ELEMENTARY
CORE Academy
UTAH STATE OFFICE OF EDUCATION & UTAH STATE UNIVERSITY

Participant Handbook

ELEMENTARY CORE ACADEMY • ELEMENTARY CORE ACADEMY • ELEM

4TH GRADE

2007

UTAH STATE OFFICE OF EDUCATION

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Organizations:

Utah State Office of Education (USOE)
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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

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

Funding Sources

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

District Funds:

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

School Funds:

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Utah State Office of Education Special Education Services

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Additionally, numerous school districts, individual schools, and principals in Utah have sponsored teachers to attend the Academy. Other educational groups 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 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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Introduction

Most children enter school confident in their own abilities; they are curious and eager to learn more. They make sense of the world by reasoning and problem solving. Young students are building beliefs about what mathematics is, about what it means to know and do mathematics, and about themselves as mathematical learners. Students use mathematical tools, such as manipulative materials and technology, to develop conceptual understanding and solve problems as they do mathematics. Students, as mathematicians, learn best through participatory experiences throughout the instruction of the mathematics curriculum.

- Mathematics instruction needs to include more than short-term learning of rote procedures.

Recognizing that no term captures completely all aspects of expertise, competence, knowledge, and facility in mathematics, the term *mathematical proficiency* has been chosen to capture what it means to learn mathematics successfully. Mathematical proficiency has five strands: computing (carrying out mathematical procedures flexibly, accurately, efficiently, and appropriately), understanding (comprehending mathematical concepts, operations, and relations), applying (ability to formulate, represent, and solve mathematical problems), reasoning (logically explaining and justifying a solution to a problem), and engaging (seeing mathematics as sensible, useful, and doable, and being able to do the work) (NRC, 2001).

The most important observation about the five strands of mathematical proficiency is that they are interwoven and interdependent. This observation has implications for how students acquire mathematical proficiency, how teachers develop that proficiency in their students, and how teachers are educated to achieve that goal. At any given moment during a mathematics lesson or unit, one or two strands might be emphasized. But all the strands must eventually be addressed so that the links among them are strengthened. The integrated and balanced development of all five strands of mathematical proficiency should guide the teaching and learning of school mathematics. Instruction should not be based on the extreme positions that students learn solely by internalizing what a teacher or book says, or solely by inventing mathematics on their own.

The Elementary Mathematics 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 and revised by a community of Utah mathematics teachers, mathematicians, university mathematics educators, and

State Office of Education specialists. It was critiqued by an advisory committee representing a wide variety of people from the community, as well as an external review committee. The Core reflects the current philosophy of mathematics education that is expressed in national documents developed by the National Council of Teachers of Mathematics, the American Association for the Advancement of Science, and the National Research Council. This Mathematics Core has the endorsement of the Utah Council of Teachers of Mathematics. The Core reflects high standards of achievement in mathematics for all students.

Organization of the Elementary Mathematics Core

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

- Each grade level begins with a brief description of areas of instructional emphasis which can serve as organizing structures for curriculum design and instruction.
- The INTENDED LEARNING OUTCOMES (ILOs) describe the skills and attitudes students should acquire as a result of successful mathematics instruction. They are found at the beginning of each grade level and are an integral part of the Core.
- 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 have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- INDICATORS are observable or measurable student actions that enable students to master an Objective. Indicators can help guide classroom instruction.
- MATHEMATICAL LANGUAGE AND SYMBOLS STUDENTS SHOULD USE includes language and symbols students should use in oral and written language.
- EXPLORATORY CONCEPTS AND SKILLS are included to establish connections with learning in subsequent grade levels. They are not intended to be assessed at the grade level indicated.

Intended Learning Outcomes for Third through Sixth Grade Mathematics

The main intent of mathematics instruction is for students to value and use mathematics and reasoning skills to investigate and understand the world.

The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should acquire as a result of successful mathematics instruction. They are an essential part of the Mathematics Core Curriculum and provide teachers with a standard for student learning in mathematics.

- ILOs describe the skills and attitudes students should learn as a result of mathematics instruction.

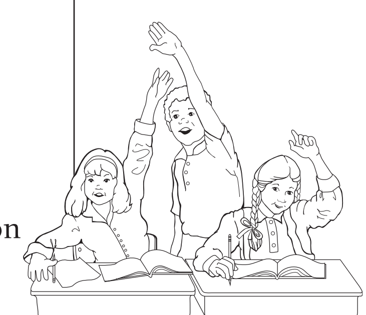
ILOs for mathematics:

1. **Develop a positive learning attitude toward mathematics.**
2. **Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.**
3. **Reason logically, using inductive and deductive strategies and justify conclusions.**
4. **Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.**
5. **Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.**
6. **Represent mathematical ideas in a variety of ways.**

Significant mathematics understanding occurs when teachers incorporate ILOs in planning mathematics instruction. The following are ideas to consider when planning instruction for students to acquire the ILOs:

1. **Develop a positive learning attitude toward mathematics.**

   When students are confident in their mathematical abilities, they demonstrate persistence in completing tasks. They pose mathematical questions about objects, events, and processes while displaying a sense of curiosity about numbers and patterns. It is important to build on students' innate problem-solving inclinations and to preserve and encourage a disposition that values mathematics.



2. **Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.**

Problem solving is the cornerstone of mathematics. Mathematical knowledge is generated through problem solving as students explore mathematics. To become effective problem solvers, students need many opportunities to formulate questions and model problem situations in a variety of ways. They should generalize mathematical relationships and solve problems in both mathematical and everyday contexts.

3. **Reason logically, using inductive and deductive strategies and justify conclusions.**

   Mathematical reasoning develops in classrooms where students are encouraged to put forth their own ideas for examination. Students develop their reasoning skills by making and testing mathematical conjectures, drawing logical conclusions, and justifying their thinking in developmentally appropriate ways. Students use models, known facts, and relationships to explain reasoning. As they advance through the grades, students' arguments become more sophisticated.

4. **Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.**

   The ability to express mathematical ideas coherently to peers, teachers, and others through oral and written language is an important skill in mathematics. Students develop this skill and deepen their understanding of mathematics when they use accurate mathematical language to talk and write about what they are doing. When students talk and write about mathematics, they clarify their ideas and learn how to make convincing arguments and represent mathematical ideas verbally, pictorially, and symbolically.

5. **Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.**

   Students develop a perspective of the mathematics field as an integrated whole by understanding connections within mathematics. Students should be encouraged to explore the connections that exist with other disciplines and between mathematics and their own experiences.

6. **Represent mathematical ideas in a variety of ways.**

   Mathematics involves using various types of representations including concrete, pictorial, and symbolic models. In particular, identifying and locating numbers on the number line has a central role in uniting all numbers to promote understanding of equivalent representations and ordering. Students also use a variety of mathematical representations to expand their capacity to think logically about mathematics.

Fourth Grade Mathematics Core Curriculum

By the end of grade four, students develop quick recall of the basic multiplication facts and related division facts. They develop fluency with efficient procedures for multiplying multidigit whole numbers, understand why the procedures work, and use them to solve problems. Students recognize decimal notation as an extension of the base-ten system. They relate their understanding of fractions to decimals. They generate equivalent fractions, simplify fractions, and identify equivalent fractions and decimals; compare and order whole numbers, simple fractions, and decimals to hundredths; and estimate decimal or fractional amounts in problem solving.

Students use transformations, including those that produce line and rotational symmetry. Students understand area as a measurable attribute of two-dimensional regions. They select appropriate units, strategies, and tools for solving problems that involve measuring area. They connect area measure to the area model for multiplication as a way to justify the formula for the area of a rectangle.

Standard I:
Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.

Standard I: **Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.**

Objective 1: Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

a. Read and write numbers in standard and expanded form.

b. Demonstrate multiple ways to represent whole numbers and decimals by using models and symbolic representations (e.g., 36 is the same as the square of six, three dozen, or 9 x 4).

c. Identify the place and the value of a given digit in a six-digit numeral, including decimals to hundredths, and round to the nearest tenth.

d. Divide regions, lengths, and sets of objects into equal parts using a variety of models and illustrations.

e. Name and write a fraction to represent a portion of a unit whole, length, or set for halves, thirds, fourths, fifths, sixths, eighths, and tenths.

f. Identify and represent square numbers using models and symbols.

Objective 2: Analyze relationships among whole numbers, commonly used fractions, and decimals to hundredths.

a. Compare the relative size of numbers (e.g., 475 is comparable to 500; 475 is small compared to 10,000 but large compared to 98).

b. Order whole numbers up to six digits, simple fractions, and decimals using a variety of methods (e.g., number line, fraction pieces) and use the symbols <, >, and = to record the relationships.

c. Identify a number that is between two given numbers (e.g., 3.2 is between 3 and 4; find a number between 0.1 and 0.2).

d. Identify equivalences between fractions and decimals by connecting models to symbols.

e. Generate equivalent fractions and simplify fractions using models, pictures, and symbols.

Objective 3: Model and illustrate meanings of multiplication and division of whole numbers and the addition and subtraction of fractions.

a. Model multiplication (e.g., equal-sized groups, rectangular arrays, area models, equal intervals on the number line), place value, and properties of operations to represent multiplication of a one- or two-digit factor by a two-digit factor and connect the representation to an algorithm.

b. Use rectangular arrays to interpret factoring (e.g., find all rectangular arrays of 36 tiles and relate the dimensions of the arrays to factors of 36).

c. Demonstrate the mathematical relationship between multiplication and division (e.g., 3 x   = 12 is the same as 12 ÷ 3 =   and   = 4) and use that relationship to explain that division by zero is not possible.

d. Represent division of a three-digit dividend by a one-digit divisor, including whole number remainders, using a variety of methods (e.g., rectangular arrays, manipulatives, pictures), and connect the representation to an algorithm.

e. Use models to add and subtract simple fractions where one single-digit denominator is 1, 2, or 3 times the other (e.g., 2/4 + 1/4; 3/4 - 1/8).

Objective 4: Solve problems involving multiplication and division of whole numbers and addition and subtraction of simple fractions and decimals.

a. Use estimation, mental math, paper and pencil, and calculators to perform mathematical calculations and identify when to use each one appropriately.

b. Select appropriate methods to solve a single operation problem and estimate computational results or calculate them directly, depending on the context and numbers involved in a problem.

c. Write a story problem that relates to a given multiplication or division equation, and select and write a number sentence to solve a problem related to the environment.

d. Solve problems involving simple fractions and interpret the meaning of the solution (e.g., A pie has been divided into six pieces and one piece is already gone. How much of the whole pie is there when Mary comes in? If Mary takes two pieces, how much of the whole pie has she taken? How much of the pie is left?)

Objective 5: Compute problems involving multiplication and division of whole numbers and addition and subtraction of simple fractions and decimals.

a. Demonstrate quick recall of basic multiplication and division facts.

b. Multiply up to a three- digit factor by a two-digit factor with fluency, using efficient procedures.

c. Divide up to a three-digit dividend by a one-digit divisor with fluency, using efficient procedures.

d. Add and subtract decimals and simple fractions where one single-digit denominator is 1, 2, or 3 times the other (e.g., $2/4 + 1/4 = 3/4$; $1/3 - 1/6 = 1/6$).

Mathematical language and symbols students should use:
sum, difference, expanded form, standard form, square number, dividend, divisor, quotient, factor, product, array, multiple, numerator, denominator, sixths, eighths, tenths, equivalent, estimate, $<$, $>$, $=$, $\neq$

Exploratory Concepts and Skills
- Use concrete objects and visual models to add and subtract common decimals.
- Explore numbers less than zero by extending the number line and by using familiar applications such as temperature.
- Investigate the concept of ratio (e.g., the number of students to the number of teachers).

Standard II:
Students will use patterns and relations to represent mathematical problems and number relationships.

Standard II: Students will use patterns and relations to represent mathematical problems and number relationships.

Objective 1: Identify, analyze, and determine rules for describing numerical patterns involving operations and nonnumerical growing patterns.

a. Analyze growing patterns using objects, pictures, numbers, and tables to determine a rule for the pattern.
b. Recognize, represent, and extend simple patterns involving multiples and other number patterns (e.g., square numbers) using objects, pictures, numbers, and tables.
c. Identify simple relationships in real-life contexts and use mathematical operations to describe the pattern (e.g., the number of legs on a given number of chairs may be determined by counting by fours or by multiplying the number of chairs by 4).

Objective 2: Use algebraic expressions, symbols, and properties of the operations to represent, simplify, and solve mathematical equations and inequalities.

a. Use the order of operations to evaluate, simplify, and compare mathematical expressions involving the four operations, parentheses, and the symbols $<$, $>$, and $=$ (e.g., $2x (4 - 1) + 3$; of the two quantities $7 - (3 - 2)$ or $(7 - 3) - 2$, which is greater?).
b. Express single-operation problem situations as equations and solve the equation.
c. Recognize that a symbol represents the same number throughout an equation or expression (e.g., $\Delta + \Delta = 8$; thus, $\Delta = 4$).
d. Describe and use the commutative, associative, distributive, and identity properties of addition and multiplication, and the zero property of multiplication.

Mathematical language and symbols students should use:
growing pattern, order of operations, parentheses, inequality, expression, equation, associative property, commutative property, distributive property, zero property of multiplication, $>$, $<$, $=$

Exploratory Concepts and Skills
- Use concrete materials to build an understanding of equality and inequality.
- Explore properties of equality in number sentences (e.g., when equals are added to equals, then the sums are equal; when equals are multiplied by equals, then the products are equal).

Standard III: Students will understand attributes and properties of plane geometric objects and spatial relationships.

Objective 1: Identify and describe attributes of two-dimensional geometric shapes.

a. Name and describe lines that are parallel, perpendicular, and intersecting.
b. Identify and describe right, acute, obtuse, and straight angles.
c. Identify and describe the radius and diameter of a circle.
d. Identify and describe figures that have line symmetry and rotational symmetry.

Objective 2: Specify locations using grids and maps.

a. Locate coordinates in the first quadrant of a coordinate grid.
b. Give the coordinates in the first quadrant of a coordinate grid.
c. Locate regions on a map of Utah.
d. Give the regions of a position on a map of Utah.

Objective 3: Visualize and identify geometric shapes after applying transformations.

a. Identify a translation, rotation, or a reflection of a geometric shape.
b. Recognize that 90°, 180°, 270°, and 360° are associated, respectively, with 1/4, 1/2, 3/4, and full turns.

Mathematical language and symbols students should use:
parallel, perpendicular, intersecting lines, right angle, acute angle, obtuse angle, straight angle, circle, radius, diameter, line symmetry, rotational symmetry, coordinate, first quadrant, degree, translate, rotate, reflect, transformation

Exploratory Concepts and Skills
- Analyze results of transformations (e.g., translations, rotations, reflections) on two-dimensional shapes.
- Investigate two-dimensional representations of three-dimensional objects.

Standard III:
Students will understand attributes and properties of plane geometric objects and spatial relationships.

Standard IV:
Students will describe relationships among units of measure, use appropriate measurement tools, and use formulas to find area measurements.

Standard IV: Students will describe relationships among units of measure, use appropriate measurement tools, and use formulas to find area measurements.

Objective 1: Describe relationships among units of measure for length, capacity, and weight, and determine measurements of angles using appropriate tools.

a. Describe the relative size among metric units of length (i.e., millimeter, centimeter, meter), between metric units of capacity (i.e., milliliter, liter), and between metric units of weight (i.e., gram, kilogram).

b. Describe the relative size among customary units of capacity (i.e., cup, pint, quart, gallon).

c. Estimate and measure capacity using milliliters, liters, cups, pints, quarts, and gallons, and measure weight using grams and kilograms.

d. Recognize that angles are measured in degrees and develop benchmark angles (e.g., 45°, 60°, 120°) using 90° angles to estimate angle measurement.

e. Measure angles using a protractor or angle ruler.

Objective 2: Recognize and describe area as a measurable attribute of two-dimensional shapes and calculate area measurements.

a. Quantify area by finding the total number of same-sized units of area needed to fill the region without gaps or overlaps.

b. Recognize that a square that is 1 unit on a side is the standard unit for measuring area.

c. Develop the area formula for a rectangle and connect it with the area model for multiplication.

d. Develop and use the area formula for a right triangle by comparing with the formula for a rectangle (e.g., two of the same right triangles makes a rectangle).

e. Develop, use, and justify the relationships among area formulas of triangles and parallelograms by decomposing and comparing with areas of right triangles and rectangles.

f. Determine possible perimeters, in whole units, for a rectangle with a fixed area, and determine possible areas when given a rectangle with a fixed perimeter.

Mathematical language and symbols students should use:
millimeter, centimeter, meter, milliliter, liter, gram, kilogram, cup, pint, quart, gallon, area, perimeter

Exploratory Concepts and Skills
- Investigate perimeter of rectangles and squares.
- Investigate area of trapezoids.

Standard V:
Students will interpret and organize collected data to make predictions, answer questions, and describe basic concepts of probability.

Standard V: Students will interpret and organize collected data to make predictions, answer questions, and describe basic concepts of probability.

Objective 1: Collect, organize, and display data to answer questions.

a. Identify a question that can be answered by collecting data.

b. Collect, read, and interpret data from tables, graphs, charts, surveys, and observations.

c. Represent data using frequency tables, bar graphs, line plots, and stem and leaf plots.

d. Identify and distinguish between clusters and outliers of a data set.

Objective 2: Describe and predict simple random outcomes.

a. Describe the results of experiments involving random outcomes as simple ratios (e.g., 4 out of 9, 4/9).

b. Conduct simple probability experiments, with and without replacement, record possible outcomes systematically, and display results in an organized way.

c. Use the results of simple probability experiments, with and without replacement, to describe the likelihood of a specific outcome in the future.

Mathematical language and symbols students should use:
data, line plot, line graph, bar graph, stem and leaf plot, cluster, outlier, frequency table, probability

Exploratory Concepts and Skills
- Explore minimum and maximum values for a set of data.
- Explore mean, median, mode, and range.

Utah Elementary Science Core Curriculum

Introduction

Science is a way of deciphering, 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.

- Science is a way of deciphering, a process for gaining knowledge and understanding of the natural world.

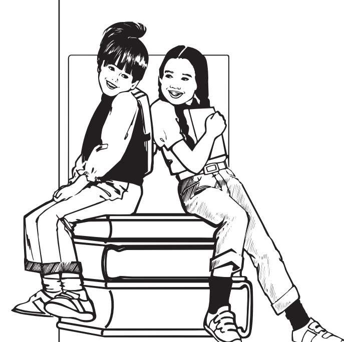
The Elementary Science Core describes what students should know and be able to do at the end of each of the K–6 grade levels. It was developed, critiqued, piloted, and revised by a community of Utah science teachers, university science educators, State Office of Education specialists, scientists, expert 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.

Eight Guidelines Were Used in Developing the Elementary Science Core

- Reflects the Nature of Science
- Coherent
- Developmentally Appropriate
- Encourages Good Teaching Practices
- Comprehensive
- Feasible
- Useful and Relevant
- Encourages Good Assessment Practices
- The Most Important Goal

Reflects the Nature of Science

Science is a way of deciphering, 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 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.

Fourth Grade Science Core Curriculum

The theme for the fourth grade Science Core curriculum is **Utah natural history**. Students will learn about Utah environments including: weather, water cycle, rocks, fossils, soils, plants and animals. Understanding the concepts of **cycles** is an essential component of science literacy and is introduced at this grade level. Emphasis should be placed on skills to classify many things. Students should come to value and use science as a process of obtaining knowledge based on observable evidence, and their curiosity should be encouraged and sustained as they develop the abilities associated with inquiry in science.

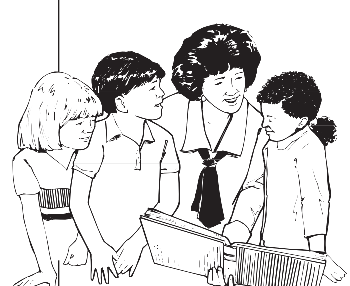
- Personal relevance of science in students' lives is always an important part of helping students to value science, and should be emphasized at this grade level.

Good science instruction requires that attention be paid to providing students with hands–on science investigations in which student inquiry is an important goal. Their curiosity should be encouraged and sustained. Teachers should provide opportunities for all students to experience many things. Fourth graders should feel the excitement of a rainstorm, hunt for fossils in rocks, observe the patterns in a spider web, and teach their parents to recognize the song of the lark. They should have many opportunities to observe and predict, to infer, and to classify. 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.

The fourth 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 fourth grade; the *Sci-ber Text*—an electronic science text book 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 fourth grade Science Core. These resources are all available on the Utah Science Home Page. 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 Fourth 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.

- Instruction should include significant science experiences that lead to student understanding using the ILOs.

By the end of Fourth Grade students will be able to:

1. **Use Science Process and Thinking Skills**
   a. Observe simple objects and patterns and report their observations.
   b. Sort and sequence data according to a given criterion.
   c. Make simple predictions and inferences based upon observations.
   d. Compare things and events.
   e. Use instruments to measure length, temperature, volume, and weight using appropriate units.
   f. Conduct a simple investigation when given directions.
   g. Develop and use simple classification systems.
   h. Use observations to construct a reasonable explanation.
2. **Manifest Scientific Attitudes and Interests**
   a. Demonstrate a sense of curiosity about nature.
   b. Voluntarily read or look at books and other materials about science.
   c. Pose questions about objects, events, and processes.
3. **Understand Science Concepts and Principles**
   a. Know science information specified for their grade level.
   b. Distinguish between examples and non-examples of science concepts taught.
   c. Explain science concepts and principles using their own words and explanations.

4. **Communicate Effectively Using Science Language and Reasoning**

a. Record data accurately when given the appropriate form and format (e.g., table, graph, chart).
b. Report observation with pictures, sentences, and models.
c. Use scientific language appropriate to grade level in oral and written communication.
d. Use available reference sources to obtain information.

Fourth Grade Science Standards

Science Benchmark

Matter on Earth cycles from one form to another. The cycling of matter on Earth requires energy. The cycling of water is an example of this process. The sun is the source of energy for the water cycle. Water changes state as it cycles between the atmosphere, land, and bodies of water on Earth.

Standard I: Students will understand that water changes state as it moves through the water cycle.

Standard I:
Students will understand that water changes state as it moves through the water cycle.

Objective 1: Describe the relationship between heat energy, evaporation, and condensation of water on Earth.

a. Identify the relative amount and kind of water found in various locations on Earth (e.g., oceans have most of the water, glaciers and snowfields contain most fresh water).
b. Identify the sun as the source of energy that evaporates water from the surface of Earth.
c. Compare the processes of evaporation and condensation of water.
d. Investigate and record temperature data to show the effects of heat energy on changing the states of water.

Objective 2: Describe the water cycle.

a. Locate examples of evaporation and condensation in the water cycle (e.g., water evaporates when heated and clouds or dew forms when vapor is cooled).
b. Describe the processes of evaporation, condensation, and precipitation as they relate to the water cycle.
c. Identify locations that hold water as it passes through the water cycle (e.g., oceans, atmosphere, fresh surface water, snow, ice, and ground water).
d. Construct a model or diagram to show how water continuously moves through the water cycle over time.
e. Describe how the water cycle relates to the water supply in your community.

Science language students should use:

vapor, precipitation, evaporation, clouds, dew, condensation, temperature, water cycle

Standard II:
Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.

Science Benchmark

Weather describes conditions in the atmosphere at a certain place and time. Water, energy from the sun, and wind create a cycle of changing weather. The sun's energy warms the oceans and lands at Earth's surface, creating changes in the atmosphere that cause the weather. The temperature and movement of air can be observed and measured to determine the effect on cloud formation and precipitation. Recording weather observations provides data that can be used to predict future weather conditions and establish patterns over time. Weather affects many aspects of people's lives.

Standard II: Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine simple weather patterns.

Objective 1: Observe, measure, and record the basic elements of weather.

a. Identify basic cloud types (i.e., cumulus, cirrus, stratus clouds).

b. Observe, measure, and record data on the basic elements of weather over a period of time (i.e., precipitation, air temperature, wind speed and direction, and air pressure).

c. Investigate evidence that air is a substance (e.g., takes up space, moves as wind, temperature can be measured).

d. Compare the components of severe weather phenomena to normal weather conditions (e.g., thunderstorm with lightning and high winds compared to rainstorm with rain showers and breezes).

Objective 2: Interpret recorded weather data for simple patterns.

a. Observe and record effects of air temperature on precipitation (e.g., below freezing results in snow, above freezing results in rain).

b. Graph recorded data to show daily and seasonal patterns in weather.

c. Infer relationships between wind and weather change (e.g., windy days often precede changes in the weather; south winds in Utah often precede a cold front coming from the north).

Objective 3: Evaluate weather predictions based upon observational data.

a. Identify and use the tools of a meteorologist (e.g., measure rainfall using rain gauge, measure air pressure using barometer, measure temperature using a thermometer).

b. Describe how weather and forecasts affect people's lives.

c. Predict weather and justify prediction with observable evidence.

d. Evaluate the accuracy of student and professional weather forecasts.

e. Relate weather forecast accuracy to evidence or tools used to make the forecast (e.g., feels like rain vs. barometer is dropping).

Science language students should use:

atmosphere, meteorologist, freezing, cumulus, stratus, cirrus, air pressure, thermometer, air temperature, wind speed, forecast, severe, phenomena, precipitation, seasonal, accuracy, barometer, rain gauge, components

Standard III:
Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

Science Benchmark

Earth materials include rocks, soils, water, and gases. Rock is composed of minerals. Earth materials change over time from one form to another. These changes require energy. Erosion is the movement of materials and weathering is the breakage of bedrock and larger rocks into smaller rocks and soil materials. Soil is continually being formed from weathered rock and plant remains. Soil contains many living organisms. Plants generally get water and minerals from soil.

Standard III: Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

Objective 1: Identify basic properties of minerals and rocks.

a. Describe the differences between minerals and rocks.

b. Observe rocks using a magnifying glass and draw shapes and colors of the minerals.

c. Sort rocks by appearance according to the three basic types: sedimentary, igneous and metamorphic (e.g., sedimentary—rounded-appearing mineral and rock particles that are cemented together, often in layers; igneous—with or without observable crystals that are not in layers or with or without air holes or glasslike; metamorphic—crystals/minerals, often in layers).

d. Classify common rocks found in Utah as sedimentary (i.e., sandstone, conglomerate, shale), igneous (i.e., basalt, granite, obsidian, pumice) and metamorphic (i.e., marble, gneiss, schist).

Objective 2: Explain how the processes of weathering and erosion change and move materials that become soil.

a. Identify the processes of physical weathering that break down rocks at Earth's surface (i.e., water movement, freezing, plant growth, wind).

b. Distinguish between weathering (i.e., wearing down and breaking of rock surfaces) and erosion (i.e., the movement of materials).

c. Model erosion of Earth materials and collection of these materials as part of the process that leads to soil (e.g., water moving sand in a playground area and depositing this sand in another area).

d. Investigate layers of soil in the local area and predict the sources of the sand and rocks in the soil.

Objective 3: Observe the basic components of soil and relate the components to plant growth.

a. Observe and list the components of soil (i.e., minerals, rocks, air, water, living and dead organisms) and distinguish between the living, nonliving, and once living components of soil.

b. Diagram or model a soil profile showing topsoil, subsoil, and bedrock, and how the layers differ in composition.

c. Relate the components of soils to the growth of plants in soil (e.g., mineral nutrients, water).

d. Explain how plants may help control the erosion of soil.

e. Research and investigate ways to provide mineral nutrients for plants to grow without soil (e.g., grow plants in wet towels, grow plants in wet gravel, grow plants in water).

Science language students should use:

mineral, weathering, erosion, sedimentary, igneous, metamorphic, topsoil, subsoil, bedrock, organism, freeze, thaw, profile, nonliving, structural support, nutrients

Science Benchmark

Fossils are evidence of living organisms from the past and are usually preserved in sedimentary rocks. A fossil may be an impression left in sediments, the preserved remains of an organism, or a trace mark showing that an organism once existed. Fossils are usually made from the hard parts of an organism because soft parts decay quickly. Fossils provide clues to Earth's history. They provide evidence that can be used to make inferences about past environments. Fossils can be compared to one another, to living organisms, and to organisms that lived long ago.

Standard IV:
Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.

Standard IV: Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.

Objective 1: Describe Utah fossils and explain how they were formed.

a. Identify features of fossils that can be used to compare them to living organisms that are familiar (e.g., shape, size and structure of skeleton, patterns of leaves).

b. Describe three ways fossils are formed in sedimentary rock (i.e., preserved organisms, mineral replacement of organisms, impressions or tracks).

c. Research locations where fossils are found in Utah and construct a simple fossil map.

Objective 2: Explain how fossils can be used to make inferences about past life, climate, geology, and environments.

a. Explain why fossils are usually found in sedimentary rock.

b. Based on the fossils found in various locations, infer how Utah environments have changed over time (e.g., trilobite fossils indicate that Millard County was once covered by a large shallow ocean; dinosaur fossils and coal indicate that Emery and Uintah County were once tropical and swampy).

c. Research information on two scientific explanations for the extinction of dinosaurs and other prehistoric organisms.

d. Formulate questions that can be answered using information gathered on the extinction of dinosaurs

Science language students should use:

infer, environments, climate, dinosaur, preserved, extinct, extinction, impression, fossil, prehistoric, mineral, organism, replacement, trilobite, sedimentary, tropical

Science Benchmark

Utah has diverse plant and animal life that is adapted to and interacts in areas that can be described as wetlands, forests, and deserts. The characteristics of the wetlands, forests, and deserts influence which plants and animals survive best there. Living and nonliving things in these areas are classified based on physical features.

Standard V: Students will understand the physical characteristics of Utah's wetlands, forests, and deserts and identify common organisms for each environment.

Objective 1: Describe the physical characteristics of Utah's wetlands, forests, and deserts.

a. Compare the physical characteristics (e.g., precipitation, temperature, and surface terrain) of Utah's wetlands, forests, and deserts.

b. Describe Utah's wetlands (e.g., river, lake, stream, and marsh areas where water is a major feature of the environment) forests (e.g., oak, pine, aspen, juniper areas where trees are a major feature of the environment), and deserts (e.g., areas where the lack of water provided an environment where plants needing little water are a major feature of the environment).

c. Locate examples of areas that have characteristics of wetlands, forests, or deserts in Utah.

d. Based upon information gathered, classify areas of Utah that are generally identified as wetlands, forests, or deserts.

e. Create models of wetlands, forests, and deserts.

Objective 2: Describe the common plants and animals found in Utah environments and how these organisms have adapted to the environment in which they live.

a. Identify common plants and animals that inhabit Utah's forests, wetlands, and deserts.

b. Cite examples of physical features that allow particular plants and animals to live in specific environments (e.g., duck has webbed feet, cactus has waxy coating).

c. Describe some of the interactions between animals and plants of a given environment (e.g., woodpecker eats insects that live on trees of a forest, brine shrimp of the Great Salt Lake eat algae and birds feed on brine shrimp).

Standard V:
Students will understand the physical characteristics of Utah's wetlands, forests, and deserts and identify common organisms for each environment.

d. Identify the effect elevation has on types of plants and animals that live in a specific wetland, forest, or desert.

e. Find examples of endangered Utah plants and animals and describe steps being taken to protect them.

Objective 3: Use a simple scheme to classify Utah plants and animals.

a. Explain how scientists use classification schemes.

b. Use a simple classification system to classify unfamiliar Utah plants or animals (e.g., fish/amphibians/reptile/bird/mammal, invertebrate/vertebrate, tree/shrub/grass, deciduous/conifers).

Objective 4: Observe and record the behavior of Utah animals.

a. Observe and record the behavior of birds (e.g., caring for young, obtaining food, surviving winter).

b. Describe how the behavior and adaptations of Utah mammals help them survive winter (e.g., obtaining food, building homes, hibernation, migration).

c. Research and report on the behavior of a species of Utah fish (e.g., feeding on the bottom or surface, time of year and movement of fish to spawn, types of food and how it is obtained).

d. Compare the structure and behavior of Utah amphibians and reptiles.

e. Use simple classification schemes to sort Utah's common insects and spiders.

Science language students should use:

wetland, forest, desert, adaptation, deciduous, coniferous, invertebrate, vertebrate, bird, amphibian, reptile, fish, mammal, insect, hibernation, migration

Common plants:

sagebrush, pinyon pine, Utah juniper, spruce, fir, oak brush, quaking aspen, cottonwood, cattail, bulrush, prickly pear cactus

Common animals:

jackrabbit, cottontail rabbit, red fox, coyote, mule deer, elk, moose, cougar, bobcat, deer mouse, kangaroo rat, muskrat, beaver, gopher snake, rattlesnake, lizard, tortoise, frog, salamander, red–tailed hawk, barn owl, lark, robin, pinyon jay, magpie, crow, trout, catfish, carp, grasshopper, ant, moth, butterfly, housefly, bee, wasp, pill bug, millipede

Facilitated

Activities

New Math Core Curriculum
Elementary CORE Academy 2007

Since the 2003 adoption of Utah's Elementary Mathematics Core Curriculum, ideas such as coherence, focus, high expectations, computational fluency, representation, and important mathematics have become regular elements in discussions about improving school mathematics. As the next step in devising resources to support the development of a coherent curriculum, the National Council of Teachers of Mathematics (NCTM) released *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics: A Quest for Coherence.*

With NCTM's release of the Curriculum Focal Points and discussion regarding high expectations, it became important for Utah to revise the Elementary Mathematics Core Curriculum. The placement of concepts within the Curriculum Focal Points guided the placement of concepts within Utah's Core.

The Core has also been designed so that, wherever possible, the 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 mathematical concepts and skills. This spiraling is intended to prepare students to understand and use more complex mathematical concepts and skills as they advance through the learning process.

The Core takes into account the psychological and social readiness of students. It builds from concrete experiences to more abstract understandings. The Core focuses on experiences with concepts that students can explore and understand in depth to build the foundation for future mathematical learning experiences.

The Elementary Mathematics 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 and revised by a community of Utah mathematics teachers, mathematicians, university mathematics educators, and State Office of Education specialists. It was critiqued by an advisory committee representing a wide variety of people from the community, as well as an external review committee. The Core reflects the current philosophy of mathematics education that is expressed in national documents developed by the National Council of Teachers of Mathematics, the American Association for the Advancement of Science, and the National Research Council. This Mathematics Core has the endorsement of the Utah Council of Teachers of Mathematics. The Core reflects high standards of achievement in mathematics for all students.

E-D-P Model
Elementary CORE Academy 2007

Each day good educators observe and interact with students to determine what course of action should be taken to achieve the best educational results for each learner. These observations, in many instances, are made with limited formal data. The E-D-P Model assists educators in the collection and use of information justifying implementation of practices. Many educators struggle with the ability to articulate and align teaching actions with student learning needs. The E-D-P Model is a method of aiding this articulation.

When assessing, it is important to know that correct answers do not necessarily mean students understand a concept. Conversely, incorrect responses may not indicate that a student hasn't learned a concept. It is important for educators to look for hidden understandings and possible misconceptions. Ongoing assessments, observations, and interviews may be necessary. When using this process, instructors should select assignments/tasks where students have opportunities to explain their understanding. Developing a tool to aid teachers in the collection of information and to assist them in determining student understanding has been the driving force in creating the E-D-P Model.

Our discussion begins with a description of the E-D-P Model. This model is based on a medical metaphor of **E**valuation-**D**iagnosis-**P**rescription (E-D-P). It is important to understand the difference between three main types of assessment: diagnostic (usually occurring prior to instruction), formative (concurrently occurs with instruction), and summative (occurs at the conclusion of an instructional period). The E-D-P Model targets diagnostic and formative assessments. By conducting ongoing assessments and using this formative information, educators can effectively impact student learning and plan instruction to meet individual learning needs (McNamee & Chen, 2005).

Evaluation

In classrooms across the country one may observe teachers interacting with students in a variety of ways. The **E**valuation portion of the E-D-P Model provides teachers with a way to identify student learning as it relates to the standard and objective of instruction. As a teacher sees a particular student response she is able to identify understandings and misunderstandings.

EXAMPLE: Marcia responded with the answer of 12 when she was asked to add 14 and 8. Using Marcia's work, an instructor sees that Marcia needs instruction on renaming. Other conclusions for the same response may also be apparent. The **E**valuation phase can then transition to the **D**iagnosis.

Diagnosis

As the student response is investigated the instructor may need to ask questions or inquire regarding the reasoning used to formulate the response. This is similar to a physician, where if a pain in the abdomen is described, the doctor poses questions to the patient or performs a physical exam to determine the source of pain. Educators can employ a similar method as they determine the cause of the incorrect responses given by a student. The diagnosis may consume large amounts of time or be rapidly identified based on student work.

Prescription

Once a learning need is **D**iagnosed/identified, renaming in the case of our example, the teacher can then determine what **P**rescriptive action should be taken. In the medical profession, the instructor or doctor has multiple medicines or treatments that can be prescribed. These multiple medicines affect individuals in different ways based on body chemistry and make up. This is also true with education in relation to learning styles. In education, teachers should have multiple activities, learning situations, or practice methods that can be prescribed to help students understand. In our example the teacher could prescribe numerous interventions to help our student understand the renaming concept. (e.g., place value practice, peer discussion groups focused on a single problem, one-on-one discussion about place value, manipulative extensions, etc.)

As teachers formalize the work that is done in a classroom they will be able to define the learning that occurs in a classroom and what learning should take place in the future. There can be a fine line between instruction and assessment when educators use quality formative assessment tasks to guide instruction and learning (Leahy, et al., 2005). The E-D-P Model encourages teachers to evaluate student work, diagnose learning needs, and determine the best prescription for continued growth in knowledge. Some teachers complete these three stages daily in classrooms around the nation without defining the process. This model provides educators a method to formalize current practice and aid them in the implementation process.

Citations

Leahy, S., Lyon, C., Thompson, M., Wiliam, D. (November 2005). Classroom Assessment: Minute by Minute, Day by Day. *Educational Leadership*, 63:3, p.18-24.

McNamee, G.D., Chen, J.Q. (November 2005). Dissolving the Line Between Assessment and Teaching. *Educational Leadership, 63:3, p.72-76.*

Medical Metaphor T-Chart	
Physician	Educator
Why would a physician complete an Evaluation?	Why would an educator complete an Evaluation?
What would a physician use to make make a medical diagnosis?	What would an educator use to make a learning diagnosis?
When evaluation and diagnosis are complete what kind of prescription would be given?	When evaluation and diagnosis are complete what kind of prescription would be given?

ELEMENTARY CORE Academy

UTAH STATE OFFICE OF EDUCATION & UTAH STATE UNIVERSITY

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

Diagnosis:		
	Strengths	Weakness
1)		
2)		
3)		
4)		
5)		
6)		

Prescription:

ELEMENTARY CORE Academy

UTAH STATE OFFICE OF EDUCATION & UTAH STATE UNIVERSITY

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

Diagnosis:		
	Strengths	Weakness
1)		
2)		
3)		
4)		
5)		
6)		

Prescription:

ELEMENTARY CORE Academy

UTAH STATE OFFICE OF EDUCATION & UTAH STATE UNIVERSITY

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

Diagnosis:		
	Strengths	Weakness
1)		
2)		
3)		
4)		
5)		
6)		

Prescription:

ELEMENTARY CORE Academy

UTAH STATE OFFICE OF EDUCATION & UTAH STATE UNIVERSITY

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

Diagnosis:		
	Strengths	Weakness
1)		
2)		
3)		
4)		
5)		
6)		

Prescription:

E-D-P Assessment Form

Evaluation: ______________________________

Students:	Diagnosis:								Prescription:				
Task:	Communication	Representation	Computation						Task #4	Comp. #6	Assignment #1		
1) Kyler	√-	√	√						X				
2) Jose	√	√+	√-								X		
3) Kyler	√+	√+	√+							X			
4) Sammy	√	√	√-								X		
5) Shelby	√-	√-	√-								X		

E-D-P Assessment Form		
Diagnosis:		Prescription:

*Copy to a label and place on student work.

