/White Earthworm
Light and Touch Response Mealworm	Light and Touch Response Earthworm
Barrier Response Mealworm	Barrier Response Earthworm
Moisture Response Mealworm	Moisture Response Earthworm
Temperature Stimulus Mealworm	Temperature Stimulus Earthworm

Mealworms-Background Information

Introducing *Tenebrio molitor*, otherwise known as the mealworm, the darkling beetle, or the stinkbug. Mealworms are part of the very large beetle family of insects. Of the three million species of insects, one million are some type of beetle. An amazing 25% of all species on earth are beetles. The darkling beetle is related to the well-known ladybug and firefly. The darkling beetle is found worldwide, but is more common in warm, dry climates. In nature, they are found under the bark of decaying logs and trees. They are also found in towns and cities, usually infesting flour, cereals and grains. Although they are not common in homes, they are often present in flour mills or barns where livestock feed is stored. Like all insects, the darkling beetle goes through a metamorphosis or change during its life cycle. Like all organisms that go through metamorphoses, the darkling beetle does not initially look like its parent organism. Its life cycle is a sequence of changes from egg to adult. The darkling beetle goes through the following four stages of development:

The egg. The eggs of the mealworm are too small to see with the naked eye. The hatching of these eggs marks the beginning of the larval stage.

The larva. Most of this insect 's life is spent in the larval or food finding stage. The larva stage of the darkling beetle is commonly known as the mealworm. Although it looks very much like a worm, it is not one. It is an immature darkling beetle in the larva stage. Several other organisms also go through a worm-like larva stages. For example, maggots are the larvae of flies, and caterpillars are the larvae of butterflies. Most animals have specialized structures that help them collect information about their environment. Humans use their senses of smell, touch, hearing, sight, and taste to perceive their surroundings. Mealworms have simple eyes that can sense changes in light brightness but cannot give the mealworm a clear picture of its surroundings. It seems mealworms mainly use their senses of touch to find their way around. They crawl with their legs and appear to sense an edge with both their legs and antennae. A mealworm 's survival depends on its finding sufficient food and hiding from predators. Its ability to assess its environment and move depends on its body form and the senses it possesses. Mealworms will shed their skin (molt)several times during the larval stage in order to grow larger. How often they molt depends on the temperature of their environment.

The pupa. During this stage the darkling beetle is relatively inactive and is going through the final change between larva and adult. Some insects ' pupa stage is spent in a cocoon, but this is not true of the mealworm. The pupa stage lasts about 1-3 weeks. The pupa is inactive but will move if touched. The head structure and other adult body parts can be seen developing.

The darkling beetle. As the pupa first changes into an adult darkling beetle it is beige in color. As it matures, it turns brown and then black. The beetles have wings which are protected by a hard covering. The adults mate and the female can lay about 500 eggs, which begin the life cycle of the next generation.

Earthworms-Background Information

Earthworms are members of the ringed animals or Annelida. There are approximately 1,800 species of earthworms worldwide. Some species are tiny; no more than 2 centimeters or 1 inch when fully grown. At the other end of the scale are giant earthworms in Australia that average 3 meters or 10 feet in length. The record holder for earthworms is found in South Africa. It measures 7 meters or 22 feet in length. Don't worry though. The largest earthworms or night crawlers in North America grow to about 30 centimeters or 13-15 inches.

Earthworms are fairly simple life forms. They are put together from a number of disk-like segments stuck together like a long flexible roll of Lifesavers™. Earthworms do not have an internal skeleton as we do, and they do not have a protective hard exoskeleton as does an insect. They are flexible, long bundles of muscle, especially designed for life underground. The characteristic wriggling of earthworms is done with two kinds of muscles. One set allows the earthworm to become thinner and longer while the other set enables it to become shorter and fatter. Earthworms can move very effectively in either direction, headfirst or tail first.

Earthworms have specialized structures that help them live very successfully in their environment. Instead of having lungs to pump oxygen, they have five sets of simple hearts. Their blood flows close to their outer surface, absorbing oxygen and releasing carbon dioxide through a thin skin. This is why worms leave the soil and crawl out on the sidewalks during a heavy rain...they are seeking oxygen.

Earthworms have a nervous system that controls their senses and detects vibrations, heat, cold, moisture, light and the presence of other worms. However, they have no brain, so earthworms do not ponder their lowly lot in life, nor do they plan out a strategy for obtaining their next meal or crossing the sidewalk safely.

Earthworms are pros at burrowing. They feed on decomposing organic material; mostly vegetation, from the surface of the soil and underneath the soil. As they burrow and feed, they process tons of soil and improve its quality for plants and other animals. So please be considerate of these valuable little animals. The next time you see them on a sidewalk after a rainstorm, help them back into the ground.

Science III&IV

Activities

Magnets/Electricity

How Many? How Far? How Thick?

