



Participant Handbook



2006



ELEMENTARY CORE ACADEMY

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UtahState
UNIVERSITY

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Utah State University (USU)
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State Mathematics Education Coordination Committee (SMECC)
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WestEd Eisenhower Regional Consortium

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UTAH STATE OFFICE OF EDUCATION

Leadership...Service...Accountability

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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, Ed.D.
State Superintendent of Public Instruction

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Major funding for the Academy comes from the following sources:

Federal/State Funds:

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

District Funds:

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

School Funds:

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

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

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

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

Goals of the Elementary CORE Academy

Overall

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

The Academy will provide elementary teachers in Utah with:

1. Models of exemplary and innovative instructional strategies, tools, and resources to meet 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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**Fourth Grade
Mathematics and Science
Core Curriculum**

Utah Elementary Mathematics Core Curriculum

Introduction

Most students 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 active, resourceful individuals who construct, modify, and integrate ideas by interacting with the physical world as well as with peers and adults. They learn by doing, collaborating, and sharing their ideas. Students' abilities to communicate through language, pictures, sound, movement, and other symbolic means develop rapidly during these years.

Young students are building beliefs about what mathematics is, about what it means to know and do mathematics, and about themselves as mathematical learners. Mathematics instruction needs to include more than short-term learning of rote procedures. Students must use technology and other mathematical tools, such as manipulative materials, to develop conceptual understanding and solve problems as they do mathematics. Students, as mathematicians, learn best with hands-on, active experiences throughout the instruction of the mathematics curriculum.

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 (using logic to explain and justify a solution to a problem), and engaging (seeing mathematics as sensible, useful, and doable, and being able to do the work).

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

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



on 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, critiqued, and revised by a community of Utah mathematics teachers, university mathematics educators, State Office of Education specialists, mathematicians, and an advisory committee representing a wide variety of people from the community. The Core reflects the current philosophy of mathematics education that is expressed in national documents developed by the National Council of the 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 Association. 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.

- The INTENDED LEARNING OUTCOMES (ILOs) describe the goals for mathematical skills and attitudes. They are found at the beginning of each grade level, are an integral part of the Core, and should be included as part of instruction.
- 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.
- An INDICATOR is a measurable or observable student action that enables one to assess whether a student has mastered a particular Objective. Indicators are not meant to be classroom activities, but they can help guide classroom instruction.

Guidelines Used in Developing the Elementary Mathematics Core

The Core is:

Consistent With the Nature of Learning

The main intent of mathematics instruction is for students to value and use mathematics as a process to understand the world. The Core is designed to produce an integrated set of Intended Learning Outcomes for students.

Coherent

The Core has 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, skills, and content. This spiraling is intended to prepare students to understand and use more complex mathematical concepts and skills as they advance through the learning process.

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 focuses on providing experiences with concepts that students can explore and understand in depth to build the foundation for future mathematical learning experiences.

Reflective of Successful Teaching Practices

Learning through play, movement, and adventure is critical to the early development of the mind and body. The Core emphasizes student exploration. The Intended Learning Outcomes are central in each standard. The Core is designed to encourage instruction with students working in cooperative groups. Instruction should include recognition of the role of mathematics in the classroom, school, and community.

Comprehensive

The Elementary Mathematics Core does not cover all topics that have traditionally been in the elementary mathematics curriculum; however, it provides a comprehensive background in mathematics. 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

The Core is:

- Consistent
- Coherent
- Developmentally Appropriate
- Reflective of Successful Teaching Practices
- Comprehensive
- Feasible
- Useful and Relevant
- Reliant Upon Effective Assessment Practices
- Engaging

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 Handbook is also available for teachers and has sample lessons on each topic for each grade level. The Teacher Handbook is a document that will grow as teachers add exemplary lessons aligned with the new Core.

Useful and Relevant

This curriculum relates directly to student needs and interests. Relevance of mathematics to other endeavors enables students to transfer skills gained from mathematics instruction into their other school subjects and into their lives outside the classroom.

Reliant Upon Effective Assessment Practices

Student achievement of the standards and objectives in this Core is best assessed using a variety of assessment instruments. Performance tests are particularly appropriate to evaluate student mastery of mathematical processes and problem-solving skills. Teachers should use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform instruction. Sample test items, keyed to each Core Standard, may be located on the “Utah Mathematics Home Page” at <http://www.usoe.k12.ut.us/curr/math>. Observation of students engaged in instructional activities is highly recommended as a way to assess students’ skills as well as attitudes toward learning. The nature of the questions posed by students provides important evidence of their understanding of mathematics.

Engaging

In the early grades, children are forming attitudes and habits for learning. It is important that instruction maximizes students’ potential and gives them understanding of the intertwined nature of learning. Effective elementary mathematics instruction engages students actively in enjoyable learning experiences. Instruction should be as thrilling an experience for a child as seeing a rainbow, growing a flower, or describing a toad. 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 learning.

Intended Learning Outcomes for Fourth 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 learn as a result of mathematics instruction. They are an essential part of the Mathematics Core Curriculum and provide teachers with a standard for evaluation of student learning in mathematics. Significant mathematics understanding occurs when teachers incorporate ILOs in planning mathematics instruction.

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

- 1. Demonstrate a positive learning attitude toward mathematics.**
 - a. Display a sense of curiosity about numbers and patterns.
 - b. Pose mathematical questions about objects, events, and processes.
 - c. Demonstrate persistence in completing tasks.
 - d. Apply prior knowledge and processes to construct new knowledge.
 - e. Maintain an open and questioning mind toward new ideas and alternative points of view.
- 2. Become mathematical problem solvers.**
 - a. Determine the approach, materials, and strategies to be used in setting up a problem.
 - b. Model problem situations in a variety of ways.
 - c. Develop understanding of new mathematical concepts and vocabulary by answering questions such as: What made you think that? Did anyone think of this in a different way? Where have we seen a problem like this before?
 - d. Construct and use concrete, pictorial, symbolic, and graphical models to represent problem situations.
 - e. Know when to select and how to use grade-appropriate mathematical tools and methods as a natural and routine part of the problem-solving process.
 - f. Build new mathematical knowledge through problem solving.
 - g. Solve problems in both mathematical and everyday contexts.
 - h. Recognize that there may be multiple ways to solve a problem.

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



3. Reason mathematically.

- a. Draw logical conclusions and make generalizations.
- b. Determine the approach, materials, and strategies to be used in solving problems.
- c. Use models, known facts, and relationships to explain reasoning.
- d. Make precise calculations and check the validity of the results in the context of the problem.
- e. Analyze mathematical situations by recognizing and using patterns and relationships.
- f. Justify answers and solution processes.

4. Communicate mathematically.

- a. Represent mathematical ideas with objects, pictures, and symbols.
- b. Express mathematical ideas to peers, teachers, and others through oral and written language.
- c. Engage in mathematical discussions through brainstorming, asking questions, and sharing strategies for solving problems.
- d. Explain mathematical work and justify reasoning and conclusions.

5. Make mathematical connections.

- a. Use one mathematical idea to extend understanding of another.
- b. Recognize the role of mathematics in the classroom, school, and community.
- c. Explore problems and describe and confirm results using various representations.

6. Represent mathematical situations.

- a. Create and use representations to organize and communicate mathematical ideas.
- b. Represent mathematical concepts using concrete, pictorial, and symbolic models.

Fourth Grade Mathematics Core Curriculum

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

Objective 1: Represent whole numbers and decimals in a variety of ways.

- Model, read, and write numerals from tenths to 100,000.
- Write a *whole number* up to 99,999 in *expanded form* (e.g., 76,539 is 7 ten-thousands, 6 one-thousands, 5 hundreds, 3 tens, 9 ones or $70,000+6,000+500+30+9$).
- Identify the place and the value of a given digit in a five-digit numeral, including decimals to tenths.
- Demonstrate multiple ways to represent numbers by using models and symbolic representations (e.g., 36 is the same as the square of six, three dozen, or 9×4).
- Identify *square numbers* using models.

Objective 2: Identify relationships among whole numbers and decimals.

- Identify the number that is 100 more, 100 less, 1,000 more, or 1,000 less than any *whole number* up to 10,000.
- Compare the relative size of numbers (e.g., 100 is small compared to a million, but large compared to 5).
- Compare whole numbers up to five digits using the symbols $<$, $>$, and $=$.
- Identify a whole number that is between two given whole numbers.
- Order and compare whole numbers and decimals to tenths on a number line.

Objective 3: Model and illustrate meanings of the four operations and describe how they relate.

- Use models to represent multiplication of a one- or two-digit factor by a two-digit factor (up to 30) using a variety of methods (e.g., rectangular *arrays*, manipulatives, pictures) and connect the representation to an *algorithm*.

Standard I:

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



- b. Recognize that division by zero is not possible (e.g., $6 \div 0$ is undefined).
- c. Select and write a multiplication or division sentence to solve a problem related to the students' environment and write a story problem that relates to a given equation.
- d. Represent division of a two-digit *dividend* by a one-digit *divisor*, including whole number remainders, using various methods (e.g., rectangular arrays, manipulatives, pictures) and connect the representation to an algorithm.
- e. Demonstrate that multiplication and division are inverse operations (e.g., $3 \times 4 = 12$; thus, $12 \div 4 = 3$ and $12 \div 3 = 4$).
- f. Describe the effect of place value when multiplying whole numbers by 10 and 100.

Objective 4: Use fractions to communicate parts of the whole.

- a. Divide regions and sets of objects into equal parts using a variety of models and illustrations.
- b. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, fifths, sixths, eighths, and tenths.
- c. Relate fractions to decimals that represent tenths.
- d. Determine which of two fractions is greater using models or illustrations.
- e. Find equivalent fractions for one-half, one-third, and one-fourth using manipulatives and pictorial representations.

Objective 5: Solve whole number problems using addition, subtraction, multiplication, and division in vertical and horizontal notation.

- a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator.
- b. Find the *sum* and *difference* of four-digit numbers and describe the process used.
- c. Multiply two- and three-digit factors by a one-digit factor and describe the process used.
- d. Divide a two-digit *whole number dividend* by a one-digit *divisor*, with a *remainder* of zero, and describe the process used.

Standard II: Students will use patterns and relations to represent mathematical situations.

Objective 1: Recognize, describe, and use patterns and identify the attributes.

- a. Represent and analyze *repeating* and *growing patterns* using objects, pictures, numbers, and tables.
- b. Recognize and extend multiples and other number patterns using a variety of methods.

Objective 2: Recognize, represent, and solve mathematical situations using patterns and symbols.

- a. Solve equations involving equivalent *expressions* (e.g., $6 \times 2 = \square \times 3$ or $6 \times \square = 9 + 9$).
- b. Use the $<$, $>$, $=$ symbols to compare two expressions involving addition, subtraction, multiplication, and division (e.g., $5 \times 49 \div 3 > 10 \times 10 - 32$).
- c. Recognize that a given variable maintains the same value throughout an equation or expression (e.g., $\square + \square = 8$; $\square = 4$).
- d. Demonstrate that changing the order of *factors* does not change the *product* (e.g., $2 \times 3 = 6$, $3 \times 2 = 6$) and that the grouping of three or more factors does not change the product (e.g., $(2 \times 3) \times 1 = 6$; $2 \times (3 \times 1) = 6$).
- e. Demonstrate the distribution of multiplication over addition using a rectangular *array* (e.g., $8 \times 14 = 8$ rows of 10 plus 8 rows of 4).

Standard II:
Students will use patterns and relations to represent mathematical situations.

Standard III:
Students will use spatial reasoning to describe, identify, and create geometric shapes.

Standard III: Students will use spatial reasoning to recognize, describe, and identify geometric shapes.

Objective 1: Describe, identify, and analyze characteristics and properties of geometric shapes.

- a. Identify and draw *parallel lines* and *intersecting lines*.
- b. Identify and draw lines of symmetry on a variety of *polygons*.
- c. Identify and describe *quadrilaterals* (i.e., rectangles, squares, *rhombuses*, *trapezoids*, *kites*).
- d. Identify *right*, *obtuse*, and *acute* angles.
- e. Compare two polygons to determine whether they are *congruent* or *similar*.
- f. Identify and describe *cylinders* and *rectangular prisms*.

Objective 2: Specify locations and describe spatial relationships using grids and maps.

- a. Locate positions on a map of Utah using *coordinates* or *regions*.
- b. Give the coordinates or regions of a position on a map of Utah.

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

- a. Identify a *slide* (translation) or a *flip* (reflection) of a geometric shape using manipulatives.
- b. Relate *cubes*, *cylinders*, *cones*, and *rectangular prisms* to the *two-dimensional* shapes (*nets*) from which they were created.

Standard IV: Students will understand and use measurement tools and techniques.

Objective 1: Identify and describe measurable attributes of objects and units of measurement.

- a. Describe the relationship among *metric* units of length (i.e., millimeter, centimeter, meter), between metric units of volume (i.e., milliliter, liter), and between metric units of weight (i.e., gram, kilogram).
- b. Identify a mile as a measure of distance and its relationship to other customary units of length.
- c. Describe the relationship among customary units of *capacity* (i.e., cup, pint, quart, gallon).
- d. Estimate length, capacity, and weight using metric and customary units.

Objective 2: Determine measurements using appropriate tools and formulas.

- a. Measure the length of objects to the nearest centimeter, meter, quarter-inch, foot, and yard.
- b. Measure *capacity* using milliliters, liters, cups, pints, quarts, and gallons and measure weight using grams, kilograms, and pounds.
- c. Read, tell, and write time to the nearest minute, identifying a.m. and p.m.
- d. Read and record the temperature to the nearest degree, in Fahrenheit, using a thermometer.
- e. Determine the value of a combination of coins and bills that total \$20.00 or less.
- f. Count back change for a single-item purchase and determine the amount of change to be received from a multiple-item purchase.
- g. 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.

Standard IV:
Students will understand and use measurement tools and techniques.

Standard V:

Students will collect and organize data to make predictions and identify basic concepts of probability.

Standard V: Students will collect and organize data to make predictions and use basic concepts of probability.

Objective 1: Collect, organize, and display data to make predictions and 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 tables, line plots, line graphs, and bar graphs.
- d. Identify and distinguish between *clusters* and *outliers* of a data set.

Objective 2: Use basic concepts of probability.

- a. Describe the results of investigations involving random outcomes as simple ratios (e.g., 4 out of 9, $4/9$).
- b. Predict outcomes of simple experiments, including with and without replacement, and test the predictions.

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.

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.

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



- 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

- 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

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.

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

- 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.



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.

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

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



- 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.

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 I:

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



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.

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

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.

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

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.

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.

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

K-6 Elementary Mathematics Core Curriculum in Table Format

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Standard I: Students will understand simple number concepts and relationships.</p> <p>Objective I: Identify and use whole numbers.</p> <ol style="list-style-type: none"> Relate a numeral to the number of objects in a set (e.g., $\square \square \square = 3$). Construct models of numbers to 10 with physical objects or manipulatives. Make pictorial representations of numbers to 10 (e.g., draw four circles, draw six squares). Recognize and write numerals from 0 to 10. Manipulate objects to demonstrate and describe multiple ways of representing a number (e.g., 5 can be 3 and 2 more, 5 can also be 2 and 2 and 1). 	<p>Standard I: Students will acquire number sense and perform simple operations with whole numbers.</p> <p>Objective I: Represent whole numbers in a variety of ways.</p> <ol style="list-style-type: none"> Relate number words to the numerals that represent the quantities 0 to 10. Sort objects into groups of tens and ones and write the numeral representing the set. Represent whole numbers up to 100 in groups of tens and ones using objects. Write a numeral when given the number of tens and ones. Write a numeral to 99 in expanded form (e.g., 39 is 3 tens and 9 ones or 30+9). Use zero to represent the number of elements in the empty set or as a placeholder in a two-digit numeral. 	<p>Standard I: Students will acquire number sense and perform operations with whole numbers.</p> <p>Objective I: Represent whole numbers in a variety of ways.</p> <ol style="list-style-type: none"> Relate number words to the numerals that represent the quantities 0-100. Represent whole numbers up to 1,000 in groups of hundreds, tens, and ones using base ten models, and write the numeral representing the set. Read and write a three-digit numeral, relating it to a set of objects and a pictorial representation. Write a numeral to 999 in expanded form (e.g., 539 is 5 hundreds, 3 tens, 9 ones or 500+30+9). Identify the place and value of a given digit in a three-digit numeral (e.g., the numeral (e.g., the two in 281 means 2 hundreds or 200). Demonstrate multiple ways to represent numbers using symbolic representations (e.g., thirty is the same as two groups of 15, the number of pennies in three dimes, or 58-28). 	<p>Standard I: Students will acquire number sense and perform operations with whole numbers and simple fractions.</p> <p>Objective I: Represent whole numbers in a variety of ways.</p> <ol style="list-style-type: none"> Model, read, and write whole numbers up to 10,000 using base ten models, pictures, and symbols. Write a numeral when given the number of thousands, hundreds, tens, and ones. Write a number up to 9,999 in expanded form (e.g., 6,539 is 6 thousands, 5 hundreds, 3 tens, 9 ones or 6000+500+30+9). Identify the place and value of a given digit in a four-digit numeral. Demonstrate multiple ways to represent numbers using models and symbolic representations (e.g., fifty is the same as two groups of 25, the number of pennies in five dimes, or 75-25). 	<p>Standard I: Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.</p> <p>Objective I: Represent whole numbers and decimals in a variety of ways.</p> <ol style="list-style-type: none"> Model, read, and write numerals from tenths to 100,000. Write a whole number up to 99,999 in expanded form (e.g., 76,539 is 7 ten-thousands, 6 one-thousands, 5 hundreds, 3 tens, 9 ones or 70,000 + 6,000 + 500 + 30 + 9). Identify the place and value of a given digit in a five-digit numeral, including decimals to tenths. Demonstrate multiple ways to represent numbers by using models and symbolic representations (e.g., 108=2x50+8; 108=10² + 8). Classify whole numbers from 2 to 20 as prime or composite and 1 as neither prime nor composite, using models. Identify square numbers using models. 	<p>Standard I: Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.</p> <p>Objective I: Represent whole numbers and decimals in a variety of ways.</p> <ol style="list-style-type: none"> Model, read, and write numerals from hundredths to one millions. Write a whole number up to 999,999 in expanded form (e.g., 876,539 = 8 hundred-thousands, 7 ten-thousands, 6 thousands, 5 hundreds, 3 tens, 9 ones or 8x100,000 + 7x10,000 + 6x1,000 + 5x100 + 3x10 + 9). Demonstrate multiple ways to represent whole numbers by using models and symbolic representations (e.g., 108=2x50+8; 108=10² + 8). Classify whole numbers from 2 to 20 as prime or composite and 1 as neither prime nor composite, using models. Represent repeated factors using exponents up to three (e.g., 8=2x2x2=2³). 	<p>Standard I: Students will acquire number sense and perform operations with rational numbers.</p> <p>Objective I: Represent whole numbers and decimals in a variety of ways.</p> <ol style="list-style-type: none"> Change whole numbers with exponents to standard form (e.g., $2^4 = 2^4=16$) and recognize that $10^0 = 1$. Read and write numerals from thousandths to one billion. Write a whole number to 999,999 in expanded form using exponents (e.g., $876,539 = 8 \times 10^5 + 7 \times 10^4 + 6 \times 10^3 + 5 \times 10^2 + 3 \times 10^1 + 9 \times 10^0$). Express numbers in scientific notation using positive powers of ten. Classify whole numbers to 100 as prime, composite, or neither. Determine the prime factorization for a whole number up to 50.