E-D-P Assessment Form

Evaluation: ______________________________

Students:	Diagnosis:								Prescription:				
Task:	Communication	Representation	Computation						Task #4	Comp. #6	Assignment #1		
1) Kyler	√-	√	√						X				
2) Jose	√	√+	√-								X		
3) Kyler	√+	√+	√+							X			
4) Sammy	√	√	√-								X		
5) Shelby	√-	√-	√-								X		

E-D-P Assessment Form		
Diagnosis:		Prescription:

*Copy to a label and place on student work.

Core Standard & Objective:	Assessment FOR Learning (Evaluate)			Assessment of Needs (Diagnosis)								
	Type of Assessment			Needs Missing Foundational Skills			Needs Basic Grade Level Core Skills			Needs Extension of Core Skills		
	Pre/Post Dates: /			Plan for Instruction (Prescription) Examples: Expicit Instruction using Graphic Organizers, Skill Specific Activities, Guided Practice, etc.								
Student Name	Limited Knowledge	Partial Knowledge	Mastery									

Mathematical Proficiency
Elementary CORE Academy 2007

How do educators know when a student "Gets It?" Elementary teachers interact with students daily using a variety of individual views regarding mathematical understanding. Success in mathematics is created through a student's composite view and aptitude in five areas of mathematics. In the book, *Helping Children Learn Mathematics,* we are introduced to this composite view of mathematics learning. The term mathematical proficiency is used to describe what it means when a person successfully learns mathematics.

Mathematical proficiency includes five strands:

1) **Understanding:** Comprehending mathematical concepts, operations and relations-knowing what mathematical symbols, diagrams, and procedures mean.
2) **Computing:** Carrying out mathematical procedures, such as adding, subtracting, multiplying, and dividing numbers flexibly, accurately, efficiently, and appropriately.
3) **Applying:** Being able to formulate problems mathematically and to devise strategies for solving them using concepts and procedures appropriately.
4) **Reasoning:** Using logic to explain and justify a solution to a problem or to extend from something known to something not yet known.
5) **Engaging: Seeing mathematics as sensible, useful, and doable-if you work at it-and being willing to do the work.**

It is critical to understand that each of these strands is interwoven and interdependent. Various views of success in mathematics emphasize one aspect of mathematical proficiency with the expectation that the other areas of mathematical knowledge will follow. Success in mathematics comes through achieving mathematical proficiency, which includes each of the five strands.

We see parents, students, and educators focus on only one strand of proficiency, which results in memorized facts that do not necessarily lead to mathematical success. This narrow treatment of math does not provide the strong basis of mathematical learning that students need.

As students learn all the aspects of mathematical proficiency, learning will become stronger, more durable, more adaptable, more useful, and more relevant. It is difficult to master any one of these strands in isolation and is therefore essential to teach the strands in an interconnected method. Developing the strands together builds a student's knowledge of any one strand through connected knowledge points that are memorable.

Citation

National Research Council. (2002). Helping Children Learn Mathematics. Mathematics Learning Study Committee, J. Kilpatrick and J. Swafford, Editors. Center for Education, Division of Behavioral and Social Sciences and Education. Washington, D.C.: National Academy Press.

Building Academic Vocabulary
Elementary CORE Academy 2007

Teaching students vocabulary that will be encountered during the study of content provides a solid background for a positive interaction with that content. Building academic vocabulary is much more than simply placing words upon a word wall or providing a matching exercise with a definition and new terms.

Initially the selection of the terms to be provided to students takes effort and time. Educators should identify key words that are important to the understanding of specific content areas, and are included in the Core Curriculum. The background work of identifying the terms is critical to providing an accurate direction for the subsequent instruction. However, the key to the success of building academic vocabulary ultimately rests upon the quality of the instruction provided by the teacher. Marzano and Pickering provide the following six-step Process for teaching new terms.

The Six-Step Process for Teaching Academic Vocabulary:

1) **Provide a description, explanation, or example of the new term.**
2) **Ask students to restate the description, explanation, or example in their own words.**
3) **Ask students to construct a picture, symbol, or graphic representing the term or phrase**.
4) **Engage students periodically in activities that help them add to their knowledge of the terms in their notebooks**.
5) **Periodically ask students to discuss the terms with one another.**
6) **Involve students periodically in games that allow them to play with the terms.**

With guidance and monitoring students have the ability to generate their own description and representations of vocabulary terms provided. The ownership of this process is valuable in that students see the term as a new tool that aids their learning. An integral step in the process of learning new vocabulary is the student notebook. As students add new terms to their notebook they also refine and update descriptions, which deepens and clarifies their understanding of the content and the terms.

Creating a deeper understanding of vocabulary terms will provide students with multiple points of learning as they encounter new content. These points of learning will broaden the knowledge base and allow students to develop an awareness of the language of learning.

Citation

Marzano, R.J., Pickering, D.J., (2005). *Building Academic Vocabulary Teachers's Manual* ASCD, Alexandria, VA.

Math I-1

Activities

Fractions

Fraction Fun

Standard I:

Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.

Objective 1:

Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

Intended Learning Outcomes:

1. Develop a positive learning attitude toward mathematics.
4. Communicate mathematical ideas and arguments coherently to peers, teachers and others using the precise language and notation of mathematics.

Content Connections:

Math II-1; Patterns and relations representing math situations.

Math Standard I

Objective 1

Connections

Background Information

One-fourth…One half…One third…whole…what are they? They are fractions! A fraction describes a *part of a whole* when the whole is divided into equal parts. Fractions can also *be parts of a group*. For example, if there is a group of animals consisting of six cats and three dogs, what fraction of the group are dogs? There are nine parts and three dogs…three out of nine are dogs. The fraction is written as 3/9.

Important mathematical vocabulary should be taught and used by the teacher. The following are important vocabulary concepts for 4th grade students.

Fraction: A fraction describes a part of a whole.

Denominator: The bottom number in a fraction tells how many equal parts are in the whole.

Numerator: The top number in a fraction that tells how many equal parts the fraction represents.

Equivalent fraction: Fractions that are equal and represent the same amount. (2/4=1/2)

Improper fraction: The denominator is greater than or equal to the numerator.

Mixed Fraction: A fraction that is a whole number and a fraction. (3 1/4)

Research Basis

Tharp, R.C., (1997). From at-risk to excellence: Research, theory, and principles for practice. Retrieved January 10, 2007 from www.cal.org/crede/pubs/research/rr1.htm.

Current research states that it is important to meet the needs of culturally diverse and other at-risk students by providing a challenging curriculum. It also requires careful leveling of tasks, so that students are stretched to reach within their zones of proximal development. Small groups, hands-on activities, and instructional conversations with the teacher make teaching a collaborative experience between teacher and student.

Dalton, S.S., (1998). Pedagogy Matters: Standards for effective teaching practice, ***Research Report No. 4***, Center for Research on Education, Diversity & Excellence, University of California, Santa Cruz.

When experts and novices work together toward a common product or goal and have opportunities to converse about the activity (Moll, 1990; Tharp & Gallimore, 1988; Wertsch, 1985), learning is a likely outcome. Current research on cooperative learning shows that students, especially minority students, who participate in integrated classrooms, increase their academic achievement, motivation, self-esteem, and empathic development.

Invitation to Learn

Fraction Action

The objective of the activity is for the students to create a picture graph and create fractions from the results.

1. Each student will select a picture that represents an animal they would like for a pet using *Animal Graph Pictures*.
2. Students color the picture, cut it out and place it on the graph. Discuss the results of the graph. Guide the students to understand that the number of pictures on the graph represents the denominator of a fraction or the number of equal parts in the entire graph.

   Demonstrate a few fractions such as 10 out of 22 animals are dogs. Write it as a fraction 10/22.
3. Ask each student to share his fractions with the class. If the students haven't discovered it, point out the fractions in just one column.

Materials

- ❏ Chart paper
- ❏ *Animal Graph Pictures*
- ❏ Crayons
- ❏ Scissors
- ❏ Glue

Instructional Procedures

1. Distribute fraction circle pieces to each pair of students. If using the *Fraction Circle Template,* have students cut templates out. Save fraction circles to use for other fraction activities.

2. Give students time to manipulate the materials, reminding students to make notes about anything they notice as they "play" with the materials.
3. Share observations with their partner.
4. Facilitate a discussion about their observations.
   a. Did you notice anything that was the same about these fraction pieces?
   b. What was different?
   c. Did you notice any two pieces that covered the same area?
   d. What different combinations can you use to make a whole piece?
5. If needed, review the basic concepts of fractions. Remind students that fractions represent a part to whole relationship.
6. Demonstrate, as needed. with the circle fraction pieces. For example: 2/4 is the same as 2 of the 4 pieces that make the whole. 3/4 is the same as 3 of the 4 pieces that make the whole.
7. Use the words *numerator* and *denominator* informally to discuss the parts of a fraction number and what they mean.

Materials

- ❏ Fraction Circles
- ❏ *Fraction Circle Template*
- ❏ Scissors
- ❏ Ziploc bag
- ❏ *1/2 Alias 2/4*
- ❏ Poster boards
- ❏ Tape or glue
- ❏ Chart paper
- ❏ Overhead projector
- ❏ Overhead fractions pieces

Exploration by Discovery -- Naming Fraction Circles

1. Have the students sort the parts of their fraction pieces by color, putting each color in a separate group. Ask the students to find the largest piece (whole circle).
2. Ask them describe the circle, directing them to name it as one whole. Talk about this shape as one whole region.
3. Next, ask the students to find the two pieces that cover the whole region. Have them hold up the halves and arrange the pieces to form a circle. Direct discussion about what students notice about these pieces demonstrate on overhead. Lead students to recognize that the pieces fit together to form a whole circle, that both pieces are the same size (equal parts), and that each piece is a half. Encourage them to compare and describe the pieces they have named so far. (Answer: 1 whole = 2 halves.)
4. Direct students to find the corresponding pieces in their sets. Ask, "What part of a circle is each piece?" (Answer: 1/2) Ask them to think about what each number in the fraction might represent in each piece. (Answer: 1/2) Ask them to think about what each number in the fraction might represent, reminding them that the denominator tells the number of parts

in the whole, and the numerator tells the number of parts counted.

5. Continue guiding and questioning students as they identify thirds, fourths, fifths, sixths, eighths, and tenths.
6. Informally assess the students understanding of "parts of a whole" by observing them during the exploration and manipulation section of the activity.

Exploring Equivalent Fractions 1/2 Alias 2/4

1. Place students in groups of four.
2. Distribute fraction pieces.
3. Students are to place the "1/2" piece on the left side of the pizza circle and use any of their other pieces to complete the right side of the circle.
4. All of the pieces need to be of the same size and color on the other half.
5. Say, "Find all the fraction pieces that are equivalent to one-half."
6. Each time a student discovers an equivalent fraction, they will trace the equivalent fraction pieces on chart paper.
7. Students will repeat this activity until all equivalent fractions to 1/2 have been discovered and recorded. (5 equivalent fractions)
8. After exploring, instruct each student to choose one of the equivalent fractions they discovered to record on the pizza circle on the *1/2 Alias 2/4* activity sheet. Color and record the fraction in the space provided.
9. Have students share their findings. When list is complete, highlight to the class that even though these fractions look different, they are all names for 1/2.
10. Instruct students to divide their poster board into fourths. Each student will have 1/4 of the board to display their work.
11. Next, students will glue her *1/2 Alias 2/4* activity sheets in their 1/4 space. Remind them to leave room in their space for the Pizza Circle recording sheet. Encourage them to decorate their poster to look like a pizza.

Take My Order Please ---Build A Pizza!

1. Distribute fraction circle pieces, fraction dice, sheet of paper, and crayons/colored pencils to each pair of students.

2. The first player rolls the die and places the fraction pieces which correspond to the number rolled on to the “whole” fraction piece.
3. Continue to take turns until the “pizza” circle is completely covered with fraction pieces.
4. A player may either add pieces to the circle or replace a piece (s) on his turn.
5. Skip a player’s turn if he rolls a fraction that cannot fit the circle.
6. When the pizza circle is complete, each student will record his the final circle, tracing the fraction pieces on the *Build a Pizza* activity sheet. Write the fraction in each section of the completed circle (1/4 - Cheese + 2/8 = pepperoni + 2/6= tomatoes + 3/12= Olives = 1 whole).
7. Color finished pizza according to their desired pizza toppings.
8. Each student places his or her finished *Build a Pizza* activity sheet on his or her 1/4 of the poster. Display poster.

Materials

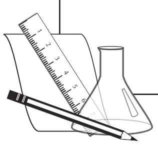
- ❏ Fraction Circle pieces
- ❏ Fraction dice
- ❏ Paper
- ❏ Crayons/colored pencils
- ❏ *Build a Pizza*

Serve Up Fractions!

1. A fast, efficient and easy way to mark the radius of 30 plates in 3 minutes or less!
   - Before activity do the following:
   - Measure exact radius on one six inch plate
   - Place small, flat board on a solid surface.
   - Stack about 10+ plates on the board, pattern on top
   - Gently drive nail through the radius hole and through the stack of plates
   - Repeat using another “hole in the middle “ plate as a guide
2. Color one paper plate, topside only. (A peeled crayon works fast and efficiently)
3. Cut a slit from the outer edge of the plate to the hole in the center (radius) of the plate.
4. Place one plate on the other plate aligning the slits and pull the bottom plate’s edge through the top plate’s slit, overlapping the plates and then rotating the plates. The bottom plate should now slide around the top plate.
5. Provide each group with Fraction Circles (commercial) or *Fraction Circle Template*. The cardstock templates can be pre-cut and re-used by the teacher.

Materials

- ❏ 6-inch paper plates
- ❏ Scissors
- ❏ Crayons
- ❏ Small board
- ❏ Nail
- ❏ Hammer
- ❏ Fraction Circle pieces



6. Activate Prior Knowledge: Relate the whole fraction circle plate to a large, yummy cookie. Explain that we will see how big of a piece of cookie each person gets. Make up interesting "food/ cookie" problems when giving fractions.
7. Students will respond to the teacher's requested fraction by displaying the fraction on their circular fraction model plate.
8. The teacher will say, "Show me 1/3 (color). One-two-three-go." After about 10 seconds say, "One-two-three-Show." Direct everyone to hold up his or her plates. Students should have slid the paper plates around so that one-third of the color called out shows. Ask students, "Does yours look like mine?" while showing the class the correct answer. If not go ahead and make necessary adjustments.
9. Continue with the game by requesting students show fractions less than one whole. Use the "one-two-three-go" and "show" steps to visually check for accuracy.
10. Students can use Fraction Circles to check for accuracy by placing the tip of the chosen fraction piece on the radius hole. The templates fit the 3" inner circle and provide an accurate self-checking tool.

- Students can do the activity independently, using the templates to check for accuracy.
- Pair up students and challenge each other to create the fraction requested by their partner. Use templates to check accuracy.
- Fraction plate can also be used to review telling time.

Assessment Suggestions

- Ongoing teacher assessment by observing accuracy in completing student resource pages, proper completion of fraction activities, and proactive participation in groups.
- Students draw and shade in equivalent fractions, 1/2, 1/4 and 1/3.
- Assess students with shapes other than circles.

Teacher will observe students during the plate model activity making sure that the students made the necessary adjustments as needed.

- Students instruct family members how to construct a fraction plate and create fraction games to play with the family.
- Play *Frac-tominoes* and *Fraction Hunt* with family.

Curriculum Extensions/Adaptations/ Integration

- Ask students if they can think of any other names for 1/2 even though they may not have the fraction pieces available.
- Make up word/story problems using fractions.
- Compare and contrast the different size of the fractions pieces. Order them from smallest to largest.

Additional Resources

Books

Fraction Fun, by David Adler; ISBN 0823412598

The Doorbell Rang, by Pat Hutchins; ISBN 0688092349

Give Me Half, by Stuart Murphy; ISBN 0590136917

Fraction Action, by Loreen Leedy; ISBN 082341244- X

Funny and Fabulous Fraction Stories by Dan Greenburg; ISBN 059096576-X

Web sites

http://www.Dositey.com

Great website for math games, quiz shows, mind twisters mystery pictures

Interactive Fractions: http://www.coolmath.com/fractions

USU Fraction site- http://nlvm.usu.edu/en/nav/frames_asid_105_g_2_t_1.html

Equivalent Matching - http://www.learningplanet.com/sam/ff/index.asp

Fun Brain Fresh baked Fractions- http://www.funbrain.com/fract/index.html

Fraction on-line games

http://www.murrieta.k12.ca.us/alta/games/fractions.html

Word problems

http://www.visualfractions.com/identify.htm

Fraction Journal

Materials

- ❏ Four paper CD holders
- ❏ Circle Fractions
- ❏ Four squares of paper cut 4 3/4" to fit inside the CD envelopes for each student
- ❏ Yarn or string 18" long

1. Trace the fraction circles that represent 1/2, 1/4, 1/3, 1/6, onto the squares that have been cut to fit inside the CD holders. Students can color them a variety of different colors or patterns. (Diagram 1)
2. Slide the squares in the holders. Have students write simple statements that relate to each specific fraction around the outside of the circle. (Diagram 2)
3. Stack the paper holders together. Bind them together with a piece of string or yarn to create a small fraction journal. (Diagram 3)
4. Students use this journal for reference when discussing fractions.

Diagram 1

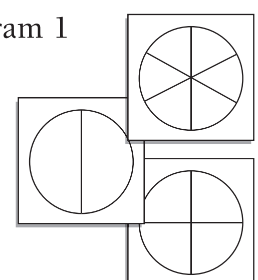


Diagram 2

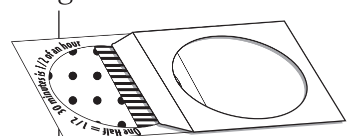
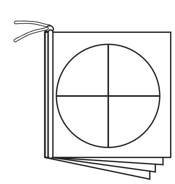
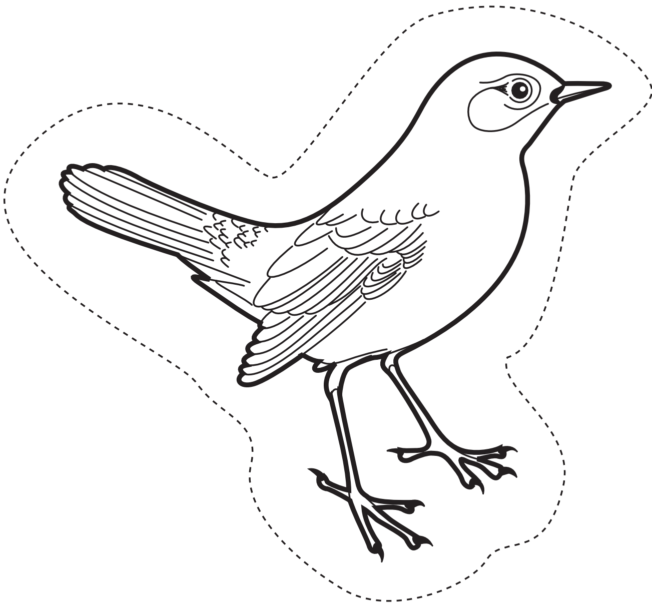


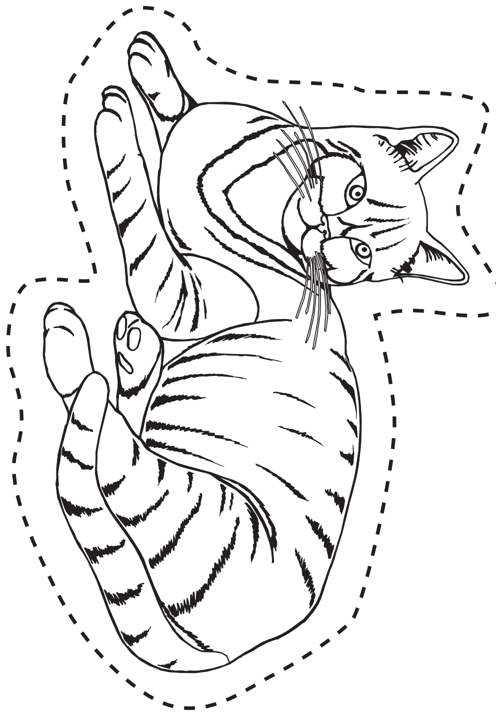
Diagram 3

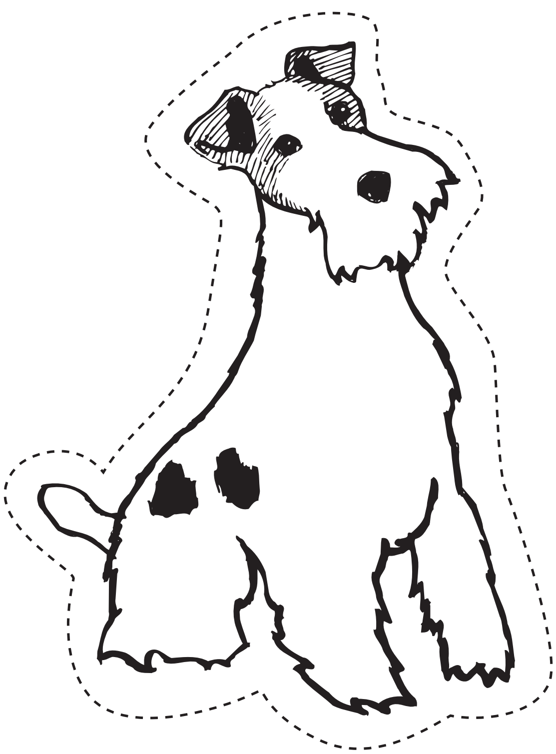


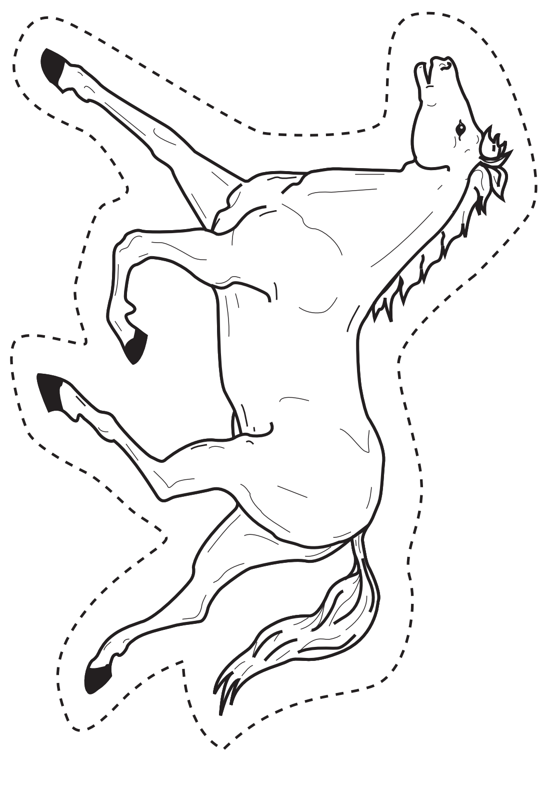
Animal Graph Pictures

Copy approximately eight copies of each picture. Students choose one picture to represent their choice. They will color and cut it out. Next they will place it on the graph under the picture of their favorite animal.





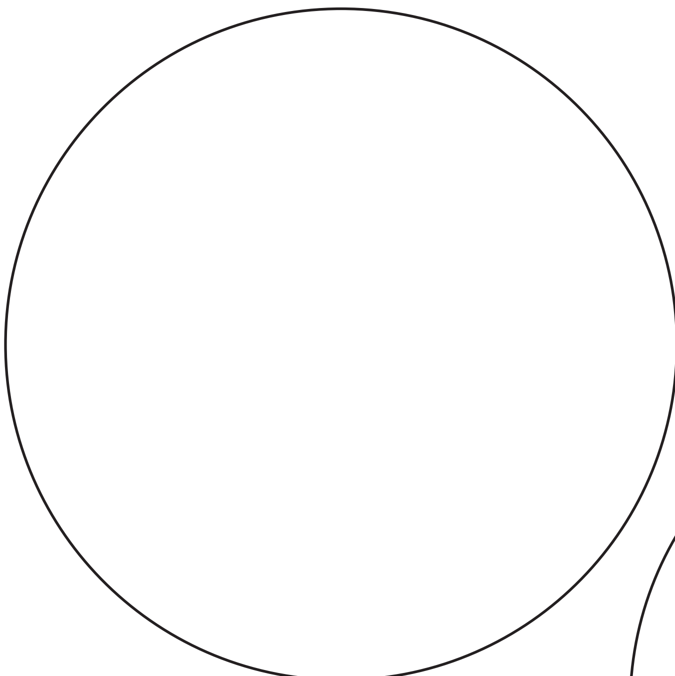




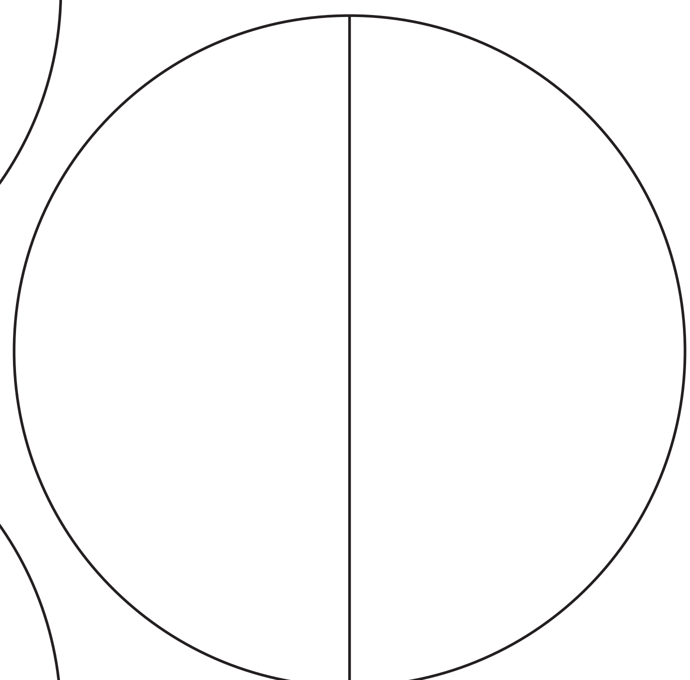
Fraction Circle Template

Copy each fraction circle on heavy paper, such as cardstock. Each fraction circle should be a separate color. The colors suggested on this template correspond to the colors on most commercial fraction circle manipulatives.

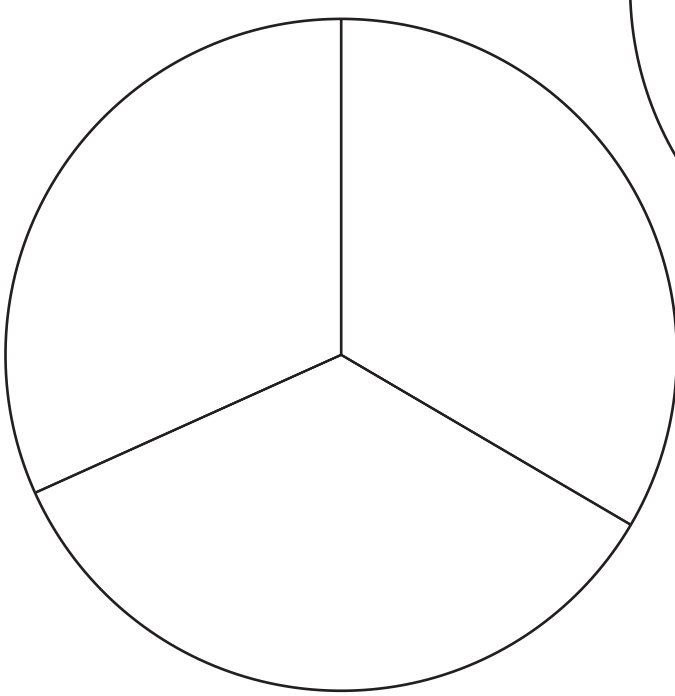
Each student, or pair, receives one each of the nine fraction templates. Prior to fraction activities, the fraction circles should be cut out, cutting on all solid black lines. Paper clip the separate fractions together and store in small plastic bag.



Whole=Red

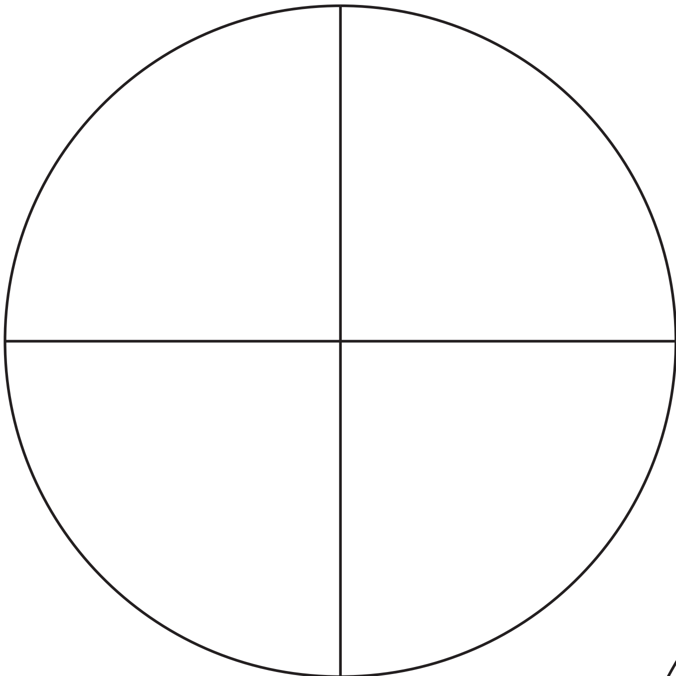


1/2=Pink

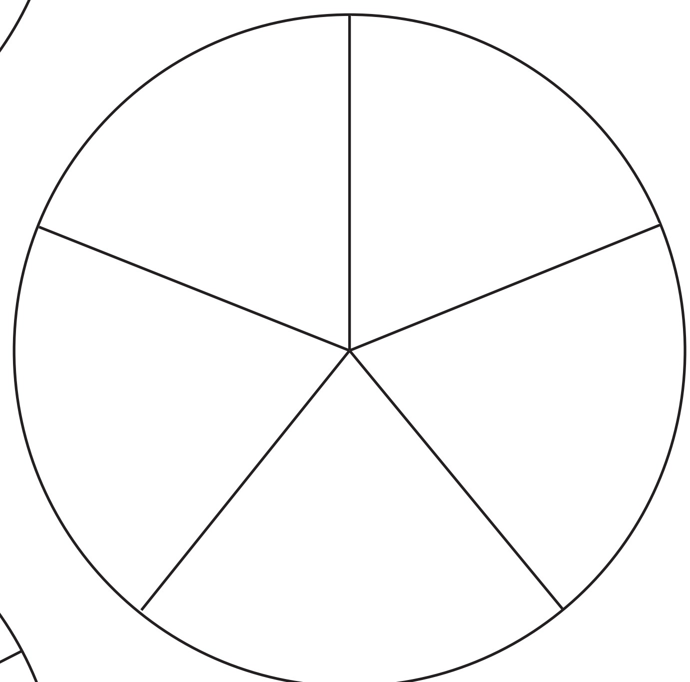


1/3=Orange

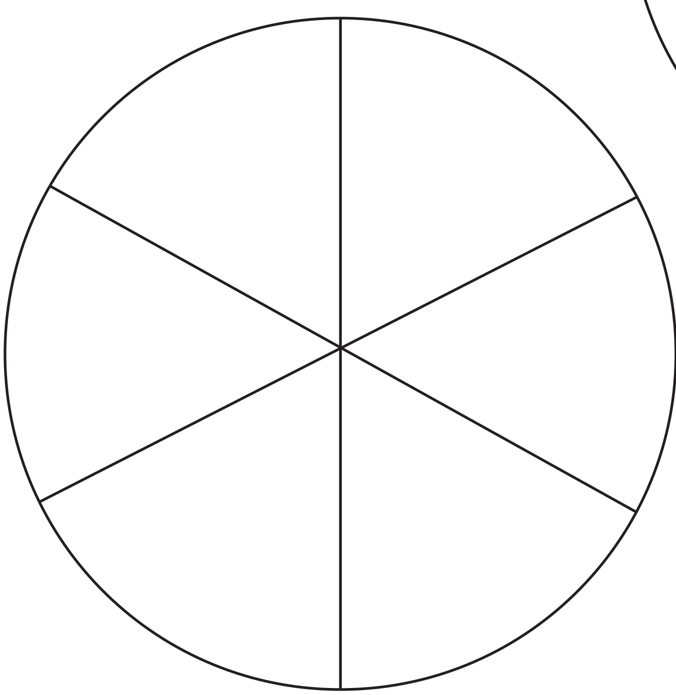
Fraction Circle Template



1/4=Yellow

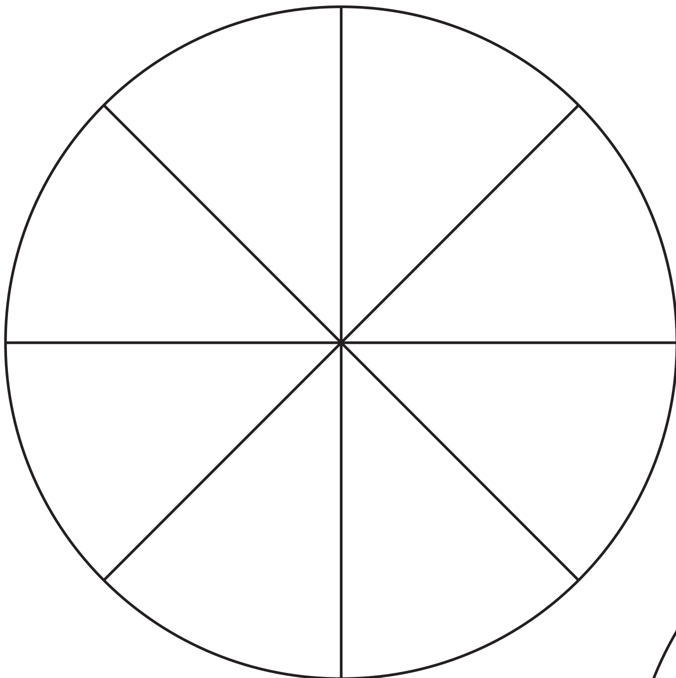


1/5=Green

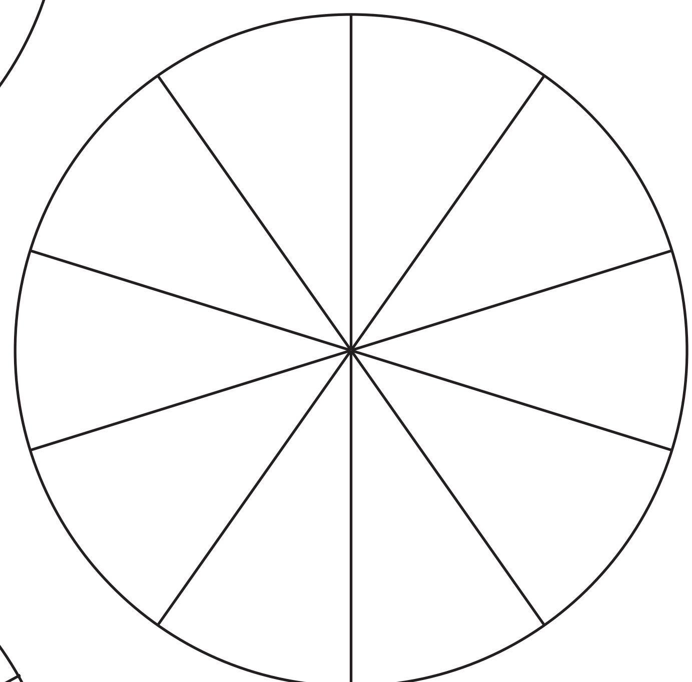


1/6=Light Blue

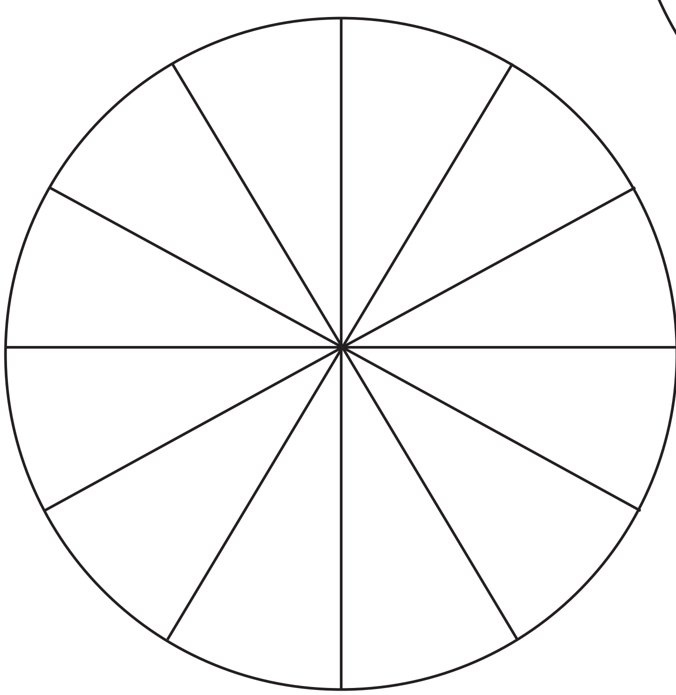
Fraction Circle Template



1/8=Dark Blue



1/10=Purple



1/12=Black

1/2 Alias 2/4

1/2 = ______________________

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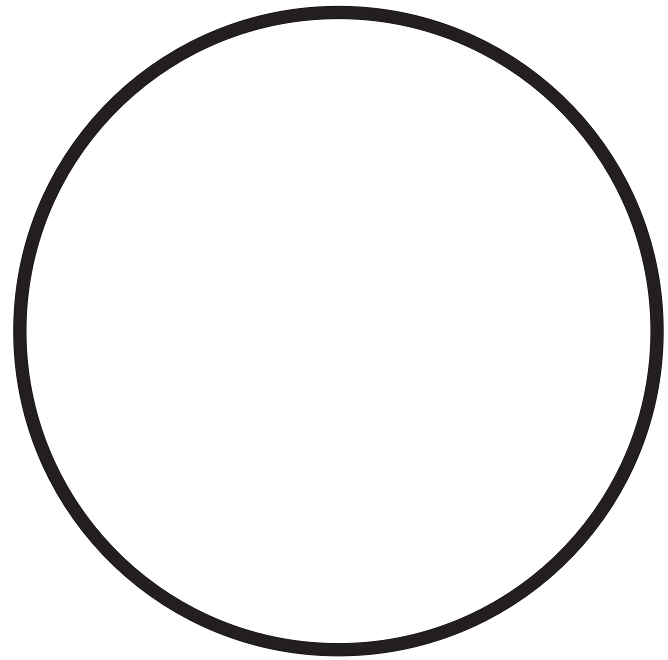
Record your favorite equivalent fraction on the circle

My favorite equivalent Fraction:

____

Build a Pizza



My Pizza Fraction Sentence

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Name______________________

Keeping Warm with Fractions

Standard I:

Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.