Standard III:

Students will understand that magnetism can be observed when there is an interaction between the magnetic fields of magnets or between a magnet and materials made of iron.

Objective 1:

Investigate and compare the behavior of magnetism using magnets.

Intended Learning Outcomes:

3. Understand Science Concepts and Principles.

Content Connections:

Language Arts VIII-6, Writing for different purposes; Math II-1, Predictions with Whole Numbers; Math V-1, Calculate Mean; Math IV-2, Measure in centimeters

Science
Standard
III

Objective
1

Connections

Background Information

Students will conduct three related investigations concerning magnetic attraction and the relative strength of magnets in this activity. They will determine how many objects a magnet can hold and then determine if additional magnets will affect the overall magnetic force. Students will work with different kinds of magnets and find that magnetic force varies greatly among the varying types and is not necessarily related to the size of the magnet. Magnets are made of many different materials including iron and iron alloys. The force that a magnet exerts depends on many variables, including the condition of the magnet, the alignment of the magnetic domains that exist within it, its material make-up, etc. When magnets are combined, the magnets act as one magnet and will have an increase in force.

Students will also measure the distance a paper clip will move toward a magnet and then add magnets to see if the distance is affected. The distance that is observed represents the extent of the magnetic force; however, the magnetic force may extend beyond what is observed. Factors such as friction may affect the observations.

Students will finally investigate the effectiveness of magnetic force through materials of varying thicknesses. A magnet's force acts through space, and certain materials appear to be relatively transparent to a magnetic field.

Research Basis

Jacobs, Struan,. (2001). *Limits to problem solving in science*. EBSCO Publishing. Retrieved November 22, 2005, from <http://www.80web19.epnet.com.hal.weber.edu:2200/citation.asp?tb=1& ug=sid+2EC21087%...>

Lee, Kam-Wah, & Chin, Christine. (2000). *Science teachers and problem solving in elementary schools in singapore*. EBSCO Publishing. Retrieved December 12, 2005, from <http://www.80web19.epnet.com.hal.weber.edu:2200/citation.asp?tb=1& ug=sid+DC302EE2...>

Classroom environments that provide opportunities for small groups of children to work together to solve problems tend to foster the development of problem-solving skills. Students should be given problems to consider and through the process of problem solving, thinking skills can be developed. Even though research shows that students should have these opportunities, these strategies are not being used in the majority of elementary and secondary classrooms.

Invitation to Learn

Begin this activity by demonstrating the “flying” paper clip (Attach a paper clip to a 12-18 inch piece of fishing line and tape one end to the desk. Pass a high powered magnet near it and pull it upward); or the “floating” magnet (Place several disk magnets on a dowel or pencil so that each is repelled from the one next to it); or allow the students to play with an Etch-A-Sketch™ or a Magna Doodle™ or any other magnet-type game.

Instructional Procedures

This is a three-part discovery activity. The activities do not need to be completed in sequential order. The activity works better when completed with partners or in small groups of three to four; each person will record on their own paper.

Part I:

1. Have the students form a hook from a paper clip and then place it on the magnet. The magnetic force will hold the paper clip in place.
2. Using the *How Many? How Far? How Thick?* Observation Sheet, have students make predictions on how many paper clips the hook will hold before it falls from the magnet.
3. The students are now ready to follow directions from and make observations on their *How Many? How Far? How Thick?* Observation Sheet.

Materials

- Various magnets (domino, disk, horseshoe, donut)
- Paper clips
- Centimeter ruler
- Paper
- Cardboard
- Plastic
- Wood
- How Many? How Far? How Thick?* Observation Sheet



Part II:

4. Have the students place a paper clip at one end of a 20-centimeter line drawn on paper. Put a magnet at the other end.
5. Using the *How Many? How Far? How Thick?* Observation Sheet, have students make predictions on the distance at which a paper clip will be attracted to a magnet.
6. The students are now ready to follow directions from and make observations on the *How Many? How Far? How Thick?* Observation Sheet.

Part III:

7. Using the *How Many? How Far? How Thick?* Observation Sheet, have the students make predictions on the thickness through which magnetic force is observable using several different materials.
8. The students are now ready to follow directions from and make observations on the *How Many? How Far? How Thick?* Observation Sheet.
9. In all of the above activities, make sure sufficient time is given to allow the students to experiment with more than one magnet.
10. Time should also be given for students to record observations, thoughts and conclusions in their science journals.

Assessment Suggestions

- *The How Many? How Far? How Thick?* Observation Sheet may serve as the best assessment tool. The correctness of the students' observations will help evaluate student performance.
- Teacher observations during student investigations will also serve as an assessment tool.

Family Connections

- Have the students create a game of some kind using magnets. Bring the game back to school and have a magnet game sharing opportunity.

Additional Resources**Books**

Electricity & Magnetism, by Dr. John B. Beaver & Don Powers, Ph.D; ISBN 1-58037-222-8

Magnets & Electricity, by Karen Lee Siepak; Carson-Dellosa Publishing Co.