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Objective 2: Identify simple relationships among whole numbers.</p> <p>a. Develop strategies for <i>one-to-one</i> correspondence and keeping track of quantities.</p> <p>b. Compare two sets of objects to determine whether they have the same, fewer, or more elements.</p> <p>c. Order sets of objects from 1 to 9.</p> <p>d. Estimate quantities less than 10.</p>	<p>Objective 2: Identify simple relationships among whole numbers.</p> <p>a. Identify the number that is one more or one less than any <i>whole number</i> from 1 to 99.</p> <p>b. Use the vocabulary "greater than," "less than," and "equal to" when comparing sets of objects or numbers.</p> <p>c. Order sets of objects and numbers from 0 to 20.</p> <p>d. Use <i>ordinal numbers</i> 1st through 5th (i.e., 1st, 2nd, 3rd, 4th, 5th).</p>	<p>Objective 2: Identify simple relationships among whole numbers.</p> <p>a. Identify the number that is one more, one less, ten more, or ten less than any <i>whole number</i> up to 100.</p> <p>b. Write number sentences using the terms "greater than," "less than," or "equal to," to compare numbers.</p> <p>c. Order four whole numbers less than 100 from least to greatest and from greatest to least.</p> <p>d. Use <i>ordinal numbers</i> 1st through 10th.</p>	<p>Objective 2: Identify relationships among whole numbers.</p> <p>a. Use a variety of strategies to determine whether a number is even or odd.</p> <p>b. Identify the number that is ten more, ten less, 100 more, or 100 less than any <i>whole number</i> up to 1,000.</p> <p>c. Compare the relative size of numbers (e.g., 31 is large compared to 4, about half as big as 60, close to 27).</p> <p>d. Compare whole numbers up to four digits using the symbols $<$, $>$, and $=$.</p> <p>e. Order and compare whole numbers on a number line.</p>	<p>Objective 2: Identify relationships among whole numbers and decimals.</p> <p>a. Identify the number that is 100 more, 100 less, 1,000 more, or 1,000 less than any <i>whole number</i> up to 10,000.</p> <p>b. Compare the relative size of numbers (e.g., 100 is small compared to a million, but large compared to 5).</p> <p>c. Compare whole numbers up to five digits using the symbols $<$, $>$, and $=$.</p> <p>d. Identify a whole number that is between two given whole numbers.</p> <p>e. Order and compare whole numbers and decimals to tenths on a number line.</p>	<p>Objective 2: Identify relationships among whole numbers, fractions, decimals, and percents.</p> <p>a. Order and compare <i>whole numbers</i>, fractions (including mixed numbers), and decimals using a variety of methods and symbols.</p> <p>b. Rewrite mixed numbers and improper fractions from one form to the other.</p> <p>c. Find the least common denominator for two fractions.</p> <p>d. Represent commonly used fractions as decimals and percents in various ways (e.g., objects, pictures, calculators).</p>	<p>Objective 2: Identify relationships among whole numbers, fractions (rational numbers), decimals, and percents.</p> <p>a. Find the <i>greatest common factor</i> and <i>least common multiple</i> for two numbers using a variety of methods (e.g., list of multiples, prime factorization).</p> <p>b. Order and compare <i>rational numbers</i>, including mixed variety of methods and symbols.</p> <p>c. Locate positive rational numbers on a number line.</p> <p>d. Convert common fractions, decimals, and percents from one form to another (e.g., $3/4 = 0.75 = 75\%$).</p>

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Objective 3: Model and illustrate meanings of the operations of addition and subtraction and describe how they relate.</p> <p>a. Demonstrate the joining and separating of sets with twelve or fewer objects and record the results with pictures or symbols.</p> <p>b. Model two meanings of subtraction: separating of sets ("take away") and comparison of sets ("how many more/fewer") using objects, pictorial representations, and symbols.</p> <p>c. Use correct vocabulary and symbols to describe addition (i.e., add, "and," plus, +, sum), subtraction (i.e., subtract, minus, -, take away, how many more/fewer), and equals (i.e., =, same as).</p> <p>d. Use zero in addition and subtraction sentences.</p>	<p>Objective 3: Model and illustrate meanings of the operations of addition and subtraction and describe how they relate.</p> <p>a. Demonstrate the joining and separating of sets with eighteen or fewer objects and record the results with pictures or symbols.</p> <p>b. Model three meanings of subtraction: separating of sets ("take away"), comparison of sets ("how many more/fewer"), and missing addends using objects, pictorial representations, and symbols.</p> <p>c. Separate a given set of objects into two, three, five, or ten groups of equal size.</p> <p>d. Model addition and subtraction of two-digit whole numbers in a variety of ways.</p> <p>e. Select an addition or subtraction sentence to solve a problem involving joining or separating of sets with eighteen or fewer objects.</p> <p>f. Recognize that addition number sentences have related subtraction sentences (e.g., $8-5=3$, $3+5=8$).</p>	<p>Objective 3: Model and illustrate meanings of the operations of addition, subtraction, multiplication, and division and describe how they relate.</p> <p>a. Model addition and subtraction of two- and three-digit whole numbers in a variety of ways.</p> <p>b. Model multiplication of a one-digit factor by a one-digit factor using various methods (e.g., repeated addition, rectangular arrays, manipulatives, pictures) and connect the representation to an algorithm.</p> <p>c. Model division as sharing equally and as repeated subtraction using various methods (e.g., rectangular arrays, manipulatives, number lines, pictorial representations).</p> <p>d. Demonstrate, using objects, that multiplication and division are inverse operations (e.g., $3 \times 4=12$; thus, $12 \div 4=3$ and $12 \div 3=4$).</p> <p>e. Select and write an addition, subtraction, or multiplication sentence to solve a problem related to the students' environment, and write a story problem that relates to a given equation.</p> <p>f. Demonstrate the effects of place value when multiplying whole numbers by 10.</p>	<p>Objective 3: Model and illustrate meanings of the four operations and describe how they relate.</p> <p>a. Use models to represent multiplication of a one- or two-digit factor (up to 30) using a variety of methods (e.g., rectangular arrays, manipulatives, pictures) and connect the representation to an algorithm.</p> <p>b. Recognize that division by zero is not possible (e.g., $6 \div 0$ is undefined).</p> <p>c. Select and write a multiplication or division sentence to solve a problem related to the students' environment and write a story problem that relates to a given equation.</p> <p>d. Represent division of a two-digit dividend by a one-digit divisor, including whole number remainders, using various methods (e.g., rectangular arrays, manipulatives, pictures) and connect the representation to an algorithm.</p> <p>e. Demonstrate that multiplication and division are inverse operations (e.g., $3 \times 4=12$; thus, $12 \div 4=3$ and $12 \div 3=4$).</p> <p>f. Describe the effect of place value when multiplying whole numbers by 10 and 100.</p>	<p>Objective 3: Model and illustrate meanings of operations and describe how they relate.</p> <p>a. Identify the <i>dividend</i>, <i>divisor</i>, and <i>quotient</i> regardless of the division symbol used.</p> <p>b. Determine whether a whole number is divisible by 2, 3, 5, 9, and/or 10, using the <i>rules of divisibility</i>.</p> <p>c. Represent remainders as <i>whole numbers</i>, decimals, or fractions and describe the meaning of remainders as they apply to problems from the students' environment (e.g., if there are 53 people, how many vans are needed if each van holds 8 people?).</p> <p>d. Model addition, subtraction, and multiplication of fractions and decimals in a variety of ways (e.g., using objects and a number line).</p> <p>e. Select or write the number sentences that can be used to solve a two-step problem.</p> <p>f. Model different strategies for whole number multiplication (e.g., partial product, lattice) and division (e.g., partial quotient).</p> <p>g. Describe the effect on place value when multiplying and dividing whole numbers and decimals by 10, 100, and 1,000.</p>	<p>Objective 3: Model and illustrate meanings of operations and describe how they relate.</p> <p>a. Represent division of a multi-digit dividend by two-digit divisors, including decimals, using models, pictures, and symbols.</p> <p>b. Model addition, subtraction, and division of fractions and decimals in a variety of ways (e.g., objects, a number line).</p> <p>c. Apply <i>rules of divisibility</i>.</p> <p>d. Select or write a number sentence that can be used to solve a multi-step problem and write a word problem when given a two-step expression or equation.</p>	

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
	<p>Objective 4: Use fractions to identify parts of the whole.</p> <p>a. Share sets of up to ten objects between two students and identify each part as half.</p> <p>b. Divide geometric shapes into equal parts, identifying halves and fourths.</p>	<p>Objective 4: Use fractions to identify parts of the whole.</p> <p>a. Separate geometric shapes and sets of objects into halves, thirds, and fourths using a variety of models and illustrations.</p> <p>b. Specify a region of a geometric shape (e.g., as “$\frac{1}{2}$ out of $\frac{1}{2}$ equal parts” when given four or fewer equal parts.</p> <p>c. Represent the unit fractions $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$ with objects, pictures, and symbols.</p>	<p>Objective 4: Use fractions to communicate parts of the whole.</p> <p>a. Identify the denominator of a fraction as the number of equal parts in the whole region or set.</p> <p>b. Identify the numerator of a fraction as the number of equal parts being considered.</p> <p>c. Divide regions and sets of objects into equal parts using a variety of models and illustrations.</p> <p>d. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, sixths, and eighths.</p> <p>e. Determine which of two fractions is greater using models or illustrations.</p>	<p>Objective 4: Use fractions to communicate parts of the whole.</p> <p>a. Divide regions and sets of objects into equal parts using a variety of models and illustrations.</p> <p>b. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, fifths, sixths, eighths, and tenths.</p> <p>c. Relate fractions to decimals that represent tenths.</p> <p>d. Determine which of two fractions is greater using models or illustrations.</p> <p>e. Find equivalent fractions for one-half, one-third, and one-fourth using manipulatives and pictorial representations.</p>	<p>Objective 4: Use fractions to communicate parts of the whole.</p> <p>a. Divide regions, sets of objects, and line segments into equal parts using a variety of models and illustrations.</p> <p>b. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, fifths, sixths, eighths, tenths, and twelfths.</p> <p>c. Represent the simplest form of a fraction in various ways (e.g., objects, pictorial representations, symbols).</p> <p>d. Represent mixed numbers and improper fractions in various ways (e.g., rulers, objects, number lines, symbols).</p> <p>e. Rename whole numbers as fractions with different denominators (e.g., $5=5/1$, $3=6/2$, $1=7/7$).</p> <p>f. Model and calculate equivalent forms of a fraction and describe the process used.</p>	<p>Objective 4: Use fractions and percents to communicate parts of the whole.</p> <p>a. Divide regions, sets of objects, and line segments into equal parts using a variety of models and illustrations.</p> <p>b. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, fifths, sixths, eighths, tenths, twelfths, and sixteenths.</p> <p>c. Write a fraction or ratio in simplest form.</p> <p>d. Name equivalent forms for fractions (halves, thirds, fourths, fifths, tenths), ratios, percents, and decimals, including repeating or terminating decimals.</p> <p>e. Relate percents less than 1% or greater than 100% to equivalent fractions, decimals, whole numbers, and mixed numbers.</p>

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
	<p>Objective 5: Solve whole number problems using addition and subtraction in horizontal and vertical notation.</p> <ol style="list-style-type: none"> Compute addition and subtraction facts to twelve. Add three whole numbers with sums to twelve. 	<p>Objective 5: Solve whole number problems using addition and subtraction in vertical and horizontal notation.</p> <ol style="list-style-type: none"> Use a variety of methods and tools to facilitate computation (e.g., estimation, mental math strategies, paper and pencil, calculator). Compute accurately with basic number combinations for addition and subtraction facts to eighteen. Add three <i>whole numbers</i> with sums to eighteen. Find the sum of two-digit whole numbers and describe the process used. 	<p>Objective 5: Solve whole number problems using addition, subtraction, multiplication, and division in vertical and horizontal notation.</p> <ol style="list-style-type: none"> Use a variety of methods and tools to facilitate computation (e.g., estimation, mental math strategies, paper and pencil, calculator). Find the sum of any two <i>addends</i> with three or fewer digits, including monetary amounts, and describe the process used. Find the <i>difference</i> of two-digit <i>whole numbers</i> and describe the process used. Find the <i>product</i> for multiplication facts through ten times ten and describe the process used. 	<p>Objective 5: Solve whole number problems using addition, subtraction, multiplication, and division in vertical and horizontal notation.</p> <ol style="list-style-type: none"> Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator. Find the sum and difference of four-digit numbers, including monetary amounts, and describe the process used. Multiply two- and three-digit <i>factors</i> by a one-digit factor and describe the process used. Divide a two-digit <i>whole number dividend</i> by a one-digit <i>divisor</i>, with a <i>remainder</i> of zero and describe the process used. 	<p>Objective 5: Solve problems using the four operations with whole numbers, decimals, and fractions.</p> <ol style="list-style-type: none"> Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator. Use estimation strategies to determine whether results obtained using a calculator are reasonable. Multiply up to a three-digit <i>whole number</i> by a one- or two-digit <i>whole number</i>. Divide up to a three-digit <i>whole number dividend</i> by a one-digit <i>divisor</i>. Add and subtract decimals with digits to the hundredths place (e.g., $35.42+7.2$; $75.2-13.45$). Add, subtract, and multiply fractions. Simplify <i>expressions</i>, without <i>exponents</i>, using the <i>order of operations</i>. 	<p>Objective 5: Solve problems using the four operations with whole numbers, decimals, and fractions.</p> <ol style="list-style-type: none"> Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator. Use estimation strategies to determine whether results obtained using a calculator are reasonable. Multiply up to a three-digit <i>factor</i> by a one- or two-digit factor including decimals. Divide up to a three-digit <i>dividend</i> by a one- or two-digit <i>divisor</i> including decimals. Add and subtract decimals to the thousandths place (e.g., $34.567+3.45$; $65.3-5.987$). Add, subtract, multiply, and divide fractions and mixed numbers. Solve problems using ratios and proportions. Simplify <i>expressions</i>, with <i>exponents</i>, using the <i>order of operations</i>.

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Standard II: Students will identify and use patterns to represent mathematical situations.</p> <p>Objective I: Identify and sort objects according to common attributes.</p> <p>a. Sort objects into groups by color, shape, size, number, or other attributes.</p> <p>b. Identify which attribute was used to sort objects into a group.</p> <p>c. Find multiple ways to sort and classify a group of objects.</p>	<p>Standard II: Students will identify and use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize and represent patterns with one or two attributes.</p> <p>a. Sort and classify objects by one or two attributes.</p> <p>b. Identify, create, and label simple patterns using manipulatives, pictures, and symbolic notation (e.g., ABAB, ...). □ ○ □ ○ △ . . .</p> <p>c. Identify patterns in the environment.</p> <p>d. Identify horizontal and vertical patterns on hundreds charts.</p> <p>e. Use patterns to establish skip counting by twos to 20 and by fives and tens to 100.</p> <p>f. Count backward from 10 to 0 and identify the pattern.</p>	<p>Standard II: Students will identify and use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize and represent patterns having multiple attributes.</p> <p>a. Sort, classify, and label objects by three or more attributes.</p> <p>b. Identify and label repeating and growing patterns using objects, pictures, and symbolic notation (e.g., ABAABBAABB...).</p> <p>c. Identify repeating and growing patterns in the environment.</p> <p>d. Construct models and skip count by twos, threes, fives, and tens and relate to repeated addition.</p>	<p>Standard II: Students will use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize, describe, and use patterns and identify the attributes.</p> <p>a. Create and extend repeating and growing patterns using objects, numbers, and tables.</p> <p>b. Record results of patterns created using manipulatives, pictures, and numeric representations and describe how they are extended.</p>	<p>Standard II: Students will use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize, describe, and use patterns and identify the attributes.</p> <p>a. Represent and analyze repeating and growing patterns using objects, pictures, numbers, and tables.</p> <p>b. Recognize and extend multiples and other number patterns using a variety of methods.</p>	<p>Objective 6: Model and illustrate integers.</p> <p>a. Identify, read, and locate integers on a number line.</p> <p>b. Describe situations where integers are used in the students' environment.</p>	<p>Objective 6: Model, illustrate, and perform the operations of addition and subtraction of integers.</p> <p>a. Recognize that the sum of an integer and its opposite is zero.</p> <p>b. Model addition and subtraction of integers using manipulatives and a number line.</p> <p>c. Add and subtract integers.</p>
<p>Standard II: Students will identify and use patterns and relations to represent mathematical situations.</p> <p>Objective I: Identify and sort objects according to common attributes.</p> <p>a. Sort objects into groups by color, shape, size, number, or other attributes.</p> <p>b. Identify which attribute was used to sort objects into a group.</p> <p>c. Find multiple ways to sort and classify a group of objects.</p>	<p>Standard II: Students will identify and use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize and represent patterns with one or two attributes.</p> <p>a. Sort and classify objects by one or two attributes.</p> <p>b. Identify, create, and label simple patterns using manipulatives, pictures, and symbolic notation (e.g., ABAB, ...). □ ○ □ ○ △ . . .</p> <p>c. Identify patterns in the environment.</p> <p>d. Identify horizontal and vertical patterns on hundreds charts.</p> <p>e. Use patterns to establish skip counting by twos to 20 and by fives and tens to 100.</p> <p>f. Count backward from 10 to 0 and identify the pattern.</p>	<p>Standard II: Students will identify and use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize and represent patterns having multiple attributes.</p> <p>a. Sort, classify, and label objects by three or more attributes.</p> <p>b. Identify and label repeating and growing patterns using objects, pictures, and symbolic notation (e.g., ABAABBAABB...).</p> <p>c. Identify repeating and growing patterns in the environment.</p> <p>d. Construct models and skip count by twos, threes, fives, and tens and relate to repeated addition.</p>	<p>Standard II: Students will use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize, describe, and use patterns and identify the attributes.</p> <p>a. Create and extend repeating and growing patterns using objects, numbers, and tables.</p> <p>b. Record results of patterns created using manipulatives, pictures, and numeric representations and describe how they are extended.</p>	<p>Standard II: Students will use patterns and relations to represent mathematical situations.</p> <p>Objective I: Recognize, describe, and use patterns and identify the attributes.</p> <p>a. Represent and analyze repeating and growing patterns using objects, pictures, numbers, and tables.</p> <p>b. Recognize and extend multiples and other number patterns using a variety of methods.</p>	<p>Objective 6: Model and illustrate integers.</p> <p>a. Identify, read, and locate integers on a number line.</p> <p>b. Describe situations where integers are used in the students' environment.</p>	<p>Objective 6: Model, illustrate, and perform the operations of addition and subtraction of integers.</p> <p>a. Recognize that the sum of an integer and its opposite is zero.</p> <p>b. Model addition and subtraction of integers using manipulatives and a number line.</p> <p>c. Add and subtract integers.</p>