Objective 1:

Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

Intended Learning Outcomes:

1. Develop a positive learning attitude toward mathematics.
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Content Connections:

Math II-1; Patterns and relations representing math situations.

Math Standard I

Objective 1

Connections

Background Information

Quilts were one of the most beautiful and important things a pioneer family could have.

Pioneer women lovingly made each individual quilt block and sewed them together. They packed as many quilts as they could take on their journey west because quilts had many uses. Besides being used as warm bedding, quilts padded a wagon seat, provided shade from the sun, kept valuables from breaking, and kept a newborn baby snug. When the winds blew across the dusty plains, quilts covered the cracks and openings in the wagons and protected the pioneer family from blowing dust and sand. When a family member became sick, the quilts provided a comfortable place to rest. The most solemn use for a quilt was to wrap one around a beloved family member before they were laid in a lonely grave along the trail.

Overall, quilts were mostly used as a warm covering for a bed. Made of three layers, a quilt consists of the top, the filling, and the back. These three layers are stitched together or tied with thread. The exact origin of quilts is in question. The name quilt originates from Latin meaning "stuffed sack," which was translated into English as quille and means "wrap around the body." The oldest known patchwork example dates back to a canopy for an Egyptian queen in 960 B.C. In the earliest quilts, grass, leaves, feathers, fleece from sheep, old rags, and sometimes straw were used for filling. The top was made from wool and linen fibers spun into thread and the thread woven into cloth. The bottom was generally muslin.

In early America fabric was very scare and costly. It was very difficult to replace a worn-out quilt, so the women began patching the quilt with fabric left over from making clothing or from worn-out clothes. Before long, the quilts took on a new look from all the patches. As the old patched quilts wore out, the women saved scrapes of cloth, cut the pieces into small squares, triangles and rectangles. From these pieces they sewed the shapes together to form designs called quilt blocks. The patchwork designs of many quilts tell the story of their lives, what they liked, or mimicked designs around them.

In pioneer times women and children often created quilt blocks as a way to tell the story of the settling of the country and quilt making evolved into a special art form. The simplest quilt blocks were the most popular patterns because pioneer women did not have much spare time and could make these easy patterns quickly. The most basic quilt blocks were used for a girl's first quilt so she could learn the skills necessary to make a quilt.

An Album quilt was very special gift made for family and friends who were moving west. Each person in the group would make a special quilt block, choosing their own fabric and design and signed each block. The album quilt was a way for a family to remember their friends and relatives who were far away.

Quilt blocks depicted other events in the pioneer family's life. They illustrated the story of their trek West. Some quilt block patterns get their names from these aspects of frontier life—Making Fences, the Red Schoolhouse, the Waterwheel, and the Log Cabin. Other quilt block names took after ordinary objects around the home—the Spool Block (named for the thread spool), the Kitchen Woodbox, Friendship Basket, Secret Drawer, and Broken Dishes. Quilt blocks were even named after food and clothing. Some quilt blocks were named after such things as ribbons, a sugar cone, a butter churn, and fruit baskets.

Special occasion quilt blocks celebrated the happy times in a pioneer family's life, such as weddings, births, and new neighbors. The weather was also a popular theme for quilt blocks and Star quilt blocks were one of the most popular. Perhaps these pioneers gazed at the wide night sky as they slept near their wagons determined to follow their dreams. The quilt block known as Star of the West was named in honor of the pioneers' trek West.

Looking at a quilt is like reading a history book but instead of learning about kings, presidents, and countries at war, you can learn a more personal history—of normal men, women, and children setting out to find a new place to live in the untamed West. You can learn about their everyday life and what they felt was important to them.

When studying a quilt, see if you can find stories in the design and read between the tiny stitches to see what tales it can tell.

Research Basis

Aronson, E., Patnoe, S. (1997). The jigsaw classroom: Building cooperation in the classroom. Retrieved January 2007, from http://www.jigsaw.org/overview.htm

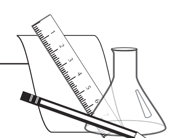
Jigsaw is a very efficient way to learn new material. The jigsaw process encourages listening, engagement, and interest by giving each member of the group an essential part to play in the activity. Group members must work as a team to accomplish a common goal. No student can succeed unless everyone works well together as a team. This strategy is ideal for ELL and special needs students.

Bagley, M. Hess, K. (1987). 200 ways of using imagery in the classroom. Munroe, NY: Trillium Press.

Interactive instruction relies heavily on discussion and sharing among participants. Seaman and Fellenz (1989) suggest that discussion and sharing provide learners with opportunities to "react to the ideas, experience, insights, and knowledge of the teacher or of peer learners and to generate alternative ways of thinking and feeling" (p. 119). Students can learn from peers and teachers to develop social skills and abilities, to organize their thoughts, and to develop rational arguments.

Invitation to Learn

1. Each student will choose a precut piece of pre-cut color/shape construction paper.
2. Divide the class into cooperative learning groups of four according to color of the paper they chose.
3. Show the class a variety of quilts and/or Quilt Patterns. Ask students to describe to you the patterns they see, using mathematical/geometric language i.e. symmetry, ½, 1/4, squares, triangles, turns, flips.
4. Divide the class into "color and shape" groups of four and give each group a quilt pattern to examine. Students are to examine the quilt block, discussing the pattern, color, shapes, sizes, fractions, other math/geometry terms.
5. Place discussion patterns on board so all can see them.
6. Jigsaw: Next, regroup students according to the shape of their color card. Each group should have a member who has a different shape and color. (One red square, one blue square, etc.)



Materials

- ❏ Colored construction paper
- ❏ Shapes for jigsaw
- ❏ Scissors
- ❏ *Quilt Patterns*

7. Direct each member to share with their new “shape” group what their color group discussed about their pattern. Encourage them to use mathematical and geometric terms.

Assessment: This activity is an informal assessment meant to assess student’s prior knowledge. The presentations should give the teacher an idea of where students are at in terms of their understanding of geometry, basic fractions, and patterning skills. Assessment can be done when students are answering questions and during their informal presentation.

Instructional Procedures

How Amazing is That?

Exploration

a. Show students a square piece of construction paper. Brainstorm different ways to cut the square in half (i.e. diagonal, up-and-down). Brainstorm the resulting shapes that you would get.

b. Cut square in half and ask for shape, line of symmetry, fractions represented by the piece. etc. Cut in half again.

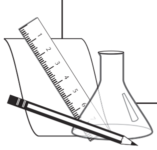
c. Ask what fraction of the whole is represented by the smallest piece.

d. Give students two squares of different colored construction paper squares (3x3).

e. Students will experiment with folding and cutting squares into triangles, rectangles

Materials

- ❑ Precut paper squares
- ❑ Scissors
- ❑ Glue
- ❑ *4 Patch Quilt*
- ❑ *Quilt Patterns*
- ❑ Address labels
- ❑ Large Construction paper



That’s Not Math…That’s Art!

1. Teacher will direct student’s attention to the 4 Patch Quilt and discuss the 2x2 array that this square forms. Ask students how many individual squares can be found in this quilt block. (4 squares)
2. Focus on the two colors used in the examples to make the square. Ask a student to show you a square that is one half of one color and one half of another.
3. Ask, “How would we write that fraction?” “Is this entire quilt square exactly one half of one color and one half of another?” “How is that possible?” “Why?”
4. Instruct students that they will be constructing a 4-patch quilt block. The quilt block must be created using two colors and each color will be exactly one half of the quilt block.

5. Each cooperative learning group of four will create a combined quilt block for the class.
6. Pass out squares to be used for the base of quilt square (4 Patch Quilt.)
7. Direct students to experiment with the shapes, moving them around to find as many ways as they can to create their half and half quilt block. NO GLUING YET!
8. Direct students to discover the many ways they can make a half and half design
9. At this point, tell students that they will be combining their quilt blocks to make a larger quilt block and each design must be different. "Different" can be color, pattern, and size.
10. Students will share their chosen design with their group. Students will compare and contrast their individual blocks with other members in their group and determine if all patterns are different.
11. When students have decided on their personal block and they have collaborated on what the group square will be, they may glue the pieces to the individual quilt blocks.
12. At this point, some students "lose" their design by removing the pieces. Suggest they trace the piece and lightly shade it in. The colored pieces will cover the sketching.
13. Gluing: Start at one corner of the square and be sure that adjacent sides fit tightly together as they glue.
14. Refer students back to how the pioneers chose names for the quilt blocks they created. Each student will name his or her own quilt block. Write the name neatly on the address label and place it on the bottom right corner.
15. Students will then combine and glue the four individual squares on a 14x14 piece of paper, forming a border around the combined quilt block.
16. The quilt squares will be displayed around the room.

Assessment Suggestions

- Write a description of their quilt block using mathematical language that includes details about the pattern they created. Encourage students to look at an individual square and identify the fraction represented by a color within that square. They should be able to identify shapes, fractions, and describe their pattern in geometric terms.

- Assess quilt project with the half & half quilt block rubric.

Curriculum Extensions/Adaptations/ Integration

- Encourage students to create as many different quilt square designs as they can using the same fraction.
- Create a quilt block using other fractions such as one fourth, thirds, etc.
- Create a quilt block using a 9-patch template or 16-patch template.
- Set up a repeating pattern center with pattern blocks.
- Provide materials to "copy" additional quilt block patterns.
- Have students make up a creative story about a pioneer child and a special quilt.
- Create a class quilt using fabric or paper about themselves, families, and science or social studies themes, such as habitats, animals, weather, or fossils.

Family Connection

- Have family members share any information or stories about family quilts.
- Does the student have a favorite blanket? Ask parents to tell child history of the blanket.
- Read quilt storybooks together.

Additional Resources

Books

The Quilt-Block History of Pioneer Days, by Mary Cobb; ISBN 1562944851

The Log Cabin Quilt, by Ellen Howard; ISBN 0823413365

The Keeping Quilt, by Patricia Polacco; ISBN 0671649639

Sweet Clara and the Freedom Quilt, by Deborah Hopkinson; ISBN 0679874720

Quilting: Then and Now, by Karen B. Willing & Julie B. Dock; ISBN 096418207

Eight Hands Round, by Ann Paul; ISBN 0060247045

Patchwork Math I, by Debra Baycura; ISBN 0590490733

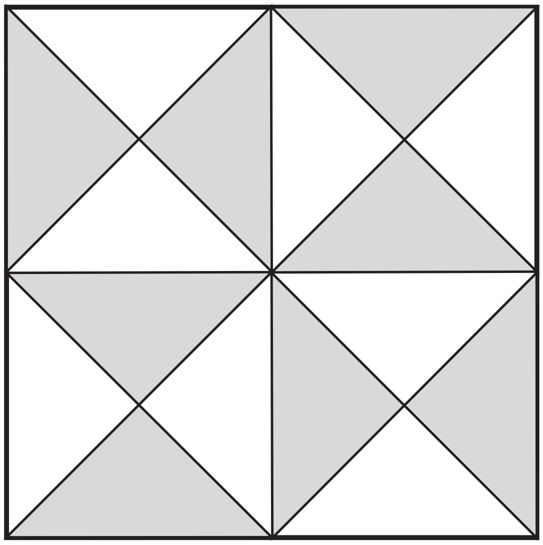
Patchwork Math I, by Debra Baycura; ISBN 0590490761

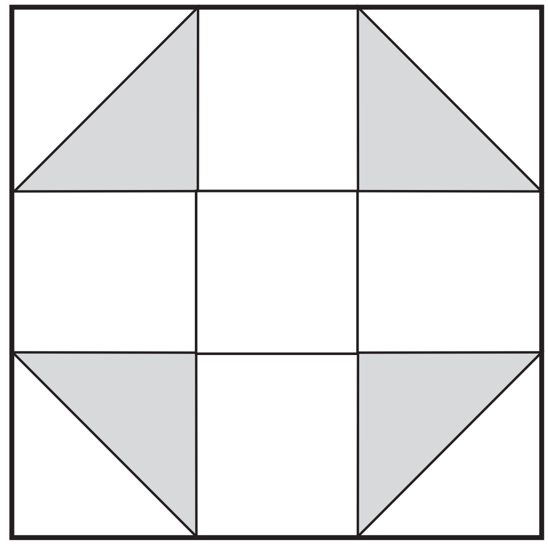
Web sites

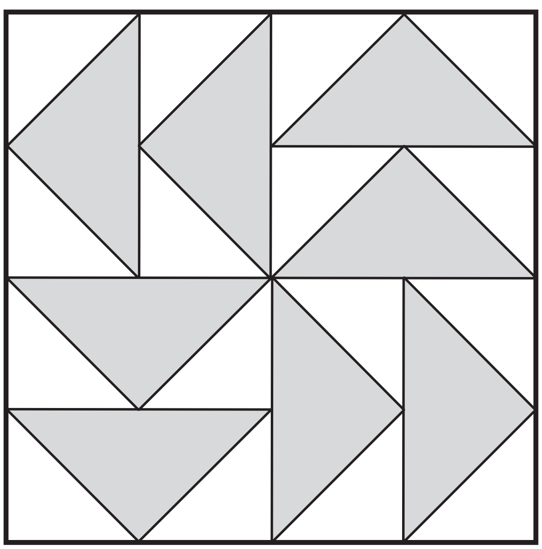
www.quilt.com - Features pictures of patterns

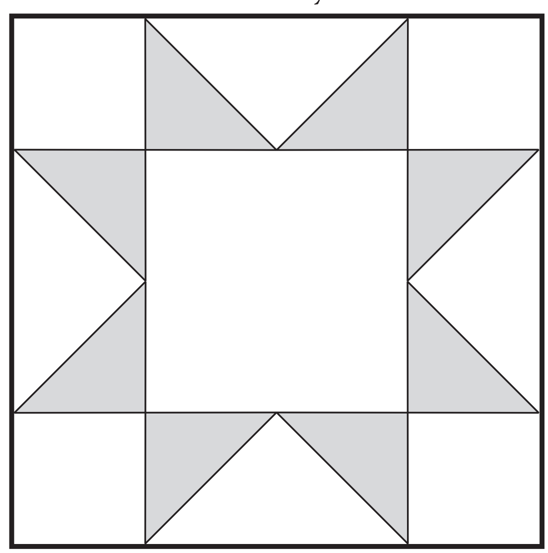
http://www.womenfolk.com/historyofquilts/articles.htm

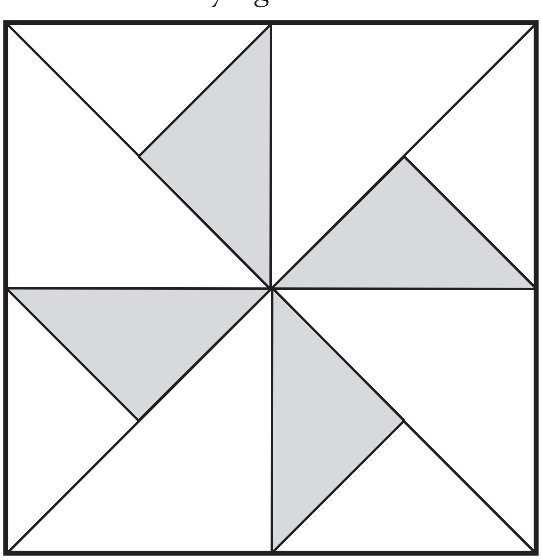
Quilt Patterns

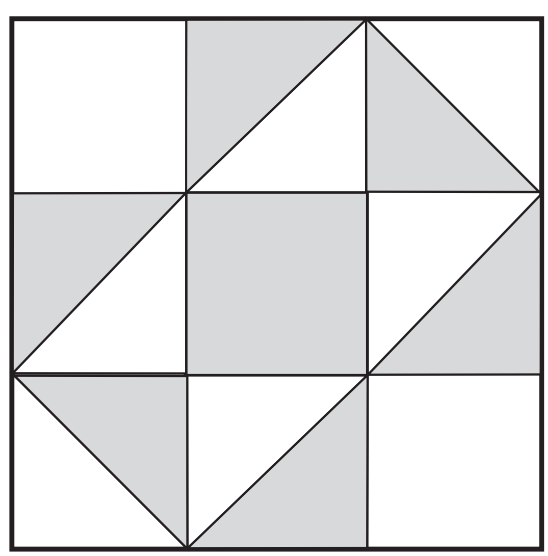

Bow Tie


Shoofly

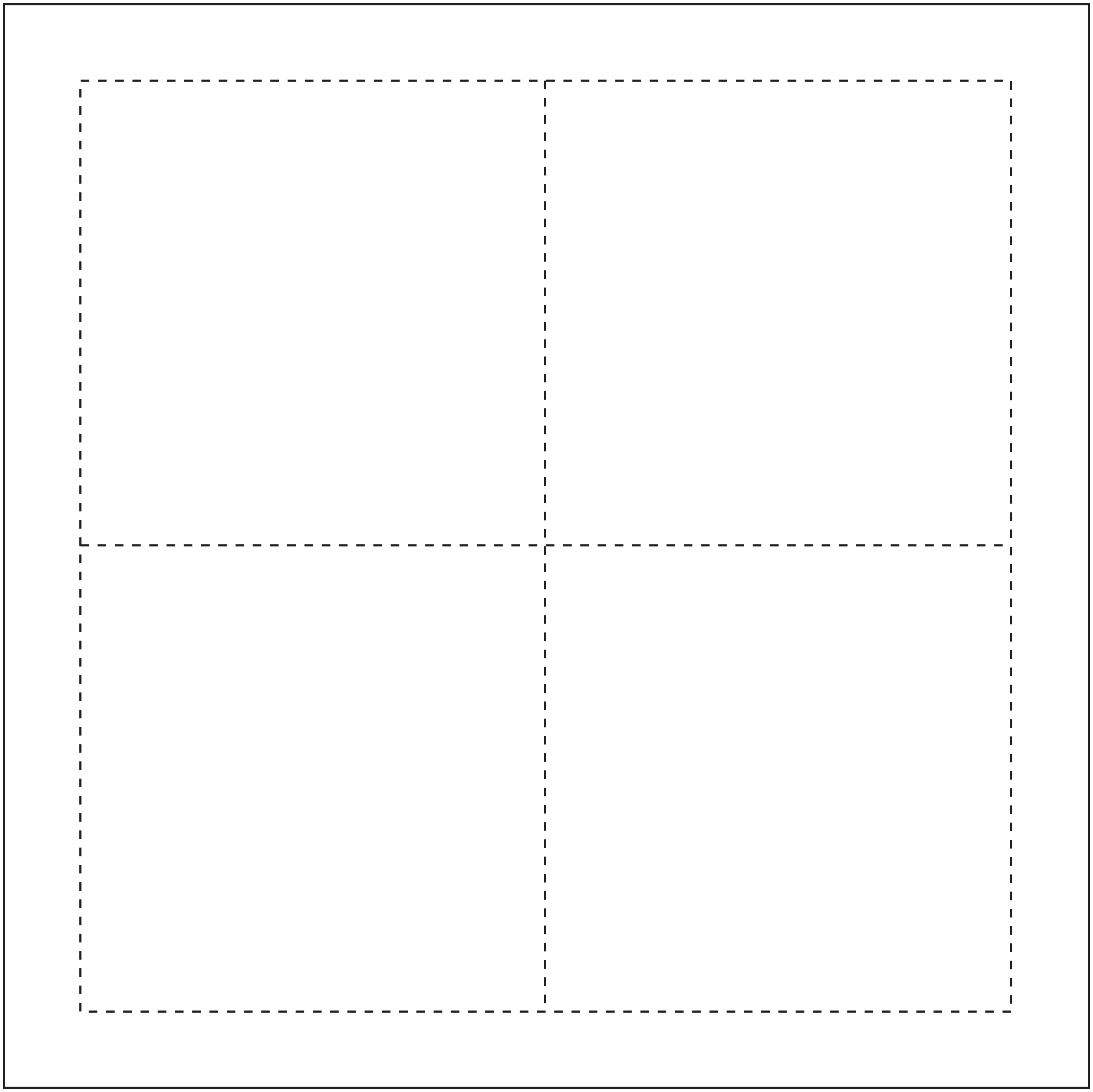

Flying Geese


Lone Star


Water Wheel


Split Nine Patch

4 Patch Quilt Template



Math I-1

Activities

Numbers

Place Value – It's about Patterns

Standard I:
Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.

Objective 1:
Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

Intended Learning Outcomes:
6. Represent mathematical ideas in a variety of ways.

Content Connections:
Language Arts IV-1; Communicating, listening, & speaking
Language Arts IV-8; Communicate effectively for a variety of purposes

Math Standard I

Objective 1

Connections

Background Information

Our place value system is based on a pattern of tens. Each place value increases ten times the value of the place to its right. We use the symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 to write any whole number. The symbols are called digits. Digits have different values depending on their position in the number. You can count items using whole numbers, but not parts of things. When you are counting items that have parts less than one we use decimals.

Numbers are arranged into groups of three called periods. The places within a period repeat (hundreds, tens, ones etc.) Starting at the left, we read the three numbers in a period and then stop at the end of each period and read the unit name before continuing on. The units period does not have to be named when reading a number. We usually separate the periods with commas.

Students need to develop conceptual understanding of numbers larger than 1000. Even though models beyond 1000 are not readily available, in order for students to develop a strong number sense they need to manipulate physical models. It is difficult for students to fully understand models pictured in books. Another important component needed to develop number sense is to have students relate large numbers to actual things in the world.

Research Basis

Jensen, E. (2000). Moving with the brain in mind. *Educational Leadership, 58 (3)*, 34-37. Retrieved January 18, 2007 from http://www.newsletteronline.com/user/user.fas/s=543/fp=3/tp=39.

Brain research has shown that physical movement – moving, stretching, and acting out concepts, can increase the learning process.

Active learners remember the information longer and better than sedentary learners. Teachers should have students: engage in a variety of postures throughout the day, engage in movement during class, use their bodies to demonstrate concepts, role play and include a variety of physical activities to help students learn and if these ideas are not possible then students should at least stop and stretch every 20 minutes.

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Invitation to Learn

Guess My Number

Tell the students that you are thinking of a two-digit number and that both of the digits are different. Check to make sure that students understand what “digit” means and what a “two digit number” is. Explain that the students are to guess your number. Inform them that you will keep track of their guesses and will give them clues to how many digits are correct and if the digits are in the correct place. Draw a three columned grid on the board to keep track of the guesses. Write how many digits are correct (0, 1, or 2) and how many digits are in the correct place (0, 1, or 2). (If one digit is correct, do not tell them which one it is; just say one is correct.) As you play the game remind the students to reflect on what they know about the number so far. Why is it important that the digits are in the correct place? Does the place change the value of the digit? For a more challenging game you can have students guess a three-digit number. For example, let’s say the number is 68.

Guesses	Digit	Place
74	0	0
26	1	0
62	1	1

Instructional Procedures

Part One – Place Value Patterns

1. Ask students to write in their journals everything that they know about our place value system. Give students about five minutes to complete this assignment and then ask some students to share what they wrote. Write some of their responses on the whiteboard or use an overhead projector.
2. After discussing some of their ideas, read the story *A Million Fish . . . More or Less*. Then ask: "Could these things really be true? How long would it take you to jump 5553 times? Could a million fish fit in a wagon? How do you write half a million?" Explain to the students that they will participate in some activities to increase their place value knowledge.
3. Use base ten blocks and review with students that a 1-centimeter cube represents the units or ones place. The tens place is ten centimeter cubes connected in a 10 cm x 1 cm strip. The hundreds place is represented by a square made up of 10 cm x 10 cm. Ask the students how they would represent the thousands place? Does anyone notice a pattern? (Although the thousand's place is often represented with a larger cube, for this activity the students need to see all of the centimeter squares and so the pattern will be square, strip, square, strip, etc.)
4. Tape ten of the hundred flats together. The strip should measure 1m x 10 cm. Make sure that students are making the connection that ten times the previous place makes the next place. How could we model ten thousand? What shape would it be? What would the dimensions be?
5. Have students work in small groups to figure out the dimensions of a ten thousand piece. (Ten one thousand strips would go together to make a square that is 1 m x 1 m.) Work together to complete a ten thousand square.
6. If students are interested you can use a long piece of butcher paper to make the next strip to represent one hundred thousand. If you don't want to tape base 10 grids together you

Materials

- ❏ Base 10 blocks
- ❏ Base 10 grid blackline
- ❏ *A Million Fish. . . More of Less*
- ❏ Butcher paper
- ❏ Scissors
- ❏ Glue or tape
- ❏ Journals

can mark off ten 1m x 1m squares on butcher paper to show how large one hundred thousand is. The strip would be 1 m x 10 m

7. Extend the activity as far as students show interest. (See extensions)
8. Have the students discuss what they learned from the activity about place value. Have them record their thoughts in their journals.

Part Two – Reading large numbers

Materials

- ❑ *Bear Family Story*
- ❑ *Bear Family Houses*
- ❑ *Bear Family Digit Cards*
- ❑ Place value tents
- ❑ Student whiteboards
- ❑ Markers

1. Read the Bear Family story to the class.
2. Explain to the class that when we read large numbers that we first mark off the number in groups of three starting from the right. We use a comma to separate these groups.
3. Then starting at the left, we read the first group of numbers, stopping at the end to name the family or in mathematical terms the period. We do not need to name the units period.
4. Put digits in the bear's houses and have the students practice reading numbers. (In fourth grade we only use the units house and the thousands house, and the millions house.)
5. Then ask the students: "What is the value of the digit in the thousand's place? The hundred's place?" Check for understanding.
6. Explain to the students that numbers can be written in three different ways: standard form, expanded form, and word form. The following activity will give the students practice using standard form and expanded form.
7. Divide the students in partners. Pass out a whiteboard, a marker, and one set of place value tents to each partnership. Give the students an opportunity to look at the place value tents. Ask the students what they notice about the tents? (Hopefully students will point out that each digit shows its value depending on its place. You can make numbers in expanded form and standard form.)
8. Have the partner groups model a three-digit number and check for understanding. Continue to have students model larger numbers that you say verbally. Call on students to reread the number aloud and to read the expanded form of the number.
9. Explain that in each group the students will take turns writing or modeling large numbers. Have one student write a number

in standard form on the whiteboard while the other student models expanded form using the place value tents. Students should be saying the number aloud when it is their turn.

10. Have the students switch roles and take turns going first.
11. Remind the students using the tents that they can mix-up the order of the number to challenge their partners to write it correctly.

Assessment Suggestions

- Walk around the room while students are working on the above activities and observe what they are doing and saying. Are they able to read the numbers in standard and expanded form? Or are they struggling and making errors? Can they use the place value tents to form a number in expanded form? If the expanded number is out of order can the student put it in correct standard form?
- Assess students understanding during whole group discussion from their comments. Are the comments correct or do they have misconceptions?
- Assess students individually. Dictate several numbers for the student to write in standard form and expanded form. Write a number in expanded form or use the tents and mix-up the place value order and have the student put the number in correct standard form. Have the student read numbers aloud.

Curriculum Extensions/Adaptations/ Integration

- Model one million by drawing with chalk a 10 m x 10 m square on the playground.
- Group students with mixed abilities together for group activity.
- Have students write in their journals before the activity and after to explain what they have learned.

Family Connections

- Students could play “Guess my number” with a family member.
- Practice expanded and standard forms of numbers with a family member using the place value tents.

- Have students go on a number hunt and find where large numbers are used in the real world and share with the class.

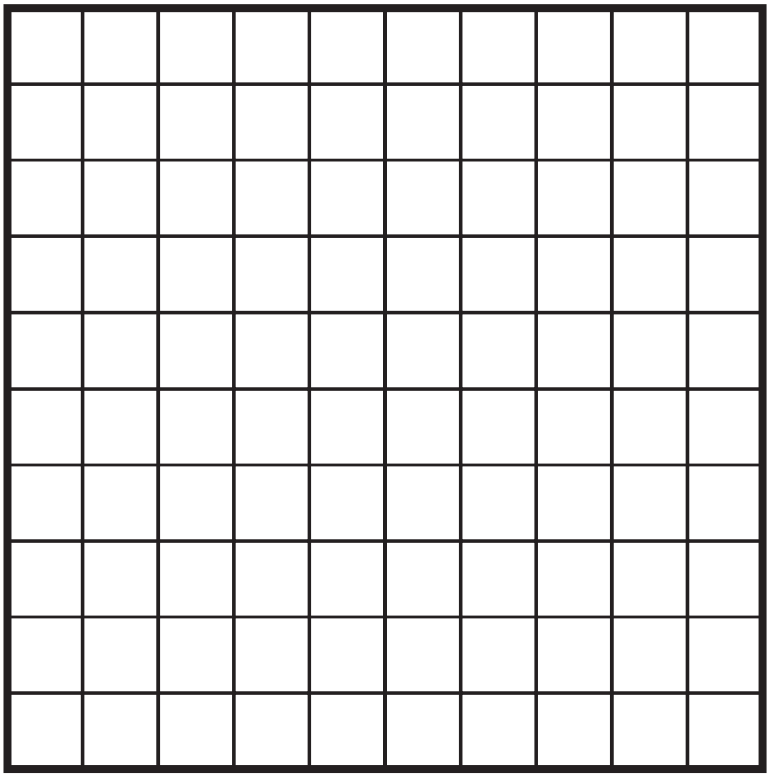
Additional Resources

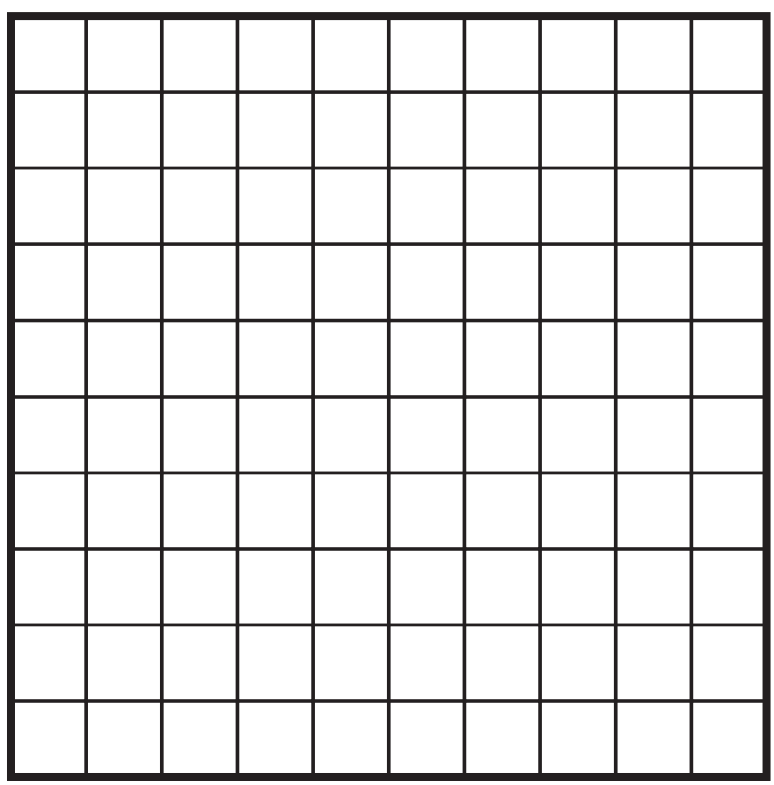
Books

A Million Fish. . . More or Less by Patricia McKissack; ISBN 069880860

How Much is A Million, by David M. Schwartz; ISBN 978-0-688-09933-6

Place Value Patterns





A Bear Family Story

Once upon a time there was a family of bears that lived on a quiet cul-de-sac in the forest. Now this family had three members. There was a papa bear named Henry Hundred. A mama bear named Tecia Ten and a baby bear named Ulani Unit. The Bear family loved the quiet street that they lived on and enjoyed exploring in the woods each day. Everyday the UPS driver would stop by the Bear's house to drop off packages, enjoy a bowl of porridge, and visit with the family. Life was good for the three bears.

Things were going along quite well until one day a new family of bears built a new house on the same cul-de-sac in the forest. This family also had three members. There was a papa bear named Henry Hundred, a mama bear named Tecia Ten, and a baby bear named Ulani Unit. At first the Bear family was a little bit upset because they liked being the only ones to live on the cul-de-sac but after getting to know the new bears, they decided that it was kind of nice having other bears to talk to. Both Bear families enjoyed exploring the woods each day while they visited with each other. Life was good for the two families.

The only one who had a problem was the UPS driver because the families had the same names. He didn't know which house to deliver the creamy honey and which house to deliver the raspberry honey. Over time the problems got worse. When it was Ulani Unit's birthday, the UPS driver didn't know which Ulani Unit to deliver the birthday package to. How would you feel if you didn't get a birthday package from you grandma and grandpa on your birthday? Well, you can understand the dilemma. So the UPS driver decided to call the first family "The Original Family" and the second family the "New Comers." This solved the problem and life was good for everyone.

Then one day, out of the blue, three more families decided to build houses on the same cul-de-sac. You guessed it! Each family had three members, and each member had the same names as the first two families. The poor UPS deliverer was ready to quit, but the "Original Bear Family" really enjoyed his visits so they called a meeting with all of the families.

It was decided that because the "Original Family" had been a family unit the longest on the cul-de-sac and everyone knew them, that they would not need a special name. The other families were given house names to identify them from everyone else. The "New Comers" house was named Thousand House, and the next three bear families were given names for their houses when they moved in too. They were:

Third family – Million House

Fourth family – Billion House

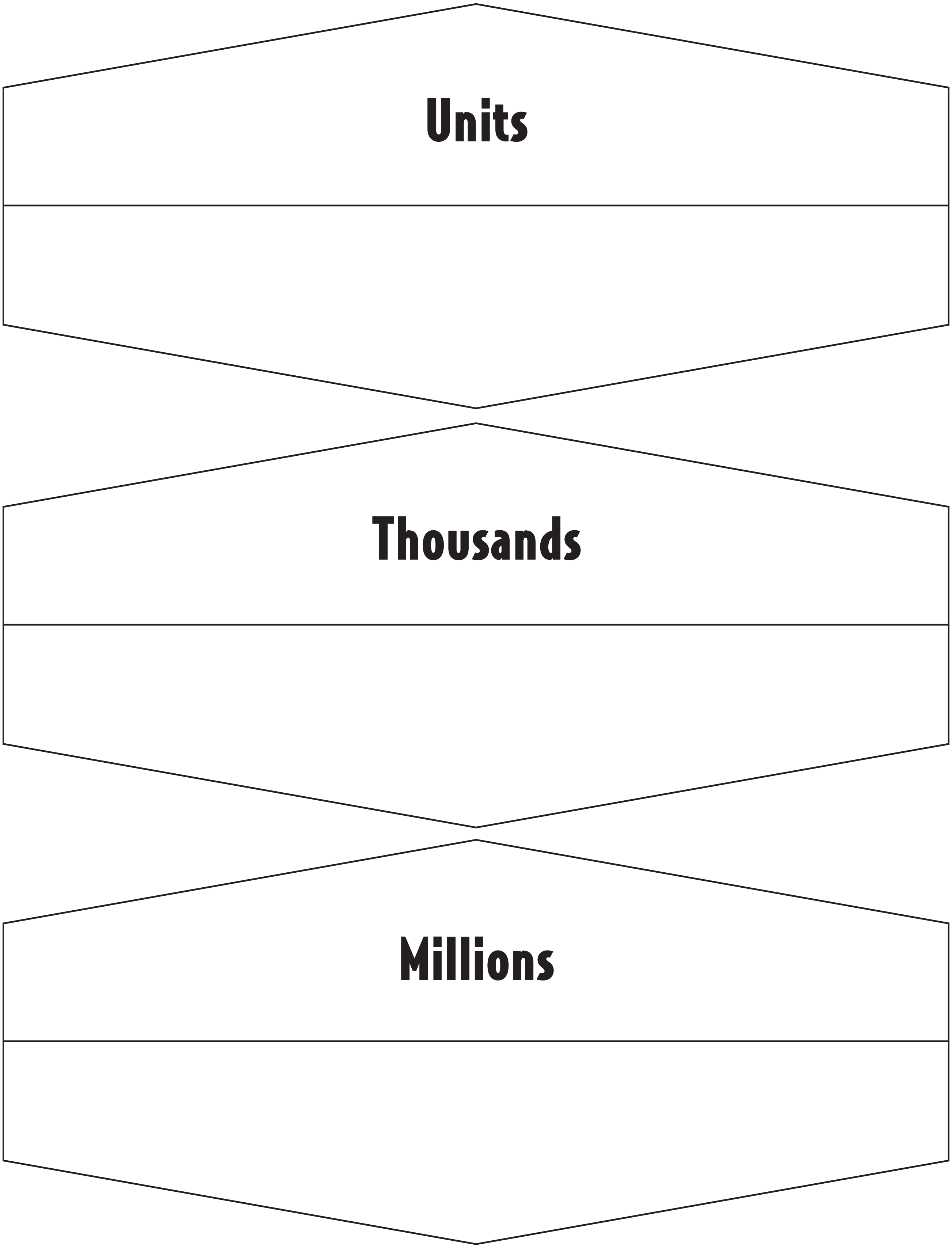
Fifth family – Trillion House

The UPS driver was ecstatic! Now he could deliver the right packages to the right families. The UPS driver kept his job and from then on really enjoyed dropping off packages, eating bowls of porridge, and visiting with all of the bear families. Life was good for everyone!

Bear Family Houses

Hundred	Ten	One
One	Ten	Hundred

Bear Family Houses continued



Bear Family Digit Cards

0	1	2	3	4
5	6	7	8	9

0	1	2	3	4
5	6	7	8	9

Stack-A-Value Cards

Run each set of value cards on a different color of heavy paper (e.g., the ones on yellow, the tens on blue, the hundreds on red, thousands on green, ten-thousands on orange, hundred-thousands on pink.) Cut each value card apart and fold it in the middle so it will stand up. Then you can start stacking the cards to represent different numbers. This is great to use so the student can visually see a representation of the number.

0	1	2	3	4
5	6	7	8	9

Stack-A-Value Cards

00	10	20	30	40
50	60	70	80	90

Stack-A-Value Cards

	400		900
	300		800
	200		700
	100		600
	000		500

Stack-A-Value Cards

	2000		5000
	1000		4000
	0000		3000

Stack-A-Value Cards

	8000		
	7000		
	6000		9000

Stack-A-Value Cards

	10000		30000
	00000		20000

Stack-A-Value Cards

	50000		70000
	40000		60000

Stack-A-Value Cards

	90000
	80000

Stack-A-Value Cards

	100000		300000
	000000		200000

Stack-A-Value Cards

	500000		700000
	400000		600000

Stack-A-Value Cards

	600000
	800000

Make My Number

Standard I:
Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.