Web sites

http://www.exploratorium.edu/snack/charge_carry.html

<http://www.howstuffworks.com>

<http://www.entertainment.howstuffworks.com/magna-doodle>

How Many? How Far? How Thick? Observation Sheet

Part I: How Many?

1. Make a hook with one of the paper clips and hang it from one of the magnets.
Predict how many paper clips you think the magnet will hold before the clip falls off. Record this prediction on the table below.
2. Carefully place paper clips on the hook until the hook falls from the magnet. Record your data on the table below.
3. Repeat this three times making sure to record your data each time.
4. Repeat with two magnets, and then three. Make your predictions first, and then test the magnets three times and record your data in the table. You will average the numbers at the end of the experience.

How many clips will the magnet hold?

Predict the number of paper clips that the magnet(s) will hold.	1 magnet	2 magnets	3 magnets
First trial			
Second trial			
Third trial			
Average number			

5. You are now ready to explore the magnetic forces of other kinds of magnets by repeating the experiment above. Record your observations here:

6. Based on your observations, what conclusions can you make about the force exerted by the different magnet combinations? Did adding magnets make a significant difference in the number of paper clips the magnet could hold? Did the number of clips vary between one kind of magnet and another kind?

The Electrophorus and Static Discharge

Science
Standard
IV
Objective
1

Standard IV:

Students will understand features of static and current electricity.

Objective 1:

Describe the behavior of static electricity as observed in nature and everyday occurrences.

Intended Learning Outcomes:

3. Understand Science Concepts and Principles.

Content Connections:

Language Arts Standard VIII-6, Writing for different purposes.

Connections

Background Information

Electrostatic refers to electric charges confined to an object and is called “static electricity.” Static charges are created by friction between two or more objects or materials and can be generated through various means using friction.

There are several kinds of electrostatic generators, including an electrophorus, which is the simplest to set up and use in a classroom. Rubbing the Styrofoam™ plate with the woolen cloth causes the Styrofoam™ to become charged with electrons (- charge) at the surface. Since Styrofoam™ is an insulator, it cannot transfer its electrons to another material. When the aluminum pie pan is placed on the Styrofoam™, a charge is produced in the pie pan. Since aluminum is a good conductor, the negative charge at the surface of the Styrofoam™ plate causes the electrons in the pie pan to move away from the Styrofoam™ up to the edge of the pie pan. As your finger comes close to the edge of the pie pan as it sits on the Styrofoam™, you will see a charge jump the space between the pie pan and your finger as the electrons are repelled toward Earth, or grounded. When the pie pan is lifted off the Styrofoam™ using the insulating handle (Styrofoam™ cup) and your finger is once again brought near the pie pan edge, a second charge may be seen as the electrons return through the air from your finger to the aluminum pie pan. This can be repeated over and over again without much electrical charge loss from the Styrofoam™ plate. Students may think that materials that lose electrons have lost them permanently. The electrophorus demonstrates how electrons are not lost, but are transferred from one conductor to another.

After students have experimented with the discharge of electrons from and to the pie pan, they are asked to attach a sewing needle to the edge of the pie pan, pointed side out. The needle acts as a lightning

rod. Sharp-pointed conductors, such as lightning rods, when attached to a building’s highest point, allow electrons to escape from the building’s outer surfaces to the sky, instead of through the building. The needle on the pie pan keeps the pie pan from building up an observable charge.

Research Basis

Burns, Marilyn. (2005). Looking at how students reason. *Educational leadership*, Volume 63.3, pp. 26-35.

Marianne Barnes, & Kathleen Foley (1999). Inquiring into three approaches to hands-on science in elementary and secondary science methods courses. *Ebsco publishing*. Retrieved January 14, 2006, from <http://www.unr.edu/homepage/crowther/ejse/barnesfoley.html>

All students need to learn scientific skills, such as observation and analysis. Active, student-centered inquiry, in which students learn to apply scientific problem solving, should be at the core of science education. Learning through well-planned activities and experiences promotes cause and effect thinking and the questioning of observed events and resulting data.

Invitation to Learn

Begin the activity by giving each student a Static Starter Kit (salt and pepper mixed, a plastic spoon and a piece of woolen fabric). Ask the students to carefully dump the salt and pepper mixture onto their desk top. Without mentioning the word “static,” give them the challenge to use the other items in the kit to separate the salt from the pepper. They CANNOT touch the salt or the pepper with anything to accomplish this task. (Teacher hint: By quickly rubbing the bowl of the spoon with the woolen fabric and then passing the spoon just above the salt/pepper mixture, the static created will cause the pepper to jump onto the bowl of the spoon.)