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Objective 2: Identify and use patterns to describe numbers or objects.</p> <p>a. Use patterns to count orally from 1 to 20 and backward from 10 to 0.</p> <p>b. Identify simple patterns in the environment.</p> <p>c. Predict what comes next in an established pattern and justify thinking.</p> <p>d. Duplicate, extend, and create simple patterns using objects and pictorial representations.</p>	<p>Objective 2: Recognize and represent relations using mathematical symbols.</p> <p>a. Recognize that “=” indicates a relationship in which the quantities on each side of an equation are equal.</p> <p>b. Recognize that symbols such as \square, \triangle, or \diamond in an addition or subtraction equation represent a missing value that will make the statement true (e.g., $\square + 3 = 6$, $5 + 7 = \triangle$, $4 = 5 - \diamond$).</p> <p>c. Demonstrate that changing the order of <i>addends</i> does not change the <i>sum</i> (e.g., $3+2=5$ and $2+3=5$).</p>	<p>Objective 2: Recognize and represent mathematical patterns using symbols.</p> <p>a. Recognize that “\neq” indicates a relationship in which the quantities on each side are not of equal value.</p> <p>b. Recognize that symbols such as \square, \triangle, or \diamond in an addition or subtraction equation represent a value that will make the statement true (e.g., $\square + 3 = 6$, $5 + 7 = \triangle$, $7 = 9 - \diamond$).</p> <p>c. Demonstrate that changing the order of <i>addends</i> does not change the <i>sum</i> (e.g., $3+2+7=12$, $7+3+2=12$) and that changing the grouping of three or more <i>addends</i> does not change the <i>sum</i> (e.g., $(2+3)+7=12$, $2+(3+7)=12$).</p>	<p>Objective 2: Recognize and represent mathematical patterns using symbols.</p> <p>a. Recognize that symbols such as \square, \triangle, or \diamond in an addition, subtraction, or multiplication equation represent a value that will make the statement true (e.g., $5+7=\triangle$, $\square-3=6$, $\diamond=2\times 4$).</p> <p>b. Solve equations involving equivalent expressions (e.g., $6+4 = \square+7$).</p> <p>c. Use the $>$, $<$, and $=$ symbols to compare two expressions involving addition and subtraction (e.g., $4+6 > 3+2$, $3+5 < 16-9$).</p> <p>d. Demonstrate that grouping three or more <i>addends</i> does not change the <i>sum</i> (e.g., $3+(2+7)=12$, $(7+3)+2=12$) and changing the order of <i>factors</i> does not change the <i>product</i> (e.g., $3\times 7=21$, $7\times 3=21$).</p> <p>e. Use a variety of manipulatives to model the <i>identity property of addition</i> (e.g., $3+0=3$), the <i>identity property of multiplication</i> (e.g., $7\times 1=7$), and the <i>zero property of multiplication</i> (e.g., $6\times 0=0$).</p>	<p>Objective 2: Recognize, represent, and solve mathematical patterns and symbols.</p> <p>a. Solve equations involving equivalent expressions (e.g., $6\times 2 = \square \times 3$ or $6 \times \square = 9 \times 9$).</p> <p>b. Use the $<$, $>$, $=$ symbols to compare two expressions involving addition, subtraction, multiplication, and division (e.g., $5 \times 4 < 9 \times 3$).</p> <p>c. Recognize that a given variable maintains the same value throughout an equation or expression (e.g., $\square + \square = 8$; $\square = 4$).</p> <p>d. Demonstrate that changing the order of factors does not change the product (e.g., $2 \times 3 = 6$, $3 \times 2 = 6$) and that the grouping of three or more <i>factors</i> does not change the <i>product</i> (e.g., $(2 \times 3) \times 1 = 6$; $2 \times (3 \times 1) = 6$).</p> <p>e. Demonstrate the distribution of multiplication over addition using a rectangular array (e.g., $8 \times 14 = 8$ rows of 10 plus 8 rows of 4).</p>	<p>Objective 2: Represent, solve, and analyze mathematical algebraic symbols.</p> <p>a. Recognize a variety of symbols for multiplication and division including \times, \bullet, and $*$ as symbols for multiplication and \div, $\overline{)$, and a fraction bar ($/$ or $-$) as division symbols.</p> <p>b. Recognize that a variable (\diamond, n, x) represents an unknown quantity.</p> <p>c. Solve one-step equations involving <i>whole numbers</i> and a single variable (e.g., $n+7=3$).</p> <p>d. Recognize that the answer to a multiplication problem involving a factor of zero is equal to zero (e.g., $0 \times 45 = 0$).</p> <p>e. Use expressions or one-step equations to represent real-world situations.</p> <p>f. Use the <i>associative</i>, <i>commutative</i>, and <i>distributive properties</i> to compute with whole numbers.</p>	<p>Objective 2: Represent, solve, and analyze mathematical situations using algebraic symbols.</p> <p>a. Recognize that a number in front of a variable indicates multiplication (e.g., $3y$ means 3 times the quantity y).</p> <p>b. Solve two-step equations involving <i>whole numbers</i> and a single variable (e.g., $3x+4=19$).</p> <p>c. Recognize that “\neq” indicates a relationship in which the quantities on each side are approximately of equal value (e.g., $\pi \approx 3.14$).</p> <p>d. Recognize that an <i>exponent</i> can be represented in the following ways: 4^3 or $4 \wedge 3$.</p> <p>e. Evaluate expressions and formulas, substituting given values for the variables (e.g., $2x+4$; $x=2$; therefore, $2(2)+4=8$).</p> <p>f. Recognize that if the <i>product</i> is zero, then one or more <i>factors</i> equal zero (i.e., if $ab=0$ then either $a=0$ or $b=0$ or a and $b=0$).</p>

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Standard III: Students will identify and create simple geometric shapes and describe spatial relationships.</p> <p>Objective I: Identify and create simple geometric shapes.</p> <ol style="list-style-type: none"> Identify circles, triangles, rectangles, and squares. Combine shapes to create <i>two-dimensional</i> objects. Draw circles, triangles, rectangles, and squares. Recognize circles, triangles, rectangles, and squares in the students' environment. 	<p>Standard III: Students will describe, identify, and create simple geometric shapes and describe spatial relationships.</p> <p>Objective I: Describe, identify, and create simple geometric shapes.</p> <ol style="list-style-type: none"> Identify, name, draw, create, and sort circles, triangles, rectangles, and squares. Identify circles, triangles, rectangles, and squares in the students' environment. Recognize that combining simple geometric shapes can create more complex geometric shapes. 	<p>Standard III: Students will describe, identify, and create geometric shapes and describe spatial relationships.</p> <p>Objective I: Describe, identify, and create geometric shapes.</p> <ol style="list-style-type: none"> Identify, name, draw, sort, and compare circles, triangles, and <i>parallelograms</i>. Identify and name spheres, cones, and cylinders. Find and identify familiar geometric shapes in the students' environment. Determine whether a circle, triangle, square, or rectangle has a <i>line of symmetry</i>. 	<p>Standard III: Students will use spatial reasoning to describe, identify, and create geometric shapes.</p> <p>Objective I: Describe, identify, and create geometric shapes.</p> <ol style="list-style-type: none"> Identify and draw <i>points, lines, line segments, and endpoints</i>. Identify and draw <i>lines of symmetry</i> on triangles, squares, circles, and rectangles. Determine whether an angle is <i>right, obtuse, or acute</i> by comparing the angle to the corner of a rectangle. Classify polygons (e.g., <i>quadrilaterals, pentagons, hexagons, octagons</i>) by the number of sides and corners. Identify, make, and describe cubes (e.g., a cube has 6 square <i>faces</i>, 8 <i>vertices</i>, and 12 <i>edges</i>). 	<p>Standard III: Students will use spatial reasoning to recognize, describe, and identify geometric shapes.</p> <p>Objective I: Describe, identify, and analyze characteristics and properties of geometric shapes.</p> <ol style="list-style-type: none"> Identify and draw <i>parallel lines</i> and <i>intersecting lines</i>. Identify and draw lines of symmetry on a variety of polygons. Identify and describe quadrilaterals (i.e., rectangles, squares, rhombuses, trapezoids, kites). Identify right, obtuse, and acute angles. Compare two polygons to determine whether they are congruent or similar. Identify and describe cylinders and rectangular prisms. 	<p>Standard III: Students will use spatial reasoning to recognize, describe, and identify geometric shapes and principles.</p> <p>Objective I: Describe, identify, and analyze characteristics and properties of geometric shapes.</p> <ol style="list-style-type: none"> Identify and draw <i>perpendicular lines</i>. Draw, label, and describe rays and describe an angle as two rays sharing a common endpoint. Label an angle as <i>acute, obtuse, right, or straight</i>. Identify and describe <i>equilateral, isosceles, scalene, right, acute, and obtuse</i> triangles. Identify the <i>vertex</i> of an angle or the <i>vertices</i> of a polygon. Compare <i>corresponding angles</i> of two triangles and determine whether the triangles are <i>similar</i>. Identify and describe <i>pyramids</i> and <i>prisms</i>. 	<p>Standard III: Students will use spatial and logical reasoning to recognize, describe, and identify geometric shapes and principles.</p> <p>Objective I: Identify and analyze characteristics and properties of geometric shapes.</p> <ol style="list-style-type: none"> Identify the <i>midpoint</i> of a <i>line segment</i>. Identify concave and convex <i>polygons</i>. Identify the center, <i>radius, diameter</i>, and <i>circumference</i> of a circle. Identify the number of <i>faces, edges, and vertices</i> of <i>pyramids</i> and <i>prisms</i>.

<p>Kindergarten</p> <p>Objective 2: Describe simple spatial relationships.</p> <p>a. Visualize how to fit a shape into a design.</p> <p>b. Use and demonstrate words to describe position with objects (i.e., on, over, under, above, below, top, bottom, up, down, in front of, behind, next to, beside).</p> <p>c. Use and demonstrate words to describe distance with objects (i.e., far, near).</p>			<p>1st Grade</p> <p>Objective 2: Describe simple spatial relationships.</p> <p>a. Use and demonstrate words to describe position (i.e., between, before, after, middle, left, right).</p> <p>b. Use and demonstrate words to describe distance (i.e., closer, farther).</p>		<p>2nd Grade</p> <p>Objective 2: Describe spatial relationships.</p> <p>a. Create and use verbal or written instructions to move within the environment.</p> <p>b. Find and name locations using coordinates (A, 1).</p> <p>c. Identify shapes in various orientations (e.g., Δ and ∇).</p>		<p>3rd Grade</p> <p>Objective 2: Describe spatial relationships.</p> <p>a. Give directions to reach a location.</p> <p>b. Use coordinates (A, 1) or regions to locate positions on a map.</p> <p>c. Demonstrate and use horizontal and vertical lines.</p>		<p>4th Grade</p> <p>Objective 2: Specify locations and describe spatial relationships using grids and maps.</p> <p>a. Locate positions on a map of Utah using coordinates or regions.</p> <p>b. Give the <i>coordinates</i> or <i>regions</i> of a position on a map of Utah.</p>	<p>5th Grade</p> <p>Objective 2: Specify locations and describe spatial relationships using coordinate geometry.</p> <p>a. Locate points defined by ordered pairs in the first quadrant.</p> <p>b. Write an ordered pair for a point in the first quadrant.</p> <p>c. Specify possible paths between locations on a <i>coordinate grid</i> and compare distances of the various paths.</p>	<p>6th Grade</p> <p>Objective 2: Specify locations and describe spatial relationships using coordinate geometry.</p> <p>a. Graph points defined by ordered pairs in all four quadrants.</p> <p>b. Write the ordered pair for a point in any quadrant.</p>
			<p>Objective 3: Visualize and identify geometric shapes after applying transformations.</p> <p>a. Demonstrate the effect of a slide (translation) or flip (reflection) on a figure, using manipulatives.</p> <p>b. Determine whether two polygons are <i>congruent</i> by sliding, flipping, or turning to physically fit one object on top of the other.</p> <p>c. Identify <i>two-dimensional</i> shapes (<i>nets</i>) that will fold to make a cube.</p> <p>d. Create a <i>polygon</i> that results from combining other polygons.</p>		<p>Objective 3: Visualize and identify geometric shapes after applying transformations.</p> <p>a. Identify a <i>slide</i> (<i>translation</i>) or <i>flip</i> (<i>reflection</i>) on a figure using manipulatives.</p> <p>b. Relate <i>cubes</i>, <i>cylinders</i>, <i>cones</i>, and <i>rectangular prisms</i> to the <i>two-dimensional</i> shapes (<i>nets</i>) from which they were created.</p>	<p>Objective 3: Visualize and identify geometric shapes after applying transformations.</p> <p>a. Identify a <i>slide</i> (<i>translation</i>) or <i>flip</i> (<i>reflection</i>) on a figure across a line.</p> <p>b. Demonstrate the effect of a <i>turn</i> (<i>rotation</i>) on a figure using manipulatives.</p> <p>c. Relate pyramids and prisms to the <i>two-dimensional</i> shapes (<i>nets</i>) from which they were created.</p>	<p>Objective 3: Visualize and identify geometric shapes after applying transformations.</p> <p>a. <i>Turn</i> (<i>rotate</i>) a shape around a point and identify the location of the new vertices.</p> <p>b. <i>Slide</i> (<i>translate</i>) a polygon either horizontally or vertically on a coordinate grid and identify the location of the new vertices.</p> <p>c. <i>Flip</i> (<i>reflect</i>) a shape across either the x- or y-axis and identify the location of the new vertices.</p>				

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Standard IV: Students will understand and use simple measurement tools and techniques.</p> <p>Objective I: Identify measurable attributes of objects and units of measurement.</p> <ol style="list-style-type: none"> Identify the appropriate tools for measuring length, weight, capacity, temperature, and time. Identify the values of a penny, nickel, dime, and quarter. Estimate the length of an object by comparing to a nonstandard unit (e.g., How many new pencils wide is your desk?). 	<p>Standard IV: Students will understand and use measurement tools and techniques.</p> <p>Objective I: Identify measurable attributes of objects and units of measurement.</p> <ol style="list-style-type: none"> Sequence a series of events of a day in order by time (e.g., breakfast at 7:00, school begins at 9:00). Identify the name and value of a penny, nickel, dime, quarter, and dollar. Estimate length, capacity, and weight using customary units. 	<p>Standard IV: Students will understand and use measurement tools and techniques.</p> <p>Objective I: Identify and describe measurable attributes of objects and units of measurement.</p> <ol style="list-style-type: none"> Recognize the two systems of measurement: <i>metric</i> and <i>customary</i>. Describe the relationship between metric units of length (i.e., centimeter, meter). Describe the relationship among customary units of length (i.e., inch, foot, yard) and the relationship between customary units of capacity (i.e., cup, quart). Estimate length, capacity, and weight using metric and customary units. 	<p>Standard IV: Students will understand and use measurement tools and techniques.</p> <p>Objective I: Identify and describe measurable attributes of objects and units of measurement.</p> <ol style="list-style-type: none"> Describe the relationship among metric units of length (i.e., millimeter, centimeter, meter), between <i>metric</i> units of capacity (i.e., milliliter, liter), and between metric units of weight (i.e., gram, kilogram). Identify a mile as a measure of distance and its relationship to other <i>customary</i> units of length. Describe the relationship among customary units of capacity (i.e., cup, pint, quart, gallon). Estimate length, capacity, and weight using metric and customary units. 	<p>Standard IV: Students will understand and apply measurement tools and techniques.</p> <p>Objective I: Identify and describe measurable attributes of objects and units of measurement.</p> <ol style="list-style-type: none"> Describe the relationship among <i>metric</i> units of length (i.e., millimeter, centimeter, meter, kilometer). Describe the relationship among <i>customary</i> units of weight (i.e., ounce, pound). Identify the correct units of measurement for <i>volume</i>, <i>area</i>, and <i>perimeter</i> in both metric and customary systems. Estimate length, volume, weight, and area using metric and customary units. Convert units of measurement within the metric system and convert units of measurement within the customary system. 	<p>Standard IV: Students will understand and apply measurement tools and techniques.</p> <p>Objective I: Identify and describe measurable attributes of objects and units of measurement.</p> <ol style="list-style-type: none"> Compare a meter to a yard, a liter to a quart, and a kilometer to a mile. Identify π as the ratio of the <i>circumference</i> to <i>diameter</i> of a circle. Explain how the size of the unit used in measuring affects the precision. Estimate length, volume, weight, and area using <i>metric</i> and customary units. 	

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Objective 2: Use appropriate techniques and tools to determine measurements.</p> <p>a. Compare two objects (e.g., shorter/longer, heavier/lighter, larger/smaller, more/less).</p> <p>b. Find the length of an object using nonstandard units (e.g., pencils, paper clips).</p> <p>c. Name the days of the week in order.</p> <p>d. Sort pennies, nickels, dimes, and quarters.</p>	<p>Objective 2: Use appropriate techniques and tools to determine measurements.</p> <p>a. Compare objects, using nonstandard units, according to their length, weight, or volume (e.g., pencils/length, books/weight, boxes/volume).</p> <p>b. Read and tell time to the nearest hour.</p> <p>c. Name the days of the week, months of the year, and seasons in order.</p> <p>d. Determine the value of a set of the same coins that total 25¢ or less (e.g., a set of 14 pennies equals 14¢, a set of 5 nickels equals 25¢, a set of 2 dimes equals 20¢).</p>	<p>Objective 2: Use appropriate techniques and tools to determine measurements.</p> <p>a. Compare and order objects, using nonstandard units, according to their length, weight, or capacity.</p> <p>b. Measure length using inches and feet, weight using pounds, and capacity using cups.</p> <p>c. Determine the value of a set of up to five coins that total \$1.00 or less (e.g., two quarters and one dime equals 60¢; three dimes, one nickel, and one penny equals 36¢).</p> <p>d. Read, tell, and write time to the hour and half-hour.</p> <p>e. Use a calendar to determine the day of the week and date.</p> <p>f. Determine the perimeter of a square, triangle, and rectangle by measuring with nonstandard units.</p>	<p>Objective 2: Use appropriate techniques and tools to determine measurements.</p> <p>a. Measure the length of objects to the nearest centimeter, meter, inch, foot, and yard.</p> <p>b. Measure capacity using cups and quarts, and measure weight using pounds.</p> <p>c. Determine the value of a combination of coins and bills that total \$5.00 or less and write the monetary amounts using the dollar sign and decimal notation.</p> <p>d. Identify the number of hours in a day, the number of days in a year, and the number of weeks in a year.</p> <p>e. Read, tell, and write time to the quarter-hour.</p> <p>f. Identify any given day of the month (e.g., the third Wednesday of the month is the 18th).</p> <p>g. Read and record the temperature to the nearest ten degrees using a Fahrenheit thermometer.</p> <p>h. Estimate and measure the perimeter and area of rectangles by measuring with nonstandard units.</p>	<p>Objective 2: Determine measurements using appropriate tools and formulas.</p> <p>a. Measure the length of objects to the nearest centimeter, meter, quarter-inch, foot, and yard.</p> <p>b. Measure capacity using milliliters, liters, cups, pints, quarts, and gallons and measure weight using grams, kilograms, and pounds.</p> <p>c. Read, tell, and write time to the nearest minute, identifying a.m. and p.m.</p> <p>d. Read and record the temperature to the nearest degree, in Fahrenheit, using a thermometer.</p> <p>e. Determine the value of a combination of coins and bills that total \$20.00 or less.</p> <p>f. Count back change for a single-item purchase and determine the amount of change to be received from a multiple-item purchase.</p> <p>g. 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.</p>	<p>Objective 2: Determine measurements using appropriate tools and formulas.</p> <p>a. Measure length to the nearest 1/8 of an inch and to the nearest centimeter.</p> <p>b. Measure volume and weight using metric and customary units.</p> <p>c. Measure angles using a protractor.</p> <p>d. Calculate elapsed time within a.m. or p.m. time periods.</p> <p>e. Read and record the temperature to the nearest degree (above and below zero) when using a thermometer with a Celsius or Fahrenheit scale.</p> <p>f. Calculate the perimeter of rectangles and triangles.</p> <p>g. Calculate the area of squares and rectangles using a formula.</p>	<p>Objective 2: Determine measurements using appropriate tools and formulas.</p> <p>a. Measure length to the nearest one-sixteenth of an inch and to the nearest millimeter.</p> <p>b. Estimate and measure an angle to the nearest degree.</p> <p>c. Calculate the circumference of a circle using a given formula.</p> <p>d. Calculate elapsed time across a.m. and p.m. time periods.</p> <p>e. Calculate the areas of triangles, rectangles, and parallelograms using given formulas.</p> <p>f. Calculate the surface area and volume of right, rectangular prisms using given formulas.</p>

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Standard V: Students will collect and draw conclusions from data and understand basic concepts of probability.</p> <p>Objective I: Collect, organize, and display simple data. a. Collect, organize, and record data using objects and pictures. b. Represent data in a variety of ways (e.g., graphs made from people, <i>pictographs</i>, bar graphs) and interpret the data (e.g., more people like red than blue).</p>	<p>Standard V: Students will collect and draw conclusions from data and understand basic concepts of probability.</p> <p>Objective I: Collect, organize, and display simple data. a. Collect physical objects to use as data. b. Collect, represent, and interpret data using tables, tally marks, <i>pictographs</i>, and bar graphs. c. Use a variety of methods to organize, display, and label information, including keys, using <i>pictographs</i>, tallies, bar graphs, and organized tables. d. Report information from a data display.</p>	<p>Standard V: Students will collect and organize data to make predictions and identify basic concepts of probability.</p> <p>Objective I: Collect, organize, and display data to make predictions. a. Collect, read, represent, and interpret data using tables, graphs, and charts, including keys (e.g., <i>pictographs</i>, bar graphs). b. Make predictions based on a data display.</p>	<p>Standard V: Students will collect and organize data to make predictions and use basic concepts of probability.</p> <p>Objective I: Collect, organize, and display data to make predictions and 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 tables, line plots, line graphs, and bar graphs. d. Identify and distinguish between <i>clusters</i> and <i>outliers</i> of a data set.</p>	<p>Standard V: Students will collect, analyze, and draw conclusions from data and apply basic concepts of probability.</p> <p>Objective I: Formulate and answer questions using statistical methods to compare data. a. Formulate a question that can be answered by collecting data. b. Collect, compare, and display data using an appropriate format (i.e., <i>line plots</i>, bar graphs, <i>pictographs</i>, circle graphs, line graphs). c. Identify minimum and <i>maximum</i> values for a set of data. d. Identify or calculate the <i>mean</i>, <i>mode</i>, and <i>range</i>. e. Propose and justify inferences based on data.</p>	<p>Standard V: Students will collect, analyze, and draw conclusions from data and apply basic concepts of probability.</p> <p>Objective I: Design investigations to reach conclusions using statistical methods to make inferences based on data. a. Design investigations to answer questions by collecting and organizing data in a variety of ways (e.g., bar graphs, line graphs, frequency tables, stem and leaf plots). b. Collect, compare, and display data using an appropriate format (i.e., bar graphs, line graphs, <i>line plots</i>, circle graphs, scatter plots). c. Compare two similar sets of data on the same graph and compare two graphs representing the same set of data. d. Recognize that changing the scale influences the appearance of a display of data. e. Develop and evaluate inferences and predictions based on data.</p>	