Objective 1:
Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

Intended Learning Outcomes:
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Content Connections:
Oral language IV-1; Communication through listening, speaking, and viewing

Math Standard I

Objective 1

Connections

Background Information

When you are counting items that have parts less than one we use decimals. Decimals are used in our place value system to write fractions in tenths, hundredths, thousandths, and so on. We use a dot as a symbol to separate the whole number part from parts that are less than one. The dot is called a decimal point. The decimal indicates that the position to the left is being counted as units or ones. Numbers that are written with a decimal point are called decimals. Decimals follow the same place value pattern as whole numbers. When you are using a base ten system, no matter what place you are looking at, its value increases ten times the value of the place to its right and when you move to the right on this system each piece gets smaller by one-tenth.

Students need to read 2.7, as two and seven-tenths. This helps them to relate decimal fractions to common fractions and reinforces the fact that decimals are fractions written in a different symbolic form. When we read numbers with decimals in them we say "and" when we get to the decimal point.

Research Basis

Jensen, E. (2000). Moving with the brain in mind. *Educational Leadership, 58 (3)*, 34-37. Retrieved January 18, 2007 from http://www.newsletteronline.com/user/user.fas/s=543/fp=3/tp=39.

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Invitation to Learn

Model the following sharing problems as a whole class. Ask students to volunteer and come to the front of the class to help solve each problem. You can use real items or paper representations of the items. Ask the students to represent the remainder as a fraction.

Share five cookies between four people. How much does each person get?

Share seven cookies among three children. How much does each child get?

Divide nine apples between two people. How much does each person get?

Divide seven brownies among four children. How much does each person get?

Divide a whole pie among ten people. How much does each person get?

Ask the students what answers they would get if they used a calculator? Have a group use a calculator to solve the problem. Explain that the answer is a decimal number and that it is the way a calculator represents a number that is between two whole numbers. The decimal number and the fraction are the same amounts, they are just written two different ways. Our place value system is a decimal system so that we can write numbers less than one using digits.

Instructional Procedures

Materials

- ❏ Paper unit squares
- ❏ Sandwich boards

Lesson 1 - Decimals

1. Review the place value activity previously completed. Ask the students what pattern our place value system follows? (Each place increases 10 times to the place to the right.)
2. Explain that the students just discovered that we can write numbers in our place value system that are less than one or in between two whole numbers. What do you think the pattern would be for those numbers? (Guide students by going from the ten-thousand place down to the ones place and show them that the values decrease by one-tenth when you move from left to right.)
3. Ask: How many pieces would we cut the unit into to make the tenths place?
4. Cut a unit square into 10 pieces and place it on the place value chart.
5. Illustrate .5, .9, and other tenths by drawing ten strips on the whiteboard and telling them to pretend that they are looking at the small pieces under a microscope. Shade in various pieces and then talk about half of the pieces being shaded or nine tenths being almost a whole. (You can refer back to the remainders from the story problems used in the “Invitation to Learn.”)
6. Practice reading five digit numbers including the tenths place. Remind the students that when they are reading a large number they follow the same steps learned earlier, except when a number has a decimal they say “and” at the decimal point and then read the tenths place.

Lesson 2 – Make that Number!

1. Divide the class into two teams. Have six students from each team come up to the front of the classroom. Give each student a *sandwich board* to wear. Boards should be prepared prior to class. The boards should have the following numbers on the front and back. (0, decimal point) (1,2) (3,4) (5,6) (7,8) (9,6). Two sets need to be prepared.
2. Explain that you (the teacher) will read a number aloud and that the students need to model the number. The team that completes the task first and correctly gets a point. Let that

group model a few numbers and then have them change places with someone on their team that has not had a turn.

Assessment Suggestions

- Walk around the room while students are working on the above activities and observe what they are doing and saying. Are they able to model the numbers in standard form? Or are they struggling and making errors? Are they able to use the tenths place correctly?
- Assess students' understanding during whole group discussion from their comments. Are the comments correct or do they have misconceptions?
- Assess students individually. Dictate several numbers for the student to write in standard form including the tenths place. Have the student read numbers aloud.

Curriculum Extensions/Adaptations/ Integration

- Have students write in their journals and explain the 10 to 1 relationship of our place value system.
- For struggling students let them see the number to be modeled before you read it aloud when playing "Make that Number".

Family Connections

- Ask students to find examples from the newspaper that show decimal numbers being used and bring the examples to class to share.
- Students can practice reading large numbers and decimals to the tenths place to parents.

Square Numbers

Standard I:

Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.

Objective 1:

Demonstrate multiple ways to represent whole numbers and decimals, from hundredths to one million, and fractions.

Intended Learning Outcomes:

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.

Content Connections:

Language Arts IV-1; Communicating, listening, & speaking

Language Arts IV-8; Communicate effectively for a variety of purposes

Math Standard I

Objective 1

Connections

Background Information

When a number is multiplied by itself, the product is called a square number. Example: 3 x 3 equals 9. When students model square numbers using arrays they can visually see that the array makes a square. An array is a grouping of objects that makes equal rows. It is important to teach students to read arrays by rows first, and then columns.

Research Basis

Jensen, E. (2000). Moving with the brain in mind. ***Educational Leadership, 58 (3)***, 34-37. Retrieved January 18, 2007 from http://www.newsletteronline.com/user/user.fas/s=543/fp=3/tp=39.

Brain research has shown that physical movement – moving, stretching, and acting out concepts, can increase the learning process. Active learners remember the information longer and better than sedentary learners. Teachers should have students: engage in a variety of postures throughout the day, engage in movement during class, use their bodies to demonstrate concepts, role play and include a variety of physical activities to help students learn and if these ideas are not possible then students should at least stop and stretch every 20 minutes.

Marzano, R.J., Pickering, D.J., & Pollock, J.E. (2001). ***Nonlinguistic Representations. In classroom instructions that works,*** (72-83). Alexandria, Virginia: ASCD.

Researchers believe that students learn and store information in two different ways. The first form is a linguistic form where the learner either listens to the information or reads it in a book. In the second form, non-linguistic, the learner forms a mental image or a physical sensation by touching, smelling, listening, tasting, or kinesthetic association. Research has shown that when students learn using both forms their achievement improves greatly. After a non-linguistic form of learning has taken place students should be asked to explain and justify what they have learned. When students are able to explain their thinking and reasoning to others their knowledge increases and they are able to recall it easier. Non-linguistic representations include: making physical models, using manipulatives, drawing pictures, graphic organizers, or engaging in kinesthetic activities.

Invitation to Learn

Pass out a small bag of centimeter cubes to each student. Explain that the students are going to make arrays using the cubes. An array is a grouping of objects in equal rows. Ask the students to count out nine cubes. Have students share their arrays as they make them and then model them on the overhead. Students should come up with 1 x 9, 9 x 1, and 3 x 3. These numbers represent the factors of nine. Ask the students if they notice anything about the 3x3 array? Explain that nine is a square number. Can anyone tell why it is called a square number? Are there more square numbers?

Instructional Procedure

Materials

- ❏ *My Full Moon is Square*
- ❏ Centimeter cubes
- ❏ Overhead cubes
- ❏ Journals
- ❏ *Square Numbers Foldable*
- ❏ Scissors
- ❏ Glue

1. Read the story *My Full Moon is Square*, but stop and have the students model what the array for four fireflies would be using their cubes. Ask a student to share what the array should look like and then model it on the overhead projector.
2. Continue reading and stopping to have the students model and share the square arrays using their centimeter cubes that corresponds with the story. Continue modeling on the overhead projector.
3. After the story, have the students define what square numbers are and write the definition in their journals.
4. Pass out the *Square Numbers Foldable* black line, scissors, and glue to the students. Fold the title page into three equal parts vertically. Have the students cut out the cards and glue them onto the title page.
5. In the inside of each card the students should draw the array that makes the square number.

Assessment Suggestions

- Walk around the room while students are working on the foldable activity and observe what they are doing and saying. Are they able to model square numbers with the centimeter cubes? Or are they struggling and making errors?
- Assess students understanding during whole group discussion from their comments. Are the comments correct or do they have misconceptions?
- Assess students individually. Dictate several square numbers for the student to model the array using the cubes.

Curriculum Extensions/Adaptations/ Integration

- Advanced learners could continue to explore larger square numbers.
- Have learners with special needs use the centimeter cubes to model the array when making the foldable.

Family Connections

- Have students share their *Square Number's Foldable* with family members.

Additional Resources

Books

My Full Moon is Square, by Elinor J. Pinczes; ISBN 0-618-15489-2

Square Numbers	**Square Numbers**	**Square Numbers**

9	36	81
4	25	64
1	16	49

$3 \times 3 = 9$

$2 \times 2 = 4$

$1 \times 1 = 1$

$6 \times 6 = 36$

$5 \times 5 = 25$

$4 \times 4 = 16$

$9 \times 9 = 81$

$8 \times 8 = 64$

$7 \times 7 = 49$

144	144	144
121	121	121
100	100	100

$12 \times 12 = 144$	$12 \times 12 = 144$	$12 \times 12 = 144$
$11 \times 11 = 121$	$11 \times 11 = 121$	$11 \times 11 = 121$
$10 \times 10 = 100$	$10 \times 10 = 100$	$10 \times 10 = 100$

Science III-3

Activities

Soil/Plants

S-O-I-L SOIL

Standard III:
Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

Objective 3:
Observe the basic components of soil and relate the components to plant growth.

Intended Learning Outcomes:
1. Use Science Process and Thinking Skills
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:
Language Arts I-3 Listening and speaking
Language Arts VII-3 Different genres (tall tales)

Science Standard III

Objective 3

Connections

Background Information

Prior to teaching this lesson your students need to have basic knowledge of the components of soil.

You will also need to enlist a student or another teacher to help you with your invitation to learn.

At the end of this activity students should know these things:

- Plants need nutrients to grow.
- Plants get those nutrients from the soil
- Nutrients can be added to soil to help plants grow better.

Research Basis

Dickinson, V.L, Young, T.A. (1998) Elementary Science and language arts: Should we blur the boundaries? Retrieved 1/4/2007 from http://www.education.ky.gov Literacy and Science

Helping teachers see, understand, and implement instructional practices which rely on teachers' strengths in language arts instruction to improve their teaching of science content could be a solution to the lack of confidence in science instruction.

Nixon, D.T. Akerson, V. L. (2002) Building Bridges: Using Science as a Tool to Teach Reading and Writing Retrieved 1/4/2007 from http://www.education.ky.gov Literacy and Science

This study cited many previous studies that proved the value of integrating science and language arts. There are many reasons to consider the integration of science and language arts. The most compelling is evidence showing cognitive parallels. Reading, writing, and science all require a combination of cognitive processes and the activation of conceptual knowledge. The strategies that are applicable to reading and writing are comparable with the strategies used to construct science understanding.

Invitation to Learn

Teacher dresses up as Old MacDonald. (Overalls, straw hat, shovel) Comes in classroom carrying a small, wilted plant.

Old MacDonald: (Acting sad and discouraged) I am just not having any luck growing crops on my farm and I'm very worried about my farm and my animals! If I can't grow hay, my cow will get skinny and not give milk. If I can't grow corn there'll be no food for my chickens and they won't lay eggs and my pigs won't grow big and fat and there'll be no bacon to eat for breakfast! Even my poor old horse will get too tired to take me for a ride if I can't grow oats. Something is wrong with my farm, but I just don't know how to fix it—I must be a bad farmer!

Student or another teacher dressed as a scientist in a lab coat enters the room carrying a bucket of soil.

Scientist: " Old MacDonald I think I know what your problem is..... you're not a bad farmer...it's your soil!"

Old MacDonald: My soil? (Looks in bucket) That's just plain old dirt! What's dirt got to do with not being able to grow crops for my animals to eat?

Scientist: What's dirt got to do with it? Just everything Old MacDonald!

(In an aside whisper to students: "Maybe he is a bad farmer if he doesn't even know that–lucky we came along to help him!")

Lucky for you, I'm a soil scientist and I've got all these great assistant scientists to help you out. We'll dig (ha-ha) until we find out what the problem with your farm is, don't you worry! And to cheer you up and help you understand what soil has to do with your crops we'll sing you a song! Okay, assistants you know this song...help me sing it so we can get started on helping Old MacDonald fix this farm.

Song (To the tune of Old MacDonald Had a Farm)

Old MacDonald had a farm

S-O-I-L SOIL

And on his farm he had some crops

S-O-I-L SOIL

With some shriveled corn here and a skinny cow there

Here no crops, there no crops

Your soil's why there's no crops

Old MacDonald had a farm

S-O-I-L SOIL

Scientist: Are you ready assistants? We're going to fix this soil and help Old MacDonald have the best farm in Utah!

Old MacDonald: Yippee! Let's get going!

Instructional Procedures

1. Make Soil Journals (It would be best to have these made ahead of time)
2. Access students' prior knowledge about what plants need to grow. Draw a plant on the board or on a poster showing what plants need. Patterns for students to trace to make their flowers are included in Soil Journal blacklines. Have students copy this information onto the flower. Each section goes on a different petal. When done they can insert the flower into the cover of their Soil Journal.

Plants need:

Sunlight: They need to be planted where they can get the amount of sunlight they need. Some plants like shade and some like full sun.

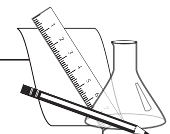
Water: Plants get water through their roots. If they have too much or too little water they will not grow well.

Air: Soil needs to be loose and have air pockets in it for the plants. If the soil is too wet or too tightly packed there is not enough air.

Nutrients: Plants need certain foods called nutrients to grow and be healthy just like you do. These nutrients come mainly from decaying organic (plant and animal) materials in the soil.

3. Ask this question: What does soil have to do with plant growth? Listen to this excerpt from a tall tale about a farmer named McBroom who bought a wonderful one-acre farm. See if you can figure out what the soil on his farm had to do with the way his crops grew.

Read this excerpt from *McBroom Tells the Truth* by Sid Fleischman



Materials

- ❏ Farmer costume
- ❏ Scientist lab coat
- ❏ Bucket of soil
- ❏ Old MacDonald song overhead
- ❏ Soil journals
- ❏ Sample of fertile soil, organic rich
- ❏ Sample of infertile soil, poor nutrients
- ❏ Small wilted plant
- ❏ White butcher paper
- ❏ Magnifying glasses
- ❏ Crayons / colored pencils
- ❏ 12 x 18 white art paper
- ❏ Fine point markers
- ❏ *Old MacDonald's Script*
- ❏ *SOIL*

But the moment I ran the topsoil through my fingers, my farmer's heart skipped a beat. That pond bottom felt as soft and rich as black silk. "My dear Melissa!" I called. "Come look! This topsoil is so rich it ought to be kept in a bank."

I was in a sudden fever of excitement. That glorious topsoil seemed to cry out for seed. My dear Melissa had a sack of dried beans along, and I sent Will and Chester to fetch it. I saw no need to bother plowing the field. I directed Polly to draw a straight furrow with a stick and Tim to follow her, poking holes in the ground. Then I came along. I dropped a bean in each hole and stamped on it with my heel.

Well, I had hardly gone a couple of yards when something green and leafy tangled my foot. I looked behind me. There was a beanstalk traveling along in a hurry and looking for a pole to climb on.

"Glory be! " I exclaimed. That soil was rich! The stalks were spreading out all over. I had to rush along to keep ahead of them.

By the time I got to the end of the furrow the first stalks had blossomed, and the pods had formed, and they were ready for picking.

You can imagine our excitement. Will's ears wiggled. Jill's eye's crossed. Chester's nose twitched. Hester's arms flapped. Peter's missing front teeth whistled. And Tom stood on his head.

"Willjillhesterchesterpeterpollytimtommarylarryand littleclarinda," I shouted. "Harvest them beans!"

Within an hour we had planted and harvested that entire crop of beans. But it was hot working in the sun! I sent Larry to find a good acorn along the road. We planted it, but it didn't grow near as fast as I had expected. We had to wait an entire three hours for a shade tree.

Of course, there was a secret to that topsoil. A government man came out and made study of the matter. He said there had once been a huge lake in that part of Iowa. It had taken thousands of years to shrink up to our pond, as you can imagine. The lake fish must have been packed in worse than sardines. There's nothing like fish to put nitrogen in the soil. That's a scientific fact. Nitrogen makes things grow to beat all.

4. Tell the class: This story gave us some good clues about what needs to be in soil for plants to grow. We are going to study two soil samples. One sample is rich, fertile soil...this would be the kind of soil on McBroom's farm where the crops grew very well. The other will be poor, infertile soil, like the kind on Old MacDonald's farm where the crops are not growing well at all.

   Discuss the adjectives "rich" and "poor" used to describe soil–why do you think these are good descriptions of soil?

Our job will be to examine these soil samples and figure out what the difference is between rich fertile soil and poor infertile soil

5. Put class into groups. Have them put their desks into tables and then cover the desks with white butcher paper or large white art paper. Give each group two soil samples–label the Fertile Soil "McBroom's Farm" and the infertile soil "Old MacDonald's farm. They will need their crayons or colored pencils and their Soil Journals.
6. Instruct students to carefully spread out their two soil samples–making sure not to mix the two samples. Closely examine and compare the two soils, use the magnifying glasses. Look at the color and the composition of the soil. Does it look like there would be air in the soil? How much water is in the soil? What texture is the soil?

   Separate the living and once-living organic materials from the non-living inorganic materials.

   You could have students draw a graphic organizer such as a word web to help them organize the different components.
7. In their Soil Journals they need to do a Compare/Contrast rectangular Venn diagram.

McBroom's Rich Fertile Soil Things that are Different	Things that are alike about the two soils	Old MacDonald's Poor Infertile Soil Things that are Different

   They need to look for things that are similar between the soils and things that are different. Use words and pictures to complete the diagram.

8. Each group needs to come up with a hypothesis about what differences in the soil affected the plant growth. They need to use words like fertile, infertile, nutrients, and organic in their hypothesis. Have each group choose a scribe or secretary to write down their ideas. Give them a large 12 x 18 paper and

markers to write with so the others can see it to copy it into their journals after the groups are satisfied that they have correct final version of their hypotheses.

Example: The fertile soil from McBroom's farm had lots of organic material in it. There were decaying plants and even a worm. We think the organic matter provided the nutrients that the plants needed to grow better. The soil had enough air in it for the plants to live and the right amount of water.

The infertile soil from Old MacDonald's farm was very (sandy, dry, loose) or (heavy, wet, sticky, hard) so it did not have the right amounts of air and water. There was hardly any organic matter in it, so there weren't enough nutrients for the plants to grow.

9. On the next page in their journals they need to illustrate the two farms, showing the type of soil and the way plants would grow. Label the first drawing "McBroom's Fertile Farm". Label the second drawing Old MacDonald's Infertile Farm.
10. Discuss with class:

    Can we help Old MacDonald with his problem?

    Can he improve the soil on his farm so his crops will grow better?

    What are some things you think would help?
11. Tell class that you have a Readers' Theater that will help them learn about things they can do to help improve soil so it can grow crops better. When you finish the Reader's Theater have a class discussion and talk about what they learned about soil from doing the play.

Assessment Suggestions

- Formative: Teacher observation as they come up with hypotheses about soil.
- Evaluation of their journal pages
- Final Assessment: S-O-I-L Soil (Blackline in appendix)
- Read situation cards with multiple-choice answers to class. Have them write their answers on an answer sheet.
- Example:

  The flowers in Bob's garden are dying. The roots and stems are all waterlogged. What does he need to do?

  A. Mix more clay in with the soil

B. Mix more sand in with the soil
C. Water the flowers more
D. Add fertilizer

Curriculum Extensions/Adaptations/ Integrations

- Struggling readers: Give them a copy of the Reader's Theater in advance and have them practice their parts.
- Have students make props and figure out actions/movements to add to Reader's Theater
- Ask students to get a soil sample from their yards and bring to school to analyze
- Invite an expert gardener to come to your class and talk about what they do with their soil
- Go on a mini field trip to visit a neighborhood garden or farm.

Family Connections

Encourage students to discuss plans with their families to allow child to have a small garden plot or flower garden. Have student teach family what they can do to make the soil fertile.

Additional Resources

McBroom Tells the Truth, by Sid Fleischman; ISBN 0843179437 (available at amazon.com)

McBroom's Wonderful One Acre Farm, by Sid Fleischman; ISBN 0688155952

Readers' Theater
"Old MacDonald's Soil"

Characters: Adjust the number of characters for each part so each child in the class has a part
Old MacDonald
Farm Animals
Soil Scientists
Crops
Worms

Old: (*Surveying his crops*) Oh dear...My farm is just not doing well. The crops are not growing. What am I going to do?

Crops:

Corn: (*Falling over*) We just can't stand up in this sandy soil Old MacDonald! And we're dying of thirst. As soon as you give us water it runs right through the soil so fast that our roots can't even catch any of it to give us a drink! You need to do something fast!

Hay: *(Acting like they're swimming)* Well what about us Old MacDonald? We're drowning over here.... you planted us in the heavy clay soil. The water just puddles up so we can't get enough air because our roots are always soaking in water. Then when the water finally starts to dry up this soil is like cement. Would you like to have your feet stuck in cement?

Vegetables: *Acting weak and sickly*) You think you guys got it rough? You should be us! Old MacDonald expects us to grow big healthy vegetables to feed his animals and his family...but we're not getting anything to eat ourselves! There are no nutrients in this soil. How's a vegetable supposed to grow up to be healthy if we don't get any nutrients? You need to go to farmer school Old MacDonald!

Animals:

Horse: If you think I'm gonna pull your wagon, or take you for a ride, you better get me some food. I'm too weak to even lift my hooves. I need food now!

Cow: Milk? You got milk? I don't got milk! I need some good food if I'm gonna make milk. Get busy old MacDonald!

Pig: Pigs are supposed to be fat Old MacDonald! I'm ashamed to show my face... and my skinny belly. A skinny pig...that's a disgrace old MacDonald. We want food!

Chicken: (*Scratching through dirt) Corn*? Where's the corn? I've scratched until my poor feet are worn clear down to the chicken bone! How's a chicken supposed to survive if there's not any corn to scratch and peck! No eggs for you Old MacDonald!

Soil Scientists: *(Driving by in bus)* What's going on at that farm? The animals and the crops are all yelling at the farmer. We better stop and help him out before he as a war on his hands!

Scientist #1:	**What's** the problem here?
Old:	I don't know what's wrong. I just can't get my crops to grow, so I don't have any food for my animals! They said I need to go to farmer school...but I don't know where a school like that is.
Scientist #2:	Well I'd say you are in luck Old MacDonald. You don't need to go to a farmer school.... we can bring the school to you!
Scientist #3:	*Yup*...that's what we do! We're Soil Scientists and we travel around helping farmers grow better crops.
Scientist #4:	Let's take a look scientists, and see if we can figure out what the problem is.
All scientists:	*(Look carefully at the crops.... say things like* "I see" "oh dear, this is a problem, no wonder, etc.)
#1:	Old MacDonald, your problem is your soil. You need to fix your soil before your crops can grow and you can feed your animals.
Old:	Fix my soil? How on earth do you do that?
#2:	Well you have a lot of problems on this farm so we better tackle them one at a time.
Crops:	*(all together)* Me first.... we're the worst...take care of me now...I'm dying...you better get over here fast!
Animals:	*(All pointing to or gathering around their favorite crop)* Yeah, come on scientists, take care of this one...I'm sure this is the most important...I'm starving, etc.
#3:	Hold your horses! *(All the animals grab onto the horse)* Not like that...I mean just hold on a minute. We'll take care of everyone.... don't worry!
#4:	Let's start with this corn. It's falling over and it looks like it really needs a drink!
Corn:	Oh thank you thank you.... you're right. We can't last another minute!
#1:	The problem, Old MacDonald, is you planted your corn in sandy soil. Sandy soil is too loose to hold up big plants like corn.
#2:	And the water runs right through it. Your soil is all dried out before the corn gets any water!
Old:	Well what can I do.... I had to plant it somewhere. Who knew corn was so picky?
#3:	Well first thing old MacDonald is you need to mix some clay into this soil. That will make the soil stronger and it will slow down the water. Then your plants will get the water they need.
#4:	Good soil is a mixture of the different types of soil.
Hay:	Don't forget us!
Horse:	Yeah, don't forget them...it's way past my lunchtime!
#1:	Well the problem with this soil is it's straight clay. You need to mix some sand into the clay. That will make the soil lighter.
#2:	Your plants will be able to get the air they need because they won't be waterlogged all the time.
#3:	There's part of your solution Old MacDonald...just mix up these two soils. They'll both be better if you mix them together. Good soils are a combination of sand, silt, and clay.
Vegetables:	Okay, but we are growing in average soil. It's really not too heavy or not too light...but we're starving. There's nothing to eat in this soil.

#4: You need to mix in some nutrients in all your soil Old MacDonald. Plants need to eat too.
Old: Plants need to eat? That's news to me. What did you say they eat?
#1: Nutrients
Old: Well what are they and where do you get them? Can I go to a drive-thru?
#2: It's the things in the soil that plants need to grow and make their own food.
#3: You have plenty of them right here on your farm.
#4: Yes, Some nice manure from your cows, or some dead leaves and plants will help add some nutrients in the soil for your plants.
#1: You just throw them on the soil and dig them in.they break down in the soil and the plants can get the nutrients they need. That's called organic matter and it's really important that there is plenty of organic matter in soil.
Old: Well that doesn't sound too hard...is there anything else I can do?
#2: You could go the Farm store and buy fertilizer.
#3: Yes, some companies make fertilizer that you can use in your soil. It contains the nutrients that plants need to grow healthy and strong.
#4: It's called fertilizer because it helps the soil become fertile. Fertile means it can grow really good crops and plants.
Worms: *(Lying on the floor) Hey*, don't forget about us!
Old MacDonald: *Worms*? I'm not going fishing. *(Worms shudder and look scared) I* need to fix my soil. What do worms have to do with that?
Worms: *(Pop up from floor)* We'll tell you that ourselves!
Worms sing: *(Tune: Mary Had a Little Lamb)*
Worms do lots of good for soil, good for soil, good for soil
We dig and loosen up the soil and that makes room for air
Our castings fertilize the soil; make fertile soil, fertile soil
We add nutrients to the soil and that helps plants to grow.
Old: Wow! You really do help the soil...I won't use you for bait anymore!
Worms: (Look *relieved and cheer*)
Scientists:
#1: So that's the bottom line Old MacDonald. You want good crops and food for your animals you better have good food for your plants...
#2: and that means good soil...
#3: Not too light and loose and dry...
#4: Not too heavy and packed and wet...
All: And plenty of nutrients.
Old: I think I've got it. I need to go mix my soils...a good combination of sand, clay and silt is what plants need.
Crops: And don't forget the nutrients!
Animals: Yep, add organic matter and fertilizer.
Worms: And remember we can help!
Old: Yippee! I think I'm gonna have the best soil in the state!
Crops: And the best crops!
Animals: And the best fed animals!
All: The best farm!

All characters sing: Old MacDonald had a farm S-O-I-L SOIL
And on his farm was fertile soil S-O-I-L SOIL
With great soil here and nutrients there
Here great crops, there great crops
The soil's growing great crops
Old MacDonald had the best farm S-O-I-L SOIL

Final Assessment S-O-I-L Soil

The flowers in Bob's garden are dying. The roots and stems are all waterlogged. What does he need to do? A) Mix more clay in with the soil B) Mix more sand in with the soil C) Water the flowers more D) Add fertilizer	Sally is trying to grow large sunflowers in her garden, but they keep falling over. They keep wilting because they aren't getting enough water. What should she do? A) Mix more clay in with the soil B) Mix more sand in with the soil C) Water the flowers more D) Add fertilizer	Tom's crops did not grow well this summer because there was very little organic matter in the soil. It is now autumn. What could Tom use to add organic material to his soil? A) Water the garden a whole bunch before winter B) Plow or till up the soil to add air C) Put the leaves that he rakes into the garden. Let them decay and then dig what's left into the soil in the spring.
Sarah's soil is very tightly packed. It has a lot of clay in it. The plants' roots have a hard time getting down into the soil. What could she do? A) Get some sandy soil and till it into garden's soil. B) Nothing, she will just have to give up gardening C) She will have to go to the store and buy all new soil	Paul has been growing hay in the same field for 10 years. This year the hay did not grow very well. What could he do? A) Sell the field B) Water the field more C) Plant a different crop that uses different nutrients than hay and add some fertilizer.	Susan needs to add nutrients to her soil. Which of these things can she not use? A) Manure from a neighbor's farm. B) Rocks from the field across the street C) Fertilizer she can buy at the store
Farmer John says his soil is fertile. What does he mean? A) His soil is full of tile. B) His soil grows plants well. C) His soil is sand.	Organic means: A) Living and once-living things B) Non-living things such as water, air, and rocks	Tiffany's garden has poor, infertile soil. Her garden will probably: A) Produce lots of strong, healthy plants. B) Produce a few unhealthy plants.

The Dirt on Soil

Standard III:
Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

Objective 3:
Observe the basic components of soil and relate the components to plant growth.

Intended Learning Outcomes:
1. Use Science Process and Thinking Skills
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:
Language Arts Standard VIII- Objective 1 Use graphic organizers

Science Standard III

Objective 3

Connections

Background Information

This activity is set up to do demonstrations and experiences with the whole class doing them together. You need to break this activity up and do one section each day rather than trying to do it all at once. You can also set this activity up into centers and have the students rotate through them with an aide or volunteer helping with each one.

There are a number of things that need to be prepared ahead of time for this activity

Assessment will be ongoing throughout the activity. Use the Red Card/Green Card: Stop Me If I'm Wrong assessment strategy. Give each student a red card and a green card. After each section present statements to the students. If your statement is true, they show the green card. If you make a false statement the students need to STOP you by showing their red cards. They then need to decide what was false about the statement and correct it so it becomes a true statement. They then show their green cards again and you can continue.

At the end of this activity students should know the following:

- Rock is the parent material of soil. Rock is the source of the inorganic (nonliving) materials found in soils. The rock is broken down into sediments (small pieces of rock and minerals) through the process of weathering. These sediments are a component of soil.
- Most soils are formed from sediments that have been moved by erosion-blown by winds, moved by water or glaciers. (Teacher information: Fast moving water leaves behind gravel and sand. Slow moving water and lakes leave behind fine textured clay and silt when sediments in water settle.)

- Different types of sediment make different types of soil. Most common soils are a mixture of these three types.

  Sand: Large, gritty particles (Feels like sugar)

  Silt: Smaller, smooth particles (Feels like flour)

  Clay: Tiny particles, sticky when wet, forms hard clumps or clods when it dries (Feels like modeling clay)
- The sediments provide structure for plants in the soil. They give the roots something to hold onto.
- Air and water are also components of soil. These components are necessary for plants to grow. The size of the sediments affects how the soil holds air and water.
- Soil contains organic material. Living and once-living (dead and decaying) plant and animal matter. These organic materials provide most of the nutrients plants need to grow.
- Plants can be grown without soil, if they are provided air, water, and nutrients from another source.

Research Basis

Krueger, A., &Sutton, J. (2001). *EDThoughts What We Know About Science Teaching and Learning.* (84)

Hands on experiences help students make meaning about scientific phenomena and help students move from more concrete to abstract levels of thinking. Ongoing learning assessment with timely, focused feedback helps students attain deeper understanding.

Ruis-Primo, M.A., Li, M., Ayala, C., and Shavelson, R.J. (1999). *Student Science Journals and the Evidence they Provide: Classroom Learning and the Opportunity to Learn.* (Paper presented at the meeting of National Association for Research in Science Teaching. Retrieved 1/4/2007 from http://www.education.ky.gov

A study of California fifth-graders, which looked at whether journals were an effective way of assessing learning from inquiry, based science lessons. Results showed a strong correlation between student performances on journal entries with their achievement. Students with low journal scores tended to have poor understanding of science concepts. Journal writing can be a valid way to demonstrate science achievement.

Invitation to Learn

Read the book *Dirt* by Steve “The Dirtmeister” Tomecek aloud to class.

Instructional Procedures

Make Soil Journals

(Patterns and instructions are included the appendix)

Formation of Soil

- Give students a rock. Tell them their assignment is to turn the rock into soil. Do not give them any more information. Tell them they have 5 minutes to write their plan for turning the rock into soil in their journals. They can use pictures, words, phrases, or sentences.
- Show them a cake mix and explain that making soil is similar to making a cake. Think about it...do you just put the box into the oven and presto a cake comes out? What do you need to do? (Add other things, mix them together, put it into the oven and let it bake) Explain that making soil from rocks is a process much like this. You have to add other things, mix them together, and it takes time)
- The first step in turning rock into soil is that it must be broken down into sediments–small pieces. (Pass out containers of sediment for students to look at and touch) Access students' prior knowledge about weathering and ask them how rocks can be broken down. Make sure they include wind, water, ice, plant roots, people. Once the rock is broken down it is often moved to a different place. This is called erosion. Access prior knowledge about erosion. What forces cause erosion? (Wind, rivers, runoff, glaciers) The sediments are piled up. Is it soil yet or just a pile of sediment? It's not soil yet...it needs more.
- Think about the cake mix again. Pour the cake mix into a bowl. The cake mix is like the pile of sediments. What do we have to do to make this into a cake?
- Add eggs and oil
- The eggs and oil represent organic matter in the soil. Organic matter is plants and animals, which die and start to decay in the soil. Pass out containers of leaf mold. This is what leaves look like after they have started to decay. Where do you think the parts of the leaves that are gone went? (Into the ground)

Materials

- ❑ *Dirt*
- ❑ Soil journals
- ❑ Colored pencils
- ❑ Scissors
- ❑ Glue
- ❑ Red and green card for each student
- ❑ Rocks
- ❑ Cake Mix
- ❑ Bowl
- ❑ Eggs
- ❑ Oil
- ❑ Water
- ❑ Mixer
- ❑ Containers (1 per group) of sediments (small pieces of rock and minerals, gravel, etc)
- ❑ Containers (1 per group) of leaf mold
- ❑ Overhead projector
- ❑ Transparency of circle graph
- ❑ Containers of garden soil with a worm and plant
- ❑ Magnifying glasses
- ❑ Paper towels
- ❑ 3-pint jars
- ❑ Marbles
- ❑ Beans
- ❑ Rice
- ❑ Containers of sand, silt, and clay soil
- ❑ Containers of sugar, flour, and modeling clay
- ❑ Containers of water

Materials cont.

- ❑ Straws
- ❑ Straws or tubes of different diameters
- ❑ Raindrop shapes cut from blue paper
- ❑ Funnels
- ❑ Paper cups
- ❑ Measuring beakers
- ❑ Cheesecloth
- ❑ Plant growing in a pot
- ❑ Clear plastic cups
- ❑ Scotch tape
- ❑ Grass seed and beans

- So if organic matter gets mixed in with our pile of sediment then they combine and we are getting closer to making soil, just like we closer to turning this into a cake.
- Add water
- The cake mix needs water. Soil also needs water. Water is a component of soil. Rain and snow seep into the pile of sediments and organic matter.
- Mix up the cake mix
- Why do we mix up the ingredients? It combines them together and it also adds another important component to the cake. It adds air. That's why you have to mix a cake mix together for several minutes...you need to add plenty of air into it or your cake will look like a pancake!
- Soil is the same way. It needs air. That's why we dig or plow or till soil before we plant.
- Air is added to the sediments and organic matter over time.
- The last thing we need to make the cake is time. You have to put it in the oven and bake it. Soil also needs time. It's not nearly as fast as a cake. A cake takes half an hour. Soil takes hundreds of years.
- Serve a piece of cake to each of your students. Ask- "What does your body do with the cake? It takes out the nutrients your body needs–in cake there are lots of carbohydrates, which provide energy for your body. Plants do the same thing. They take the nutrients they need to live and grow out of the soil. They are adapted to just take the nutrients out and leave the other components of soil behind. (*Make sure your students understand that plants don't "eat" soil the way we eat the cake).

Journals: Have the students make a graphic organizer to show a timeline of the formation of rock. It should have at least 4 different steps in the process of changing a rock into soil.

If students are struggling have class brainstorm some ideas together to help them get started, or review the soil formation pages in the book Dirt used for the Invitation to Learn. You could also make the graphic organizer and run copies for the students if you feel they need it.

Assessment: Green Card/Red Card statements (you can add additional statements)

- Soil is made from rocks.
- Changing rock to soil takes just a few weeks

Composition of Soil

- Average soil contains these amounts of the components discussed in Step 1-Show the overhead transparency of the circle graph

  Inorganic (nonliving) 25% air 25% water Minerals 45% Organic (living/once living) 5%

  Give each student a copy of the circle graph. Paste them in their journals and complete their own circle graph –fill in each section to show that material (example: water blue drops; air gray squiggles; mineral matter different colored pebbles; organic matter-animals that live in the soil and decaying plants. Extension: You could have students show the same percentages on a bar graph to give them practice with different types of graphs.

- Pass out containers of soil containing organic matter, magnifying glasses, and paper towels.
- Tell students: We're going to examine this soil and see if we can find the different components that make up soil. Which do you think you will be able to see? Will there be any that you can't see? You should be able to see the minerals; they are the pieces of sediments. Rub the soil between your fingers and you can feel the particles. Look for organic matter-living plants and animals, and evidence of once-living things like bits of plants, twigs, leaf, or parts of dead animals. You might be able to tell that there is water by looking at the soil. Soil is darker when it has moisture in it. You can feel the moisture by touching and squeezing the soil, or you can look for dampness on the paper towel-those are all proof of water in the soil. You will not be able to see the air–but look for the spaces between the particles-they are filled with air. Spread the soil out onto the paper towel; examine it with the magnifying glasses. Separate the soil into Non-living inorganic materials: minerals and evidence of air and water and organic: living and once-living (decaying) plant and animals.

Journals: Word Web graphic organizer- Teacher draws a model of web on board or overhead for students to copy into their journals as you discuss the components they discovered as they investigated the soil sample.

Assessment: Red Card/Green Card Statements

- Soil is 45% organic material
- Soil contains both air and water

- Plants and worms are examples of inorganic, non-living material in soil
- Soil is 45% mineral matter

Soil Particle Size and Texture

- There are hundreds of different types of soil in the world, but all those types of soil are combinations of the three main types of soil: sand, silt, and clay.
- These types of soils are identified by the size of the particles or pieces of mineral matter in them.

Materials

- ❑ 3 jars
- ❑ Marbles: Sand
- ❑ Beans: Silt
- ❑ Rice: Clay
- ❑ Containers of three main soil types
  Sand
  Silt
  Clay
- ❑ Containers of sugar, flour, and modeling clay
- ❑ Container of water

- These jars (show the marbles, beans, rice) can help us compare the particle size of the different types of soil.
- Sand: Sand has large particles like these marbles. Because these particles are large they fit together loosely. You can feel the particles in the sand, it feels like sugar. Open the container of sugar and take a little bit of it. Rub it between your fingers. What does it feel like? Now open your container of sand. Take a little bit of it. Rub it between your fingers. Does it feel like the sugar? That is because you can feel the individual particles. What words would you use to describe how it feels? (Rough, gritty, etc.) This tells us the TEXTURE of the soil. Take a few drops of water and add it to the sand in your hand. What does it feel like when it is wet?
- Repeat with the jar of beans, flour, and silt. Silt has smaller particles, they are more finely textured. Silt feels smooth. It often sticks to your hands. Silt is found near lakes and mouths of rivers, or where soil particles have been carried by slow moving water.
- Repeat with the jar of rice, modeling clay, and clay. Clay has the smallest particles. They pack very closely together so there is almost no space between them. Clay feels fine and slippery. When it's wet it feel slick. When it dries it packs so closely together that it is almost like cement. The dirt clods in your garden that are really hard to break apart most likely have a lot of clay in them.
- Optional: Make a sedimentator. You need a clear plastic jar with a lid. Put in one cup of average soil and then fill with water until jar is about 2/3 full. Shake jar vigorously for 1-2 minutes. Let it sit overnight. The sediments will settle out of the water into layers of different soil types. The sand will settle first and be the bottom layer because of its large particles. Silt

particles will follow and form the second layer. Clay sediments settle last, they might even take longer than 24 hours so keep observing the jar for a few days. The organic matter will float on top of the water.