Instructional Procedures:

1. Have students secure the Styrofoam™ plate upside down on their desk with tape.
2. Have students tape the Styrofoam™ cup to the inside of the aluminum pie pan making an insulating handle for the pie pan.
3. Have students rapidly rub the Styrofoam™ plate with the piece of woolen cloth. Make sure they do not touch the plate with their hand as they are rubbing it. This process may take up to a minute.

Materials

- Styrofoam™ plate
- Aluminum pie pan
- Styrofoam™ cup
- Masking tape
- Woolen fabric
- Sewing needle
- Electrophorus Observation Sheet*
- Various materials (plastic, cardboard, cookie sheets, etc.)
- Various materials (felt, cotton, animal fur, etc.)
- Various materials (tooth picks, paper clips, drinking straws)
- Static Starter Kit



4. Holding on to the Styrofoam™ cup handle, have students carefully place the aluminum pie pan on the Styrofoam™ plate.
5. They are now ready to follow directions from and make observations on their *Electrophorus Observation Sheet*.
6. After completing the first part of the *Electrophorus Observation Sheet*, have students attach a sewing needle to the edge of the aluminum pie pan using masking tape. Make sure that the sharp edge of their needle is pointing out and that it sticks out further than the edge of the pie pan.
7. Rub the Styrofoam™ plate with the woolen cloth and repeat the same steps as before. Have your students make observations on the second half of the *Electrophorus Observation Sheet*.
8. Record their conclusions in a science journal or notebook.

Assessment Suggestions

- The *Electrophorus Observation Sheet* will serve as the best assessment tool. The assembly of the electrophorus and the correctness of the students' observations will help evaluate student performance.
- The students may discuss the activity in groups. Group consensus may serve as another way to evaluate student performance.

Curriculum Extensions/Adaptations/Integration

- Have other materials available for the students to experiment with in replacing the Styrofoam™ plate. Will other materials allow the experiment to work? Will some work better than the Styrofoam™ plate? Suggestions are several types of plastic, cardboard, metal cookie sheets. The students can also experiment with fabrics that can replace the woolen fabric and also other materials to replace the sewing needle.

Family Connections

- Have the students go on a “Static Scavenger Hunt” at home looking for as many examples as they can find of static electricity.

- Have students go to the gas station and look at the Static Warning signs on gas pumps and then come back to class and discuss it.

Additional Resources

Books

Electricity & Magnetism, by Dr. John B. Beaver & Don Powers, Ph.D; ISBN 1-58037-222-8

Magnets & Electricity, by Karen Llee Siepak,; Carson-Dellosa Publishing Co.

Web sites

http://www.exploratorium.edu/snack/charge_carry.html

<http://www.worsleyschool.net/science/files/static/electricity.html>

http://www.exo.net/~pauld/summer_institute/summer_day14electrostatic/Electrophorus.html

PART II:

- G. Predict what you think will happen when you attach a sewing needle to the edge of the aluminum pan and then bring your finger near the edge of the pan as it sits on the Styrofoam™ plate.
- H. Use a piece of masking tape and attach a sewing needle to the edge of the aluminum pie pan with the sharp end pointing out. Rub the Styrofoam™ plate with the woolen cloth and touch the edge of the pan with your finger. Record your observations.
- I. Raise the aluminum pie pan as before and touch the edge with your finger. Record your observations.
- J. Now, it is time to investigate your ideas. Record what you tried and what you observed. SUGGESTIONS: Can you touch the pie pan several times before raising it and get the same results as before? How high can you raise the pan or how far away can you take the pan? Can you substitute other materials for the Styrofoam™ plate, for the woolen cloth or for the sewing needle?
- K. Record your conclusions in your science journal.
1. Draw a diagram of the electrophorus you made.
 2. Explain what you think was happening when you touched the aluminum pan on the plate and then touched it again when it was raised.
 3. Explain the addition of the sewing needle and how it affected the experiment.
 4. Explain the importance of the Styrofoam™ cup handle.
 5. Explain your reactions to the experiment.

Circuit City

Science Standard

IV

Objective

2

Connections

Standard IV:

Students will understand features of static and current electricity.

Objective 2:

Analyze the behavior of current electricity.

Intended Learning Outcomes:

3. Understand Science Concepts and Principles.

Background Information

The lives of most children are affected more directly by electricity and its applications than by just about anything else they learn about and investigate in elementary science. Simple circuits are the basic tools for investigating electricity at the primary level, and their basic properties need to be understood before attempting to use them to explore further. Students should have investigated making circuits, adding components to a circuit (such as switches, batteries and additional bulbs) and conductors and insulators. This activity would be best used as a culminating activity after these investigations have been conducted.

Research Basis

Jorgenson, Olaf, (2005). What k-8 principals should know about hands-on science...it can be messy and noisy, but students learn science best when they do it themselves. *Principal-effective intervention- special edition*, Volume 85 (Number 2), Pages 49-52.