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
<p>Objective 2: Determine the likelihood of events.</p> <p>a. Describe events encountered in books read as possible or not possible.</p> <p>b. Describe events as likely or unlikely (e.g., It is likely to snow today. It is unlikely an elephant will be in school).</p>	<p>Objective 2: Determine the likelihood of an event.</p> <p>a. Compare events to decide which are more likely, less likely, and equally likely.</p> <p>b. Relate past events to future events (e.g., The sun set about 6:00 last night, so it will set about the same time tonight).</p>	<p>Objective 2: Determine the likelihood of an event.</p> <p>a. Predict events that will be the same in one day or one week.</p> <p>b. Predict the outcome when there are only two possible outcomes (e.g., tossing a coin).</p>	<p>Objective 2: Identify basic concepts of probability.</p> <p>a. Describe the results of events using the terms "certain," "equally likely," and "impossible."</p> <p>b. Predict outcomes of simple activities (e.g., a bag contains three red marbles and five blue marbles. If one marble is selected, is it more likely to be red or blue?).</p>	<p>Objective 2: Use basic concepts of probability.</p> <p>a. Describe the results of investigations involving random outcomes as simple ratios (e.g., 4 out of 9, 4/9).</p> <p>b. Predict outcomes of simple experiments, including with and without replacement, and test the predictions.</p>	<p>Objective 2: Apply basic concepts of probability.</p> <p>a. Describe the results of investigations involving random outcomes using a variety of notations (e.g., 4 out of 9, 4/9, 4:9).</p> <p>b. Recognize that outcomes of experiments and samples are fractions between 0 and 1.</p> <p>c. Predict the probability of an outcome in a simple experiment.</p>	<p>Objective 2: Apply basic concepts of probability.</p> <p>a. Write the results of a probability experiment as a fraction, ratio, or percent between zero and one.</p> <p>b. Compare experimental results with anticipated results (e.g., experimental: 7 out of 10 tails; whereas, anticipated 5 out of 10 tails).</p> <p>c. Compare individual, small group, and large group results for a probability experiment.</p>

Mathematics Glossary

acute angle	An angle with a measure less than 90° .
addend	Any number being added. In $32+4=36$, 32 and 4 are <i>addends</i> .
algorithm	A step-by-step method for computing.
area	The measure, in square units, of the inside of a plane figure.
array	An arrangement of objects in equal rows.
Associative Property	Changing the grouping of three or more <i>addends</i> does not change the <i>sum</i> . Changing the grouping of three or more <i>factors</i> does not change the <i>product</i> .
attribute	A characteristic of an object, such as color, shape, size, etc.
capacity	The maximum amount that can be contained by an object. Often refers to measurement of a liquid.
chord	Any <i>line segment</i> that joins two <i>points</i> on a circle.
circumference	The <i>perimeter</i> of a circle.
cluster	Data that are grouped together.
Commutative Property	Changing the order of the <i>addends</i> does not change the <i>sum</i> . Changing the order of the <i>factors</i> does not change the <i>product</i> .
composite number	A number greater than 0 that has more than two different factors. The number 9 is a <i>composite number</i> because it has three <i>factors</i> : 1, 3, and 9.
concave polygon	A <i>polygon</i> with one or more diagonals that have points outside the polygon.
cone	A solid bounded by a circular base and a curved surface with one <i>vertex</i> .
congruent	Having exactly the same size and shape.
convex polygon	A <i>polygon</i> with all interior angles measuring less than 180° . All diagonals of a <i>convex polygon</i> are inside the figure.

coordinate grid	A <i>two-dimensional</i> system in which the <i>coordinates</i> of a point are its distances from two intersecting, usually <i>perpendicular</i> , straight lines called axes.
coordinates	An ordered pair of numbers that identify a point on a coordinate plane or grid.
corresponding angles	Angles in the same position from one line to another.
cube (solid figure)	A regular solid with six congruent square faces.
customary system	A system of measurement used in the U.S. The system includes units for measuring length, capacity, and weight.
cylinder	A three-dimensional figure with two circular bases that are <i>parallel</i> and <i>congruent</i> .
diameter	A <i>chord</i> that goes through the center of a circle.
difference	The amount that remains after one quantity is subtracted from another.
Distributive Property	When one of the <i>factors</i> of a <i>product</i> is a <i>sum</i> , multiplying each <i>addend</i> before adding does not change the <i>product</i> . For example: $6 \times (2 + 3) = (6 \times 2) + (6 \times 3)$
dividend	A number that is divided by another number.
divisor	The number by which another number is divided.
e.g.	This abbreviation means “for example.” When used in the Core, <i>e.g.</i> is not limited to the examples given.
edge	The <i>line segment</i> where two <i>faces</i> of a solid figure meet.
elapsed time	The amount of time that passes between two times.
endpoint	A point at either end of a <i>line segment</i> , arc, or a point at one end of a <i>ray</i> .
equilateral triangle	A triangle with all sides the same length.
expanded form	A way to write numbers that shows the place value of each digit. $263 = 200 + 60 + 3$ or 263 is 2 hundreds, 60 tens, and 3 ones.
exponent	The number that tells how many equal <i>factors</i> there are.

expression	A variable or combination of variables, numbers, and operation symbols that represents a mathematical relationship. 6 , $2 + 3$, x , $x + 4$, and $x + 2y$ are all <i>expressions</i> .
face	A plane figure that serves as one side of a solid figure. The <i>faces</i> of a <i>cube</i> are squares.
factors	The <i>whole numbers</i> that are multiplied to get a <i>product</i> . In $6 \times 3 = 18$, 6 and 3 are factors of 18 .
flip	A transformation creating a mirror image of a figure on the opposite side of a line. A <i>flip</i> is also called a <i>reflection</i> .
greatest common factor	The greatest number that is a <i>factor</i> of every number in a set of numbers. 3 is the <i>greatest common factor</i> of 9 and 15 .
growing pattern	A pattern that grows or increases.
horizontal line	A line that is <i>parallel</i> to the horizon. A <i>horizontal line</i> is straight across.
i.e.	This abbreviation means “that is to say.” When used in the Core, <i>i.e.</i> is limited to the specific examples given.
Identity Property of Addition	If you add zero to a number, the <i>sum</i> is the same as that number. For example, $8 + 0 = 8$.
Identity Property of Multiplication	If you multiply a number by one, the <i>product</i> is the same as that number. For example, $18 \times 1 = 18$.
integers	<i>Whole numbers</i> and their opposites.
intersect	To meet or cross.
isosceles triangle	A triangle that has exactly two <i>congruent</i> sides.
least common multiple	The least common multiple of a set of two or more numbers. For example, the <i>least common multiple</i> of 3 and 5 is 15 .
line	A set of connected points continuing without end in both directions.
line of symmetry	A line that divides a figure into two <i>congruent</i> halves that are mirror images of each other.

line plot	A graph showing frequency of data on a number line.
line segment	A part of a line with two <i>endpoints</i> .
mean	A number found by dividing the sum of two or more numbers by the number of <i>addends</i> . The <i>mean</i> is often referred to as the average.
metric system	A system of measurement based on tens. The basic unit of length is the meter. The basic unit of mass is the gram. The basic unit of <i>capacity</i> is the liter.
midpoint	The point on a <i>line segment</i> that divides it into two <i>congruent</i> segments.
mode	The number that appears most frequently in a set of numbers. There may be one, more than one, or no mode.
net	A <i>two-dimensional</i> shape that can be folded into a three-dimensional figure is a <i>net</i> of that figure.
numeral	A symbol used to represent a number.
obtuse angle	An angle with a measure greater than 90° and less than 180° .
obtuse triangle	A triangle with one <i>obtuse angle</i> .
one-to-one correspondence	The relationship between the spoken word and the written symbol.
Order of Operations	A set of rules that tells the order in which to compute.
ordinal number	A <i>whole number</i> that names the position of an object in sequence. First, second, and third are <i>ordinal numbers</i> .
outlier	A number in a set of data that is much larger or smaller than most of the other numbers in the set.
parallel lines	Lines in the same plane that are always the same distance apart.
parallelogram	A <i>quadrilateral</i> with two pairs of <i>parallel</i> and <i>congruent</i> sides.
perimeter	The distance around a figure.

perpendicular	Forming <i>right angles</i> .
pi	The ratio of the <i>circumference</i> of any circle to its <i>diameter</i> , approximately equal to 3.14.
pictograph	A graph that uses pictures to show data.
plane	A flat surface that extends infinitely in all directions.
point	An exact location in space represented by a dot.
polygon	A closed plane figure made by <i>line segments</i> .
prime factorization	A way to show a number as the <i>product</i> of <i>prime factors</i> . The <i>prime factorization</i> of 12 is $2 \times 2 \times 3$.
prime number	A <i>whole number</i> greater than 0 that has exactly two different <i>factors</i> , 1 and itself. 5 is a <i>prime number</i> because its only <i>factors</i> are 1 and 5.
prism	A three-dimensional figure that has two <i>congruent</i> and <i>parallel</i> faces that are <i>polygons</i> . The rest of the faces are <i>parallelograms</i> .
product	The answer to a multiplication problem. For example, $6 \times 3 = 18$, 18 is the <i>product</i> of 6×3 .
pyramid	A polyhedron whose base is a <i>polygon</i> and whose other <i>faces</i> are triangles that share a common <i>vertex</i> .
quadrants	The four sections of a <i>coordinate grid</i> that are separated by the axes.
Quadrilateral	A four-sided <i>polygon</i> .
quotient	The answer to a division problem.
radius	The segment, or the length of the segment, from the center of a circle to any point on the circle.
Range	The difference between the greatest number and the least number in a set of numbers.
rational number	A number that can be expressed as a ratio of two non-zero <i>integers</i> .
ray	A part of a line that has one <i>endpoint</i> and goes on forever in one direction.
rectangular prism	A <i>prism</i> with six rectangular faces.

reflection	A transformation creating a mirror image of a figure on the opposite side of a line. A <i>reflection</i> is also called a <i>flip</i> .
region	A part of a plane.
remainder	In <i>whole number</i> division, when you have divided as far as you can without using decimals, what has not been divided yet is the remainder.
repeating pattern	A pattern of a group of items that repeats over and over.
rhombus	A <i>parallelogram</i> with all four sides equal in length.
right angle	An angle that measures exactly 90° .
right triangle	A triangle that has one 90° angle.
rotation	The transformation that occurs when a figure is turned a certain angle and direction around a point. A rotation is also called a turn.
Rules of Divisibility	Patterns that make it easier to tell whether one number is <i>divisible</i> by another.
scalene triangle	A triangle that has no <i>congruent</i> sides.
scientific notation	A form of writing numbers as the <i>product</i> of a power of 10 and a decimal number greater than or equal to 1 and less than 10.
similar figures	Figures that have the same shape, but not necessarily the same size.
slide	A transformation that slides a figure a given distance in a given direction. A <i>slide</i> is also called a <i>translation</i> .
square number	A number that is the result of multiplying an <i>integer</i> by itself. Any <i>square number</i> of dots can be arranged in a square array.
standard form	A number written with one digit for each place value. The <i>standard form</i> for the number three thousand three is 3,003.
straight angle	An angle with a measure of 180° .
sum	The answer to an addition problem. In $32+4=36$, 36 is the <i>sum</i> .
surface area	The total <i>area</i> of the <i>faces</i> (including bases) and curved surfaces of a solid figure.

translation	A transformation that slides a figure a given distance in a given direction. A <i>translation</i> is also called a <i>slide</i> .
trapezoid	A <i>quadrilateral</i> with one pair of <i>parallel</i> sides and one pair of sides that are not parallel.
turn	The transformation that occurs when a figure is turned a certain angle and direction around a point. A <i>turn</i> is also called a <i>rotation</i> .
two-dimensional	A figure that has length and width, but not height. Having <i>area</i> , but not <i>volume</i> . The image on a movie screen is two-dimensional.
vertex	The point at which two <i>line segments</i> , <i>lines</i> , or <i>rays</i> meet to form an angle.
vertical line	A line that has right angles to the horizon. A <i>vertical line</i> is straight up and down.
vertices	Plural of <i>vertex</i> .
volume	The number of cubic units it takes to fill a figure.
whole number	Any of the numbers 0, 1, 2, 3, 4, 5, and so on.
Zero Property of Multiplication	The <i>product</i> of any number and zero is zero. For example, $8 \times 0 = 0$.



Facilitated Activities

Science III-1

Activities

Rocks & Minerals

Rock Discovery

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.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills
2. Understand Science Concepts and Principles

Content Connections:

Science IV; fossil formation, Language Arts

Science Standard

III

Objective

1

Connections

Background Information

We will be using the idea of rock forming processes to identify rock characteristics, thus identifying the rock. The name of the rock is secondary to the knowledge of how and where in the process it was formed. Each activity will start with an inquiry/learning segment, after which the students will revise their ideas of the material. Students should already have been exposed to the three basic rock types: igneous, sedimentary, and metamorphic. By the end of the lesson, students should understand the processes that form the three main types of rock, as well as identify characteristics of some common rocks.

Rocks are combinations of minerals found naturally on or in Earth. Rocks record the history of Earth in their structure. Earth materials can change over time from one form to another. Rocks can be identified by properties such as color, crystal size or texture, banding patterns, presence of pores, and other characteristics. Color is an easy one for students but not all that helpful. The size and shape of the particles that make up rock or lack of them, are more meaningful. Characteristics of the three categories of rocks are used to help students identify rocks found in Utah.

Eroded materials, dissolved mineral, and the remains of living things are moved by water and wind and deposited as sediments. Sedimentary rock is formed when these sediments become solid material. Most were formed of sediments deposited by ancient shallow seas. Sedimentary rocks include having rounded fragments of a variety of sizes, occurring in thick layers, and—in the case of water deposited minerals—a very smooth texture. The sediments are held together by mineral cements which have testable



Materials

- ❑ Handouts: *Take a Closer Look*, *Rock Formations*, *What's this Rock? – Reference Sheet*, *What's this Rock? – Cards*, *Rock Cycle Song*, *My Rock Discovery Field Guide*
- ❑ Rock samples, hand lens, solid color taffy pieces
- ❑ Rock Field Guides, template, hole punch, cord

properties. If calcite is the cement it will fizz with acid. Most limestone, some sandstone, and some conglomerates will fizz.

All igneous rocks were once molten rock. Their locations in Earth's crust controlled the rate at which they cooled. When magma cools before reaching the surface it cools slowly and tends to have large crystals. This is called intrusive rock, like granite. Other igneous rocks form on Earth's surface, cooling more quickly. The crystals formed are often microscopically small. These are called extrusive rock, like basalt or obsidian.

Metamorphic rocks have been changed by heat and pressure over time, but not enough to melt them. These rocks may have been buried under Earth's surface or have been near a heat source. They form from igneous, sedimentary or other metamorphic rocks. They are recognized by the occurrence of thin bands or layers which form as minerals in the rock rearrange themselves.

Lesson sequence: This lesson should be taught after students have knowledge of the three types of rocks.

Research Basis

Woods, Robin, (1994). A close-up look at how children learn science". *Educational Leadership*. Feb.1994, pgs.33-35.

Building on her desire to understand how children learn science, the author designed a science lesson that uses the "Conceptual Change" idea. It was that the students will revise their theories of the natural world, once they see and learn new evidence, based on their investigations.

Champagne, A.B., R.F. Gunstone, & L.E. Klopfer, (1985). Instructional consequences of students' Knowledge about physical phenomena. *Cognitive Structure and Conceptual Change*. edited by L.H.T. West and A.L. Pines .Orlando, Fla.: Academic Press.

The constructivist model of learning contends that each student must build his or her understanding. In such a process, understanding can never be completed. Each student must work through his or her path toward deeper and deeper understanding and skills. Research for these learning strategies focuses on students being engaged in open-ended activities in which they try using their previous knowledge, participate in new learning experiences, and then restructure their beliefs.

Invitation to Learn

Look at the items or pictures. What type of rock do you think the items were made from, metamorphic, sedimentary, or igneous? Mark your answer on the tally sheet.

Children have a natural excitement and interest in rocks. They see them everywhere. Use this connection and take advantage of student’s travels throughout the state, as well as in their own community to advance their motivation to learn and discover.

Instructional Procedures

This is a discovery lesson. Students will use the inquiry method, participate in learning activities, and then restructure their learning as they go. Be careful not to give in to the urge to provide all the answers before they have a chance to think and process the discussion. You will be assessing their understanding as you go. Every time you see REVISE IDEAS ↓↑, students are experiencing things that can change their ideas about what they are learning. These are good opportunities to bring the class back for some discussion.

1. We are going to be learning about processes that have been going on inside and outside Earth for all of its history. Rocks are changing all the time, but “time” in the geological sense is millions of years. By understanding the cycle that affects rock, we can look at rocks around us and try to tell their story: where they have been and what processes made them what they are now. Give students a piece of paper. Ask, “what do you think a rock cycle might look like? Take a minute and draw your idea of what a rock cycle might be.” Emphasize that this is a rough sketch, a pre-assessment to see ideas. Pick one person from each table to stand and briefly share their ideas.

*Remember, it is important for them to come up with their idea of this process so they can revise as they learn more about it. No right or wrong on this activity. REVISE IDEAS ↓↑.

2. In order to understand some of the rock processes, we need to talk about some action words that describe what is going on. Ask the students for discussion and list on the board. Add additional words as needed, and circle key words they need to know. We are going to make a vocabulary helper to keep with us as we discover the rock processes. Pass out *Take a Closer Look* handout. Students will cut out the wheel and put it on the magnifying glass with a fastener. When they are finished have them try to match the words with the definitions by moving the wheel. After everyone has had a turn to work with it, call for volunteers to state the definitions that match the words. This is a self-checking activity the students check during the discussion. REVISE IDEAS ↓↑.

3. Pass out the black line of *Rock Formations* with no labels on it. Have students compare this to their rock cycle. What things are similar? What things are different? Using their vocabulary wheel words, discuss what processes are occurring on the rock cycle graphic? After some group responses, ask the class to come up with sentences describing what is going on in the picture. For example, “I see a place where rock looks like it is melting from the heat.” Have a student try this using each word. There are three main processes in the rock cycle. These processes can happen over and over again during geologic time. Thus the idea of rock cycle. The rocks we look at today have been in many different places during their geologic history. As we look at them, we can observe their characteristics to see what they have become. Using the labels, have students lightly glue the labels in the correct locations. They may make some adjustments later as they REVISE IDEAS ↓↑.
4. It’s time to look at rocks. Give each table a set of rocks. Have students use hand lenses to spend some time observing rocks. Look at the characteristics that are most obvious. What kind of process might have caused this rock to look this way? Next, within your group, each person picks a rock and tells the others what might have happened to that rock to make it look like that. For instance, “I see a lot of layers that might have gotten there by sediment layering and pressing together.” Let everyone have a turn. After the discussion, pass out *What’s This Rock? – Reference Sheet*, and *What’s This Rock? - Cards*. Introduce (or review) the three basic types of rock forming process: igneous, sedimentary, and metamorphic. Looking at the general characteristics of each type of rock on your table, and then looking at the rock descriptions, match up the names with the rocks. Discuss with your group why the rock was placed with that label and why it doesn’t belong with one of the other labels. REVISE IDEAS ↓↑.
5. Pass out three different solid color taffy pieces to each person. Start by unwrapping the pieces. Say “We are going to use our taffy to demonstrate the processes that form the three basic types of rock. Who would like to try sedimentary?” If no one volunteers, go ahead and demonstrate. Flatten out three colors of rock in your palm. Lay them on top of each other to demonstrate layering. Metamorphic: Take taffy and twist and fold it to show how the heat and pressure work on rocks inside the Earth. Igneous: Place the taffy inside your hand or under your arms to represent melting. Next, have students divide into

three groups for the *Rock Cycle Song*. Pass out the song and choose one type of rock for each group. Practice a minute and then SING. After this review activity, have students go back to their rock cycle graphic and see if they would like to make any changes on their label placement. Now put up the overhead of the graphic to have students correct any mistakes in the label placement. Glue labels securely. REVISE IDEAS ↓↑.