Journals:

- Particle Size: Give students patterns of jars and have them trace and cut out three jars and glue them into their journal. Label each jar: sand, silt, and clay. Draw particles to show each type of soil. Remind them that the bigger the particle, the bigger the space between it. Have them look at the jars of marbles, beans, and rice to see the difference in the size of the spaces.
- Texture: Have them write the name of each type of soil using block letters that represent the texture of that soil. Example: Sand–use pointy, rough looking letters, spread the letters far apart. Fill in the letters with a texture pattern that represents that soil. Choose one or two words that describe the texture of that soil and write them underneath the name. Cut the name and words out and glue into journal.

Assessment: Red Card/Green Card Assessment Statements

- Sand is rough and gritty and has large particles.
- Clay has the largest particles.
- Silt feels smooth like flour, it has medium sized particles.
- Sand particles pack very tightly together with no space between them
- Clay feels slippery when its wet and dries rock hard

Air in Soil

Give each student a straw and give each group a container of water. Tell them to blow bubbles in the water. Ask what made the bubbles? (Air) Bubbles are evidence of air. Challenge class to think of other examples of bubbles being evidence of air. (Fish tanks, scuba divers, bubblegum bubbles, bottles of bubbles, etc.)

Give each group a measuring beaker, a cup of soil, and a cup of water. Pour the water slowly over the soil. Watch very carefully for bubbles. That is evidence of air in the soil. Where is the air in the soil? (Fills the spaces between the particles)

Which types of soil, sand, silt, or clay do you think has the most air? Which has the least air?

Why?

Journal: How can you show that there is air in the soil? Could you add anything to the particle jars to show that there is air? Have them color in the spaces between the particles gray and then make a key on the page to show that gray = air.

On the next page have them do a drawing of each type of soil to show how much air would be in it. Do a circle for each type of soil. Have them fill the circle showing the particles and air in each type of soil. Label each circle.

Assessment: Red Card/Green Card Assessment Statements:

- There is no air in soil.
- Air fills in the spaces between the particles in soil.
- The more tightly packed the particles the more air there will be in soil.
- Sand has the largest particles so it has the largest spaces and the most air.
- Clay has the smallest particles so it has the most air.

Water in Soil

- Get three different size (diameter) straws and tell the class that you are going to have a race. Choose three students; give each one a straw and a cup of water. Tell the class that the race is to see who can suck all of the water out of their cup the fastest.... have them predict who they think will win and why. Conduct the race.

  Explain that water moves differently through different types of soils. Water moves through the air spaces, so the more and bigger the air spaces are, the more rapidly water can move through it, just as the water moved more quickly through the larger tube.
- Do "Pick a Path" activity to demonstrate: (from Dirt: Secrets in Soil page 43 Utah Agriculture in the Classroom Utah State University)
- Remind students what they learned about the particle and space size in each soil type.
- Divide the students into four groups. Assign each group one of the following titles: water, sand, silt, and clay.
- Give each member of the water group a raindrop cut from blue paper.

- Have the sand group stand together so that just their fingertips are touching. Their arms should be extended straight out.
- Have the silt group stand together with their elbows touching.
- Have the clay group stand together with their shoulders touching.
- Tell the water group that their job is to make their way through each soil group. Have them start with the sand. Discuss the results. Repeat with the silt and clay. Have class come up with a statement about how water moves through each type of soil.
- Do a demonstration with actual soil samples. Invite students up close so they can observe closely. You need:
  - A container of water and three paper cups
  - 3 measuring beakers
  - 3 funnels (you can use tops of 2 liter pop bottles) covered in cheese cloth
  - Sample of each soil type: sand silt clay
- Place funnels on top of measuring beakers; place one soil sample in each funnel. Do not pack them down. Slowly pour a cup of water simultaneously into each of the soil-filled funnels. Watch to see if water soaks into the soil quickly or if it pools on top. Time for 1 minute and compare how much water has passed through the soil into the beaker.
- Set timer for 4 more minutes. At the end of 4 minutes (total time of 5 minutes) Compare again.
- Discuss results with class.
- Journals: Write a simile statement about how water moves through each soil. Draw a drop of water for each soil and illustrate to show how it moves through that soil.
- Example: Water moves through sand like a cheetah running.
- Then draw the water drop to look like a cheetah. (Other possibilities: a jet plane, a racecar, a rocket ship, etc.)
- Silt: The raindrop could be a trotting horse, or a person jogging, or a car driving through a neighborhood.
- Clay: The raindrop could be a tortoise or a snail.
- Ask students if they think that the water in soil will stay forever or if it will leave. Leave the soil uncovered until the next day. Have students check for moisture content again. Ask them why they think the soil is drier and what caused it. Review evaporation from the water cycle curriculum.

Assessment: Red Card/Green Card Assessment Statements:

- Water moves through all soils exactly the same.
- The bigger the particles the more quickly water will move through soil.
- Water moves through the spaces between particles.
- Water moves quickly through clay soils.
- Water move quickly through sandy soils.

Organic Material in Soil

Look back at the samples of soil that you separated into organic and inorganic materials, and at the word web graphic organizer in your journal. Review what types of things are organic matter.

Discuss: Why is organic material so important in soil? The organic material is what provides the majority of the nutrients that plants need. Dead and decaying plant and animal material provide fertilizer to the soil. Without organic matter the soil would not be fertile and plants would not grow well in it. This would be like you trying to live and grow without food. Organic materials provide food for plants.

Journal: Life in Soil (2 pages- Blacklines in appendix)

Give each student a copy of the "Life in the Soil" outline and a copy of the Is Organic /Is Not Organic worksheet. Cut out the Life in Soil outline and glue it into their journals.

Have them look at each item on the Is Organic/Is Not Organic. If they agree that is a correct example of organic matter in soil have them cut it out and glue it onto the Life in Soil page.

Assessment: Red Card/Green Card Assessment Statements:

- Organic means the non-living matter in soil such as minerals, air, and water
- You can find both living and once-living, organic matter in soil.
- Pieces of twigs and leaves are examples of once living material in soil.
- Rocks are organic matter.
- Dead and decaying animals are once-living organic matter.
- Organic materials provide nutrients or food for plants to live and grow.

How Do These Components of Soil Affect Plants?

- Show the class a plant in a pot. Make sure the plant has lots of roots. Ask the class what soil has to do with plants. Review that soil is important because all life depends on the soil. Plants need the soil to grow and animals eat the plants.

- Carefully take plant from pot and shake off some of the soil so class can see the roots. The roots are the part of the plant that grow down into the soil. What do the roots do and how do they relate to the soil? Soil particles keep the roots in place and help hold the plant up. The water, air, minerals, and organic matter in the soil are all used by the plant to live and grow. Plants take these things from the soil through their roots.
- Make sure you reinforce the concept that plants don't use up the soil; they just use the components of the soil.
- What would happen to plants if there were too little or too much of the different components of soil? Use creative movement to show these situations. Act like a plant:

  …in clay type soil that holds too much water so there is very little air, and then dries rock hard. (Help, we're drowning, there's no air, are roots are getting squished, they can't bring us any food)

  …in sandy soil that has large, loose particles where the water flows through too quickly for the plants to use it. (Help we're dying of thirst, we're falling over)

  …in soil that has no organic material so it has no nutrients (Help, we're starving to death, there's nothing to eat, we're small and weak because we have no food.)
- Journal: Have students draw and label the soil and plants from each situation they acted out in their journals.

Assessment: Red Card/Green Card Assessment Statements:

- Soil is necessary for all life on earth.
- If there was no soil on earth we would still be able to live
- Plants take air and water from the soil through their roots
- Plants grow best in soil that has no organic material in it
- Dead and decaying plants and animals add nutrients and food for the plants to the soil

Assessment Suggestions

Red Card/Green Card: Stop Me If I'm Wrong statements after each section.

Teacher observation of activities, discussions, and journals

Final Assessment: How Much Do You Really Know About Soil.

Curriculum Extensions/Adaptations/ Integrations

- The What? No Soil? Mystery! We have learned that soil is necessary for plants to live and grow. Do you think that plants could ever grow without soil? What would you need to do? You would need to find some other way to give them the things like air, water, and nutrients that they usually get from the soil. You would also have to find a way to support the plants without having their roots held in soil. Scientists around the world are studying ways to do this. Discuss why we would want to be able to grow plants without soil.
- We're going to do an experiment and see if we could start to grow plants without soil–maybe you can grow up to be a scientist and work on this idea to help save our planet's resources.
- Give each group 2 clear plastic cups. Have them moisten the inside of one cup and sprinkle grass seed on the sides and bottom of the cup. Then give them a paper towel and have them moisten it. Carefully fit the paper towel inside the cup, try to disturb the grass seed as little as possible. Place 2 or 3 beans on the paper towel. Take half of another paper towel, moisten it and carefully place it on top of the beans. Put the second cup upside down on top of the first cup and seal them together with tape. Put the cups where they will get sunlight. Observe them and watch for signs of plants growing. The grass and beans should start to sprout within 2-3 days. Ask students what they think will happen if they leave the grass just in the cup. The grass will eventually die because it cannot get the nutrients it needs. So plants can grow without soil but you need to find a way to give them nutrients.
- Challenge your high level students to do some research on their own, and share with the class ways scientists are working on solving this problem. These methods are called hydroponics. They could also research plants called epiphytes that grow on other plants. The website kidsgardening.com has information on this presented in a child friendly manner.
- Integration with language arts: Write similes for each type of soil:

Sand is as rough as a scrub brush.

Silt is as smooth as silk.

Clay is as slippery as wet soap.

Or couplets:

Sand is gritty, loose, and dry
It hurts when it gets in your eye!

Silt is soft, powdery, and fine
If it's in your garden, you won't whine

Clay is slick when it's wet
But when it's dry, it's hard you bet

Family Connections

Do a Soil Treasure Hunt activity. Ask students to bring in samples from their yard or neighborhood that they think are sand, silt, or clay.

Ask students to look for areas in their neighborhoods where plants grow well and areas where they don't. Have them bring in soil samples and compare them to see if they find out why.

Additional Resources

Dirt, by Steve Tomecek; ISBN 0-7922-8204-3

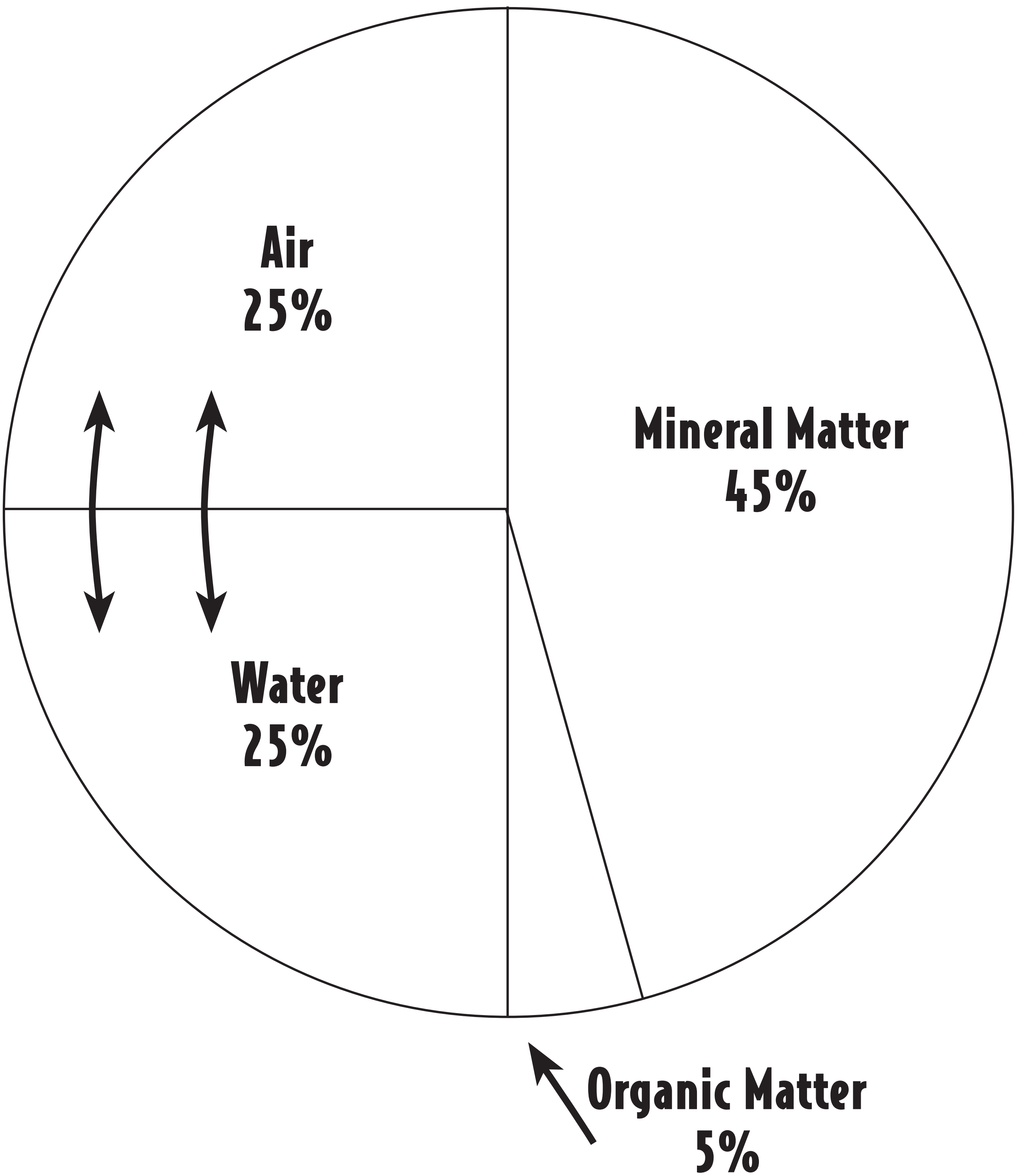
Dirt: Secrets in Soil video and lesson plans, Utah Agriculture in the Classroom Utah State University 435-797-1657 www.agclassroom.org/ut

Life in a Bucket of Soil, by Alvin and Virginia Silverstein; ISBN 0-486-41057-9 This book contains information on all the different living creatures who make their home in soil.

Sprout and Grow Window and RootVue Farm: These allow students to actually see roots growing beneath the soil. Available at teacherdirect.com

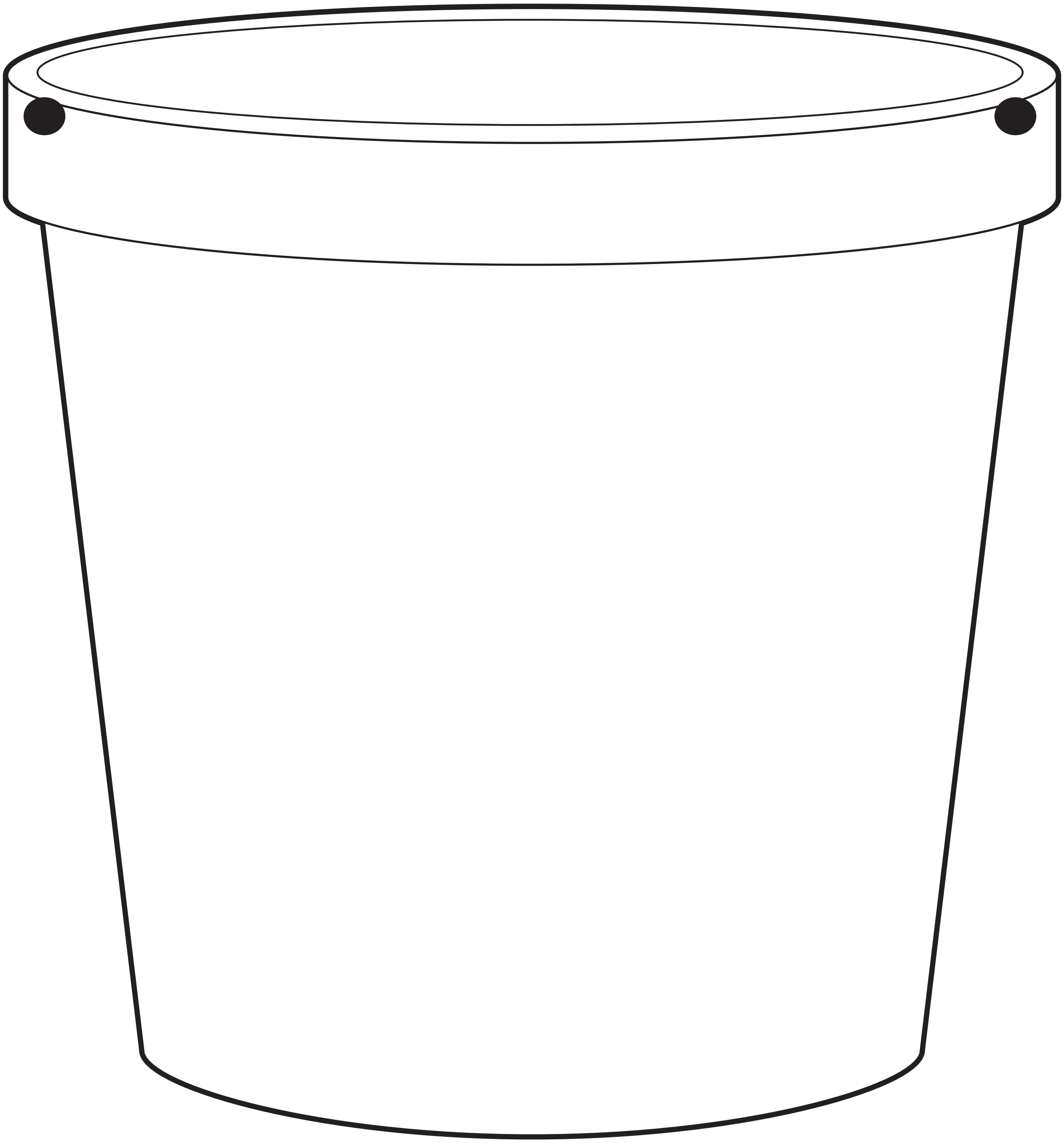
awww.school.discovery.com/school adventures/soil kidsgardening.com Lots of information on soil and hydroponics

Soil Pie: Components of Soil

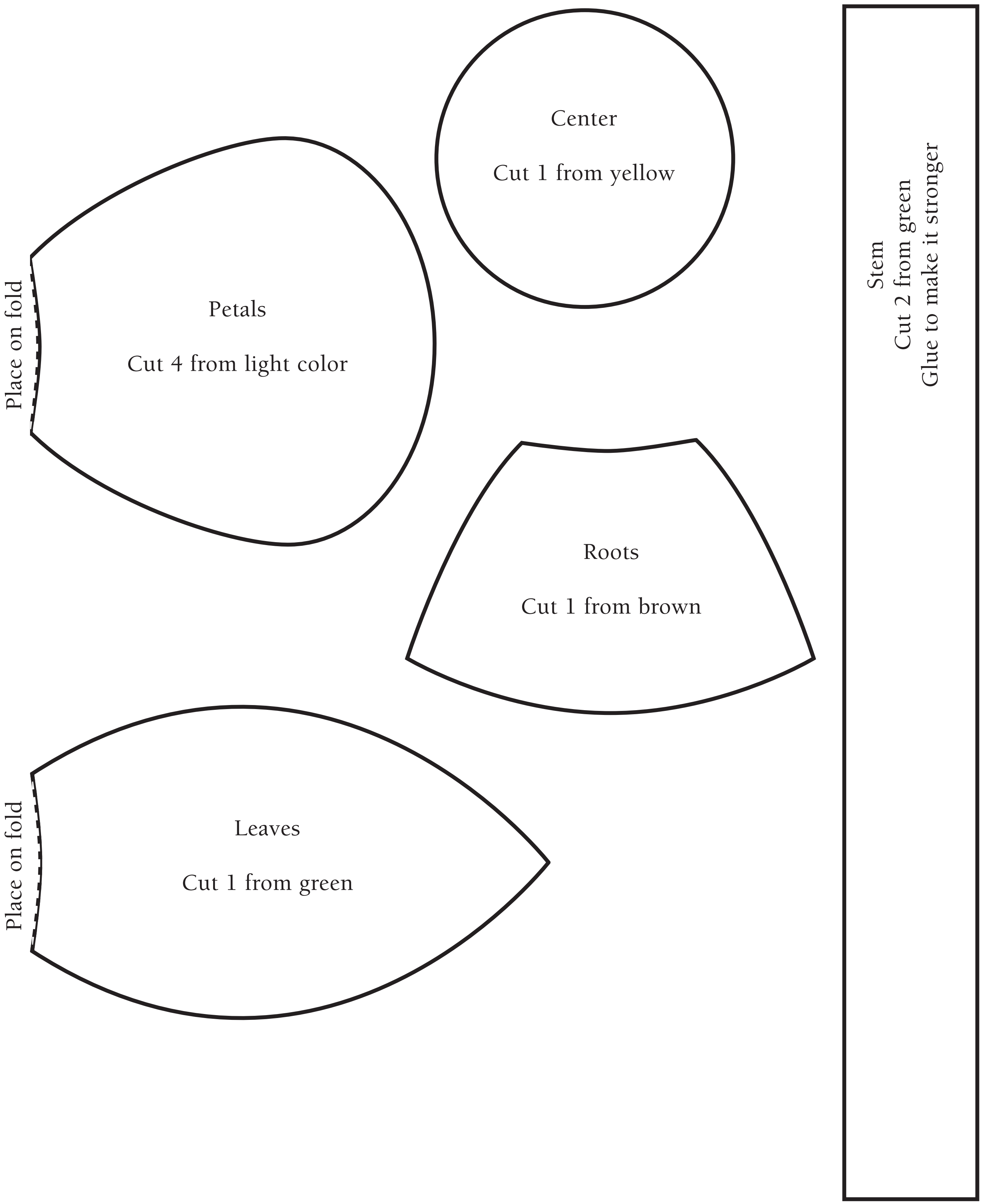


Soil Journal Patterns

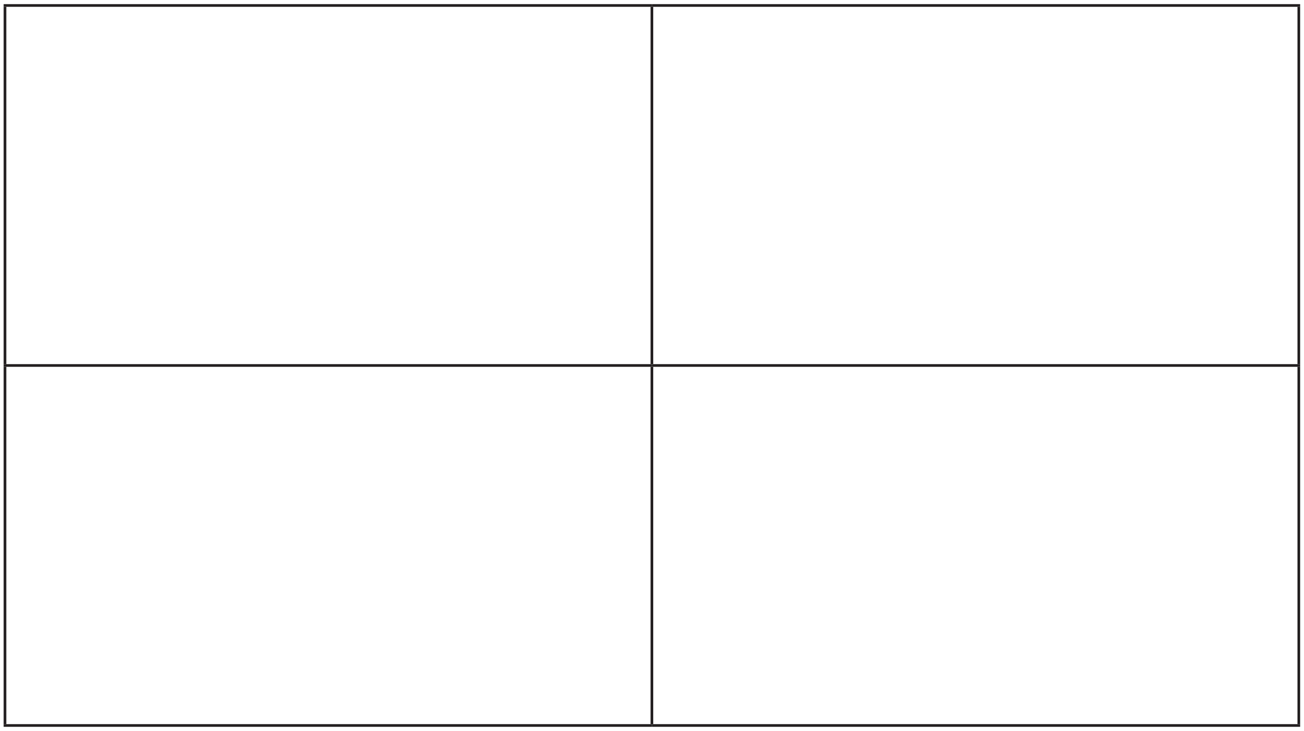
Two from brown constructio, one white art - made into a soil profile, six blank pages - (use front and back). Punch on dots - hook together with pipe cleaner or yarn.



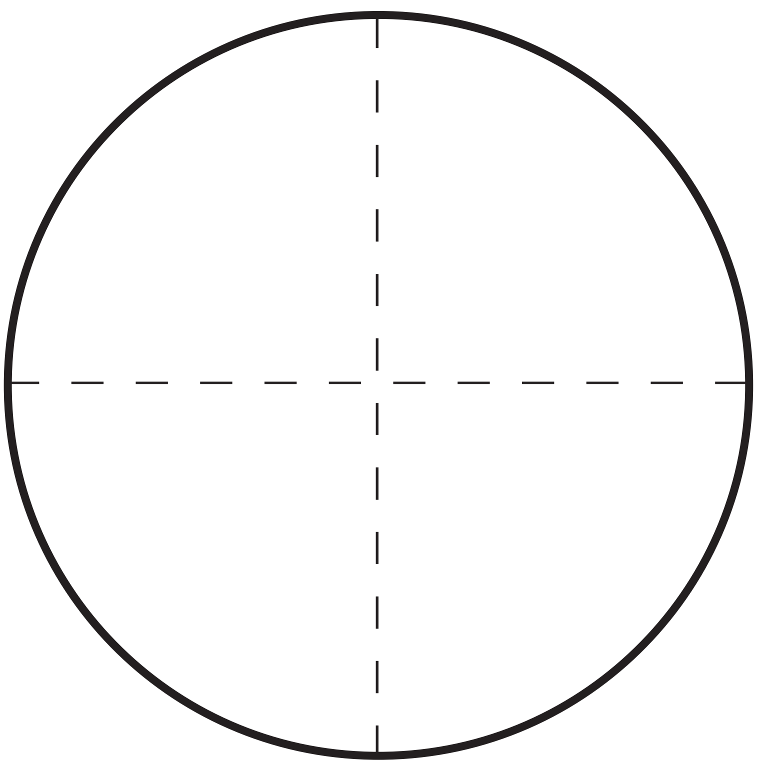
Patterns for Soil Journal Plant



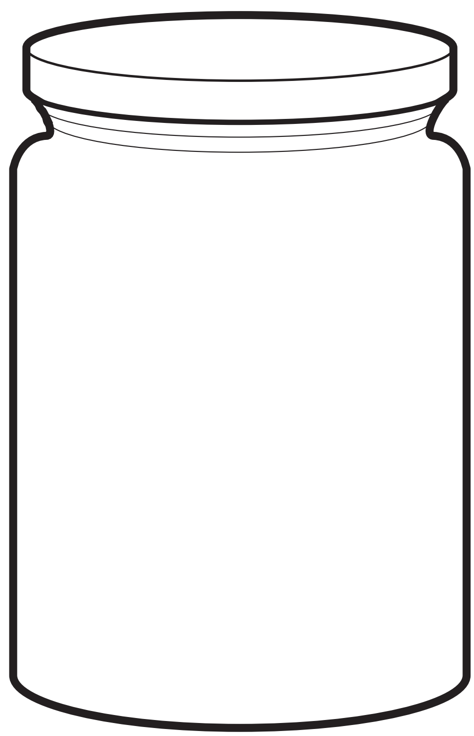
Soil Journal



Soil Formation Timeline



Circle Graph

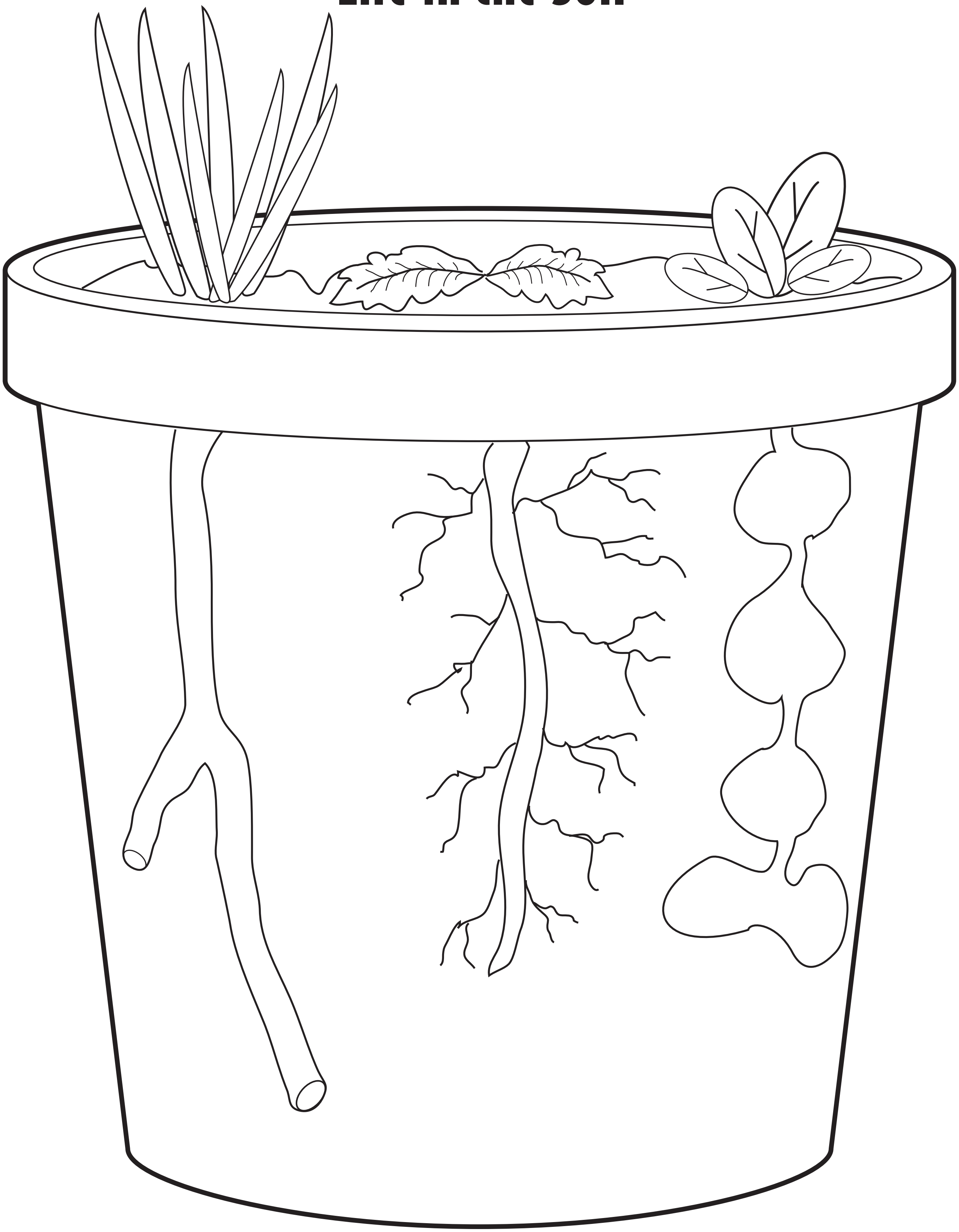


Jar - Need 3

Is Organic/Is Not Organic

Cut out the things which are organic and glue them onto your Life in the Soil Journal page.

Life in the Soil



Name ____________________ Soil Unit Assessment

How Much Do You Really Know About Soil?

1. Is soil an important natural resource?
   A. Yes, without soil plants and animals would die.
   B. No, soil is not important...it is just dirt that makes a mess.

2. Is the parent material of soil fossils?
   A. Yes, soil is made from fossils.
   B. No, the parent material of soil is rock.

3. Are weathering and erosion exactly the same thing?
   A. Yes, there is no difference between the two.
   B. No, weathering is wearing away and breaking down and erosion is moving things like rocks and soil.

4. Are plant roots, freezing and thawing, wind, and moving water all things that cause weathering?
   A. Yes, all of these things will wear away and break down earth's surface.
   B. No, these things could never break down rock, they are too weak.

5. Do plants help control erosion?
   A. Yes, the roots of plants help hold the soil in place so it can't move.
   B. No, plants make erosion worse.

6. Can soil be formed in just a few days?
   A. Yes, soil is always manmade in giant factories and it only takes a few days.
   B. No, soil is made from rocks and the process takes thousands of years.

7. Are there different layers in soil? What are they?
   A. Yes, there are different layers. You have topsoil, subsoil, the transition layer and bedrock or parent material.
   B. No, soil is exactly the same whether you dig down just a few inches or twenty feet.

8. Which of these statements gives an accurate description of the composition of soil?
   A. Soil contains 50% organic material, 20% minerals, 10% air, and 10% water.
   B. Soil contains 45% minerals, 25% air, 25% water, and 5% organic material.

9. Which of these lists the three main types of soil we studied?
   A. Bedrock, parent material, organic material
   B. Sand, silt, and clay

10. Is all the soil the same?
    A. Yes, all soils have the same colors, textures, and characteristics.
    B. No, soils in different places will have different characteristics.

11. Of the three types of soil which one has the biggest particles and roughest texture?
    A. Sand
    B. Clay

12. Of the three types of soil which one has the smallest particles and smoothest texture?
    A. Clay
    B. Silt

13. Water and air are both found in the spaces between the particles in soil. Which soil has the smallest spaces and keeps water from moving through it?
    A. Sand
    B. Clay

14. Which soil dries out the fastest because water moves through it quickly?
    A. Sand
    B. Clay

15. Which of these is a true statement?
    A. Water and air occupy all the open spaces between particles in soil. Plants grow better in soils that have the right amount of air and water.
    B. Plants cannot survive in soil if it has any water or air in it.
16. Organic matter in soil provide nutrients that plants need to live and grow.
    A. False, organic matter needs to be removed from the soil immediately.
    B. True, organic matter (living and once living things such as decaying plants and animals such as worms) provides nutrients that plants need to survive.

17. If plants are not growing well there is nothing you can do to the soil to fix it. You just need to give up.
    A. True, soil cannot be changed because it would take millions of years.
    B. False, you can fix problems with your soil and help the plants grow better.

18. If your soil is clay and holds too much water and not enough air you can add sandy soil to loosen it up so the water can move through it better.
    A. True, good soil is usually a combination of the different types and mixing in sandy soil will improve the clay soil.
    B. False, what you need to do is add lots and lots of organic material and rocks.

19. If your soil is not fertile enough to give the plants the nutrients they need to grow what should you add to your soil?
    A. You should add as much sand as you can.
    B. You should add nutrients by adding organic material and fertilizer.

20. Can plants grow without soil?
    A. Yes, you can get some plants to grow for a short time with just water. Some scientists are experimenting with hydroponic (water) gardening.
    B. No, without soil plants would die instantly. Scientists would make fun of you if you asked them about plants growing without soil.

What is the most interesting thing you learned during our Soil Unit?

Math III-1 & IV-2

Activities

Geometry

The Angle Tangle

Standard III:
Students will understand attributes and properties of plane geometric objects and spatial relationships.

Objective 1:
Identify and describe attributes of two-dimensional geometric shapes.

Intended Learning Outcomes:
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.
6. Represent mathematical ideas in a variety of ways.

Content Connections:
Math IV-1; Measure angles

Math Standard III

Objective 1

Connections

Background Information

Prior knowledge needed to complete this activity: Be able to identify parallel, intersecting, and perpendicular lines. By the end of this activity students should be able to identify:

Right angle: A 90º angle

Acute angle: An angle that is less than 90%

Obtuse angle: An angle that is greater than 90%

Know that angles are measured in degrees and develop benchmark angles (e.g. 45º, 60º, 120º) and be able to measure angles using protractors or angle rulers.

Research Basis

John Sutton, J., Krueger, A., (2002). *EdThoughts What We Know About Mathematics Teaching and Learning,* (92).

Brain research demonstrates that: The more senses used in instruction, the better learners will be able to remember, retrieve, and connect the information in their memories. Physical experiences or meaningful contexts can provide learners with strong blocks for building knowledge. Providing our students with many different types of activities will help them learn the concepts or skills we are presenting.

Marzano, R.J., Pickering, D., & Pollack, J.S. (2001). *Classroom Instruction that Works: research based strategies for increasing student achievement.* ASCD, Alexandria, VA.

This text identifies instructional strategies most likely to lead to improved student learning. It looks at the research and theories behinds these strategies and gives suggestions for implementing in the classroom. One of the strategies discussed is kinesthetic activity that uses physical movement to generate an image of the knowledge in the learner's mind. Physically making things such as geometric shapes helps students connect terms and definitions to the actual things. Drawing pictures or symbols is also a powerful way to generate nonlinguistic representations in the mind.

Invitation to Learn

Divide class into two groups. Have them stand arm length apart in a circle. Give each group a ball of yarn. Instruct them to pass the yarn to make a web. They may not pass the yarn to the person next to them; encourage them to pass across the circle as much as possible. Each child needs to hold onto the yarn and not let go. When they are all holding onto the yarn have them carefully lay their web down on the ground, stretching it slightly so the yarn is in straight lines.

Review parallel, intersecting, and perpendicular lines by finding them within the web. Have students identify the places where the lines intersect and mark them with points. Explain that when two lines meet together at one point we call that the VERTEX and that the lines, which are called rays, extending from the vertex form an ANGLE. Now look at the web to see if you can identify angles. Review how lines are named by points. Explain that angles are named using three points, with the vertex point always in the middle (ABC) and that we use this symbol < for angle. (<ABC) Find some angles in the web and write their names on the board.