Haury, David L., & Rillero, Peter. (1997). Perspectives of hands-on science teaching. *Eric clearinghouse for science*. Retrieved January 14, 2006, from <http://www.ncrel.org/sdrs/areas/issues/content/cntareas/science/eric/eric2.htm>

The importance of providing children with direct experience with materials, objects, and phenomena is widely supported. While information can be remembered if taught through books and lectures, true understanding and the ability to use knowledge comes when students are given hands-on learning opportunities.

Invitation to Learn

Give the students an Emergency Flashlight Kit: a brown bag with the following items: three Hershey Kisses™ (or a candy bar wrapped in foil...beware, some are now wrapped in paper treated with silver, but are not foil), a pencil, a piece of woolen cloth, a D-cell battery, a toothpick, and a small bulb. Tell the students they must make an emergency flashlight using only the items in the bag.

Instructional Procedures

This activity is meant to be a culminating activity or even a performance assessment. DO NOT use this activity until the students understand and can make a simple circuit with a switch.

Working in groups of four to six, the students are going to design a subdivision, with each student making their own property with a house containing one light source and another outside light source. The neighborhood will also include one commercial-type building of their choice with two light sources.

1. Have the students meet together to decide on the placement of their properties and what commercial building they are going to make. Then have each student draw up the circuit diagram for their individual property.
2. Give each student a piece of foam board or cardboard to use as his or her property. This works best if each of the individual pieces has been cut from a larger piece so that they fit back together nicely. Make sure that one extra piece is reserved for the commercial building.
3. Have the students each save two milk cartons from the cafeteria. One will be used for the house and the other as a cover for the power source. The group will also need a *small* cardboard box for their commercial building.
4. Give each student two bulbs and two D-size batteries for their power source.
5. Have lots of insulated wire, wire cutter/strippers, and electrical tape available for making circuits. They will also need to make a switch using two brads and a paper clip attached to a small piece of oak tag or cardboard.
6. Have art supplies available for making their properties attractive (construction paper to cover the milk cartons, craft sticks for fences, Spanish moss for bushes, etc.).
7. The students will then proceed to put a light through the bottom of their milk carton house, place the house on the board and run the wires underneath the board to complete the simple circuit. The power source should be placed near the switch and then covered with the other milk carton (cut the top part off and turn it over). The outside light source can be a lamppost (flexible drinking straws work well for this) or any other creative use of outside lighting (a porch light, light inside a hot tub, on a sport court, etc.).

Materials

- Emergency Flashlight Kit (three Hershey Kisses™, a pencil, a piece of woolen cloth, a D battery, a small bulb and a toothpick)
- Foam board or cardboard
- Insulated wire
- Wire cutters/strippers
- Electrical tape
- Small bulbs (Christmas lights cut up)
- D-cell batteries
- Milk cartons
- Electrical switches (two brads, paper clip on a small square of oak tag)
- Art supplies



8. Once the students have completed their own properties, they make the commercial property and run the circuitry for two light sources.
9. Once everyone has their subdivisions complete and put together, turn off the lights in your classroom and have the official “lighting” ceremony.

Assessment Suggestions

- The best assessment for this activity is to see that each student has successfully made the simple circuit for two light sources on their property.
- The circuit drawing made by the student can also serve as an assessment tool.

Curriculum Extensions/Adaptations/Integration

- An alternative activity that uses students making simple circuits is a quiz board. The students can make simple quiz boards by punching equal numbers of holes down both sides of oak tag. The students then make up matching questions, such as states and capitals, amendments and their numbers, and presidents and fun facts. Write the information in two columns. The next step is to run a thin strip of aluminum foil on the back side of the oak tag from one side to the other making sure that they match up to correct information. The aluminum foil strip is completely covered using adhesive tape. Make sure there is no aluminum foil left uncovered so that it will not short circuit with another strip. Also, make sure that the aluminum foil completely covers the small holes. Repeat this process as many times as necessary to complete the quiz board. The students then make the “tester” by connecting materials in this order: wire to battery, battery to second wire, second wire to bulb, and then bulb to third wire. Strip the ends of the outside wires and use them to touch the small aluminum circles on the front side of the quiz board. If the information is correct, the circuit will be complete and the light will go on. Have the students check their board by testing all the answers themselves. If everything has been done correctly, they then staple a second sheet of oak tag to the back of their boards so no one can see the “answers.” They can exchange boards with other classmates. This is a great

way to test their knowledge of circuits, as well as a review for other curriculum facts.

Family Connections

- Invite parents in to see the subdivisions, or include it as part of another parent night activity or conferences.
- Allow the students to take home their quiz boards and testers and let a parent try to match up the correct information.
- Give the students a supply bag with a bulb, a battery and several feet of insulated wire. Have the students create a game at home using a simple circuit. Have them bring the game to school for a game sharing activity.