6. After groups have worked on naming rocks using characteristics, introduce the Rock Field Guide. This is a great reference to identify rocks. See if your group can find the rocks you have in this guide to verify the names you have put with the rocks. REVISE IDEAS ↓↑. The last part of this activity is to make your own rock field guides. Using the template, write a description for each of the rocks on your table. Draw a small sketch of the rock. Decorate your cover, punch holes along the top, and tie with cord. You can add to this when you find rocks you like.

*Students should have gained a good understanding of the processes that make rocks, and the characteristics of common rocks of Utah using the discovery/inquiry method.

Assessment Suggestions

- Ongoing assessment is a big part of this activity. At each step you can verbally assess, as well as monitor what students are learning. As you monitor, you can re-teach as they reframe their knowledge.
- Use the overhead of the graphic and have students check their final placement of labels.
- Use the field guide to verify rock names.

Curriculum Extensions/Adaptations/Integration

- Advanced students may be given the task of creating their own master of the rock cycle.
- Technology: Using the computer, students can make a “rock field guide,” or create a power point presentation about rocks or the rock cycle.
- Music: Students can make up their own rock cycle song or raps.

- Math: Graph a rock collection by weight, size, texture, color, layers, fizz, where they were found, etc.
- Art: Put up paper and have students make a wall-sized mural of the rock graphic. Place actual rocks where they are being formed.
- Writing-Students bring in their own rock and write a story about its' life and the changes it goes through to become what it is today.
- Since this is mostly a group activity with interaction, slower learners can fully participate with a partner doing the reading and guiding. The teacher could provide a labeled rock cycle for the students to use.

Family Connections

- Rock collecting is a great family activity. There are many places in Utah to collect a variety of rocks.
- Rocks are used for so many things. Have students go on a rock hunt for homework and list the uses of rocks in and around their homes. Add the use of a digital camera and they could make a great poster.

Additional Resources

Books

If you find a rock, by Peggy Christian: ISBN 0-15-239339-0

First field guide: Rocks and minerals, by Scholastic: 0-590-5484-8

Rocks and minerals, my first pocket guide, by National Geographic ISBN 004390655650-X

Everybody needs a rock, by Byrd Baylor, ISBN 068971058

Videos

Eyewitness Rocks and Minerals; Item #1234 OR ISBN 1234567890

Bill Nye the Science Guy-Erosion

Web sites

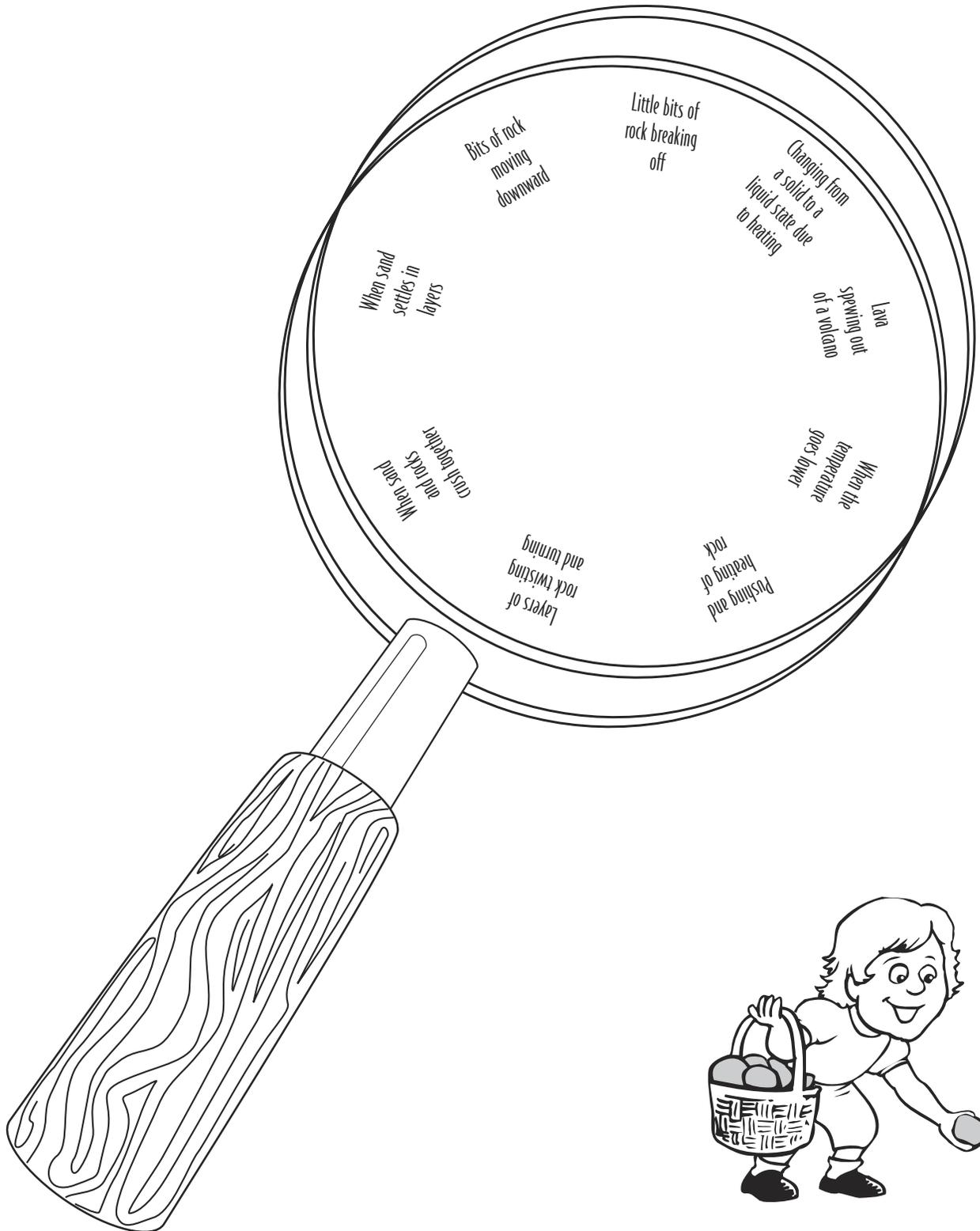
<http://www.rockhounds.com>

www.nps.gov/brca/Geodetect/Rocks

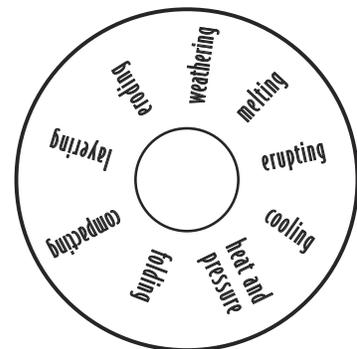
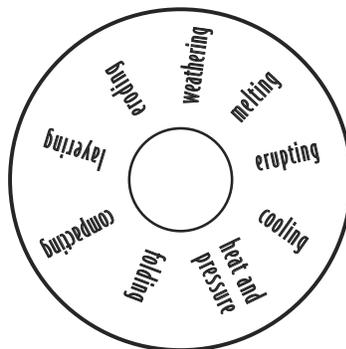
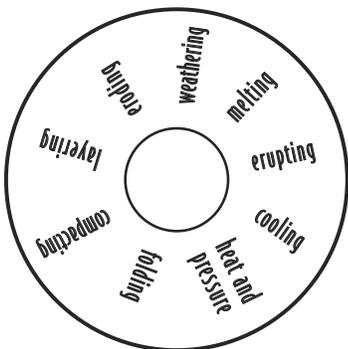
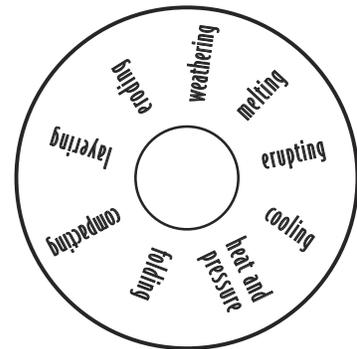
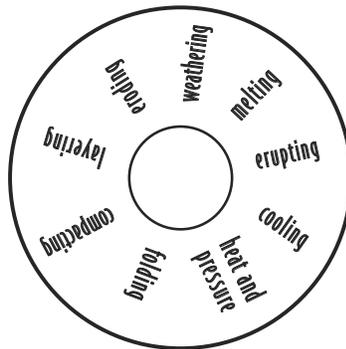
www.rock-and-minerals.com

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

Take A Closer Look!!



Rock Processes



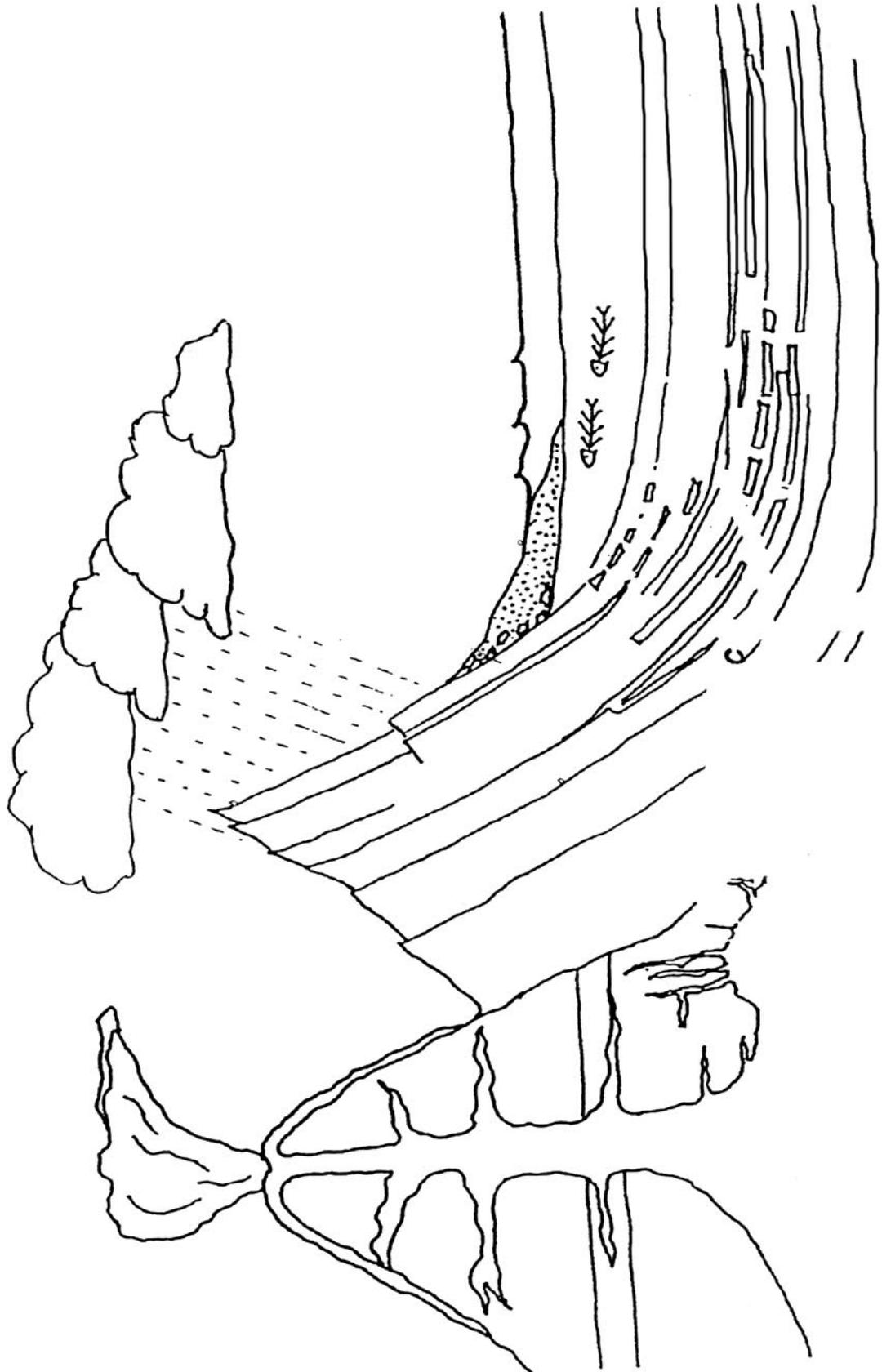
What's This Rock: Reference Sheet

IGNEOUS: Cools very fast = glassy with holes
Cools fast = glassy
Cools slow = small crystals
Cools very slow = large crystals

SEDIMENTARY: Layers
Loosely compacted
Distinct particles
Dull
Light colored and light weight

METAMORPHIC: Thick Layers
Blended colors
Tightly compacted
Blurred particles
Shiny

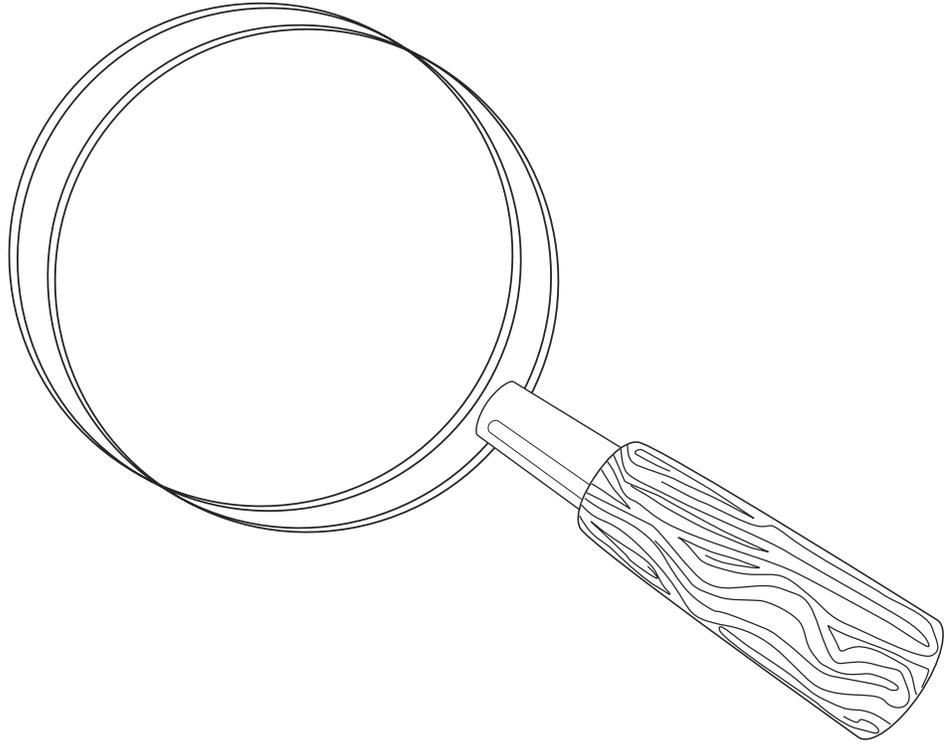
Rock Formations



What's This Rock-Cards

 <p>Limestone Limestone - contains a lot of calcite, sugary texture, blue-grey</p>	 <p>Conglomerate Conglomerate - rounded rock fragments cemented together</p>	 <p>Sandstone Sandstone - grains are visible, has patterns, common</p>	 <p>Shale Shale - small grains, thin, flaky layers</p>
 <p>Granite Granite - very hard, large crystals, mostly grey, glossy when polished</p>	 <p>Obsidian Obsidian - grains too small to see, shiny and black</p>	 <p>Pumice Pumice - very light, grayish, air bubbles, small grains</p>	 <p>Basalt Basalt - small holes, dark blue or black, rough</p>
 <p>Marble Marble - can be sugary or smooth, hard, calcite crystals</p>	 <p>Gneiss Gneiss - lightly compacted, sparkly</p>	 <p>Schist Schist - thin bands, flacky and crumbles, grey</p>	 <p>Slate Slate - usually grey, breaks in smooth, flat sheets</p>
 <p>Quartz Quartz - glassy and clear, crystals easy to see, common</p>			

My Rock Discovery Field Guide



Rock Cycle Song

(Sing to the tune of “Row, Row, Row, Row Your Boat”)

Sedimentary rock

Has been formed in layers

Often found near water sources

With fossils from decayers

Then there’s Igneous rock

Here since Earth was born

Molten lava, cooled and hardened

That’s how it is formed

These two types of rocks

Can also be transformed

With pressure, heat, and chemicals

Metamorphic they’ll become

**(Don’t forget to sing this as a “round”;
after all, it is the Rock “cycle”)**

Name: _____ Date: _____

Rock Number: _____

Name of Rock: _____

Color: _____

Shape: _____

Size: _____

Where I found the Rock: _____

My Notes/Drawings:

Name: _____ Date: _____

Rock Number: _____

Name of Rock: _____

Color: _____

Shape: _____

Size: _____

Where I found the Rock: _____

My Notes/Drawings:

Math IV-1

Activities

Units of Measure

Which Unit to Use?

Standard IV:

Students will understand and use measurement tools and techniques.

Objective 1:

Identify and describe measurable attributes of objects and units of measurement.

Intended Learning Outcomes:

4. Communicate mathematically.

Content Connections:

Math IV – 2

Math Standard IV

Objective 1

Connections

Background Information

Width, height, length and distances can be measured using two different measurement systems. The customary system is used in the United States. Students in the fourth grade need to be familiar with inches, feet, and yards. The metric system is a base ten system, and is used throughout the world. Students need to be familiar with millimeter, centimeter, and meter.

Research Basis

Bryant, V.A. (1992). *Improving Mathematics Achievement of At-Risk and Targeted Students in Grades 4-6 through the Use of Manipulatives*. ERIC # ED355107. Retrieved December 10, 2005, from <http://eric.ed.gov>

This document presents a study designed to improve mathematics achievement of students in grades 4-6 through the use of manipulatives. The primary goal was to provide mathematics manipulatives that would assist in helping at-risk and targeted students. Results indicated improvement on test scores, report card grades, and use of mathematics manipulatives.

Reineke, J.W. (1993). *Making Connections: Talking and learning in a fourth-grade class*. *Elementary Subjects Center*, Series No. 89. ERIC # ED365537. Retrieved December 10, 2005, from <http://eric.ed.gov>

This report describes a fourth grade classroom where students' thinking was made public through discussions in which students presented and justified their interpretations of, and solutions to, the problems presented in class. Results suggested that the teacher and her students learned to talk about mathematics in ways that made their thinking visible and indicated that they know mathematics in fresh, inventive ways.

Materials

- How Big is a Foot?*
- Metric rulers
- Meter sticks
- Metric Measures*
- Which Unit?*
- Inch/foot ruler
- Yard sticks
- Inch, Foot, and Yard*
- Appropriate Measures*



Invitation to Learn

Read *How Big is a Foot?* to your students. Discuss the book and why it is necessary to have measurement systems.

Instructional Procedures

Day 1

1. Pass out rulers to every student. Show them a millimeter. Have students look around the room to find items they would measure with a millimeter. Share their findings with the class. Explain to your students that 10 millimeter = 1 centimeter.
2. Have them look at one centimeter. Explain that for many people, the width of their pinkie is about one centimeter. Have students measure their pinkie and see how close it is to one centimeter.
3. Have students work with a partner to estimate the length of a few small items in their desks. Write their estimates in their journals. Review the process of measurement and have students check estimates with a ruler. How close were their estimates? Why did they estimate the way that they did? Have them explain their reasoning in their journals.
4. Use meter sticks and have students locate a section of their body that is about a meter. It could be their arm span, or the height from the floor to their waist, or any section that will help them remember the length of a meter.
5. Make sure that students know that 1 meter = 100 centimeter = 1000 millimeter.
6. Hand out the worksheet, *Metric Measures*.
7. Have students determine the most appropriate unit with which to measure each item. Have them describe their strategies.
8. Cut up the worksheet, *Which Unit*. Have a student pick one and read it aloud. In their journals, have students identify which unit they would use (millimeter, centimeter, or meter), and then estimate its length. Have them explain how they decided which unit to use and how they arrived at their estimate. Grouping could occur in pairs, small groups, or as a whole class.
9. After finishing with the strips, discuss with the class what unit they used for each item, their estimates, and the strategies they used.