Materials

- ❏ 2 balls of yarn
- ❏ A-Z cards
- ❏ 12 angle cards
- ❏ Rulers
- ❏ Overhead projector
- ❏ Angle rulers
- ❏ Protractors
- ❏ Pattern blocks
- ❏ 360% Circle
- ❏ Whiteboards
- ❏ Dry erase markers
- ❏ 4" Angle manipulative
- ❏ Large angle manipulative
- ❏ *Angle Assessment*
- ❏ Crayons
- ❏ White art paper

Instructional Procedure

1. Classifying Angles (Right, acute, obtuse)

   Before the lesson prepare 12 angle cards-use cardstock and draw one angle on each card–make 4 right angles, 4 acute angles, and 4 obtuse angles. Label the points and write the angle name (example: <ABC) on each card also.

   Place the angle cards on the board. Ask the class to carefully examine them and see if they can classify them into three groups. Have students come to board and move the angle cards into three groups. Continue working until students have correctly grouped them into right, acute, and obtuse angles. Write the name of each type of angle above the cards. Have class practice reading the names and identify the characteristics of each.

2. Identifying Angles

Put students into small groups or partners. Give each group a set of pattern blocks.

Tell them they need to look at each type of pattern block and identify the types of angles on each. Give each student a piece of art paper. Have them divide it into three sections labeled: Right Angle, Obtuse Angle, and Acute Angle. Have them trace the angles of the pattern blocks into the correct section.

3. Identifying Benchmark Angles using fraction circles

Give each student a copy of the 360° Circle worksheet, which has been copied on cardstock.

Discuss how a circle has 360 degrees. Link it to skateboard and snowboard tricks like the 180 and the 360. As you discuss each one have the students find it on their 360° Circle worksheet.

If you divide a circle in half how many degrees to you have? 180. Have them jump and spin and try to land at 180 degrees. Now start at 0º on your circle and trace your finger around to 180º. What about a half of the half? That would be 90 degrees. Jump 90 degrees at a time and see if they can figure out the degrees–link it to the 9 times tables. So if you could jump all the way around you would be doing a 360!

Have students put away their 360° Circle paper so they cannot see it during the following activity. Give each student a piece of 9 x 12 art paper. Put students into partners and give each group a set of fraction circles cut out of foam board. You need to have a whole, halves, fourths, eighths, sixths, and thirds.

Have students fold their art paper to make four boxes. Have them trace their whole circle in each of the boxes on the front and in two boxes on the back. (Total of 6 boxes)

Work with students to identify the benchmark angles:

Begin with the whole circle. Review how many degrees are in a complete circle. Write: "A whole circle has 360 degrees". Ask how much of the circle 180° would be. Have them find the fraction pieces that would cover half the circle. In the second box have the students trace the halves onto the circle, write 180° on the circle in the correct place, trace the 180° angle in crayon and shade it in. Above the circle write "180 degrees is half the circle." (You can also teach your students that this is called a straight angle)

Note: As you do these fraction pieces make sure they lay the first fraction piece so its baseline is on the 0 degree line of the circle, this will form the angle correctly.

Continue with 90 degrees. Remind them how far they had to jump. How could you relate 90 degrees to a fraction of your circle? Lay your fraction pieces on your circle and see which ones correspond to 90 degrees on the circle. Find the fractions that would make 90-degree angles. Trace the fourths, highlight the first one-fourth, and label 90° on the circle and then above the circle write "90 degrees is 1/4 of the circle". As you work through the rest of these angles have the students compare them to the 90° angle to give them a reference point.

Repeat for 45 degrees, 60 degrees, and 120 degrees.

4. Make an angle manipulative. Give each student two 1" x 6" strips of oaktag and a fastener.

   Draw a ray on each strip. Mark an endpoint on each ray, then put the strips together to form a vertex and put the fastener through them. Make a larger version for you to use to demonstrate on the board. Have them look at their fraction circle papers and try to reproduce the angles using their angle manipulatives.

5. Formative Assessment: Have students use whiteboards or white art paper and crayons. Example: Draw two angles, one 90° and one 45°, on the board or overhead. Instruct students to copy the 90° angle. Have them hold up their white boards or papers to check. Continue with other angle comparisons; include right, acute, and obtuse angles also.

6. Measuring Angles using an angle ruler or protractor

   Show students an angle ruler and a protractor; explain that these are the tools we use for measuring angles. Demonstrate how they work. Put students into partners and let them experiment with the tools. Draw different angles on the overhead and measure them. Have students draw and measure them with you. Have students use their angle manipulative. Have them work in partners. One student will make an angle using their manipulative; the other student will use the angle ruler or the protractor to measure the angle.

7. Play "What's Your Angle?"

   Draw angles on the board or overhead. Have students estimate and write down the angle's degrees. Then have students come up and measure. If their estimate is exactly correct they get 10 points. Deduct one point for every degree they are off—if they are one degree off they will get 9 points, continuing down to 9 degrees off they will get 1 point, 10 or more degrees off they will get 0 points. Variation: Play STOP! Use a large angle manipulative on the board. Tape the bottom ray so that it stays at 0º. Identify the degree of angle you want to make. Choose a student to come to the front. Their job is to yell, "STOP" when they think you have made that degree of angle. They can solicit help from the other students. Move the other ray slowly (remember that angles are measured going counterclockwise) The student yells stop when they think you have reached the correct degree. Tape the ray down and measure the angle. Choose your "winner" criteria before starting. Example: They have to be within 5 degrees to win. If they win give them a small treat.

Assessment Suggestions

Use the *Angle Assessment* blackline as a final assessment.

Curriculum Extensions/Adaptations/ Integration

Struggling learners can be paired with more advanced learners

Angle Tangle: Assign students to draw 5-7 straight lines with several intersections. Then connect the endpoints of the lines. Mark the angles created within in the design and color code them by right, acute, and obtuse angles. Color the rest of the design.

String Art: Do a line design but give students string, oaktag, and safe plastic needles. Have them make the design using the string.

Use AngLegs sets which include connecting pieces to form angles and a protractor that attaches to the pieces for independent practice in measuring angles.

Integrating Technology: Take a digital camera and take your class on an "Angle Hunt". Have them identify angles in architecture, machines, nature, etc. Take photographs of the students and the angles. Use them to make a Power Point presentation.

Family Connections

Have students enlist the help of their families to go on an "Angle Hunt" at their homes. Have them find and describe at least one example of each type of angle.

Additional Resources

Find-the-Angle Pro Ruler: Item #FA-779 Lakeshore Elementary 2007-08 1-800-778-4456 lakeshorelearning.com

AngLegs Item #DG205057TS Summit Learning 1-800-777-8817 summitlearning.com

amblesideprimary.com This is a website published by an elementary school. It was many interactive activities dealing with geometry. Try the one on measuring angles.

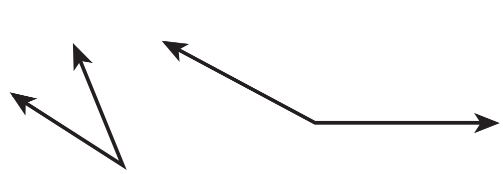
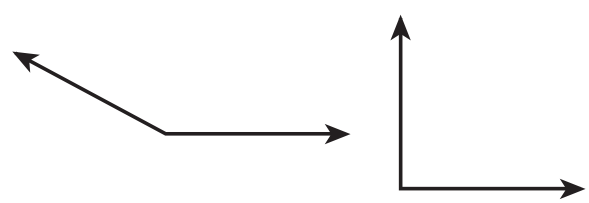
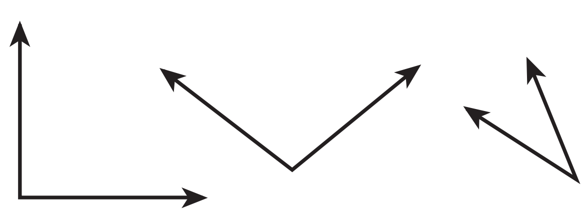
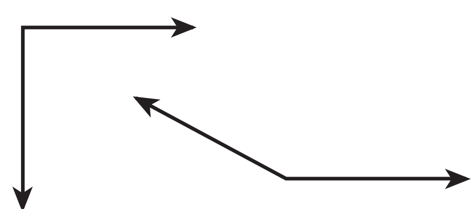
www.mathopenref.com This website features explanations and examples of each type of line, plus an interactive features which allows students to manipulate lines to make lines, line segments, perpendicular, parallel, and intersecting lines.

Basic Geometry Blackboard Topper. This is a chart to display in your room for a quick review of line concepts. (It includes lines, angles, polygons, and solid shapes) Summit Learning 1-800-777-8817 or online at www.summitlearning.com. Item Number DG20368ITS

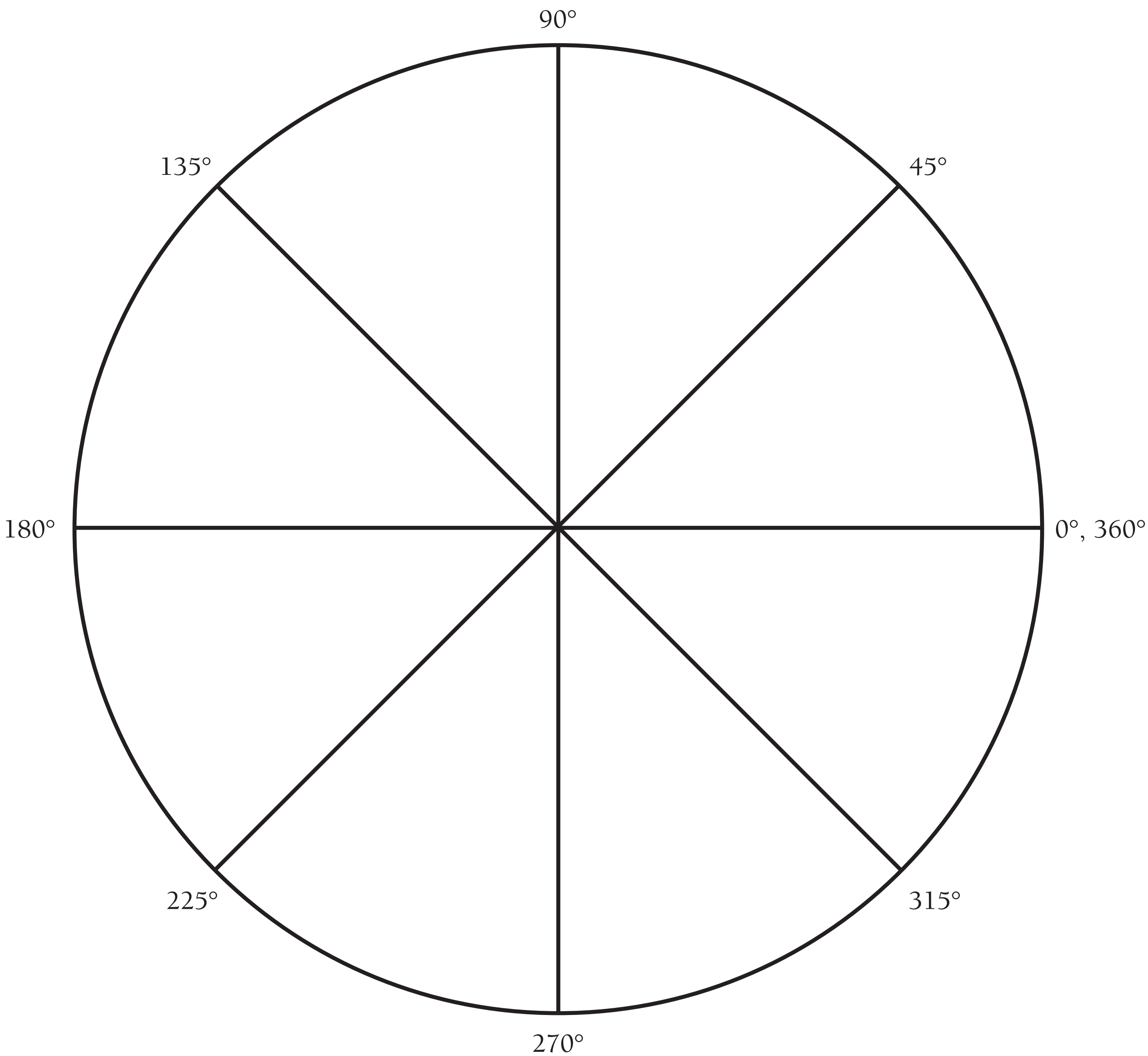
Name ________________________________

Angle Assessment

Follow the directions in each box carefully. If you are asked to draw an angle make sure you use your ruler and be as accurate as you can.

Draw a 90° angle	Draw an acute angle
Draw a circle. Show how many degrees are in a circle.	Draw a 45° angle
Draw an obtuse angle	Circle the right angle 
Circle the acute angle 	Circle the obtuse angle 
Circle the 90° angle 	Circle the 120° angle 

360° Circle



Cut—Stretch—Fold

Standard IV:
Students will describe relationships among units of measure, use appropriate measurement tools, and use formulas to find area measurements.

Objective 2:
Recognize and describe area as a measurable attribute of two-dimensional shapes and calculate area measurements.

Intended Learning Outcomes:
2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
3. Reason logically, using inductive and deductive strategies and justify conclusions.

Content Connections:
Math Standard 3-1: Congruency and Symmetry
Social Studies: China and Japan

Math Standard IV

Objective 2

Connections

Background Information

Tangrams are ancient Chinese puzzles. A tangram begins with a square that is then cut into seven pieces. Each individual piece is called a tan. The pieces are used to form different shapes or pictures. They must touch, but not overlap when you put them together to form a tangram (shape).

The Chinese invented paper 2,000 years ago and along with it they also invented origami, or the art of paper folding. The Chinese brought paper folding to Japan in about the year 600 A.D. Once the Japanese people learned origami they became wonderful origami artists.

Working with both tangrams and origami has proven to have a beneficial impact on students' spatial reasoning and can also be used to teach other math skills and principles.

Before doing the tangram activities students need a basic understanding of what area is and the formula for finding the area of a rectangle. This lesson will help them determine the area of each tangram piece without using formulas. After completing this activity students will use their knowledge to help them develop and use the formulas to determine the area of squares, rectangles, triangles, and parallelograms.

Research Basis

Carter, J.A. (2003). Focus on Learning Problems in Mathematics: A survey of paper cutting, folding and tearing. Retrieved 12/14/2006 from www.findarticles.com

Origami or the art of paper folding receives substantial endorsement from current reform initiatives in mathematics education. Particularly, at the elementary school level, the National Council of Teachers of Mathematics in its Principles and Standards for School Mathematics recommends that students use paper folding for initial investigations in geometry. Students benefit from experimenting and exploring with physical materials and models, and learning opportunities that require students to visualize, draw, and compare figures that help them develop spatial sense. Silverman and Marzano (1996) noted that what is accomplished by using origami is no less than the planting and nourishing of the seeds of geometric thinking.

Sutton, J., Krueger A. (2002). EDThoughts What We Know About Mathematics Teaching and Learning, (90).

Mathematics achievement is increased through the long-term use of concrete instructional materials and active lessons at various grade levels. The more avenues there are to receive data through the senses, the more connections the brain can make. The more connections that are made, the better a learner can understand a new idea. Teachers must intervene frequently to help students focus on underlying mathematical ideas and to help build bridges from students' active work to their corresponding work with mathematical symbols or actions.

Materials

- ❏ Geometry Journal
- ❏ *Grandfather Tang's Story*
- ❏ Chinese costume
- ❏ Poster board
- ❏ Tangram sets
- ❏ Overhead projector
- ❏ 9 x 12 art paper
- ❏ Geoboards
- ❏ Geobands
- ❏ Graph paper
- ❏ *Origami Math*
- ❏ Origami paper
- ❏ Scissors
- ❏ Ruler
- ❏ *What's My Area?*

Invitation to Learn

Dress up as Grandfather Tang with a Chinese hat, a long mustache, and a tunic. Then read the book *Grandfather Tang's Story*. As you read the story make the twelve tangram pictures from the story on a large poster or flannel board. Cut the twelve sets of tangram pieces from construction paper or foam board so they will attach easily to the poster or flannel board.

Instructional Procedures:

1. Provide each student with a simple Geometry Journal to record definitions and activities in.

   It can be a student notebook or you can make a simple bound book for them to use. Dinah Zike's Foldables book has many different types of books that you could use as a journal.
2. Use paper folding to make your own set of tangrams. As you decompose the square point out the relationships between the pieces. (e.g. A square cut in half on the diagonal forms two triangles; what two shapes can you see in the parallelogram.)

- Fold a 9 x 12 piece of art paper to form a square. Cut off the extra piece at the bottom.
- Cut the square in half on the diagonal fold to form two triangles.
- Take one of the triangles and fold it in half to form two smaller congruent triangles. Cut along the fold.
- Take the other large triangle and make a small pinch crease in the middle of the baseline to identify the center. Take the apex of the triangle and fold it to touch the center of the baseline. This forms a trapezoid.
- Cut along the fold line. This gives you a trapezoid and a small triangle.
- Fold the trapezoid in half (two congruent shapes) and cut along the fold line.
- Take one half of the trapezoid and fold the pointed end to form a small square. Cut along the fold. This will give you a small square and a small triangle.
- Take the remaining half of the trapezoid. Fold one of the corners of the square end to form a small triangle and a parallelogram. Cut along the fold.

This should make a complete set of tangrams: One small square; two small congruent triangles; two large congruent triangles; a medium size triangle and a parallelogram.

Give students a few minutes to experiment with making different animals from the tangrams like they saw in the Grandfather Tang book. Let them choose their favorite animal they made and glue it into their journals.

3. Use Tangram Pieces to Compute Area

Give each student a set of plastic tangrams to use for this activity. They are easier to trace than the paper ones.

Review the definition of area: The measure of the number of square units needed to cover the surface of a plane figure. Write the definition in journals.

We will be figuring the area of each of our tangram pieces by comparing it to the small square. We will call the small square "one square unit". The length and width are both one unit so we multiply 1 x 1 and get one square unit.

Model each step on the overhead for the students, but give them time to try to determine how to make the shapes before you show them. This thinking and experimenting process will help them develop their spatial reasoning. On each step have the students trace the shape into the journals, then after determining the area, write it next to the shape.

- Find the two small congruent triangles and review the definition of congruent: same size, same shape. Put them together to make a square. What would the area of this shape be? Why?
- Take just one of the small triangles. What would its area be? Why? Remember to relate it to the square.
- Trace the parallelogram. How can we figure the area for a shape like this? We can also relate it to the square. Take your two small congruent triangles and lay them on the parallelogram. What do you discover? The two triangles make a congruent shape for the parallelogram. So what is the area of the parallelogram?
- Trace the medium size right triangle. It is a right triangle because it has a square corner that is a right angle. Fit the two small congruent triangles on top of the right triangle. They form a triangle that is congruent with the right triangle you traced. Trace the two small triangles. What is the area of the right triangle? (1 square unit) How do you know? It has the same area as the two small triangles that we already know have an area of one square unit.
- Make a triangle using the small square and the two small triangles. What will the area be? How do you know? 2 square units-the small square is one unit and the two small triangles together are another unit.

You can extend this activity to finding the area of any other polygons constructed from the tangram pieces.

- Make a square using the medium size triangle and two small triangles. What will the area be? (2 square units) How do you know?
- Make a rectangle with the parallelogram and the two small triangles. What is the area? (2 square units) How do you know?
- Make a triangle congruent to one of the large triangles. Do not use the square. What is its area? (2) How do you know?
- Construct a square using all seven tangram pieces. What is its area? (8) How do you know?
- Construct a trapezoid. Determine its area.
- Construct a parallelogram. Determine its area.
- Make a pentagon. Determine its area.

4. Using Geoboards to Determine Formulas to Compute Area

Make a square with an area of nine square units. Determine its length (3) and its width (3). Remember that a square is also a rectangle, then review how we multiply length x width to determine the area of a rectangle so 3 x 3 = 9 square units. Divide the square in half diagonally. Ask what shapes they have made. (Two triangles) Is a triangle half of the rectangle? What would the area be? Half of nine, which is four and one-half. Make several more rectangles, figure the area, and then divide each of them in half to form triangles. Lead students to discover that a triangle's area is half of the rectangle. It is too difficult to try and count the square units so instead we can again use the formula "length x width"...if we divide it in half. Go back and multiply to find each rectangle's formula, then divide the area in half and they will get the triangle's areas. Have them write the formula for finding the area of triangles in their journals. The area of a triangle = ½ (length x width). Explain that when we are just working with triangles, we use the words base and height in place of length and width. The official formula to find the area of a triangle is ½ b x h.

5. Using Graph Paper to Determine Formulas to Compute Area for Parallelograms

   There is also another strategy for determining the area of a parallelogram. Trace the parallelogram tangram onto a sheet of graph paper and cut it out. You must be very accurate! Cut off one end of the parallelogram-follow a line on the graph paper and it will be easier to be accurate. Now take that piece and slide it to the other end, what shape do you have now? It is a rectangle. So we can now use the area formula of length x width which we use for rectangles. It is four squares long and eight squares wide so multiply 4 x 8 = 32 square units. Can you use this formula on a parallelogram without cutting it apart? Put your parallelogram back the original way. Count how many units tall it is (4) and how many units long it is (8). The formula for area works perfectly on parallelograms!

6. Origami

   Use any of the activities from *Origami Math* by Karen Baiker to continue developing spatial reasoning and recognition of congruency and symmetry. You can also use other origami projects and simply adapt them yourself by looking for shapes formed as you fold, determining the area, lines of symmetry, and congruent shapes.

Formative Assessment can be done by observing students during the activities and evaluating their journals.

Final Summative Assessment *"What's My Area?"* is included in the activity.

Curriculum Extensions/Adaptations/ Integration

Use the Geoboards to play CopyCat. Pair students up, give each a geoboard. Have them sit back to back so they cannot see each other's boards. Have Student 1 make a polygon on their board. He then needs to tell Student 2 the area of his figure. Student 2 tries to "copycat" his figure. Switch roles. You can also do this activity using perimeter.

You can play a variation of this against your class. Say: I have made ______figures with a perimeter of _______. Give them 2 minutes to see how many figures they can come up with that have that perimeter. If they can make more than you did they win that round. Do the same with a fixed area.

For students with fine motor control difficulties do not have them trace the shapes. Just let them manipulate the tangrams. It might be helpful to give them two sets in different colors so they can more easily see the relationships. You can also make a copy of the tangram puzzle so they just have to cut and not fold to make the shapes.

Integration with language arts. Have them make a tangram animal and then write a legend about it.

Family Connections

Let students make a set of tangrams to take home to their families. Have them see how many figures their families can make. Remind them that every shape they make will have an area of 8 square units. Challenge them to explain that to their families.

Let the students take geoboards home and play CopyCat with their families.

Additional Resources

Grandfather Tang's Story, by Ann Tompert; ISBN 0-517-88558-1

Dinah Zike's Foldables, by Dinah Zike; ISBN 0-02-149593-9

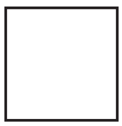
Groovy Geometry, by Lynette Long; ISBN 0-471-21059-5

Geometry for Every Kid, by Janice VanCleave; ISBN-0-471-31141-3

Origami Math, by Karen Baicker; ISBN-0-439-53992-7

Name ______________________________

What's My Area?
Final Assessment

1. This square  has an area of 4 square units. If you divided the square into two triangles, what would the area of each triangle be?

A. 2 square units

B. 8 square units

2. What would the area of a rectangle be if it is 5 units long and 3 units wide?

A. 5 x 3 = 15 square units

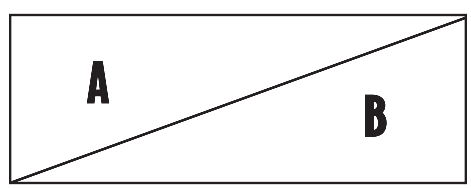
B. 5 + 3 = 8 square units

3. What would the area of a triangle be if the base was 6 units and the height was 4 units?

A. 2 x b x h = 48 square units

B. 1/2b x h = 12 square units

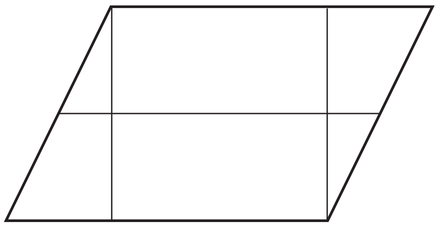
4. If the rectangle has a length of 1 unit and a width of 6 units, what is the area of triangle A?



A. 1 x 6 = 6 square units

B. 1/2 1 x 6 = 3 square units

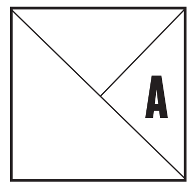
5. What would the area of this parallelogram be?



A. 4 square units

B. 6 square units

6. If this square has an area of 4 square units, what is the area of Triangle A?



A. 2 square units

B. 1 square unit

7. What is the area of a triangle which has a base of 10 and a height of 2?

A. 1/2 of 10 x 2 = 20 square units

B. 1/2 of 10 x 2 = 10 square units

8. What is the area of a rectangle that is 8 units long and 10 units wide?

A. 8 x 10 = 80 square units

B. 1/2 of 8 x 10 = 40 square units

9. If the area of a rectangle is 8 square units and the length is 4 units, what would the width have to be?

A. 2 units

B. 4 units

10. Use your ruler and draw a rectangle with a length of 2 inches and a width of 3 inches. Divide it diagonally to form two triangles. What is the area of one of the triangles?

A. Each triangle would be 1/2 the area of the rectangle so one triangle wold have an area of 3 square inches.

B. Each triangle would have the same area as the rectangle so one triangle would have an area of 6 square inches.

Science IV-1

Activities

Fossils

Fossil Formation Fun

Standard IV:
Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.

Objective 1:
Describe Utah fossils and explain how they were formed.

Intended Learning Outcomes:
1. Use science process and thinking skills.
2. Manifest scientific attitudes and interests.
3. Understand science concepts and principals.
4. Communicate effectively using science language and reasoning.

Content Connections:
Language Arts VII-2; Understanding informational text

Science Standard IV

Objective 1

Connections

Background Information

The three fossil types that are dealt with in this lesson are those specifically required by the Utah State Core for this grade level, the first being preserved organisms. In preserved organisms, the actual organism is basically unaltered and stays intact, e.g., mammoths that have been found in ice and frozen ground. The soft body parts are preserved as well as the hard parts. Preserved organisms have been found in tar pits and amber. Amber is formed when the soft resin from conifers and tropical flowering plants hardens. Organisms, e.g., insects, spiders, leaves, flowers, mosses, and even frogs, have been found in amber. Organisms trapped in this resin may experience a degree of decomposition, but because resin has a strong antibiotic component the decay of the organism is minimal.

The next type of fossils is mineral replacement. In this type of fossil the organism is buried in sediment, and the soft parts decay quickly. Bones, teeth, claws, and other hard parts decay more slowly. Water seeps through the sediment and passes through the bone. The seeping water dissolves the bone, and minerals in the water replace the bone one cell at a time. This eventually becomes stone. The same process happens in wood; except that wood is often covered with volcanic ash instead of sediments. The ash prevents the wood from rotting, and as rainwater falls on the ash over many years it seeps through the ash into the wood. The mineral replacement makes an exact replica of the original organism.

The last fossil type is impression fossils. These fossils may show detailed outlines of thin plants or small animals, e.g., leaves, feathers, and fish, which die in sediment. As they decay, they leave a carbon deposit which shows as a dark print of the organism. Impression fossils also include tracks, tail prints, body outlines, teeth marks, and burrows. Mold and cast are impression fossils made by larger organisms. When the organism dies it is covered by sediment. The organism decomposes slowly and leaves a mold (hole) in its place. If the mold is later filled with sediment, it produces a cast that will physically look like the outside of the original organism.

Be aware that students may become confused by pseudofossils when examining rock specimens. These are rock structures that resemble fossils in external form, but lack the detailed structure of true fossils. Sometimes concretions that are harder than the rock in which they occur are found on the surface of the rock, and resemble fossil material.

Research Basis

House, J. D. (2006).The Effects of Classroom Instructional Strategies on Science Achievement of Elementary-School Students in Japan: Findings from the Third International Mathematical and Science Study (TIMSS). *Academic Search Premier* (EBSCO HOST). Retrieved 11/21/2006, from http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=21408846&site=ehost

This article addresses how cooperative learning activities and active learning strategies have helped to improve student interest and achievement in science. The purpose of the study was to investigate the relationship between instructional strategies and student achievement. It was found that students who were frequently involved in cooperative learning and who frequently performed experiments in class earned higher scores.

Mercier, S., & Ostlund, K. (1999). Rising to the Challenge of the National Science Education Standards: The Process of Science Inquiry. California, Squaw Valley: S & K Associates

The beginning of this book gives a practical introduction to inquiry and implementing the National Science Education Standards. It also includes an overview to the process skills which are the key to success in science. There is a section on cooperative and collaborative learning groups and guidelines for helping students learn cluster, task, and camaraderie skills. Help with assessing social skills is also provided.

Puntambekar, S. (2006). Analyzing Collaborative Interactions: Divergence, Shared Understanding and Construction of Knowledge. *Academic Search Premier* (EBSCO HOST). Retrieved 11/21/2006, from http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ738994&site=ehost-li

This article discusses the interaction between individuals during collaborative learning, sharing divergent perspectives, and shared knowledge bases. Learners move from divergent perspectives to collaborative knowledge building. Students create understanding from the discussions that they have. The purpose of the study was to understand how collaborative interactions develop over time.

Anderson, K.L., Martin, D.M., & Faszewski, E.E. (Sept 2006). Unlocking the Power of Observations. *Science and Children* (pp. 32-3).

This article discusses how observation is the cornerstone of the inquiry process which lays the groundwork for future scientific learning. Suggestions are given on how to help students make good observations and how to help students communicate those observations. Also given is an assessment checklist and rubric for assessing students' observation abilities.

Invitation to Learn

Fossil Questions

Read each statement carefully. If you believe it is true, place a check in the "Agree" column. If you believe the statement is false, place a check in the "Disagree" column. After learning more about fossils, you may go back and change any of your answers using a different color of pencil.

	Agree	Disagree
1. Scientists learn about Earth's history by studying fossils.		
2. Fossils are usually found in igneous rocks.		
3. Only the soft part of an organism can become a fossil.		
4. Impression fossils are also called track fossils.		
5. An organism can be preserved without changing by being frozen in ice.		
6. Amber is an insect found fossilized in rocks.		
7. Minerals that fill tiny holes in an imprint form mineral replacement fossils.		
8. Replacement fossils are all the same color.		

Instructional Procedures

Fossil Observations

In this activity, students will work in cooperative groups of five to six students (depending on class size) to use the process skills of

Materials

- ❑ Science notebook
- ❑ Pencil
- ❑ Five different fossils
- ❑ Timer
- ❑ *Fossil Chart*

observing, comparing, and inferring. When doing this activity it helps to use a timer; typically, about five to seven minutes allows them enough time to observe their fossil and record the information.

1. Students in each group should count off from one to five. Then students assemble with students from other groups who have the same number. Each numbered group will examine a different fossil, discussing the characteristics they observe.
2. Students will record their fossil observations in their own science notebook, along with a detailed drawing of the fossil. Their written observations should include such things as size, color, shape, texture, and any defining features.
3. Students go back to their original group to share what they have observed and learned about their fossil. Use the *Fossil Chart* to organize the group's information.
4. Students can then use their observations to ascertain similarities and differences among the fossils. They should use logical thought processes to show relationships and make inferences as to the fossil organism's original environment. It is also important that students use the identified features to compare the fossils to living organisms that are familiar.
5. Each group can then share with the class as a whole.

Materials

- ❑ 3 x 5 index cards
- ❑ Crayons
- ❑ Hot glue gun and glue sticks
- ❑ Brown pipe cleaners or actual insects

Preserved Organisms- Model of Amber

Begin by discussing with students what a fossil is and how scientists use fossils to help explain Earth's past. Since there are currently no living dinosaurs, the only evidence we have about dinosaurs and other prehistoric organisms is what can be inferred from fossilized remains. Physical models that correspond to real objects and events can be used to explain and understand things and how they work. Using the process skill of formulating models, students will develop a physical representation of a preserved organism:

1. Give each student a 3 x 5 index card. Have each student draw about a one inch circle on the left hand side of the index card. Have them color it the color that they think is closest the color of real amber.
2. Students should place the item representing the insect on the colored circle.
3. Students will bring the index card and insect to you to encase in hot glue, covering the colored circle and insect.

4. Discuss how this represents the resin which fossilized into amber over a period of millions of years, preserving the insect.
5. On the right hand side of the card, have them write the process which preserved the insect.

Mineral Replacement- Sponge Fossil

Materials

- ❑ Sponges
- ❑ Scissors
- ❑ Sand
- ❑ Salt
- ❑ Water
- ❑ Large container with pouring spout
- ❑ Large Cool Whip containers
- ❑ Measuring cups
- ❑ Long handled spoon

Using the process skill of formulating models, students will develop a physical representation of a mineral replacement fossil:

1. Each group will place their sponge shapes into a container holding sand, covering the sponge shapes completely. There should be a layer of sand below and above the sponges.
2. Mix two parts salt to 5 parts water in another container. Make sure that the salt is dissolved into the water.
3. Slowly poor the salt water on top of the sand until it completely soaks the sand.
4. Leave the container of sand in a warm, dry place until it completely dries. You can expedite the process by putting it in the oven at 250 degrees F for a few hours, but you will need to use a container that can go into the oven.
5. When it is dry, excavate the sponges with a spoon. Have students use a grid to record where each “bone” was found.
6. See how the sponges turned “bonelike.” Discuss with students how when the salt water was added to the sand, it filled the pores in the sponge. When the water evaporated, the salt remained in those pores. This simulates how dissolved minerals replaced the cells in bones, wood, etc. Fossils are found in sedimentary rocks which are formed by cementation and compression.

Impression Fossils- Making Traces

Materials

- ❑ Bag of Plaster of Paris
- ❑ Bowl and spoon
- ❑ Water
- ❑ 8 oz. paper cup
- ❑ Measuring cups
- ❑ Plastic fossils
- ❑ Petroleum jelly

In this model, Plaster of Paris represents the soft sediment that an organism would fall into before it becomes a fossil. Using the process skill of formulating models, students will develop a physical representation of an impression fossil:

1. Mix up Plaster of Paris to about the consistency of thick cream.
2. Pour approximately an inch into each student’s cup, or have students mix their own in a margarine tub or their school milk carton that has been opened completely and rinsed out. Have them measure ½ cup of Plaster of Paris dry, then add

approximately 1/4 cup water, and stir. Let it sit for a couple of minutes to start setting up.

3. Place their leaf, feather, shell, or other small item vein side down, gently into the Plaster of Paris until it makes complete contact with the surface. (I've had better results in getting the object out, if they have put a thin layer of petroleum jelly on the surface of it before putting it into the plaster.)
4. Allow this to cure for several hours.
5. After the object making the impression is removed, have students in different groups trade and match fossils with the objects that made the fossil.
6. Students should respond to these questions in their journals: How are your fossil models like a real fossil? How are your fossil models different from a real fossil? How can your fossil models help us to understand real fossils? What can real fossils tell us about the world at the time they were formed?
7. Follow the journal writing with a class discussion sharing their journal responses.

Assessment Suggestions

- Pre-Assessment- See the *Fossil Questions* blackline used as the Invitation to Learn.
- 3-2-1 Assessment: Have students write three facts that they have learned about fossils, two terms they want to remember, and one question that they have about fossils.
- Using a tri-fold piece of paper, have students label and draw a different picture in each section that shows the formation of: a preserved organism, mineral replacement fossil, and an impression fossil.
- Use the *Fossil Assessment* which is included.

Curriculum Extensions/Adaptations/ Integration

- Extend student learning by having students create a model which shows a dinosaur trackway. This can be done with various mediums such as clay or sand dough. Use different dinosaur models to make the tracks. Have students evaluate what information might be learned from the dinosaur trackway, such as: Does the dinosaur walk on two or four legs? Do you see evidence of a tail? Is there more than one type of dinosaur track? Can you see evidence of change of direction or increase in the speed of movement? What story is indicated from these tracks?

- Use the book, *Fossils Tell of Long Ago*, by Aliki, as a read aloud. Then have students create a chart listing the different types of fossils described and how they were formed.
- Vocabulary is often a stumbling block in science. Focus on vocabulary by creating a vocabulary study guide or by working with a group to illustrate the meaning of each important vocabulary word.
- If accommodations are needed for students who may be in pull-out programs or absent on the day of the fossil observation activity, it can be done as a center activity. Students can record their information on the fossils and compile it in booklet form instead of using their notebooks. The drawback of this approach is that it doesn't allow for the use of comparing and inferring with classmates. This can also be used with students who have completed the group activity to focus a second time on making a better observation. Students will almost always increase the length and complexity of their responses.
- If Plaster of Paris is too messy for students to use, Play- Doh also works well for making an impression or track fossil. It dries completely in two days.
- Using the fossils from the observation activity, students can write a riddle about their fossil. Students can then share their riddles with classmates. Classmates can try and match the fossil with the riddle.
- Integrating with Language Arts:

Introduce the Student Content Reading

1. Each student will individually read the *Fossils* article to themselves silently.
2. Assign each student a partner. (Assign partners carefully, allowing the best reader to read aloud first. This will give the slower reader a second time through the material before their turn, and allow for better performance on the task.) Partner #1 reads the article aloud to their partner. When finished with the reading, partner #1 retells the article information to partner #2, who uses the *Fossil Retell* report form to record the retell.
3. Partner #2 then reads the article aloud to their partner. When finished with the reading, partner #2 retells the article

information to partner #1, who uses the *Fossil Retell* report form to record the retell.

4. Partners should then discuss the information they learned from the article.
5. Randomly select students in the classroom to share with the class what they discussed with their partners.
6. Allow students to go back to their pre-assessments and change any responses that they now think were incorrect.

Family Connections

- Students can take home the Fossil background reading and read to parents, discussing what they learned from the article.
- As a family, take a trip to an Earth Science Museum or a dinosaur exhibit in your area. (See the website listed for more information.)

Additional Resources

Books

Adventures in Paleontology: 36 Classroom Fossil Activities, by Thor Hansen and Irwin Slesnick; ISBN- 13: 978-0-87355-272-1

A Golden Guide from St. Martin's Press: Fossils, by Frank H.T. Rhodes, Herbert S. Zim, and Paul R. Shaffer; ISBN 1-58238-142-9

Boy, Were We Wrong About Dinosaurs!; ISBN 0-525-46978-8

Fossils Tell of Long Ago, by Aliki; ISBN-13: 1978-0-06-445093-5

Linking Science & Literacy in the K-8 Classroom, Edited by Rowena Douglas, Michael P. Klentschy, and Karen Worth, with Wendy Binder; ISBN-13: 978-1-933531-01-4

New Dinos, by Shelley Tanaka; ISBN 0-689-85138-9

Reader's Digest Pathfinders: Dinosaurs; ISBN 1-57584-288-2

The Complete Book of Dinosaurs; ISBN 0-681-37578-7

Web-linked, Online: Dinosaurs; ISBN 0-7566-2228-X

Media

Reading Rainbow: Digging Up Dinosaurs; ASIN 6302033365

Eyewitness: Dinosaurs; ISBN 0-7894-0038-3

Articles

Science and Children (Nov 2006), NSTA.

Web sites

http://www.utah.com/dinosaurs/index.htm

Fossil Chart

	Size	Color	Shape	Texture	Defining features
Fossil #1					
Fossil #2					
Fossil #3					
Fossil #4					
Fossil #5					

Fossil Questions

Read each statement carefully. If you believe it is true, place a check in the "Agree" column. If you believe the statement is false, place a check in the "Disagree" column. After learning more about fossils, you may go back and change any of your answers using a different color of pencil.