Additional Resources

Books

200 Science Investigations for Young Students, by Martin Wenham; ISBN 0-7619-6349-9

Hands–On Physical Science Activities for Grades K-8, by Marvin N. Tolman; ISBN-0-13-230178-4

Electricity and Magnetism, by Dr. John B. Beaver & Don Powers, Ph.D.; ISBN 1-58037-222-8

Web sites

<http://www.andythelwell.com>

<http://www.worsleyschool.net/science/files/steady/hand.html>

Appendix

<p>STATION 3: Light and Touch Response</p> <p>Predict how you think the mealworms will respond to light stimulus and to being touched with the chenille stem. Why do you think this?</p> <p>Shine the flashlight into the box. See if the mealworm will stay in the light or to the dark part of the box. Record your observations.</p> <p>Now touch the mealworms with the rounded end of the chenille stem. How did the mealworms react? Record your observations.</p> <p>How do you know which end of the mealworm is its head? Record how you know.</p> <p>Is this behavior learned or instinctual? (<i>Circle one</i>)</p>	<p>STATION 4: Light and Touch Response</p> <p>Predict how you think the earthworm will respond to light stimulus and to being touched with the chenille stem. Why do you think this?</p> <p>Shine the flashlight into the box. See if the earthworm will stay in the light or to the dark part of the box. Record your observations.</p> <p>Now touch the earthworm with the rounded end of the chenille stem. How did the earthworms react? Record your observations.</p> <p>How do you know which end of the earthworm is its head? Record how you know.</p> <p>Is this behavior learned or instinctual? (<i>Circle one</i>)</p>
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STATION 9: Temperature Stimulus

Predict whether the mealworms will prefer a cold or hot temperature. Write why you think this.

Place the mealworms on the warm area.
Record your observations.

Now place it on the cold side. Again, record your observations.

Which temperature did the mealworm prefer?

Why do you think this is so?

Is this behavior learned or instinctual? (*Circle one*)

STATION 10: Temperature Stimulus

Predict whether the earthworm will prefer a cold or hot temperature. Write why you think this.

Place the earthworm on the warm area.
Record your observations.

Now place it on the cold side. Again, record your observations.

Which temperature did the earthworm prefer?

Why do you think this is so?

Is this behavior learned or instinctual? (*Circle one*)

PART II:

- G. Predict what you think will happen when you attach a sewing needle to the edge of the aluminum pan and then bring your finger near the edge of the pan as it sits on the Styrofoam™ plate.
- H. Use a piece of masking tape and attach a sewing needle to the edge of the aluminum pie pan with the sharp end pointing out. Rub the Styrofoam™ plate with the woolen cloth and touch the edge of the pan with your finger. Record your observations.
- I. Raise the aluminum pie pan as before and touch the edge with your finger. Record your observations.
- J. Now, it is time to investigate your ideas. Record what you tried and what you observed. SUGGESTIONS: Can you touch the pie pan several times before raising it and get the same results as before? How high can you raise the pan or how far away can you take the pan? Can you substitute other materials for the Styrofoam™ plate, for the woolen cloth or for the sewing needle?
- K. Record your conclusions in your science journal.
1. Draw a diagram of the electrophorus you made.
 2. Explain what you think was happening when you touched the aluminum pan on the plate and then touched it again when it was raised.
 3. Explain the addition of the sewing needle and how it affected the experiment.
 4. Explain the importance of the Styrofoam™ cup handle.
 5. Explain your reactions to the experiment.

What a Reaction

Predict what you think will happen when a seltzer tablet and water are combined in a balloon? Do you think the combined mass of the objects will be the same or different? Explain your prediction. Will this experiment support the “Law of Conservation of Matter?”

Collect the items from the table that you will need to perform this experiment: one balloon, string, one seltzer tablet, one vial with lid, a small cup of water, and a balance scale. Return with these items to your group and perform the out-lined activity.

To begin your experiment you will first need to get the weight of the seltzer tablet, balloon, string, water, and vial with lid.

1. Make sure that your balance is working correctly.	Weight
2. Break your seltzer tablet into four small pieces. Place these pieces in your balloon. Place the balloon on the balance scale along with your piece of string and record the weight.	2.
3. Place your vial and lid on the balance scale. Record their weight.	3.
4. Fill the vial with water to the mark indicated and weigh it again. Subtract the weight of the vial and lid from the weight of the vial with water and lid to get the weight of the water. Place this weight in column four.	Weight of vial, lid and water minus the weight of vial and lid. Place the difference on line four. _____ - _____ = _____ Lid, vial, and water – vial and lid 4.
5. Now pour the water from the vial into the balloon. Hold the balloon tightly around the vial while a partner ties the string around the balloon. Remove the vial. Watch and feel what happens to the balloon and record your observations in column five.	