Day 2

1. With students, create a list of six objects and six distances they could measure in the classroom.
2. Pass out an inch/foot ruler to each student. Review the inch unit with them. Point out the markings for $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ inch. Hold up your ruler. How long is the ruler? How many inches are in $\frac{1}{4}$ foot?, $\frac{1}{2}$ foot?, $\frac{3}{4}$ foot?
3. Hold up a yardstick. Explain that the 1 yard = 3 feet = 36 inches. How many inches are in $\frac{1}{4}$ of a yard? How many feet are in $\frac{1}{2}$ yard? How many inches in $\frac{1}{2}$ yard? How many inches is $\frac{3}{4}$ yard?
4. Hand out the worksheet, *Inch, Foot, and Yard*.
5. Have them pick eight of the twelve items generated earlier and measure them in inches, feet, and yards.
6. Hand out the worksheet, *Appropriate Measures*.
7. Have students choose what unit they would use to measure each item, measure that item, and then record the results.
8. Discuss the worksheets.

Assessment Suggestions

- Informal assessment includes class discussions, *Which Unit?*, and journal entries.
- Formal assessment includes the worksheets – *Metric Measures*, *Appropriate Measures* and *Inch, Foot, and Yard*.

Curriculum Extensions/Adaptations/Integration

Weekly, pick a few items from your classroom and show your class. Have them choose what unit they would use to measure the item, then estimate its length.

Family Connections

- Have students use the worksheet, *Home Measurements*, and the paper yard stick to measure six items in their bedroom using inches, feet, or yards. Before they measure each item, have them decide the most appropriate unit to use, and estimate the length of the item.

- Have students make a list of nine objects around their house. Three objects that they would measure using millimeters, three using centimeters, and three using meters.
- Have students find four items from their house. Two that would be appropriate to measure in centimeters or inches, and two that would be appropriate to measure in yards or meters.

Additional Resources

Books

How Big is a Foot?, by Rolf Myller; ISBN 0440404959

Connect to NCTM Standards 2000, Fourth Grade, by Francis (Skip) Fennell, Honi J. Bamberger, Thomas E. Rowan, Kay B. Samillimeterons, & Anna R. Suarez; ISBN 0762212462

Name _____

Metric Measures

For each item, circle the most appropriate measure, then measure each object or distance and record your results.

Object	Most Appropriate Measure	Actual Measurement
1. Height of student chair	mm cm m	
2. Length of thumb nail	mm cm m	
3. Height from knee to hip	mm cm m	
4. Distance across classroom	mm cm m	
5. Length of eraser	mm cm m	
6. Width of chalkboard	mm cm m	
7. Distance from your desk to door	mm cm m	
8. Height of teacher desk	mm cm m	
9. Length of arm	mm cm m	
10. Width of pencil	mm cm m	

Which would be the best unit for measuring the height of your bedroom door?
Explain your reasoning.

Name _____

Which Unit?

Length of a pencil	Distance of a football field	Height of a piece of paper
Width of math book	Length of a penny	Width of a doorway
Distance from classroom to lunchroom	Length of a paperclip	Distance from elbow to wrist
Width of pinkie finger	Height from floor to knee	Length of a school bus
Distance around classroom	Height of classroom wall	Width of math journal

Name _____

Inch, Foot, and Yard

Select eight objects or distances from the class list to measure. Measure each item using inches, feet, and yards, then circle what you think is the most appropriate measure.

Object	Length in Inches	Length in Feet	Length in Yards	Most Appropriate Measure
				in. ft. yd .
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.

Name _____

Appropriate Measures

For each item, circle the most appropriate measure, then measure each object or distance and record your results.

Object	Most Appropriate Measure	Actual Measurement (to nearest $\frac{1}{4}$ unit)
1. Height of student chair	in. ft. yd.	
2. Length of table	in. ft. yd.	
3. Height from knee to hip	in. ft. yd.	
4. Distance across classroom	in. ft. yd.	
5. Length of eraser	in. ft. yd.	
6. Width of chalkboard	in. ft. yd.	
7. Distance from your desk to door	in. ft. yd.	
8. Height of teacher desk	in. ft. yd.	
9. Length of arm span	in. ft. yd.	
10. Width of hand	in. ft. yd.	

Which would be the best unit for measuring the depth of water in a swimming pool? Explain your reasoning.

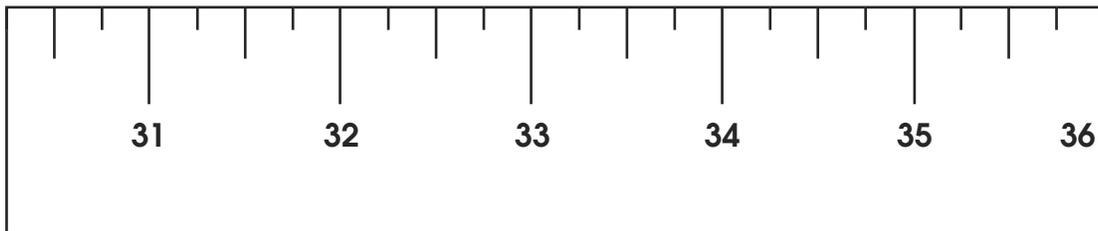
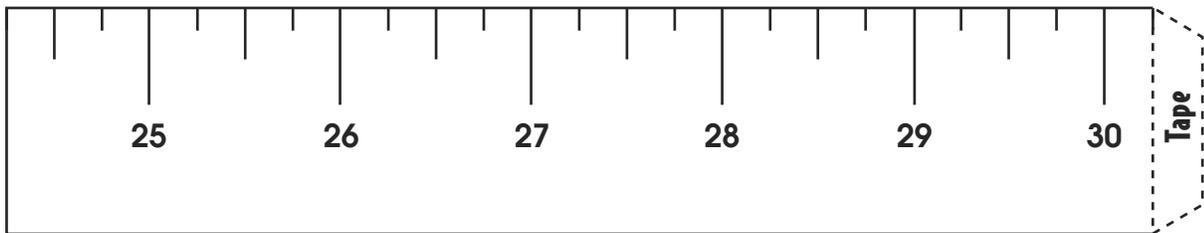
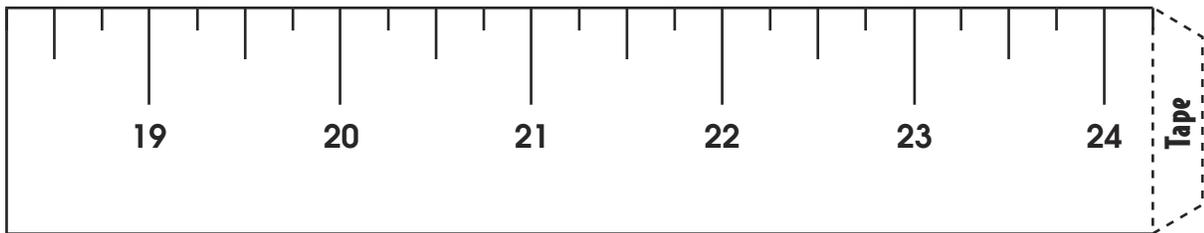
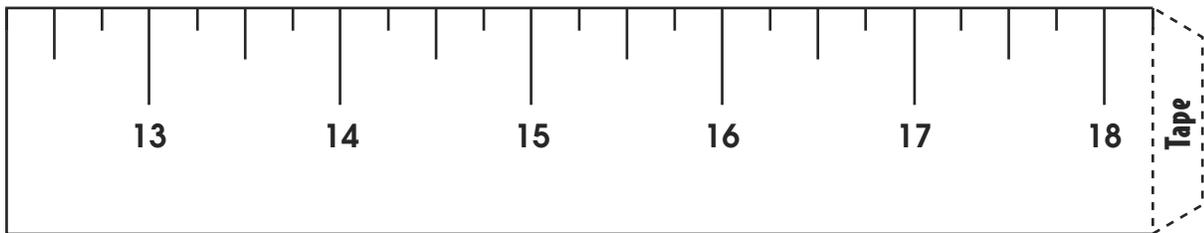
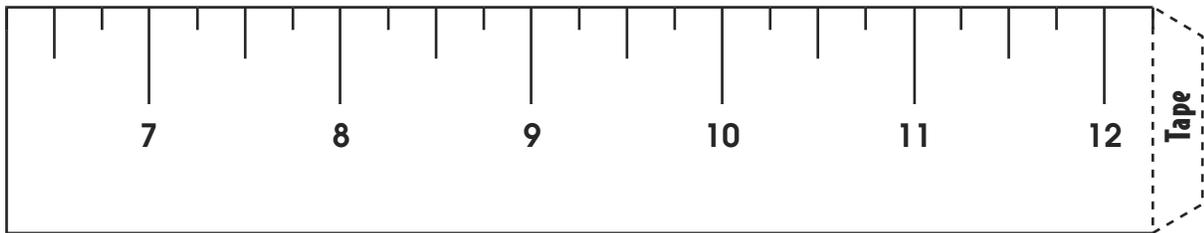
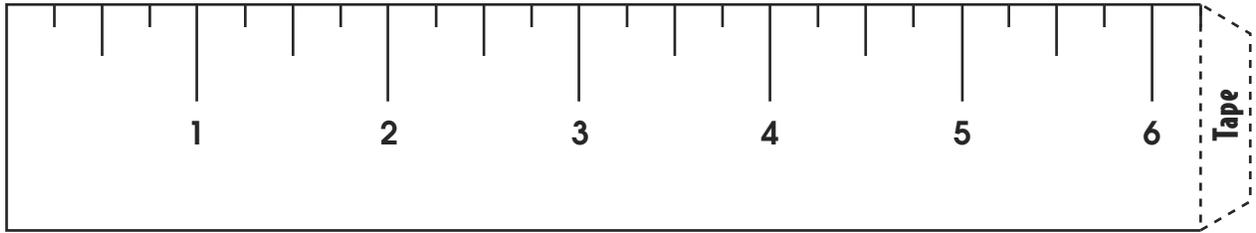
Name _____

Home Measurements

Pick six items from your bedroom to measure. Decide which unit would be the most appropriate to use for each item, and then estimate the measurement. Using the paper yard stick, record the actual measurement.

Object	Most Appropriate Measure	Estimate	Actual Measurement (to nearest $\frac{1}{4}$ unit)
1.	in. ft. yd.		
2.	in. ft. yd.		
3.	in. ft. yd.		
4.	in. ft. yd.		
5.	in. ft. yd.		
6.	in. ft. yd.		

Inch Ruler



Fill it to Capacity

Standard IV:

Students will understand and use measurement tools and techniques.

Objective 1:

Identify and describe measurable attributes of objects and units of measurement.

Intended Learning Outcomes:

4. Communicate mathematically.

Content Connections:

Math IV – 2

Math Standard IV

Objective 1

Connections

Background Information

The capacity of an object is the maximum amount that can be contained by the object. It often refers to the measurement of a liquid. Students need to be familiar with the customary units of capacity—cups, pints, quarts, and gallons.

Research Basis

Hinzman, K.P. (1997). *Use of Manipulatives in Mathematics at the Middle School Level and Their Effects on Students' Grades and Attitudes*. ERIC # ED411150. Retrieved December 10, 2005, from <http://www.eric.ed.gov>

This paper reports on a study that examines mathematics scores when hands on manipulatives and group activities are used in the classroom. Results indicate that student performance is enhanced by the use of manipulative materials; and students' attitudes toward mathematics are significantly more positive than those in previous years when manipulatives were not used.

Sowell, E.J. (1989). Effects of manipulative materials in mathematics instruction. *Journal for Research in Mathematics Education*, 20 (4), 498-505.

This review of research sums up the result of sixty studies addressing the effectiveness of manipulatives on student learning and attitudes in mathematics teaching. Sowell concludes that the more concrete the manipulatives, and the longer time spent using them, the better instructional outcomes.

Invitation to Learn

Read the book, *Room for Ripley*, to your class. After Carlos adds one cup of water to the bowl, stop reading. In their journals,

Materials

- Room for Ripley*
- Measuring cups for each center
- Funnels for each center
- Water for each center
- 1 pint cottage cheese container
- 1 quart pickle jar
- Gallon milk carton
- ½ gallon orange juice container
- 1 quart mayonnaise jar
- 1 pint pickle jar
- Filled to Capacity*



have students predict how much more water they think Carlos will need to fill the fish bowl. Finish reading the book and discuss how much water it actually took to fill the bowl. Have students write in their journal if their predictions were correct.

Instructional Procedures

1. Divide the class into six groups.
2. At each of the six centers, have a measuring cup, funnel, water, and the container labeled gallon, $\frac{1}{2}$ gallon, quart, or pint as indicated below.
3. Have them rotate through the following centers:

Center 1

- Have students estimate how many cups it will take to fill a cottage cheese container (one pint). Have them write their estimates in their journals. Using the measuring cup and funnel, fill the cottage cheese container with water until it is full. Have them write in their journals if their estimates were accurate, or how they could have improved on their estimates.

Center 2

- Have students estimate how many cups it will take to fill a one-quart pickle jar. Have them write their estimates in their journals. Using the measuring cup and funnel, fill the pickle jar with water until it is full. Have them write in their journals if their estimates were accurate, or how they could have improved on their estimates.

Center 3

- Have students estimate how many cups it will take to fill a one-gallon milk jug. Have them write their estimates in their journals. Using the measuring cup and funnel, fill the gallon milk jug with water until it is full. Have them write in their journals if their estimates were accurate, or how they could have improved on their estimates.

Center 4

- Have students estimate how many cups it will take to fill a half-gallon orange juice container. Have them write their estimates in their journals. Using the measuring cup and funnel, fill the orange juice container with water until it is full. Have them

write in their journals if their estimates were accurate, or how they could have improved on their estimates.

Center 5

- Have students estimate how many cups it will take to fill a one-quart mayonnaise jar. Have them write their estimates in their journals. Using the measuring cup and funnel, fill the mayonnaise jar with water until it is full. Have them write in their journals if their estimates were accurate, or how they could have improved on their estimates.

Center 6

- Have students estimate how many cups it will take to fill a one-pint pickle jar. Have them write their estimates in their journals. Using the measuring cup and funnel, fill the pickle jar with water until it is full. Have them write in their journals if their estimates were accurate, or how they could have improved on their estimates.
1. Discuss the centers, and how many cups of water it took to fill each item.
 2. Hand out worksheet, *Filled to Capacity*, and have students complete it based on what they learned from the centers.
 3. Discuss the worksheet as a class.
 4. Create a “G” gallon graphic as a visual reminder to keep in their math journals.



Assessment Suggestions

- Informal Assessment is class discussions and journal entries.
- Formal Assessment is the worksheet, *Filled to Capacity*

Curriculum Extensions/Adaptations/Integration

Use this lesson as a framework to have students use the metric system for capacity - milliliters and liters.

Family Connections

- Have students look in their kitchen or at a grocery store and identify items that come in containers of different capacities. Have them write down what comes in cups, pints, quarts, and gallons.
- At home, have students fill a one-quart container with water. Then have them find three other containers that they think will hold the same amount of water. Pour the water from the quart container into the other containers to see if they do have the same capacity.

Additional Resources

Books

Room for Ripley, by Stuart J. Murphy; ISBN 0064467244

Name _____

Filled to Capacity

1. Would you drink a gallon of milk at dinner? What unit would you use to measure the amount of milk you would have at dinner?

Explain your reasoning.

2. Which is a more reasonable measure of the capacity of a bathtub, 2 quarts or 25 gallons?

Explain your reasoning.

3. You want to buy a juice box for lunch. Do you think you will buy 1 quart or 1 cup of juice?

Explain your reasoning.

4. Your family car needs gas. What unit would you use to measure the amount of gas needed to fill your car?

Explain your reasoning.

5. For breakfast, a family of five drank some orange juice. Do you think it would be more appropriate to measure the amount in cups or quarts?

Explain your reasoning.

6. How much does your class drink with their lunch? Would you measure the amount using pints or quarts?

Explain your reasoning.



Worth the Weight

Math Standard IV

Objective 1

Connections

Standard IV: Students will understand and use measurement tools and techniques.
Objective 1: Identify and describe measurable attributes of objects and units of measurement.
Intended Learning Outcomes: 4. Communicate mathematically.
Content Connections: Math IV-2

Background Information

In fourth grade, students need to be familiar with the terms gram and kilogram. Grams and kilograms are metric units used to measure the mass of an object. One kilogram is equal to 1000 grams. One gram weighs about as much as a large paperclip and one kilogram is equal to about 2.2 pounds.

Research Basis

Lo, J.J. (1991). Learning To Talk Mathematics. ERIC # ED334073. Retrieved December 14, 2005, from <http://www.eric.ed.gov>

This study focused on mathematical discourse, with the main goal being both the characterization of the potential learning opportunities and the inference of students' construction of mathematical meanings. Results indicate that classroom mathematical discourse is a rich environment for both student growth and mathematical learning, which was confirmed by more elaborate schema for mathematical reasoning and problem solving.

Ball, D. (1991). What's all this talk about discourse? *Professional Standards for Teaching Mathematics*. National Council of Teachers of Mathematics, 1991.

Deborah Ball defines "discourse" as described by the NCTM Standards. A discussion taken from her classroom, along with entries from her teaching journal, illustrate how thoughtful discourse can be used to help students learn to discuss and understand mathematics concepts.

Invitation to Learn

Have students make a list of items they think weigh one gram. Discuss the lists as a class. Does everyone agree? Why or why not?

Materials

- Large Paperclip
- Gram Hunt
- Gram weight
- Balance
- Book that weighs 1 kg (2.2 lbs.)
- Kilogram Hunt
- 1 kg weight
- Spring Scales



Have students make a list of items they think weigh one kilogram. Discuss as a class.

Instructional Procedures

1. Hold up a large paperclip and explain that it weighs about one gram. In their journals, have students write a list of things they could weigh using grams. Ask the class for a few suggestions.
2. Hand out the worksheet, *Gram Hunt*, and divide the class into groups.
3. Have groups go on a hunt to find six items they want to weigh using grams. Have them estimate the weight first, and then write down the actual weight of each item using a balance and one gram weights. Have students write down how they made their estimates. Discuss the worksheet as a class.
4. Talk about kilograms, and how $1 \text{ kg} = 1000 \text{ g}$. Explain that one kilogram is a little over two pounds. As a reference, find a book or something in your room that weighs about 2.2 lbs., one kilogram. Pass the item around so students can get an idea of what a kilogram weighs. In their journals, have the students write what items they would measure using a kilogram. Ask the class for a few suggestions.
5. Use a spring scale to measure a few objects around the room to see if they are heavier or lighter than a kilogram. Before measuring each item, have students predict if it will weigh more or less than a kilogram.
6. Hand out the worksheet, *Kilogram Hunt*.
7. Have groups go on a kilogram hunt and find items around the room that weigh less than, about, and more than one kilogram. After items are found, have students weigh each item with a spring scale to see if their predictions were correct. Discuss the worksheet as a class.

Assessment Suggestions

- Use class discussions and journal entries as informal assessments.
- Formal assessment is the worksheet, *Gram Hunt*, and the worksheet, *Kilogram Hunt*.

Curriculum Extensions/Adaptations/ Integration

- During unit on rocks, have students estimate the weight of rock samples. Have them decide if it would be more appropriate to weigh each rock using grams or kilograms. Have them weigh the rock and compare the weight with their estimates.
- Each week, have a ten minute discussion about units of weights. Have students pick an item from the classroom, and then discuss the appropriate unit to use to measure the weight, and then estimate the weight of the object.
- In math journals, have students make a reference list of how much eight different items weigh using grams and kilograms. This can be used throughout the year.

Family Connections

- Have students find ten items around their house that they would measure the weight using grams or kilograms. Five items for grams, and five items for kilograms. Have them estimate how much each item weighs.
- Have students estimate how many kilograms five different people weigh. (Family members, neighbors, friends, babysitters, etc.)

Name _____

Gram Hunt

Select six objects from the classroom. Estimate the weight of each object in grams. Then record the actual weight.

Object	Estimated Weight (g)	Actual Weight (g)

How did you make your estimates?

Name _____



Kilogram Hunt



Work with your group. Find at least five objects in the classroom that fit under each heading of the chart. Then weigh each object to see if your predictions were correct.