	Agree	Disagree
1. Scientists learn about Earth's history by studying fossils.		
2. Fossils are usually found in igneous rocks.		
3. Only the soft part of an organism can become a fossil.		
4. Track fossils are one type of impression fossil.		
5. An organism can be preserved by being frozen in ice.		
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Fossil Assessment

In each box below, write the name of a different category of fossil.	Identify at least three key details about how that category of fossil is formed.
	1. 2. 3.
	1. 2. 3.
	1. 2. 3.

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Fossils

Fossils teach us about plants and animals that lived on Earth long ago. Scientists study these fossils to learn about what happened on Earth millions of years ago. Fossils are usually found in sedimentary rocks. Hard parts of an organism such as bones or shells can become a fossil, but soft parts rot too quickly. The plant or animal must be buried quickly by sediments and stay untouched for a long period of time.

Sometimes a fossil is just a mark left behind by an organism when it was alive such as a footprint or a burrow. Sometimes a dead plant or animal sinks into mud leaving its shape when it decays. When the sediment hardens, it becomes an **impression or track fossil**.

Some organisms are preserved without changing. This might happen when an animal falls through ice and is frozen. An animal might also be trapped in a tar pit. Some organisms have been preserved in amber (the fossilized resin from ancient trees and plants). These are called **preserved organisms**.

Mineral replacement fossils are made when water dissolves part of the dead plant or animal and washes it away. Minerals fill in the tiny holes left in the imprint of the plant or animal. These minerals harden into stone. The fossil is the same shape and size as the original plant or animal. Sometimes you can see very detailed parts of the once living organism. Replacement fossils can be very colorful because the minerals which fill in the holes may be different colors.

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Sorting and Sifting the Fossil Data

The words and phrases in the following cards have been taken from the selected text in the activity. Similar activities could be used with the students literacy pieces in the Teacher Resource Book.

Before reading:

1. Cut the cards on the page apart into rectangles that can easily be moved or shifted.

2. Have partners decide which words or phrases seem to go together. Write a sentence that makes a statement and uses the target vocabulary.

3. As students do activities, they gain greater understanding and can group words and phrases into threes and again make statements.

4. Students are now ready to read the informational text. While they read, they should be looking for the words and phrases they used for the vocabulary activity. Have them try to match up the words or phrases they have with those in the text. Pay attention to how they are used in the writing. Did the student created sentences match or are they similar to the passage?

Words sorted together: Sentences:

Bones or shells can make *impressions* in soil.

Trilobites are a kind of *fossil*.

Fossil Word Sort

impression	track fossil	hard parts of an organism	preserved organism
mineral replacement fossil	sedimentary rocks	infer	water dissolves
bones or shells	fossilized resin from ancient trees and plants	minerals harden into stone	footprint
amber	trilobite	dead plant or animal	imprint in the mud

Fossil Retell

Free Retell	Cued Retell	Main Ideas
		1. Fossils teach us about plants and animals from long ago.
		2. Fossils are found in sedimentary rock.
		3. Dinosaur footprints are impression or track fossils.
		4. Some organisms are preserved without changing.
		5. Amber is an example of a preserved organism.
		6. Water dissolves part of the dead plant or animal in a mineral replacement fossil.
		7. Minerals can fill in the tiny holes of an imprint and turn to stone.

Date: ______________

Free Retell: ________

Cued Retell: _______

Student Pair: ____ (1st Retell)

____ (2nd Retell)

Science II-2

Activities

Weather Patterns

Weather Tools of the Trade

Standard II:

Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine and determine simple weather patterns.

Objective 3:

Evaluate weather predictions based upon observational data.

Intended Learning Outcomes:

3. Understand Science Concepts and Principles.

Content Connections:

Language Arts VII-2; Comprehension to Understand Text.

Science Standard II

Objective 3

Connections

Background Information

For students to predict the weather they need to know the simple weather patterns. To know the simple weather patterns they need to know the simple instruments used by meteorologists that measure the elements of weather. These simple instruments that 4^{th} graders need to know are the thermometer, barometer, weather vane, anemometer, and rain gauge. When the students have learned the identity of these instruments, they need to know how they work and how to interpret the information they have gathered. In this lesson you will learn how to teach what these instruments are, how they are used, data that can be collected from the use of these instruments, and why we keep records of the data. Later in another lesson we will interpret the data.

Research Basis

Myhill, D. (2006). Talk, talk, talk: teaching and learning in whole class discourse. *Research Papers in Education,* Vol. 21, No. 1, pp. 19-41

It is important that teachers don't take up too much of student learning time by talking that limits opportunities for pupil learning. Teachers are encouraged to only take up about 15 minutes of whole class time. Teachers are encouraged to use questions for student interaction with each other for discussion and discovery. The teacher only acts as a facilitator during the student learning time. Teachers are also encouraged to have students work in groups to learn from each other.

Enfield, M. (2007). Discussion maps make sense. *Science and Children,* Vol. 44, No. 5, pp. 46-49.

Discussions can be useful for teachers in evaluating students' ideas. They offer windows for teachers to help understand student thinking.

Through discussions, students can express their ideas. Some students feel more comfortable during a discussion than during any other school task. The "discussion map" lets a teacher gain insight into the students' level of participation and helps the teacher get an idea if the student understands the concept taught.

Invitation to Learn

Make about six groups with four students in each group. Pass out pictures of the rain gauge, barometer, thermometer, anemometer, weather vane, and ruler (or the real articles if you have enough) to each group. These pictures shouldn't have the name of the instruments on them. (If possible, have a real sample of each of the weather instruments by you that the students have pictures of.) Tell the students that these are some of the weather instruments meteorologists use to find out what the current weather conditions are.

Without telling the name of the instruments show the real instruments to them one by one. Pass out cards that that tells the names of each weather instrument. Give the groups time to put the name of the weather instruments with the pictures of the weather instruments. When they are done see if they have correctly matched the names with the instruments.

At this time you can see if any of the students know how these instruments measure the weather elements. As they tell about each one, pass out the card that tells about that particular weather instrument and its use. Elaborate on what the student has stated about the instrument. Do this until all the instruments have been talked about. Tell the class that these are the basic instruments that meteorologists use to tell us what the past weather was and what the current weather is now.

Materials

- ❏ Pictures, word Cards, and samples of:
  - Barometer
  - Thermometer
  - Rain gauge
  - Ruler
  - Anemometer
  - Weather vane
- ❏ Weather instruments description cards
- ❏ Local weather forecast video
- ❏ *What Did The Meteorologist Say To Us?*
- ❏ Journals

Instructional Procedures

Tell the students that today they are going to learn more about these weather instruments and how meteorologists use them by watching a weather newscast from a local TV station.

1. Have the students get out their journals and tell them they are going to take notes of what they see in the local weather broadcast. Tell them to look for the instruments they use, the order they present the information, and what is the final idea they want to present to us. Right now, we are not interested in the numbers they show, just the type of information they are giving us.

2. Show a clip of a 10:00 p.m. weather broadcast from a local news station.
3. Have the class members write down what the meteorologist showed as part of his/her weather presentation.
4. They may write:
    - The current day's past statistics (kind of precipitation, amount of precipitation, air temperature—highs and lows, and wind speed).
    - The present conditions (kind of precipitation, air temperature, wind direction, wind speed, cloud cover, and air pressure—rising, dropping, or stable).
    - What tomorrow's weather is going to be (kind of precipitation, amount of precipitation, air temperature—highs and lows, wind speed, wind direction, and cloud cover).
5. Discuss what they observed about the weather broadcast.
6. Pass out the worksheet *What Did The Meteorologist Say To Us?*
7. Ask the students, "How did the meteorologist know what the past weather conditions were? (They used the weather instruments we talked about.)
8. Ask the students, "How did the meteorologist know what the present weather conditions were? (They used the weather instruments we talked about.)
9. Ask the students, "What are the instruments he used to tell us about the weather of the day?" (The rain gauge or ruler, thermometer, anemometer, and others they may name.)
10. Ask the students, "Why are these weather instruments important?" (They tell us what the past weather was and what the present weather is.)
11. Ask the students, "Why is it important to us to know what the present weather is?" (We know what we need to wear to be comfortable out in the weather.)
12. Ask the students, "Why do you think it is important that we keep track of the weather and record it day by day?" (Some will give guesses to this question, but the students may not directly know this answer. You may want to help them along with more questioning to get to the right answer.)
13. When they can't answer it totally correct, tell the students that meteorologists use the past weather data to watch for patterns. They watch the patterns of the temperature, wind direction, wind speed, the kind of precipitation, the amount of

precipitation, and the barometric pressure and make weather predictions.

14. Ask the students, “Are there other instruments the meteorologist used for presenting the weather to us?” (Yes, he used satellite pictures.)
15. Tell the students they are going to learn about weather patterns by keeping a record of the basic elements of weather by using these tools we have talked about.

Assessment Suggestions

- Look in their journals to see if they took good notes on the weather forecast segment that they viewed. They needed to have written the three parts that a meteorologist presents—present day’s past statistics, the current conditions, and the forecast. They should have written down the instruments they used during the weather broadcast.
- Look at the worksheet the students answered during the discussion.
- Test the students if they know the weather instruments by using the pictures and the words of the pictures to match them up.
- Have the students write what the uses of the instruments are.
- Have the students tell why the information that is recorded by these instruments is helpful.

Curriculum Extensions/Adaptations/Integration

- Advanced learners can do some research on these instruments.
- Advanced learners can do some presentations on these instruments in depth during the presentation or after the presentation.
- Learners of special needs should be able to physically touch the weather instruments and match them to the pictures. They will need special help in the group to match the names with the instruments.
- Have the students make the weather instruments in class.
- Have the students read more about the instruments they have learned about.

Family Connections

- Send the pictures of the weather instruments home with the students to explain to their families what each of the instruments are and how they are used to find out what the current weather is.
- If the students made some of the instruments in school, send them home to show and explain their families about the weather instruments. Have them use them at home.
- Give an assignment to the students to watch a weather report on any of the channels to reinforce what they learned in school. Have them take notes on what the weather is going to be the next day and see if it is correct the following day.

Additional Resources

Books

Weather, Science Alive; ISBN 0-7787-0611-7

Media

Forecasting and Weather Instruments DVD, UNITED LEARNING, 2001

Web sites

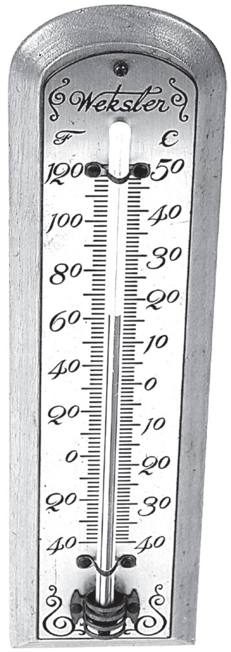
http://www.weatherwizkids.com/index.htm

http://schoolscience.rice.edu/duker/winstruments.html

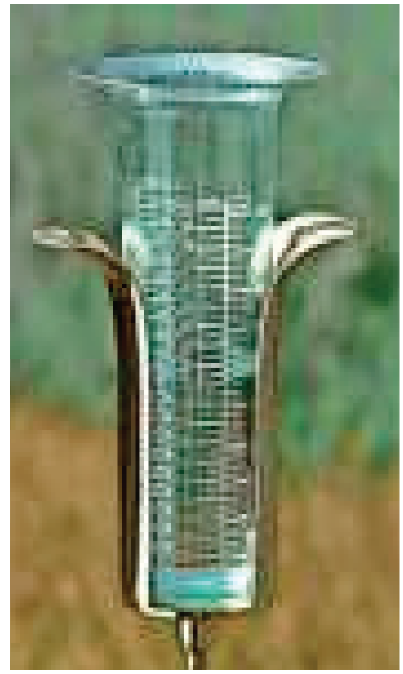
http://www.fi.edu/weather/todo/todo.html

Weather Instruments

Barometer



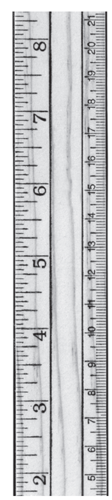
Thermometer



Rain Gauge

Weather Vane

Anemometer



Ruler

Names of the Weather Instruments

Barometer	Thermometer
Rain Gauge	Anemometer
Weather Vane	Ruler

Weather Instrument Descriptions

Barometer

There is air pressure around us all the time. The barometer measures the air pressure around us. Sometimes this air pressure changes because of changes in the atmosphere. When the air pressure changes there is usually a change in the weather. When there is a big change in the air pressure a storm is coming.

Thermometer

The thermometer measures the temperature of the air around us. The air temperature outside changes constantly. It changes because the sun changes its position in the sky, when the sun goes down at night, when the sun goes behind a cloud, or when warm or cold air moves into our area.

Anemometer

The anemometer measures how fast the air is moving around us. It may be blowing softly telling us that we will enjoy fair weather for a while, or it may be blowing hard telling us that a low pressure is near and a storm may be coming our way. The wind can be very pleasant or it can do a lot of damage.

Weather Vane

The weather vane tells us from which direction the wind is coming from. It is set up so the arrow points in that direction. The wind hits the back tail and turns it so the arrow will point in the direction the wind is coming from. Sometimes we can tell if a storm is coming by knowing which direction the wind is coming from.

Rain Gauge

The rain gauge measures how much rain we got during a rainstorm. After the rainfall is measured, meteorologists will look at the other weather instruments to see what the conditions were like right before it rained. They will record this data. When they see the other instruments all measuring the same again before another rainstorm, they can predict how much rain we will get with the storm coming in.

Ruler

The ruler measures the depth of the snow after a snowstorm. After the snow depth is measured, meteorologists will look at the other weather instruments to see what the conditions were like right before it snowed. They will record this data. When they see the other instruments all measuring the same again before another snowstorm, they can predict how much snow we will get with the storm coming in.

What Did The Meteorologist Say To Us?

1. How did the meteorologist know what the past weather conditions were?

2. How did the meteorologist know what the present weather conditions were?

3. What are the instruments he used to tell us about the weather of the day?

4 Why are these weather instruments important?

5. Why is it important to us to know what the present weather is?

6. Why do you think it is important that we keep track of the weather and record it day by day?

Winter and Summer Storms Scenarios

Science Standard I

Objective 3

Standard I:

Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine and determine simple weather patterns.

Objective 1:

Observe, measure, and record the basic elements of weather.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills.

Content Connections:

Math V-1; Data to make predictions

Connections

Background Information

Winter storms and summer storms in Utah come from two different sources. However, they both have a lot in common. Both storms tend to move from the west to the east. Both have moisture in them that come from the Pacific Ocean. They have a low pressure for the moist, warm air to expand rapidly. Both have warm winds that feed into the low pressure as it is approaching. As the warm air expands rapidly it cools instantly to create cold air to make clouds and eventually could produce precipitation. Lastly, they both produce wind prior to the their storms. Usually the winds associated with the two storms are warm.

But there are some differences in the two storms. Winter storms are generally from October through April. Summer storms are generally from May through September. Winter storms have their beginnings from the north where the air is cold. Summer storms have their beginnings from the south where the air is warm. Winter storms bring in cold air from the north that can last for many days after the storm. After a summer storm the air may be cooler for a few hours but quite comfortable. Summer storms can produce violent, strong winds that can do a lot of damage. Winter storms will bring wind, but they won't do much damage. Summer storms can have thunder and lightning associated with them. Generally, winter storms don't have thunder and lightning. The whole process of a winter storm coming in can last up to a week from beginning to end. The whole process of a summer storm will only last a few hours. The barometer usually drops quite a bit before a winter storm, but the barometer doesn't drop much at all (if any) before a summer storm.

There are reasons that summer storms are different from winter storms. There are different patterns to watch for in each. Today we are going to discover these patterns.

Research Basis

Black, R. (2005). Why demonstrations matter. ***Science and Children***, Vol. 44 (Number 1), page 56.

It is still a good practice to have teacher-centered demonstrations in the classroom. Children get excited when they see unfamiliar objects in front of them that they know are going to part of a science experiment. Careful planning and questions techniques give the teacher more control for the students to understand the results.

Bransford, J.D., Brown, A.L., & Cocking, R. R. (Eds). (1999). ***How people learn: brain, mind, experience, and school.*** Washington, DC: National Academy Press

Hands-on learning provides the students with kinesthetic, auditory, and visual learning. As students perform hands-on tasks, they make learning happen for themselves. They learn quickly from their experiences. They begin to make a connection to their world. As this approach in being taught the students learn through the process of inquiry. The teachers ask many questions during science lessons to make students' thinking process complete.

Invitation to Learn

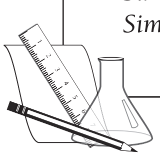
Get two bowls. Put hot water in one and cold, ice water in the other. Get an empty plastic soda bottle that has strong sides. (Most bottled water bottles won't work because their sides are too weak.) Put a nine-inch balloon over the plastic bottle so that it hangs limply. Put the soda bottle in the hot water. Notice that the balloon rises. You can ask the students to give reasons why they think the balloon is rising. *(The air in the bottle is getting hot. When air increases in temperature, the air molecules separate and need more room in the bottle. Some get pushed out the bottle and they go into the balloon. This is called expansion.)* Now, take the soda bottle out of the hot water and put it in the cold water. Notice that the air goes back into the bottle. You can ask the students to give reasons why they thing the air went out of the balloon back into the bottle. *(The air in the bottle is cooling down. When air decreases in temperature, the air molecules gather and sink and leave empty spaces in the bottle. This leaves room for the air in the balloon to go back down into the bottle. This is called contraction.)* So, when air heats up it expands and rises and when it cools it contracts and sinks. (We can associate this with summer storms.)

Have a few quart jars ready with hot water in them to place on their desks. Have the same amount of small trays with ice in them and place them on their desks. Tell the students that there is hot water in the jars. Ask what the hot water is doing to the air. *(It is heating the air, making it expand and rise.)* Ask if there is anything else in the air in the bottle. *(There is moisture in the air because the water is evaporating.)* Tell them to put the tray of ice on top of the bottle. Ask them to predict what they think will happen to the air in bottle with the ice on top. *(The moist air will hit the bottom of the ice tray and form moisture on the bottom of the tray. Water may condense on the side of the bottle. A small cloud will form near the top of the bottle next to the ice tray.)* (We can associate this with winter storms.)

Tell them that today we are going to set up a couple experiments that show the patterns of these summer and winter storms. One experiment will show how a winter storm forms and the other experiment will show how a summer storm forms. As we observe these experiments we will be able to watch for patterns.

Materials

- ❏ 2 large plastic bowls
- ❏ Empty plastic soda bottle, 50 ml
- ❏ Nine-inch balloon
- ❏ Ice
- ❏ Shoe-sized plastic box with lid
- ❏ Small bowl
- ❏ Barometer
- ❏ Thermometer
- ❏ Goose-necked lamp
- ❏ 2” masking tape
- ❏ Quart-sized plastic baggie
- ❏ Two-liter bottle
- ❏ Thermometer
- ❏ #4 rubber stopper with 2 small holes
- ❏ Ball needle
- ❏ Air pump
- ❏ Wood matches
- ❏ *Winter Storm Simulation Box*
- ❏ *Summer Storm Simulation Bottle*



Instructional Procedures

Part One: Winter Storm Simulation

1. Get a shoe-sized, see-through plastic box with a lid. This will be your Winter Storm Simulation Box.
2. Tape a thermometer on the side of the inside of the Simulation Box so it can be read. With the lid on the table, place the barometer on the inside of the lid and tape it down.
3. Put water in the bowl and place the bowl next to the barometer.
4. Put the box on top of the lid so lid is the bottom of the box.
5. Carefully tape the lid to the box by going around the box so air cannot get in or out of the box.
6. Take the readings of the thermometer and the barometer in the beginning and then take readings of the two weather instruments for the rest of the experiment every 10 minutes.
7. Place a goose-necked lamp over the Simulation Box so it shines onto the box. Leave it over the box for about one hour. *(This creates heat and a high air pressure inside.)*
8. After an hour, ask the students what they noticed about the temperature and the barometer inside the Winter Storm Simulation Box. *(They both went up because the heat causes the molecules to move more rapidly but are trapped inside because of the lid.)*
9. At this time take away the light and put some ice in a quart-sized plastic baggie and lay it on top of the box. *(This creates a lower temperature causing the air molecules to move slower reducing the air pressure.)*

10. After about a half-hour look to see what is happening inside the box. Ask the students what they observe happening inside the Winter Storm Simulation Box. (*The temperature dropped, the barometer dropped, and water drops have formed on top on the top of the box.)*
11. Ask the students where the water came from. (*The water on top of the box came from the water that had evaporated from the water. When the ice was put on the top it cooled the water vapor and turned in back into water.)*
12. Keep the ice on for another half-hour until most of the water vapor has turned into water. Continue to keep track of the temperature, air pressure, and precipitation inside the Winter Storm Simulation Box.

In real life most winter storms come in from the north. They bring with them cold air, low pressure, and generally moist air. This is usually a huge storm system that stretches the width of Utah. When it comes in it usually travels across the whole state and continues west. When this low pressure is approaching us from the north, winds begin to blow from the south since the pressure is higher in the south than the low pressure coming in. The wind coming in from the south is warmer and will raise our temperatures up many degrees. As the warm air approaches the low pressure, the air rises up and quickly expands and then cools. The moisture in the cooled air turns into clouds. As these clouds approach us, they could produce snow. It could drop between an inch to two feet of snow. The wind generally dies down but the snow keeps coming until the storm system passes over us. Afterward there is a lot of cold air behind it that can linger on for days.

Part Two: Summer Storm Simulation Bottle

1. Get a two-liter bottle. We will call it the "Summer Storm Simulation Bottle".
2. Put a ball needle in one of the holes of the rubber stopper so that it sticks all the way through.
3. Stick the pointed end of the thermometer through the other hole of the rubber stopper.
4. Put about one inch of room temperature water into the Simulation Bottle.
5. Light a wooden match, blow it out, and stick the smoking end into the Simulation Bottle so the smoke goes into the bottle. When water vapor condenses into water droplets, they need dust particles to form around called condensation nuclei. (You

may have to do this a couple of times to get enough smoke in the bottle.)

6. Put the stopper on the opening of the Simulation Bottle by twisting it on so it is tight.
7. With a ball pump, put about 5 pumps of air into the Simulation Bottle. *(This creates a high pressure.)*
8. Look at the temperature gauge. What is happening to the temperature inside the Simulation Bottle? *(It is going up.)*
9. Ask why they think the temperature is going up. *(Because the bottle is under pressure the air molecules need more room in the bottle. They cannot escape and are hitting each other and creating heat. Then in turn because they are creating more heat they want more room and it will get warmer and warmer inside.)*
10. Tell the students that just like the Simulation Bottle, there is high pressure over us in the summer that creates a lot of heat. The air molecules are hitting against each other making the air warmer and warmer around us.
11. Let's see what happens when the rubber stopper is taken off. (Twist off the rubber stopper.)
12. Ask the students what happened in the bottle? (A cloud formed.)
13. Ask the students why a cloud formed? *(High pressure quickly went into a lower pressure area. When this happened the air molecules expanded and produced cold air. Because there was moisture in the air, the water vapor condensed and turned into tiny water droplets forming a cloud.)*

In real life, most summer storms come in from the south because the air pressure in Utah is a little less than in Arizona a New Mexico. As the winds move in from the south it can bring in moisture from the Pacific Ocean. As the hot air in Utah is rising because of convection currents it creates a low pressure in the upward current. The winds that come in from the south carrying moisture get caught in this convection current and move up. As the moist air moves up it expands. When the air expands it cools turning the moisture into a cloud. As more and more air comes in, the cloud gets bigger and bigger turning it into a huge cumulonimbus cloud. These clouds can rise up as far as 25,000 feet. They are also known as thunderheads. These are the clouds that cause thunder and lightning, produce hail and/or heavy rainfall, and violent winds. The violent winds are caused by the air rushing into the low pressure of the convection current. The huge storm clouds gradually move on. The storm turns into a summer rain caused by the lingering clouds behind the storm clouds. It will rain less and less and the thunder and lightning can only be heard and seen off into the distance. The storm leaves behind it cooler, comfortable air.

14. Look at the temperature in the Simulation Bottle. (*It is low again because the pressure is gone and the fast moving air caused it to drop.*
15. Twist the rubber stopper on the top of the Simulation Bottle again. Pump in some more air. What is happening to the cloud? (*It is disappearing. There is a high pressure inside the bottle making the air heat up and turning the cloud back into water vapor.)*

Assessment Suggestions

- Look at the notes in their journals to see if they wrote down the proper events that happened in the two experiments.
- Look at the question sheets about the experiments to see if they are answered correctly.
- Have the students write a summary about the two experiments.
- Have the students explain which experiment simulates a summer storm.
- Have the students explain which experiment simulates a winter storm.
- Have the students draw pictures of the experiments and label the pictures.

Curriculum Extensions/Adaptations/ Integration

- Advanced learners can do research about winter storms from the north.
- Advanced learners can do research about moisture that comes up from the south in the summer that creates storms.
- Special learners are able to do these experiments and see what is happening with help. Let them do the experiments to see and feel what is happening in each storm. Have them tell what they see happening.
- Have the students read about lightning and thunder and how they are created.

- Have the students read about the clouds that are associated with winter storms.
- Have the students read about the clouds that are associated with the summer storms.
- Have the students learn about hail and other severe weather phenomena, and tell others what they have learned.

Family Connections

- Send home directions to make a Simulation Summer Storm by making a cloud in a bottle. Have the students explain to their families what is happening.
- Have the students look on the Internet about winter storms and summer storms to write about them and share the information with their families.

Additional Resources

Books

How the Weather Works, by Michael Allaby; Reader's Digest; ISBN 0-7621-0234-9

The Amateur Meteorologist, by H. Michael Mogil and Barbara G. Levine; ISBN 0-531-15696-6

The Best Weather Book, by Simons Adams; ISBN-10: 0-753-45368-1

Clouds, Rain, and Fog, by Fred and Jeanne Biddulph; USBN 0-7802-1372-6

Wind and Storms, by Fred and Jeanne Biddulph; USBN 0-7802-1375-0

Hot and Cold Weather, by Fred and Jeanne Biddulph; USBN 0-7802-1378-5

Media

Storms, DVD, by SVE/CHURCHILL MEDIA 2004

Web sites

http://www.weatherwizkids.com/winter_storms.htm

http://www.nws.noaa.gov/om/brochures/wntrstm.htm

http://www.fema.gov/hazard/winter/index.shtm

http://www.nws.noaa.gov/om/winterstorm/winterstorms.pdf

http://weatherpix.com/OllaPod/?p=28

Winter Storm Simulation Box

Keep track of what is happening inside the Winter Storm Simulation Box with this sheet. Take temperature and air pressure readings ever 15 minutes.

Time Weather Elements	Initial Read-ings	10 min heat on	20 min heat on	30 min heat on	40 min heat on	50 min heat on	60 min heat on	70 min ice on	80 min ice on	90 min ice on	100 min ice on	110 min ice on	120 min ice on
Temperature													
Air Pressure													
Precipitation Observation													

After the first hour, answer these questions.

1. What do you notice about the temperature? ______________________________

____

2. What do you notice about the air pressure? ______________________________

____

3. Is there any precipitation on top? ______________________________

Describe what you see.______________________________

After the first hour and a half, answer these questions.

4. What do you notice about the temperature? ______________________________

____

5. What do you notice about the air pressure? ______________________________

____

6. Is there any precipitation on the top? ______________________________

Describe what you see. ______________________________

After two hours answer these questions.

7. What do you notice about the temperature? ______________________________

____

8. What do you notice about the air pressure? ______________________________

____

9. Is there any precipitation on the top? ______________________________

Describe what you see. ______________________________

Summer Storm Simulation Bottle

Prepare the Summer Storm Simulation Bottle. Pump air into the bottle.

1. Describe what the Simulation Bottle feels like when air is pumped into it.

___

2. What is happening to the temperature inside the Simulation Bottle?

___

3. Why is the temperature doing this?

___

After the rubber stopper is taken off the Simulation Bottle answer these questions.

4. What happened inside the bottle?

___

5. Why did this happen?

___

6. Feel the Simulation Bottle now. Describe what it feels like.

___

7. What is the temperature inside the Simulation Bottle? Describe what happened to the temperature.

___

8. Why did the temperature do this?

___

Graphing the Weather

Standard II:
Students will understand that the elements of weather can be observed, measured, and recorded to make predictions and determine and determine simple weather patterns.

Objective 3:
Evaluate weather predictions based upon observational data.

Intended Learning Outcomes:
1. Use science process and thinking skills.
4. Communicate effectively using science language and reasoning.

Content Connections:
Math V-1; Collect, organize, and display data

Science Standard II

Objective 3

Connections

Background Information

Meteorologists gather information each day about the weather using their weather instruments. They have been gathering this information for decades. With all this data they gathered they look for patterns. When they notice a certain pattern for any given day, they can predict the weather. Many years ago before there were satellites, Doppler Radar and specialized weather instruments they would just use a barometer, thermometer, weather vane, anemometer, hygrometer, and rain gauge to predict the weather. When they saw the barometer at a certain pressure, the temperature at a certain level, and the wind blowing at a certain speed and a certain direction they could generally predict what the weather was going to be like the next day. Now with the all their special weather instruments added to these other tools they can predict the weather pretty well.

Just like meteorologists of old, students can take the weather readings using the simple weather instruments and be able to predict the weather. To do this they must take these reading for a month during a season and chart it. With the information, they can graph what is happening with each instrument each day. As storms are coming in and going out, the written data shows certain patterns the storms follow for that particular season. When they graph each instrument each day they can see what happens to each instrument as a storm comes in and when it leaves. It is also fun to compare the graphs of the instruments to each other each day. The more they do it the more they will see the patterns of the storms. It is recommended that students do a month of instrument reading for each season so they can know the patterns of each season.

Research Basis

Armstrong, T. (1994). ***Multiple intelligences in the classroom.*** Alexandria, VA: Association for Supervision and Curriculum Development.

Multiple intelligences let students choose a method of learning in connecting one subject to other subjects to their world. The integration of instructional methods focuses on teaching a standard in one curricular area and matching it to a standard in another curricular area such as integrating science with Language Arts, math, math, or social studies. As educators teach with this idea in mind it helps students see a connection between subjects relating to the real world. It helps students understand their world better to see how subjects relate to each other. This method puts into practice the teaching of multiple intelligences.

Ketch, A. (2005). Conversation: the comprehension connection. *The Reading Teacher,* Vol. 59, No. 1, pp. 8-18.

Students who engage in conversation in the classroom become reflective thinkers. Conversation brings meaning to students as they contemplate to understand our complex world. Conversation is the comprehension connection. There are literature circles, book clubs, whole-class discussions, pair-share, small-group discussion, and individual conferences that help in conversation comprehension.

Invitation to Learn

Put the students' desks in groups or six. Hand out some pattern blocks to each student. Give them a couple of minutes for each to make something that shows a somewhat complicated pattern. Have them make it so the pattern is recognizable and can be added upon. It can be in any shape or design he/she desires. Have each student show his/her pattern to the group. Have the group discuss the patterns they see in each one to see if they can add more pattern blocks to continue the pattern. Discuss as a whole class how we are able to know which types of blocks should be placed next to complete the pattern. Ask the class where we might see patterns each day. Ask where we might rely on patterns. Tell the class that we are going to talk about patterns of the weather. We rely on these patterns so the weather can be predicted.

Instructional Procedures

Part One

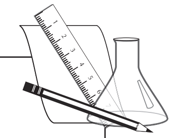
1. One month previous to doing this activity have the students take instrument readings of the weather each day with a

barometer, thermometer, anemometer, weather vane, rain gauge/ruler, and noticing the types of clouds in the sky.

2. Put the students in groups of six.
3. Pass out to the groups the *Weather Data Chart* that shows the recorded data telling the weather readings of the weather elements—precipitation, cloud type, air temperature, wind speed, wind direction, and barometric pressure.
4. Pass out the *Recognizing Changes in Different Weather Events* worksheet. This is a list of weather events that happen regularly.
5. As a group, have the students look for the dates that led up to each weather event on the *Weather Data Chart*—fair weather, cloudy weather, rainy weather, snowy weather, snowy weather, windy weather, and cold weather. Have the students write down on their *Recognizing Changes in Different Weather Events* worksheets the dates they found for each weather event. Have them share with each other the dates they found.
6. After the groups have worked together, have the class share what they found.
7. Have a discussion about weather events of what is happening to the weather elements in each weather event.

Part Two

1. Put the students in the same groups they were in before.
2. Have the students take out their *Recognizing Changes in Different Weather Events* worksheet.
3. Review with the students what they have done so far. (They have recognized that changes happen with each weather instrument when there is a weather change.)
4. Pass out some graph paper.
5. Assign each group a weather event they are going to graph. Assign each student one of the weather elements to graph (air pressure, temperature, wind speed, wind direction, precipitation, and cloud type) for that weather event.
6. By using the *Weather Data Chart* and the dates they found that are on the *Recognizing Changes in Different Weather Events* worksheet, have them graph their own weather element readings of the dates of their category. If there is more than one



Materials

- ❏ Pattern blocks
- ❏ Barometer
- ❏ Anemometer
- ❏ Weather vane
- ❏ Thermometer
- ❏ Rain gauge
- ❏ Ruler
- ❏ Graph paper
- ❏ Colored pencils
- ❏ *Weather Data Chart*
- ❏ *Recognizing Changes in Different Events*

event in each category, make sure they graph each set of dates separately if there is time.

Part Three

1. Put the students in the same groups they were in before.
2. Review with them what each group has done so far. They written down dates that lead to weather events on the *Recognizing Changes in Different Weather Events* worksheet acquired from the *Weather Data Sheet*. They each graphed a weather element change in one of the weather events.
3. Now that the students have graphed the information for each event, have each student write about the pattern he/she sees for the type of weather element he/she was assigned.
4. Have the group of student tell each other, one by one, what happened to each weather element for the event they graphed. They may even tell it about each on day by day.
5. Have the students share what they learned with the whole class about each weather event.
6. Put the graphs on the wall in weather event groups, labeling each one. Put the statement the students wrote about the weather element change by each graph.
7. Have them continue to use the instruments to find more weather data within the same season. Have them gather enough data to be able to make a prediction by graphing the data and comparing it to the data that data that has already been taken. Have them predict what the upcoming weather will be.

Assessment Suggestions

- In the first activity, watch carefully that the dates they wrote shows a change in the weather event.
- In the second activity, look at the graphs they made to make sure they are accurate.
- In the third activity, read the statements they wrote that tell about their patterns.
- Have the students take more reading of the weather as a group. Have them look at the patterns and tell what type of weather event will be coming up in the near future—storm, wind, fair weather, etc.

- Give the students a scenario of a weather pattern. See if they can identify what type of weather event the pattern is leading up to.

Curriculum Extensions/Adaptations/Integration

- For the advanced learners, have the students watch a weather forecast on TV. Have the students watch to see what the different forecasts are for different parts of the state. Have them tell why the forecasts are different for the different parts of the state.
- For the advanced learners, have the students watch a weather forecast on TV. Have them watch for a pattern in the weather broadcast. Have them watch the meteorologist's forecast and tell why he/she predicted that forecast.
- For the special learner, have him/her work with someone in the group to help him/her understand the information they are graphing and what it means.
- Math V, 1; Put all the graphs about one weather event on one graph paper so the information can be compared about each weather element.
- Choral Reading of poetry about weather is always fun to do.
- Use the follow rhythm music to enhance science. This activity uses sets of percussion musical instruments, or "found" instruments that students discover in the classroom (tapping pencil, shaking pencil box, etc.)

Sound Storm

1. Invite class to tap the rhythm to music. (The music should represent a storm.) They may keep the beat on their laps, tap their feet, nod the rhythm with their heads, etc. (See suggested titles for use.)
2. Divide into groups. Assign or have students choose a Summer Storm or Winter Storm. They will create a "Sound Storm" that will represent their choice.
3. Have the pattern for each storm posted, or give each group a copy of the pattern to follow.
4. Plan which instruments will best "mimic" the sounds and represent the steps in the pattern of their storm. (If students have not explored instruments lately, it might be necessary to "test" their sounds during a discovery time.)

5. Have specific music chosen for them to use. Remind them they need to follow the pattern correctly in order to have a storm that is typical of summer or winter.
6. Practice together to the music. They might need to have a conductor in order to stay together and play the instruments in the correct sequence.
7. Have fun! Exploring the sounds and the steps of the storm means everyone will have a different interpretation. There is no “right” answer!

Summer Storm Pattern

Sun shines

Temperature warm

Sudden gusts of wind

  50-60 mph

  Abrupt change

Dark clouds

Bursts of rain

Thunder

Lightning

Strong rain continues

Less thunder/lightning

Wind slows

Sun returns

Temperature cooler

Winter Storm Pattern

Wind begins

Wind gets stronger

No sign of rain clouds-just cirrus

Stratus clouds on horizon

Wind blowing hard

Temperature warms from south winds

Stratus clouds dark and close

Snow begins to fall silently

Wind dies down

Snow falls

Very quiet as snow falls

Music to use: Your can access sound clips of Vivaldis Four *Seasons* on the following Internet site: wikimedia.de/~gmaxwell/jorbis/JOrbisplayer.

Suggest Summer-presto, mvt 2 for the summer storm

Thunder and Lightning, by Decca Records PolyGram Company, 1995 CD.

Family Connections

- Make a copy of the graph the student made and let him/her take it home. Have the student explain it to his/her family what category he/she worked with and what his/her job was. Have him explain what his graph means.
- The teacher can type up the patterns that were found for each category. Give each student in each group the pattern statements of each weather element. Have the student explain the patterns of his/her category.
- Have the students go to www.weather.com each evening for a few days to find out what each weather instrument reading is. Have him/her record it for a few days on a paper. From what they learned in class, have each student find the pattern for one of the weather events studied. Have him/her predict what the weather will be in the upcoming day(s).

Additional Resources

Books

Weather Forecasting, by Gail Gibbons; ISBN 0689716834

Weather, by Seymour Simon; ISBN 0060884398

Dr. Fred's Weather Watch: Create and Run Your Own Weather Station, by Fred Bortz; ISBN 0071347992

Earth's Weather, by Rebecca Harman; ISBN: 1403470650

Web sites

http://www.weather.com

http://ksl.com

http://kutv.com

http://news4utah.com

Recognizing Changes in Different Weather Events

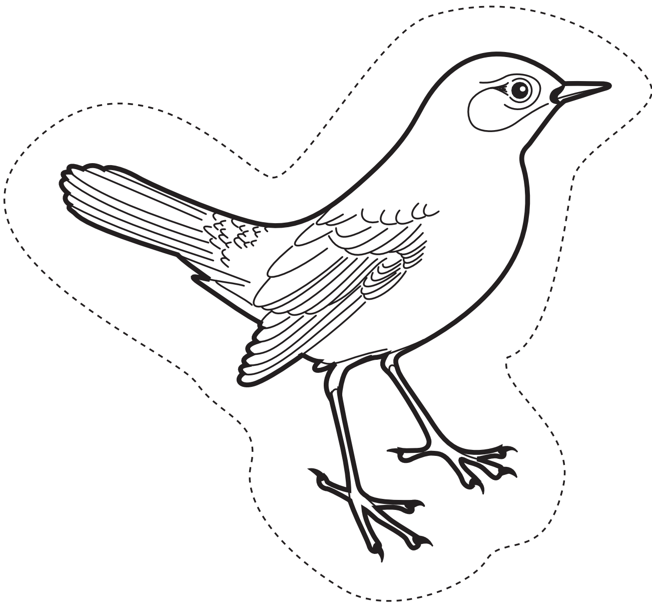
Find dates from the Weather Data Chart that lead up to each weather event.