6. Place the balloon on the scale and measure the weight of the balloon.	Place the weight of the balloon on six. 6.
7. Add the weight of the water to the weight of the balloon, string and seltzer tablet. Record this on line seven	$\underline{\hspace{2cm}} + \underline{\hspace{2cm}} = \underline{\hspace{2cm}}$ Total of line two + line four 7. Total of line two, and four. $\underline{\hspace{2cm}}$
8. Does your balloon weigh the same as the sum of numbers two and four? Yes or No. Explain your answer in column eight.	8.
9. What might explain any changes in weight? Record your answer in column nine.	9.
10. What law was demonstrated with this experiment?	10.

11. Did you prediction match the outcome of your experiment? Explain

12. What is the “Law of Conservation of Matter” and how did your experiment prove this law.

13. Reflection, tell about what you did and what you learned from this experiment.

Hot Shapes Activity Sheet

Predict what you think will happen when this mysterious powder and water are mixed together?

Record the weight of all the individual ingredients. Add all individual weights for a total.

- 1 cup of mystery powder in baggie
- ½ cup water
- bowl for mixing

Weigh mystery powder and baggie _____

Weigh bowl with ½ cup water _____

Total _____

Make and record observation of what the mysterious powder looks like and take a temperature reading.

Students Will:	Record Temperature	Observations
Record temperature of powder		
Mix water with mysterious powder in bowl for at least 3 minutes or until mixture becomes thick. Wait about 20 minutes		
Pour mixture in baggie, mold into desired shape tape thermometer on baggie		
Record temperature and write observations every 2 minutes		
2 minutes (4 minutes total)		
2 minutes (6 minutes total)		
2 minutes (8 minutes total)		
2 minutes (10 minutes total)		
2 minutes (12 minutes total)		
2 minutes (14 minutes total)		

Graph the time and temperature on graph paper. (Time on X axis and temperature on Y axis)

Put the “Hot Sculpture” with the bowl back in the scales and weigh. Compare your beginning weight and you ending weight. Did it change or was it about the same? Explain your answer.

Tell what the temperature did. Relate the temperature to the hardness of the mixture.

What kind of a change do you have? Physical or Chemical? Explain you reasoning.

What Can My Blobber Do?

1. Use a meter stick and see how high your Blobber bounces when dropped from different heights. Record your data.

Drop Blobber from 150 cm	Drop Blobber from 100 cm	Drop Blobber from 50 cm

2. Roll your Blobber into a ball and set it on you desk. Watch what happens to your Blobber over a four minutes period.

1 minute	2 minutes	3 minutes	4 minutes

3. Does your Blobber keep its shape or does it start to flatten out? What do you think is happening?

4. Roll your Blobber into a ball again. Use a paperclip to make an imprint in it. How long does your imprint last? What happened and why?

5. Roll your Blobber into a rope and stretch it until it breaks. Record how long your Blobber was when it broke.

10 cm	20cm	30cm	40cm

6. What conclusions can you draw from the stretch test?

7. Write a secret message on a white piece of paper with a number two pencil. Write over this message once more to make it dark. Press your Blobber over the message and see what happens. Why do you think this happens?

Comparing Different Recipes

Collect and record your data from each recipe.	Yellow Recipe	Red Recipe	Blue Recipe
Bounce Test			
Roll Blobber into a ball. How long does it stay in a ball?			
Roll Blobber into a ball again. This time press a paper clip into the ball. How long does the imprint last?			
Which Blobber stretches the best?			
Print transfer test with secret message.			

Which recipe would you use for your product? Why?

Blobber Ad

**Design a newspaper or magazine ad that you would use to sell your product.
Use the properties of Blobber in your ad to get the audience excited about buying your product.**

Blobber Ad

**Design a newspaper or magazine ad that you would use to sell your product.
Use the properties of Blobber in your ad to get the audience excited about buying your product.**