Less than 1 kilogram	About 1 kilogram	More than 1 kilogram
Object 1: Actual Weight:	Object 1: Actual Weight:	Object 1: Actual Weight:
Object 2: Actual Weight:	Object 2: Actual Weight:	Object 2: Actual Weight:
Object 3: Actual Weight:	Object 3: Actual Weight:	Object 3: Actual Weight:
Object 4: Actual Weight:	Object 4: Actual Weight:	Object 4: Actual Weight:
Object 5: Actual Weight:	Object 5: Actual Weight:	Object 5: Actual Weight:

Science IV-2

Activities

Fossil Inferences

Fossil Inferences

Standard I:
Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.
Objective 2:
Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
Intended Learning Outcomes:
1. Use Science Process and Thinking Skills
4. Communicate Effectively Using Science Language and Reasoning
Content Connections:
Math: Number Operations, Patterns and Symbols, Spatial Relationships, Attributes-Units-Measure

Science
Standard

I

Objective

2

Connections

Background Information

Scientists have good evidence that Earth is very old, approximately four and one-half billion years old. Scientific measurements such as radiometric dating use the natural radioactivity of certain elements found in rocks to help determine their age. Scientists also use direct evidence from observations of the rock layers themselves to find the relative age of rock layers. Specific rock formations are indicative of a particular type of environment existing when the rock was being formed. For example, most limestone represents marine environments, whereas, sandstones with ripple marks might indicate a shoreline habitat or riverbed.

The study and comparison of exposed rock layers or strata in different areas of Earth led scientists in the early 19th century to propose that the rock layers could be correlated from place to place. Locally, physical characteristics of rocks can be compared and correlated. On a larger scale, even between continents, fossil evidence can help in matching rock layers. The Law of Superposition, which states that in an undisturbed horizontal sequence of rocks the oldest rock layers will be on the bottom, with successively younger rocks on top of these, helps geologists correlate rock layers around the world. This also means that fossils found in the lowest levels in a sequence of layered rocks represent the oldest record of life there. By matching partial sequences, the truly oldest layers with fossils can be worked out.

By correlating fossils from various parts of the world, scientists are able to give relative ages to particular strata. This is called relative dating. Relative dating tells scientists if a rock layer is



Materials

- Pencils
- Colored Pencils
- Drawing Paper,
- Cardstock
- Handouts

Nonsense Cards Set A
Fossils Cards Set B (1)
Fossils Cards Set B (2)
Stratigraphic Section for Set B.
Fossil Map of Utah

“older” or “younger” than another. This would also mean that fossils found in the deepest layer of rocks in an area would represent the oldest forms of life in that particular rock formation. In reading Earth history, these layers would be “read” from bottom to top or oldest to most recent. If certain fossils are typically found only in a certain rock unit and are found in many places worldwide, they may be useful as index or guide fossils in finding the age of undated strata. By using this information from rock formations in various parts of the world and correlating the studies, scientists have been able to construct the geologic time scale: This relative time scale divides the vast amount of Earth history into various sections based on geological events (sea encroachments, mountain-building, and depositional events), and notable biological events (appearance, relative abundance, or extinction of certain life forms).

Research Basis

Schmoker, M. 1999. The key to continuous school improvement. *Results 2nd Edition Association for Supervision and Curriculum Development* pg. 71

“We labor under the incorrect notion that students must master basic skills before they can learn higher-order skills or engage in complex activities. Studies in math, reading, and writing clearly demonstrate that the opposite is true. Students learn best when basic skills are taught in a vital challenging context that makes the skills meaningful. The very thing that keeps students from achieving in these areas is the dry irrelevant teaching strategies we often employ, especially with students who most need real challenges.” (Means, Chelemer, and Knapp, *Teaching Advanced Skills to at Risk Students: Jossey-Bass 1991*)

Schmoker, M. 1999 The key to continuous school improvement *Results 2nd Edition ASCD* pg. 73

Virtually every teacher has acquired some semblance of training in this highly effective method (cooperative learning), estimates are that only about 10 percent of teachers use cooperative learning. One of the simplest forms of cooperative learning—having students occasionally work in pairs to ensure each other’s understanding of difficult concepts— can be expected to bring immediate effects especially among low-achievers. They also found that such simple pairings are especially effective in helping students to succeed in math and science.” (Joyce B. Weil and Showers 1992 *Models of Teaching*. New York: Allyn and Bacon.)

Invitation to Learn

Teaching about Earth’s history is a challenge for all teachers. The idea of millions and billions of years is difficult for children and adults to comprehend. However, “relative” dating or time can be an easy concept for students to learn.

In this activity, students begin a sequencing activity with familiar items—letters written on cards. Once they are able to manipulate the cards into the correct sequence, they are asked to do a similar sequencing activity using fossil pictures printed on “rock layer” cards. Sequencing the rock layers will show students how paleontologists use fossils to give relative dates to rock strata.

Instructional Procedures

Part 1:

1. Hand out *Nonsense Cards*, Set A in random order. Students place on the table and work in small groups to sequence the eight cards by comparing letters that are common to individual cards, and therefore, overlap. There should be lots of discussion. The first card in the sequence has “Card 1, Set A” in the lower left-hand corner and represents the bottom of the sequence. If the letters “T” and “C” represent fossils in the oldest rock layer, they are the oldest fossils, or the first fossils formed in the past for this sequence of rock layers.
2. Now, look for a card that has either a “T” or “C” written on it. Since this card has a common letter with the first card, it must go on top of the “TC” card. The fossils represented by the letters on this card are “younger” than the “T” or “C” fossils on the “TC” card and indicates fossils in the oldest rock layer. Sequence the remaining cards by the same process. When done you should have a vertical stack of cards with the top card representing the youngest fossils of this rock sequence and the “TC” card at the bottom of the stack indicating the oldest fossils.

Questions to ask:

1. After putting the cards in order, write down the sequence for easy checking. Start at the bottom going oldest to youngest.
2. How do you know “X” is older than “M”?

3. Explain why “D” in the rock layer represented by DM is the same age as “M.”
4. Explain why “D” in the rock layer represented by the OXD is older than “D” in the rock layer represented by DM.

Part 2:

1. Look carefully at the second set of cards with sketches of fossils on them. Each card represents a particular rock layer with a collection of fossils that are found in that particular rock stratum. All of the fossils represented would be found in sedimentary rocks of marine origin. Figure A gives some background information on the individual fossils.
2. The oldest rock layer is marked with the letter “M” in the lower left-hand corner. Don’t worry about the other letters at this time. Ask students to find a rock layer that has at least one of the fossils you found in the oldest rock layer. This rock layer would be younger as indicated by the appearance of new fossils in the rock stratum. Keep in mind that extinction is forever. Once an organism disappears from the sequence it cannot reappear later. Use this information to sequence the cards in a vertical stack of fossils in rock strata. Arrange them from oldest to youngest with the oldest layer on the bottom.

Assessment Suggestions

- Checking individual stacks of cards.
- Verbal answers to the questions.
- Students write a short paragraph explaining the Law of Superposition.
- Sequence information using items which overlap specific sets; students will relate sequencing to the Law of Superposition and then show how fossils can be used to give relative dates to rock layers.

Curriculum Extensions/Adaptations/Integration

- Students research different fossils to see where they are on the geologic time scale.
- Research the internet for fossil trivia, then write a question and answer game for the class.

- Pair learners with special needs in groups with academically strong learners.
- Students write a story telling the life of an animal that is facing extinction.
- Draw a fossil pop up book. Write a short definition below each picture.

Family Connections

- Students may take family field trips to a nearby fossil bed.
- Visit dinosaur quarries if available.
- Take home card sets A and B and teach a family member about the Law of Superposition

Additional Resources

Books

The Amazing Earth Model Book, Donald M. Silver & Patricia J. Wynne, ISBN # 0-590-93089-3
The Big Beast Book, Jerry Booth, ISBN #0-316-10266-0
Dinosaur-The story behind the scenery, Allan Hagood, ISBN # 0-916122-10-7
Dinosaurs of Utah and Dino Destinations, Pat Bagley and Gayle Wharton, ISBN #1566846013
The Dinosaur Alphabet Book, Jerry Pallotta
Everything You Need to Know About Science, Anne Zeman and Kate Kelly, ISBN # 0-590-49357-4
Eyewitness Books, Fossil, Dr. Paul D. Taylor, ISBN # 0-7566-0682-9
Eyewitness Books, Rocks and Minerals, Dr. R.F. Symes ISBN #0-7894-5805-5
The Extinct Alphabet, Jerry Pallotta, ISBN # 088106-471-8
The Fossil Factory, Douglas, Niles, and Gregory Eldredge, ISBN #1-57098-417-4
Kingfisher Young Knowledge, Rocks and Fossils, Chris Pellant ISBN, #0-7534-5619-2
Reader's Digest, Pathfinders, Dinosaurs, Paul Willis, ISBN # 0-7944-0001-9

Videos

Earth Science for Children, All About Fossils
Eyewitness Dinosaur
Eyewitness Prehistoric Life

Web Sites

<http://www.ucmp.berkeley.edu/fosrec/MunGun3.html>
<http://www.ucmp.berkeley.edu/fosrec/BarBar.html>
<http://pubs.usgs.gov/gip/fossils/scale.html>

Additional Media

University of Utah Museum of Natural History Fossil Kit Lorie Millward

Nonsense Cards - Set A

TC

CGA

AU

UBN

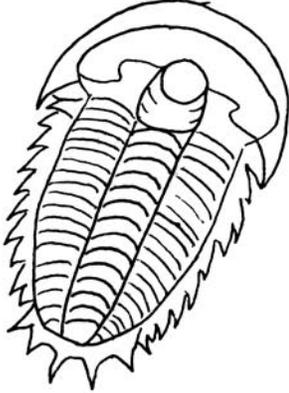
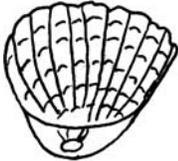
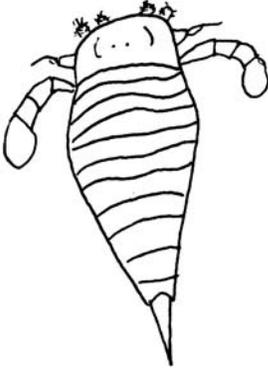
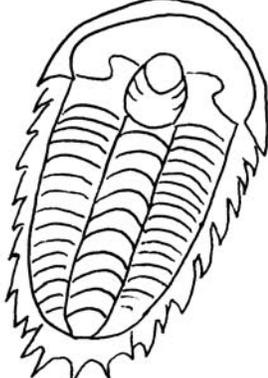
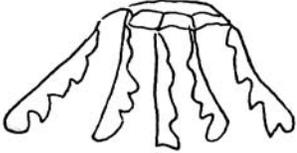
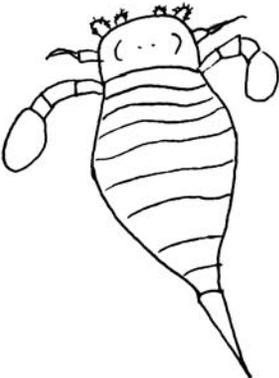
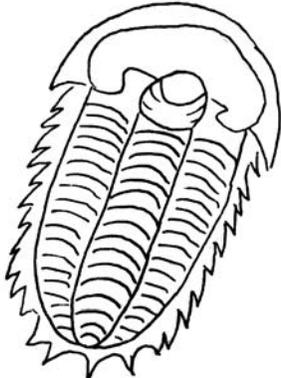
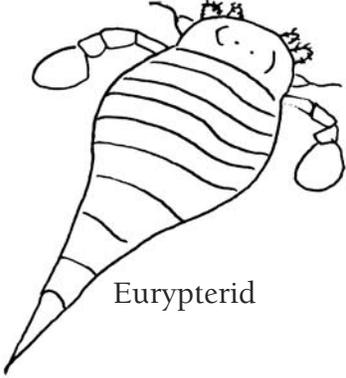
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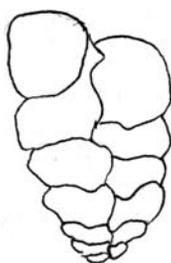
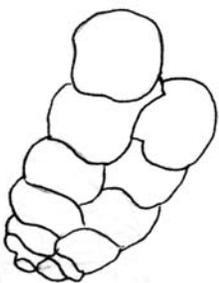
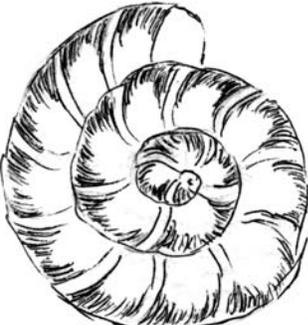
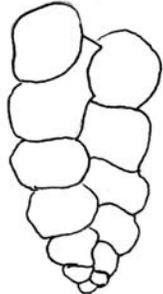
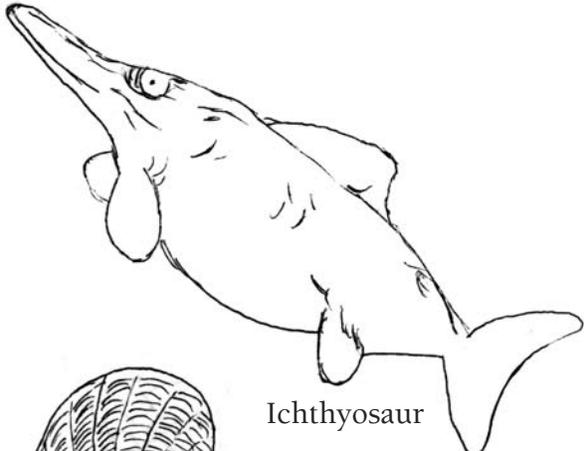
OXD

DM

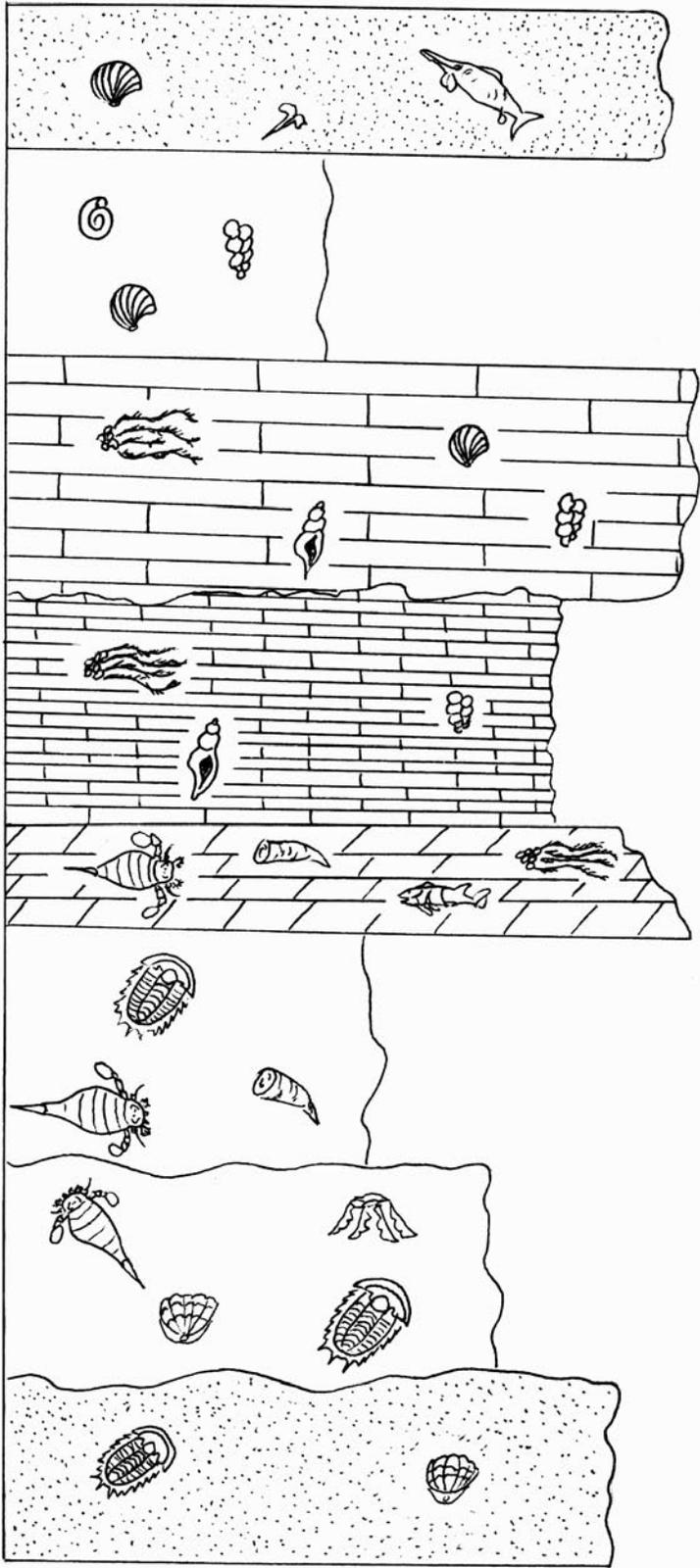
Fossil Cards - Set B (1)

<p>M</p>  <p>Trilobite</p>  <p>Brachiopod</p>	<p>S</p>  <p>Eurypterid</p>  <p>Brachiopod</p>  <p>Trilobite</p>  <p>Graptolite</p>
<p>I</p>  <p>Horn Coral</p>  <p>Eurypterid</p>  <p>Trilobite</p>	<p>N</p>  <p>Eurypterid</p>  <p>Horn Coral</p>  <p>Crinoid</p>  <p>Placoderm</p>

Fossil Cards - Set B (2)

<p> Crinoid</p> <p> Gastropod</p> <p> Foraminifer</p> <p>A</p>	<p> Gastropod</p> <p> Foraminifer</p> <p> Pelecypod</p> <p> Crinoid</p> <p>G</p>
<p> Ammonite</p> <p> Foraminifer</p> <p> Pelecypod</p> <p>R</p>	<p> Ichthyosaur</p> <p> Pelecypod</p> <p> Shark's Tooth</p> <p>O</p>

O
R
G
A
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S
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Key to rock units

-  Sandstone
-  Shale
-  Limestone
-  Dolomite

Key to fossils

-  Shark's Tooth
-  Ichthyosaur
-  Ammonite
-  Pelecypod
-  Foraminifers
-  Gastropod
-  Crinoid
-  Placoderm
-  Horn Coral
-  Eurypterid
-  Graptolite
-  Trilobite
-  Brachiopod

Fossils

Science Standard I Objective 2

Connections

Standard I: Students will understand how fossils are formed, where they may be found in Utah, and how they can be used to make inferences.
Objective 2: Explain how fossils can be used to make inferences about past life, climate, geology, and environments.
Intended Learning Outcomes: 1. Use Science Process and Thinking Skills 4. Communicate Effectively Using Science Language and Reasoning
Content Connections: Math: Use Patterns and Symbols, Attributes-Units-Measure, Language arts: Writing directions, inferring, writing poetry, Art: Using different media, drawing from life, Social Studies: Using maps of Utah, introducing Utah counties

Background Information

Understanding how the pieces of the fossil puzzle fit together allows the paleontologist to imagine Earth as it was millions of years ago. Fossils are the recognizable remains, such as bones, shells or leaves or other evidenced, such as tracks, burrows, or impressions, of past life on Earth. Scientists who study fossils are called paleontologists. Remember that paleo means ancient, so a paleontologist studies ancient forms of life.

Fossils are fundamental to the geologic time scale. The names of most of the eons and eras end in zoic, which refers to animal life, because these time intervals are generally recognized based on animal life. Rocks formed during the Proterozoic Eon may have fossils of relative simple organisms, such as bacteria, algae, and wormlike animals. Rocks formed during the Phanerozoic Eon may have fossils of complex animals and plants such as dinosaurs, mammals, and trees.

Note: paleo means ancient, meso means middle and ceno means recent so we have Paleozoic, Mesozoic and Cenozoic Eras.

Research Basis

- - Linda Williams, Teaching for the Two-Sided Mind

Children come to school as integrated people with thoughts and feelings, words and pictures, ideas and fantasies. They are intensely curious about the world. They are scientists, artists, musicians, historians, dancers and runners, tellers of stories, and

Materials

- Pencils with erasers
- Blue, Green, and Yellow Colored Pencils
- Stopwatch
- Blank Fossil Grid
- Fossil Grid Answer Key
- Fossil Line Drawings
- Environment Markings
- Two Maps of Utah with counties
- Utah Fossil Information sheet



mathematicians. The challenge we face as teachers is to use the wealth they bring us. They come with a two-sided mind. We must encourage them to use it, to develop both types of thinking so that they have access to the fullest possible range of mental abilities.