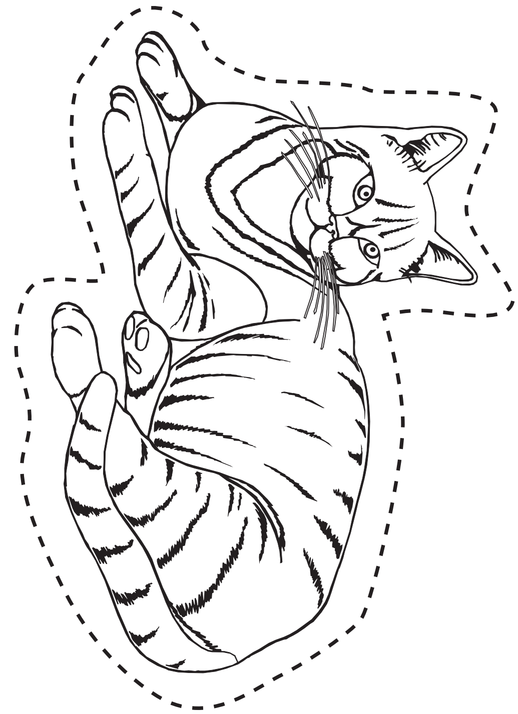
Weather Event	Dates That Lead Up to the Weather Event
Fair Weather	
Cloudy Weather	
Rainy Weather	
Snowy Weather	
Windy Weather	
Cold (cooler) Weather	

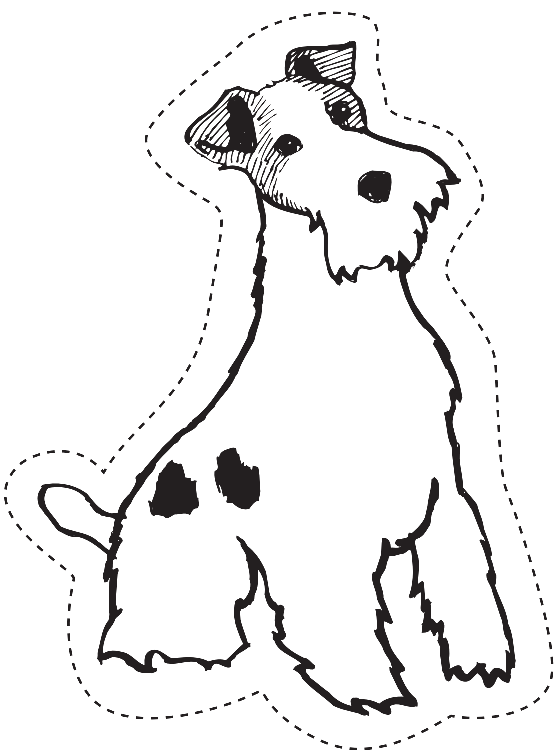
Appendix

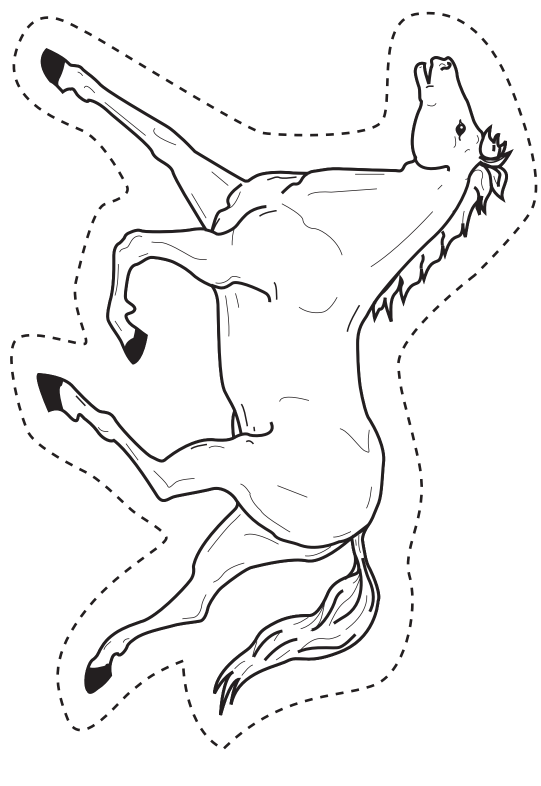
Animal Graph Pictures

Copy approximately eight copies of each picture. Students choose one picture to represent their choice. They will color and cut it out. Next they will place it on the graph under the picture of their favorite animal.





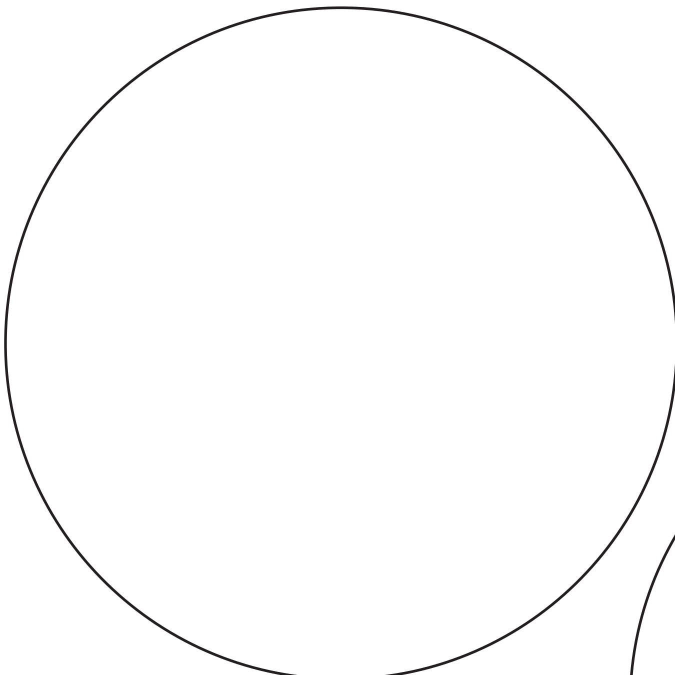




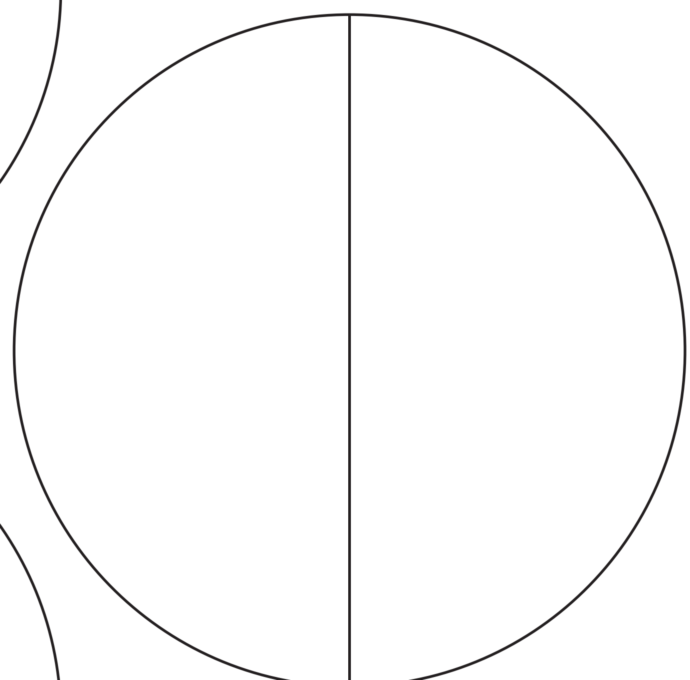
Fraction Circle Template

Copy each fraction circle on heavy paper, such as cardstock. Each fraction circle should be a separate color. The colors suggested on this template correspond to the colors on most commercial fraction circle manipulatives.

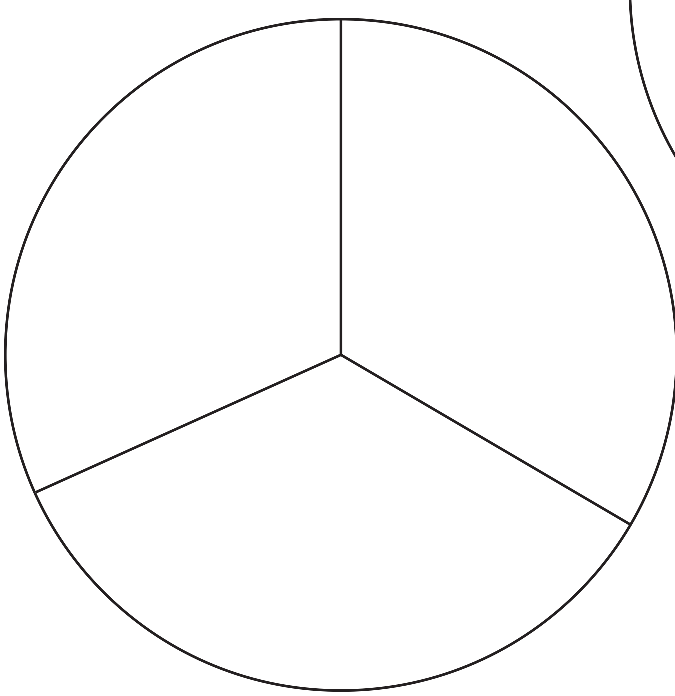
Each student, or pair, receives one each of the nine fraction templates. Prior to fraction activities, the fraction circles should be cut out, cutting on all solid black lines. Paper clip the separate fractions together and store in small plastic bag.



Whole=Red

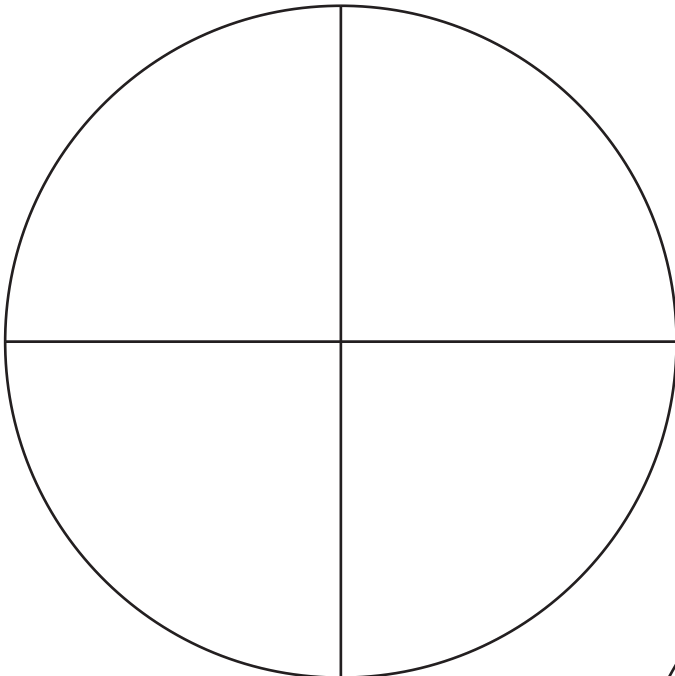


1/2=Pink

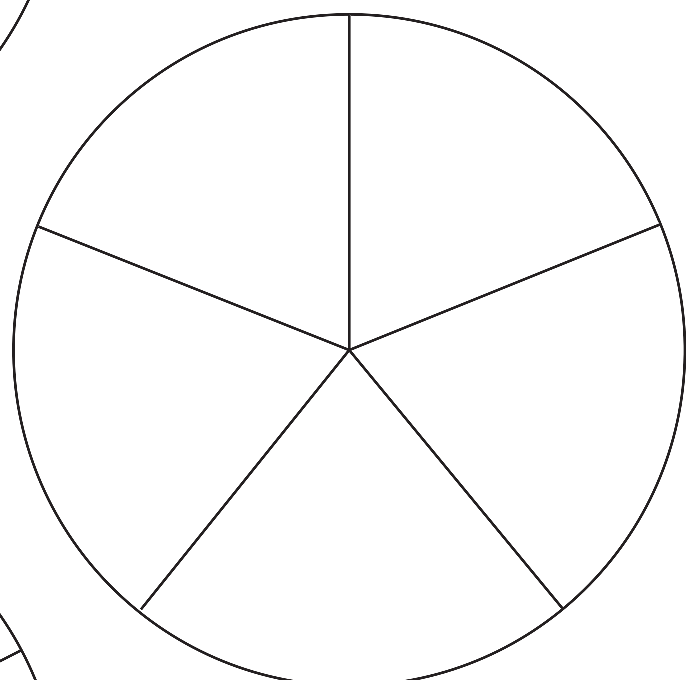


1/3=Orange

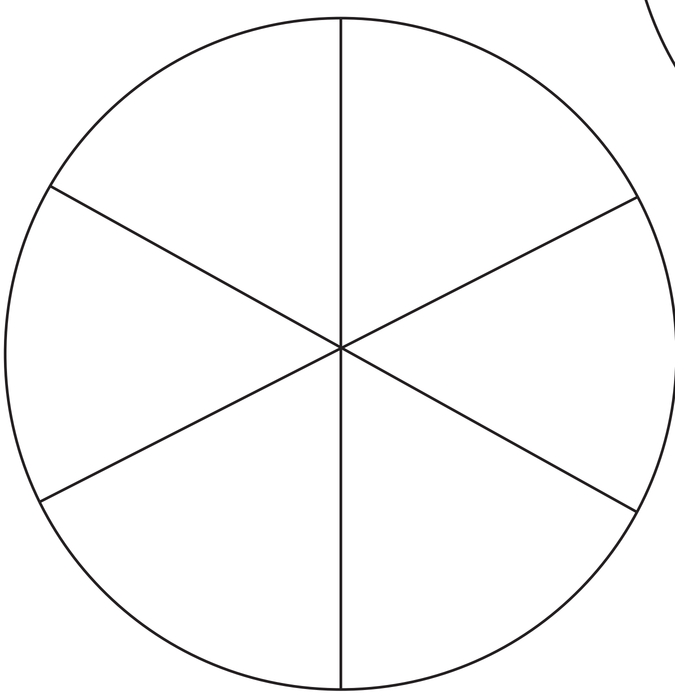
Fraction Circle Template



1/4=Yellow

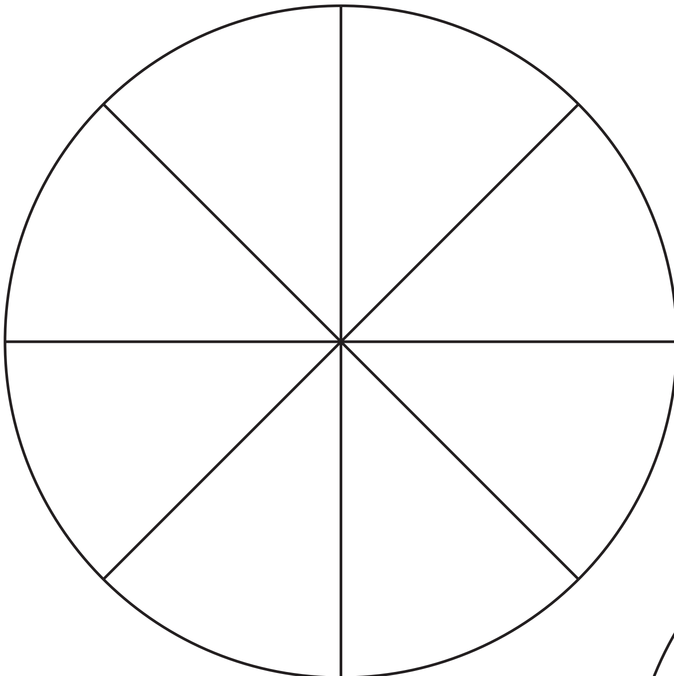


1/5=Green

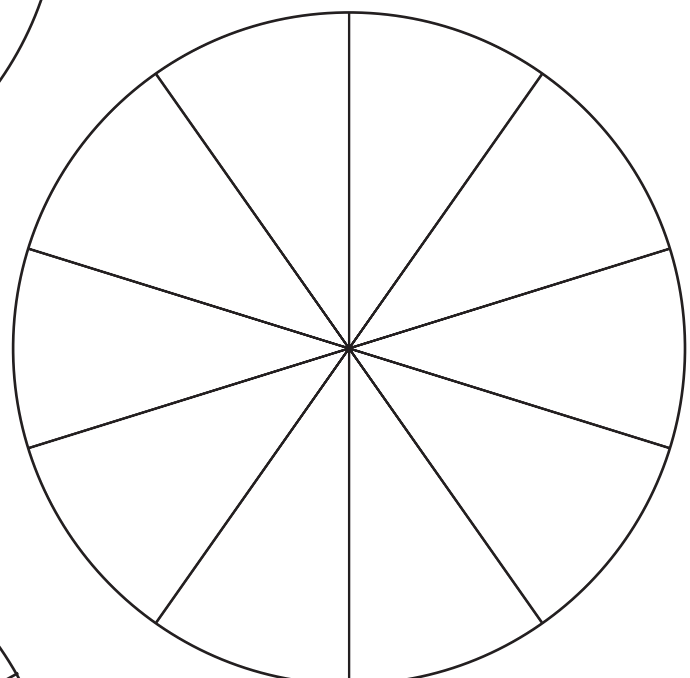


1/6=Light Blue

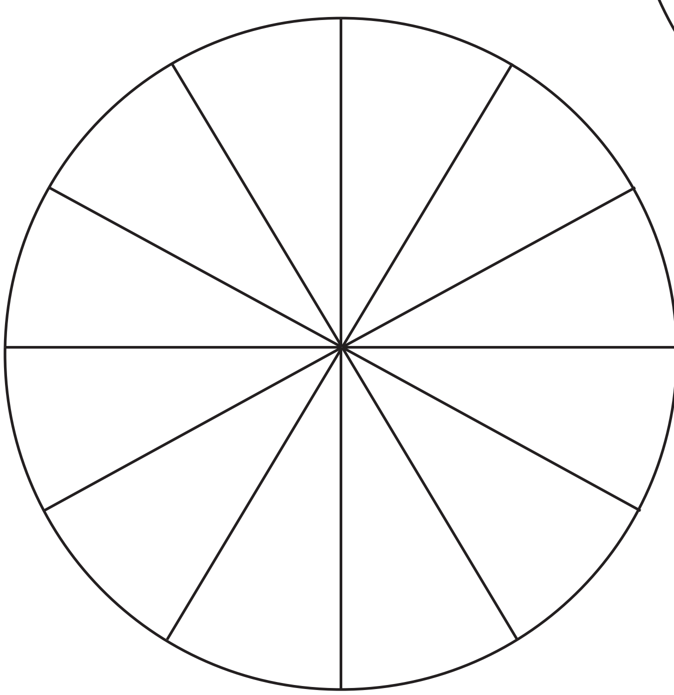
Fraction Circle Template



1/8=Dark Blue



1/10=Purple



1/12=Black

1/2 Alias 2/4

1/2 = ______________________

____

____

____

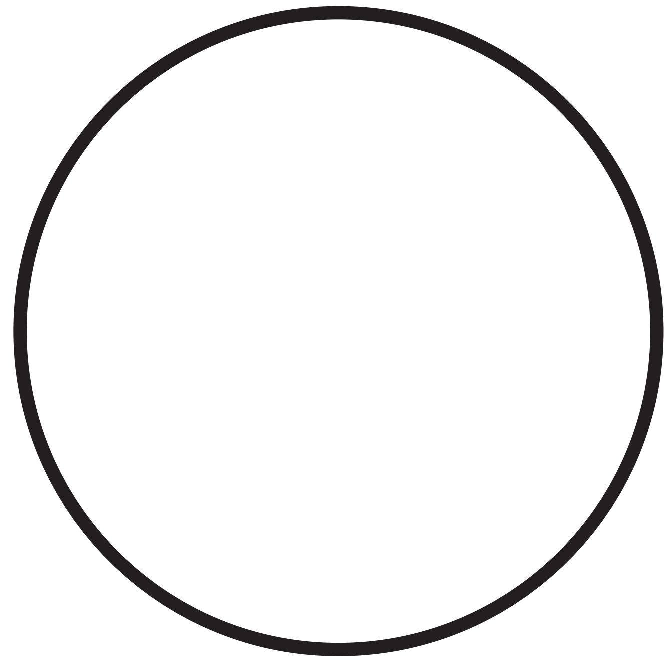
____

Record your favorite equivalent fraction on the circle

My favorite equivalent Fraction:

____

Build a Pizza

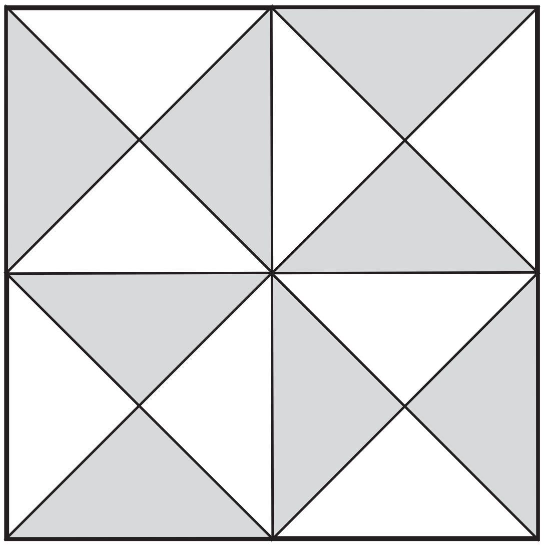


My Pizza Fraction Sentence

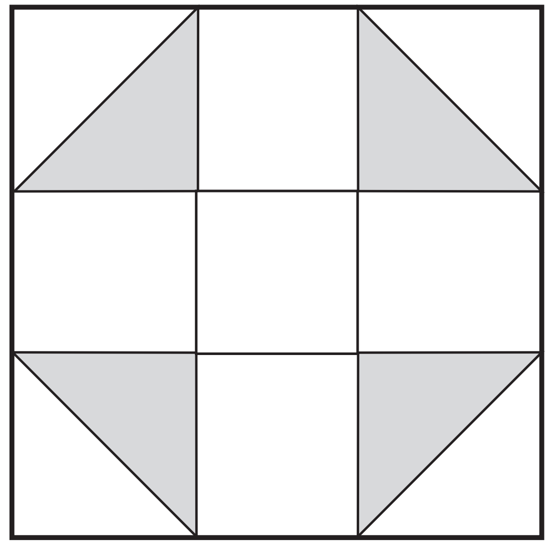
____

Name______________________

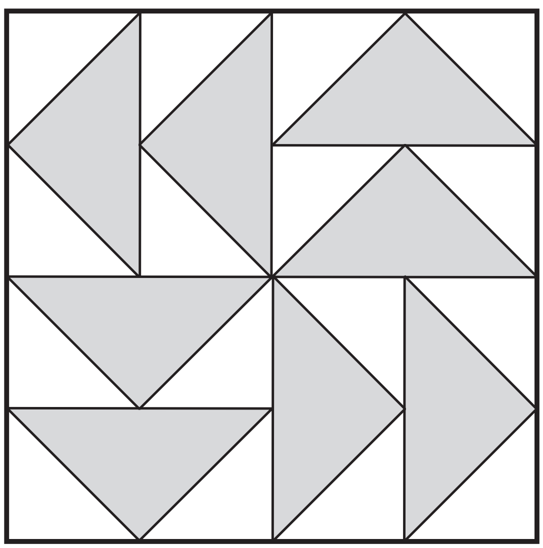
Quilt Patterns



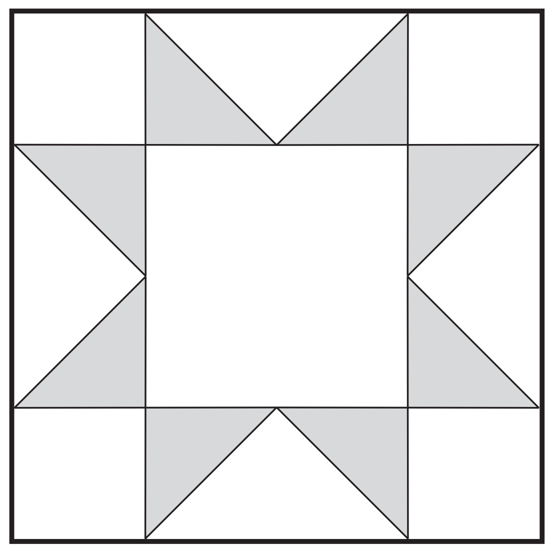
Bow Tie



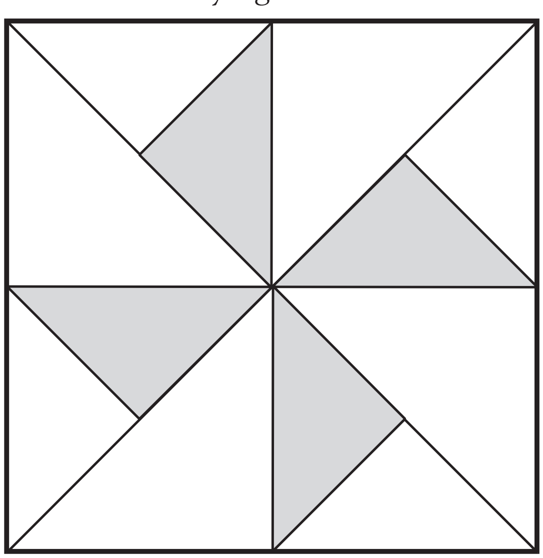
Shoofly



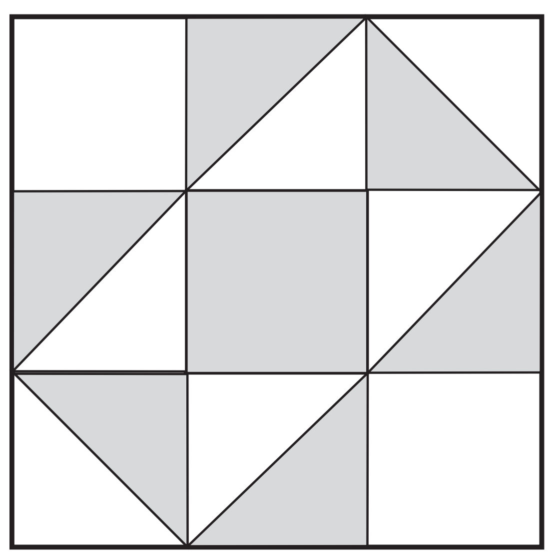
Flying Geese



Lone Star

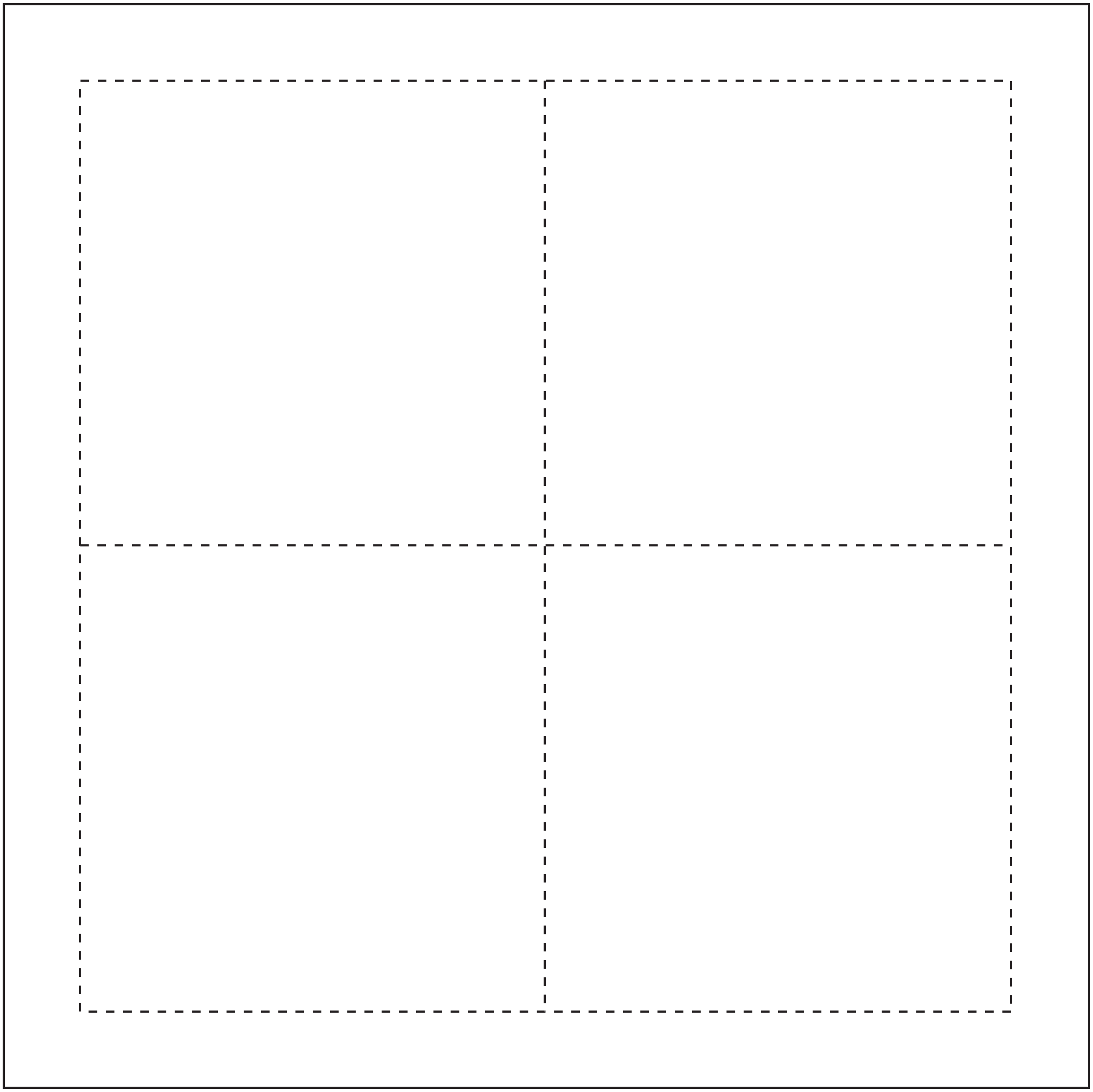


Water Wheel



Split Nine Patch

4 Patch Quilt Template



9	36	81
4	25	64
1	16	49

$3 \times 3 = 9$

$2 \times 2 = 4$

$1 \times 1 = 1$

$6 \times 6 = 36$

$5 \times 5 = 25$

$4 \times 4 = 16$

$9 \times 9 = 81$

$8 \times 8 = 64$

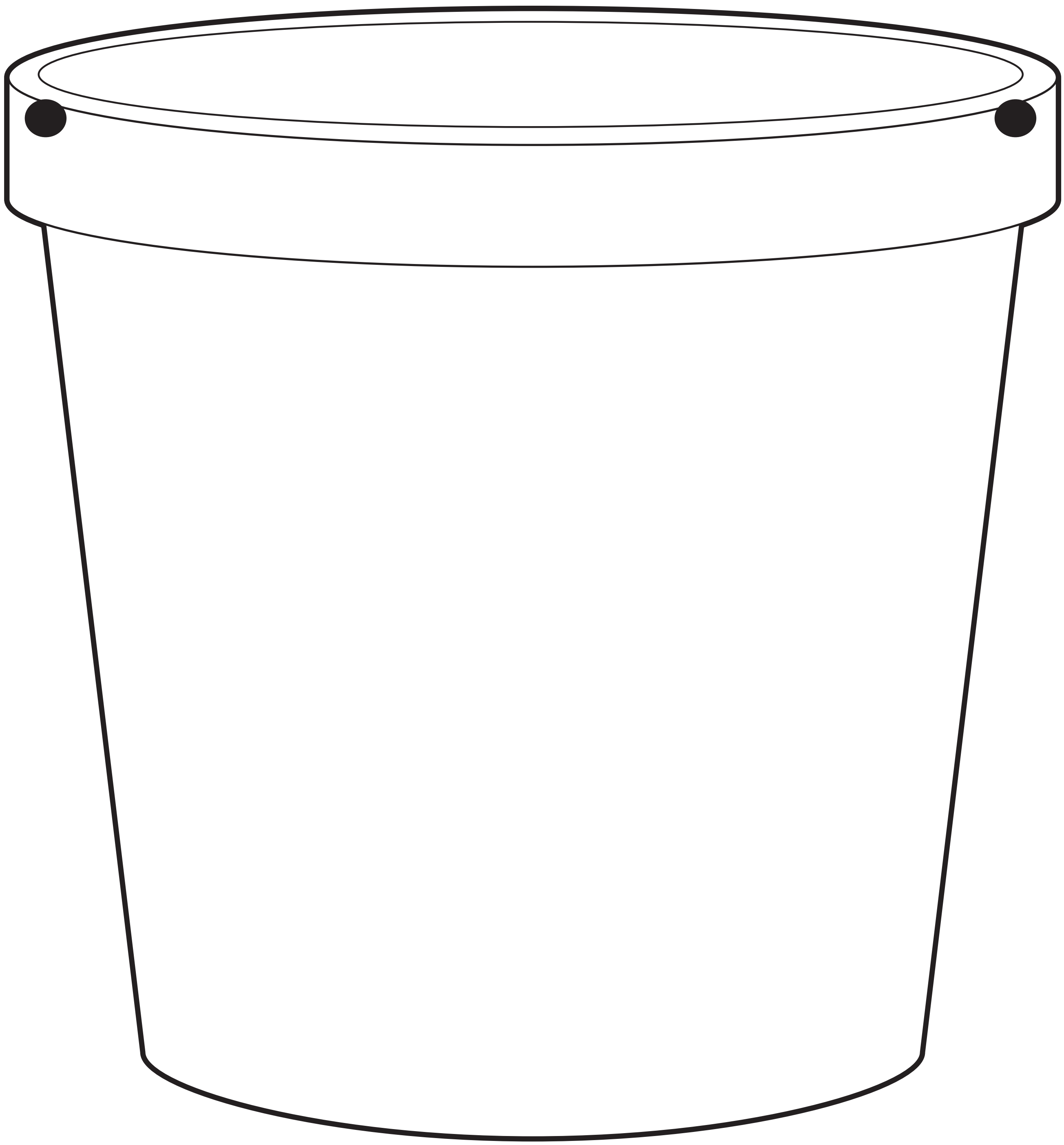
$7 \times 7 = 49$

144	144	144
121	121	121
100	100	100

12x12=144	12x12=144	12x12=144
11x11=121	11x11=121	11x11=121
10x10=100	10x10=100	10x10=100

Soil Journal Patterns

Two from brown constructio, one white art - made into a soil profile, six blank pages - (use front and back). Punch on dots - hook together with pipe cleaner or yarn.



Fossil Chart

	Size	Color	Shape	Texture	Defining features
Fossil #1					
Fossil #2					
Fossil #3					
Fossil #4					
Fossil #5					

Fossil Questions

Read each statement carefully. If you believe it is true, place a check in the "Agree" column. If you believe the statement is false, place a check in the "Disagree" column. After learning more about fossils, you may go back and change any of your answers using a different color of pencil.

	Agree	Disagree
1. Scientists learn about Earth's history by studying fossils.		
2. Fossils are usually found in igneous rocks.		
3. Only the soft part of an organism can become a fossil.		
4. Track fossils are one type of impression fossil.		
5. An organism can be preserved by being frozen in ice.		
6. Amber is an insect found fossilized in rocks.		
7. Minerals that fill tiny holes in an imprint form mineral replacement fossils.		
8. Mineral replacement fossils are all the same color.		

Fossil Questions

Read each statement carefully. If you believe it is true, place a check in the "Agree" column. If you believe the statement is false, place a check in the "Disagree" column. After learning more about fossils, you may go back and change any of your answers using a different color of pencil.

	Agree	Disagree
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6. Amber is an insect found fossilized in rocks.		
7. Minerals that fill tiny holes in an imprint form mineral replacement fossils.		
8. Mineral replacement fossils are all the same color.		

Fossil Word Sort

impression	track fossil	hard parts of an organism	preserved organism
mineral replacement fossil	sedimentary rocks	infer	water dissolves
bones or shells	fossilized resin from ancient trees and plants	minerals harden into stone	footprint
amber	trilobite	dead plant or animal	imprint in the mud

Fossil Retell

Free Retell	Cued Retell	Main Ideas
		1. Fossils teach us about plants and animals from long ago.
		2. Fossils are found in sedimentary rock.
		3. Dinosaur footprints are impression or track fossils.
		4. Some organisms are preserved without changing.
		5. Amber is an example of a preserved organism.
		6. Water dissolves part of the dead plant or animal in a mineral replacement fossil.
		7. Minerals can fill in the tiny holes of an imprint and turn to stone.

Date: ______________

Free Retell: ________

Cued Retell: _______

. . . .

Student Pair: ____ (1st Retell)

____ (2nd Retell)

Winter Storm Simulation Box

Keep track of what is happening inside the Winter Storm Simulation Box with this sheet. Take temperature and air pressure readings ever 15 minutes.

Time Weather Elements	Initial Read-ings	10 min heat on	20 min heat on	30 min heat on	40 min heat on	50 min heat on	60 min heat on	70 min ice on	80 min ice on	90 min ice on	100 min ice on	110 min ice on	120 min ice on
Temperature													
Air Pressure													
Precipitation Observation													

After the first hour, answer these questions.

1. What do you notice about the temperature? ______________________________

____

2. What do you notice about the air pressure? ______________________________

____

3. Is there any precipitation on top? ______________________________

Describe what you see.______________________________

After the first hour and a half, answer these questions.

4. What do you notice about the temperature? ______________________________

____

5. What do you notice about the air pressure? ______________________________

____

6. Is there any precipitation on the top? ______________________________

Describe what you see. ______________________________

After two hours answer these questions.

7. What do you notice about the temperature? ______________________________

____

8. What do you notice about the air pressure? ______________________________

____

9. Is there any precipitation on the top? ______________________________

Describe what you see. ______________________________

Summer Storm Simulation Bottle

Prepare the Summer Storm Simulation Bottle. Pump air into the bottle.

1. Describe what the Simulation Bottle feels like when air is pumped into it.

___

2. What is happening to the temperature inside the Simulation Bottle?

___

3. Why is the temperature doing this?

___

After the rubber stopper is taken off the Simulation Bottle answer these questions.

4. What happened inside the bottle?

___

5. Why did this happen?

___

6. Feel the Simulation Bottle now. Describe what it feels like.

___

7. What is the temperature inside the Simulation Bottle? Describe what happened to the temperature.

___

8. Why did the temperature do this?

___

Recognizing Changes in Different Weather Events

Find dates from the Weather Data Chart that lead up to each weather event.

Weather Event	Dates That Lead Up to the Weather Event
Fair Weather	
Cloudy Weather	
Rainy Weather	
Snowy Weather	
Windy Weather	
Cold (cooler) Weather	