Name _____

Animal Variations Chart

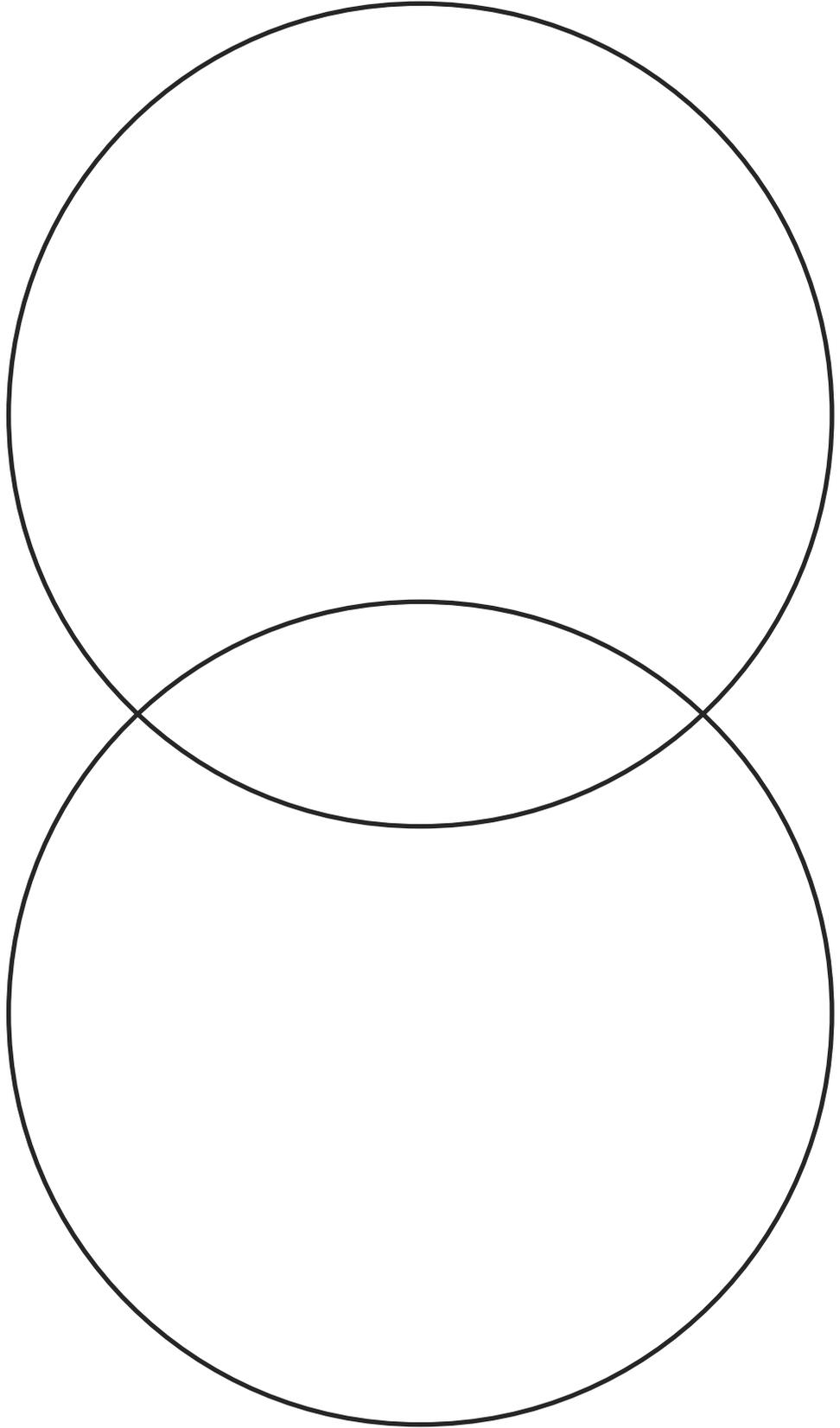
Animal Name	Range (Where it lives)	Habitat
Size	Food Source	Outstanding physical features that allow this animal to survive in its environment.
Societal Group		

Name _____

Venn Diagram for Comparing and Contrasting Animals

Animal #1

Animal #2



How Many? How Far? How Thick?

Observation Sheet

Part I: How Many?

1. Make a hook with one of the paper clips and hang it from one of the magnets.
Predict how many paper clips you think the magnet will hold before the clip falls off. Record this prediction on the table below.
2. Carefully place paper clips on the hook until the hook falls from the magnet. Record your data on the table below.
3. Repeat this three times making sure to record your data each time.
4. Repeat with two magnets, and then three. Make your predictions first, and then test the magnets three times and record your data in the table. You will average the numbers at the end of the experience.

How many clips will the magnet hold?

Predict the number of paper clips that the magnet(s) will hold.	1 magnet	2 magnets	3 magnets
First trial			
Second trial			
Third trial			
Average number			

5. You are now ready to explore the magnetic forces of other kinds of magnets by repeating the experiment above. Record your observations here:

6. Based on your observations, what conclusions can you make about the force exerted by the different magnet combinations? Did adding magnets make a significant difference in the number of paper clips the magnet could hold? Did the number of clips vary between one kind of magnet and another kind?

Part III: How Thick?

1. Place a paper clip on one sheet of each material (paper, cardboard, wood) to see if a magnet held under the sheet will attract the paper clip.
2. Predict the thickness (3 sheets, 15 sheets, 25 sheets, etc.) through which the magnetic force will work. Record this prediction on the table below.
3. You will now test your prediction by adding sheets of the material, placing the paper clip on top and watching for the magnetic attraction from below.
4. Repeat with two other materials. Make your predictions first, and then test each material. Record your data on the table.

How thick will it be?

	Prediction of thickness	Actual thickness
1st material tested:		
2nd material tested:		
3rd material tested:		

5. You are now ready to explore the magnetic forces of other kinds of magnets by repeating the experiment above. Record your observations here:

6. Based on your observations, what conclusions can you make about the magnetic force of different magnet combinations.