- - Seymour Sarason, *Parental Involvement and the Political Principle: Developing a culture of high standards for all*

To learn because you have to is one thing; to learn because you want to is quite another thing. And that is the overarching criterion: school is a place a very young child enters with awe, curiosities, expectations, questions, and the desire to feel competent and recognized, and that young child should have those personal characteristics when he or she finishes formal schooling. For those characteristics to be extinguished, to go underground, to get expressed primarily in fantasy is to impoverish a lifetime. When a child has graduated from high school and that child is motivated to learn more about self and world, then, schooling has achieved its overarching purpose.

Invitation to Learn

Understanding how the pieces of the fossil puzzle come together helps the paleontologist to imagine the earth as it was millions of years ago. Tell the students they are going to be a paleontologist for this activity. As paleontologists they have found an abundance of fossil remains and they need to figure out the environment where the fossils would have existed. Based on the fossils they have found, they will draw a map showing the environments present in a certain area more than 70 million years ago. This activity will use drawings of fossils. If you have access to actual Utah fossils and are comfortable using them do so.

Instructional Procedures

1. Students will begin the lesson in their regular seats. At specified intervals, (one and half to two minutes) they will move to another seat in a pre-selected sequence determined by the teacher. This will be repeated until they have had a chance to be in every seat.
2. Have students stand at the back of the room with pencil and paper.
3. Place one of the fossil pictures on 25 to 30 desks depending on number of students.

4. Tell the students there is a card on each desk with a fossil drawn on it and a number. It is face down, and they are not to turn them over until asked to do so. When asked to go to their seats, they are to go to their regular seat but not to touch the card in front of them.
5. Students return to their seats.
6. When they have moved to their regular seats, give them each a copy of the blank grid. Have them fill in their name and the date.
7. Explain the grid. Show figure one on an overhead.
8. Ask students to turn over the card in front of them and tell them each space has a number and each card has a number. Find the space on your grid that has the number to match the card. In that space, draw the picture of the fossil found on the card in front of you and write the fossil name underneath it. You will be moving from one seat to another until all the spaces on the grid are filled. You will have to work quickly because you will have only two minutes to draw and write the name. So draw quickly and quietly.
9. Outline the movement sequence on the board so every one gets to all of the cards. You may tape arrows to the floor. Use the first move as a practice move.
10. Students proceed until the grid is complete.
11. Once the grid is complete the students use dots and hatch marks to separate the different types of environments (*Environment Markings*). Show examples of how to do this. Discuss which fossils might indicate which environments. The normal sequence would have any fossils indicating a beach found in between those of the ocean and the land. Students may work alone or in twos. Students color their grid as follows: boxes with land fossils with green, beach fossils with yellow; and sea fossil with blue.
12. Allow students to discuss their reasons and what inferences could they make from the fossil pictures. Teacher should make an overhead transparency of the solution (*Environment Markings*) and show it to the class, placing it on top of the transparency of *Fossil Grid - Answer Key*. Discuss with students any different interpretations they may have.

Assessment Suggestions

- Successful completion of the grid.
- Students can infer environment from the fossil type.
- Students successfully interpreted the difference between beach, sea, and land fossils.

Curriculum Extensions/Adaptations/Integration

- Students identify as many “fossils” as possible that might be found 50 million years from now.
- Students with special needs may work with a partner or may use a modified grid with the pictures already on it.
- Art may include: Making Plaster of Paris fossils, amber fossils, and tri-fold three dimensional diorama of the different environments
- Write a story as a future scientist discovering our present day fossils.
- Write a newspaper story about a fossil discovery including what type of environment it would have lived in.
- Read *Tyrannosaurus Was a Beast* by Jack Prelutsky, and write a poem about fossils
- Using a map of Utah with counties outlined, make a flap book. Cut around three sides of each county so it will fold up or over and on a second copy of the map note what fossils can be found in each county.
- Go through a student’s desk to see what inferences could be made from the contents.
- Assign an environment to groups of students to research.
- Research different animals to see the adaptations that they have made to survive in their environments (e.g., flippers for animals at sea, webbed feet for aquatic birds).

Family Connections

- Students take home fossil grids and share with parents.
- Visit local museums or science departments.
- Go on a fossil search in the city. List all the fossils found.

Additional Resources

Books

- The Amazing Earth Model Book*, Donald M. Silver & Patricia J. Wynne ISBN # 0-590-93089-3
- The Big Beast Book*, Jerry Booth ISBN #0-316-10266-0
- Dinosaur-The Story Behind the Scenery*, Allan Hagood ISBN # 0-916122-10-7
- Dinosaurs of Utah and Dino Destinations*, Pat Bagley and Gayle Wharton ISBN #1566846013
- The Dinosaur Alphabet Book*, Jerry Pallotta
- Everything You Need to Know About Science*, Anne Zeman and Kate Kelly, ISBN # 0-590-49357-4
- Eyewitness Books, Fossil*, Dr. Paul D. Taylor, ISBN # 0-7566-0682-9
- Eyewitness Books, Rocks and Minerals*, Dr. R. F. Symes, ISBN # 0-7894-5805-5
- The Extinct Alphabet*, Jerry Pallotta, ISBN # 088106-471-8
- The Fossil Factory*, Douglas, Niles, and Gregory Eldredge, ISBN #1-57098-417-4
- Kingfisher Young Knowledge, Rocks and Fossils*, Chris Pellant, ISBN #0-7534-5619-2
- Reader's Digest, Pathfinders, Dinosaurs*, Paul Willis, ISBN # 0-7944-0001-9
- If You Are a Hunter of Fossils* by Byrd Baylor McMillan Pub. ISBN 0-689-70773-8
- Encyclopedia Prehistorica Dinosaurs* by Robert Sabuda And Matthew Reinhart Pub
Candlewick Press ISBN 0-7636- 2228-1

Videos

- Earth Science for Children, All About Fossils
- Eyewitness, Dinosaur
- Eyewitness, Prehistoric Life

Web Sites

- <http://www.ucmp.berkeley.edu/fosrec/MunGun3.html>
- <http://www.ucmp.berkeley.edu/fosrec/BarBar.html>
- <http://pubs.usgs.gov/gip/fossils/scale.html>

Additional Media

- University of Utah Museum of Natural History Fossil Kit, Lorie Millward

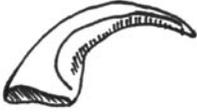
Name _____

Fossil Grid

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

Fossils - Figure 2

Fossils for gird spaces 1 through 10. (Modified from Moor, Lalicker, and Fischer)

1  Allosaurus claw	2  dinosaur eggs	3  Brachiosaurus backbone	4  sea urchin	5  Mackeral Shark tooth
6  dinosaur track	7  Tyrannosaurus foot	8  Allosaurus tooth	9  clam	10  fish scale

Fossils - Figure 3

Fossils for gird spaces 11 through 20. (Modified from Moor, Lalicker, and Fischer)

11  tyrannosaur jaw	12  cycad tree	13  Porosaurolophus skull	14  burrows	15  Plesiosour skull
16  ginkgo tree	17  dinosaur footprint from China	18  oyster	19  lobster	20  nautilus

Fossils - Figure 4

Fossils for grid spaces 21 through 30. (Modified from Moor, Lalicker, and Fischer)

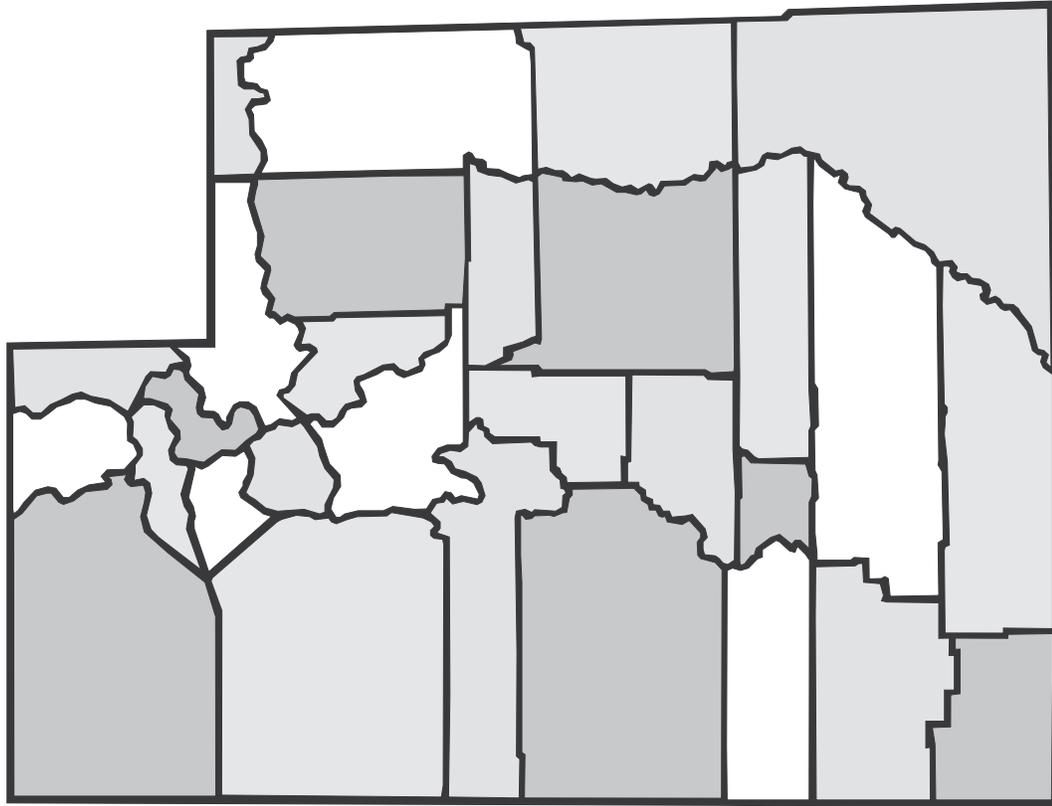
<p>21</p>  <p>Triceratops leg bone</p>	<p>22</p>  <p>Stegosaurus picle</p>	<p>23</p>  <p>marine snail</p>	<p>24</p>  <p>coral</p>	<p>25</p>  <p>marine turtle skull</p>
<p>26</p>  <p>dragonfly</p>	<p>27</p>  <p>dinosaur skin design</p>	<p>28</p>  <p>dinosaur footprint in sand</p>	<p>29</p>  <p>Tiger Shark tooth</p>	<p>30</p>  <p>Ichthyosaur skeleton</p>

Fossil Grid - Answer Key

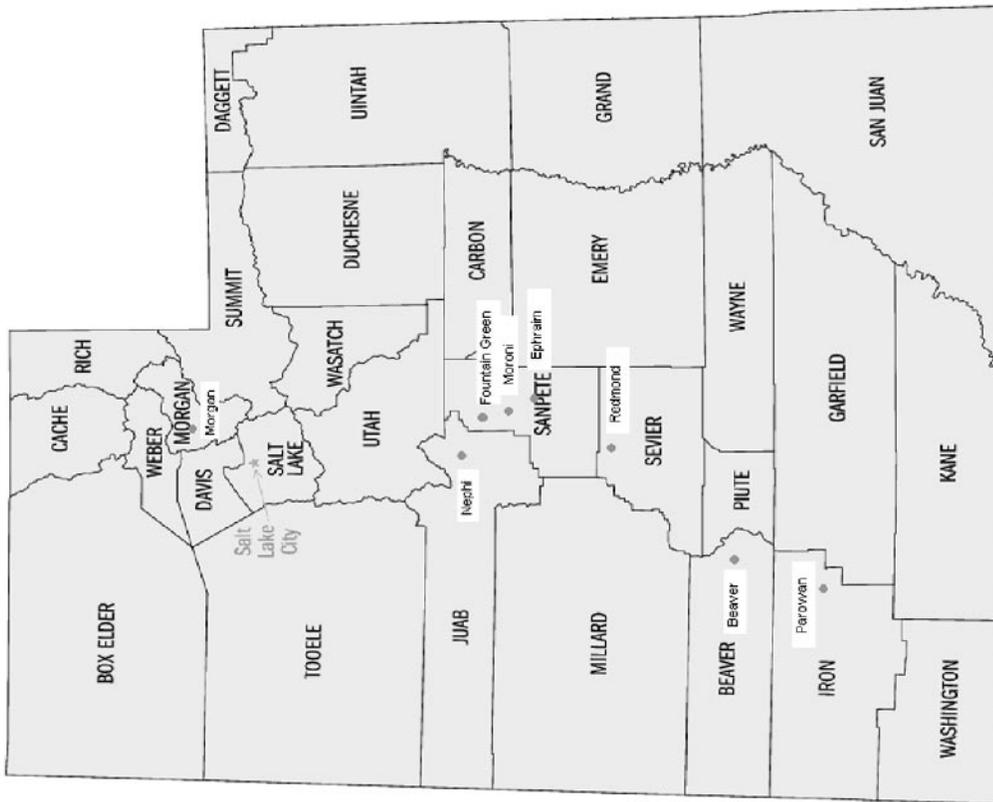
Completed grid for fossil puzzle activity. To be prepared as an overhead transparency.

1 	2 	3 	4 	5 
6 	7 	8 	9 	10 
11 	12 	13 	14 	15 
16 	17 	18 	19 	20 
21 	22 	23 	24 	25 
26 	27 	28 	29 	30 

Utah Counties - 2



Utah Counties - 1



Math 1-3

Activities

Model Operations

Getting To Know You

Standard I:

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

Objective 3:

Model and illustrate meanings of the four operations and describe how they relate.

Intended Learning Outcomes:

1. Communicate mathematically and Make mathematical connections.

Math
Standard
I

Objective
3

Connections

Background Information

This activity is designed to build upon students' knowledge of mathematics. They will discover why numbers are important, how they effect our lives. Reflection on place value, addition/subtraction families, and multiplication/division families will take place. Their involvement will help them become more fluent with number sense, skills, and problem solving. Through the use of visual and conceptual models mathematical concepts and ideas will be revealed. For more advanced learners more skills could be added, prime/composite numbers. Provide problems that have a variety of ways that can be solved, students share, explain and compare.

Research Basis

Bamberger, H., Fennell, F., Rowan. T.E., Sammons, K.B., Suarez, A.R. (2000). Connect to NCTM standards – Making the standards work, *Grade Creative Publications*, Chicago IL page iv, 3 ISBN – 0-7622-1246-2

Today, more than ever, there is a need for all students to have a strong base to mathematics. This means that students do not just memorize facts and procedures, but that they have an understanding of mathematics and mathematical thinking. The interplay between content and process is complicated, but integrating the two is crucial if our students are to receive the mathematics education they will need to function effectively in the world they will grow into. (p. iv)

For students to become mathematically powerful, it is essential that they be able to use process skills flexibly. They need to practice, experiment, communicate. Making Connections between problems within mathematics is as essential as is making mathematical connections to disciplines outside of mathematics. (p. 3)

Postlewait, Kristian B., Adams, Michelle R., Shih Jeffery C. (2003), Promoting meaningful mastery of addition and subtraction, *Teaching children mathematics*, pg 354, Volume 9, Number 6, February 2003.

The development of Number sense and computational fluency should be an integral part of the mathematics curriculum. Because other areas of the curriculum such as data and measurement are closely related to and sometimes dependent on these skills, students must have a firm foundation in number. Teachers should provide activities and experiences that develop a conceptual understanding of number and operations, instead of focusing on the memorization of rules and procedures. Meaningful mathematical learning then can occur. When left to use strategies that are natural for them, children are wonderful problem solvers and are able to make sense of numbers in the world.

Wu, H. (1999). Basic skills versus conceptual understanding. *American Educator/American Federation of Teachers* Fall 1999, pg 1 January 7, 2006, from http://www.aft.org/pubs-reports/american_educator/fall99/wu.pdf.

The truth is that in mathematics, skills and understanding are completely intertwined. In most cases, the precision and fluency in the execution of the skills are the requisite vehicles to convey the conceptual understanding. There is not “conceptual understanding” and “problem-solving skill” on the one hand and “basic skills” on the other. Nor can one acquire the former without the latter.

(September 27, 2000) *Before it's too Late – A report to the Nation for the National Commission on Mathematics and Science Teaching for the 21st Century* pg 22 January 7, 2006 from <http://www.ed.gov/inits/Math/glenn/report.pdf>.

In high-quality teaching, the process of inquiry, not merely “giving instruction,” is the very heart of what teachers do. Inquiry not only tests what students know, it presses students to put what they know to the test. It uses “hands on” approaches to learning, in which students participate in activities, exercises, and real-life situations to both learn and apply lesson content. It teaches students not only what to learn but how to learn.

Zhang, Linrong, (2005) A review of children's elementary mathematics education. *International Journal for Mathematic Teaching and Learning* pg 6 ISSN 1473-0111. retrieved January 7, 2006 from <http://www.cimt.plymouth.ac.uk/journal/zhang.pdf>.

Mathematics teaching is an interactive process between teachers and students, through which both parties communicate and improve together. Mathematics teaching should start from students' life experience and preexisting knowledge, create lively and interesting scenarios, and guide students to observe, experiment, conjecture, deduce and communicate. Through mathematical activities, students master basic knowledge and skills, learn to observe phenomena and analyze them, and motivate themselves to learn. Students are the masters of mathematical learning, while teachers are the organizers, guides, and collaborators.

Invitation to Learn

Sing Song “Getting to Know Math”

*Getting to know math,
Getting to know all about it.
Getting to like math,
Learning just what to do*

*Getting to know math,
Putting each number
in its place,
Math is precisely,
What I like best.*

*Getting to know math,
Getting to know all about it.
Getting to like math,
Learning just what to do*

*Getting to know math,
Putting each number
in its place,
Math is precisely,*

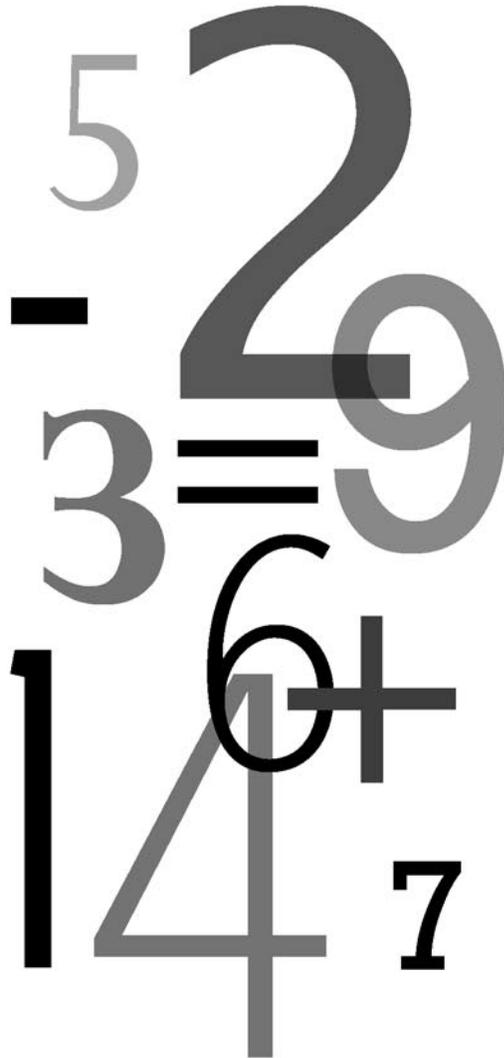
What I like best.

*Getting to know math,
It's getting simple and painless
When I work with you,
Getting to know what to do*

*Haven't you noticed
Suddenly I'm smart and brilliant?
Because of all the simple and new
Things I'm learning about you
Day by day.*

*Getting to know math,
getting to feel sure and ready.
When I am working,
getting to know what to do.*

*As I keep learning,
I'm growing more sure and steady,
Because of all the wonderfully new
Things I'm learning to do,
Day .. by ... day.*



Original Math Lyrics by Vicki Young, added onto with permission, by Marjory Paskett
<http://www.mscc.cc.tn.us/webs/vyoung/>

Invitation to Learn continued

Research has shown that people remember things better when they learn them by doing. This is even true for adults. Here is an example. You want to learn how to play softball so that you can join a team. How will you learn to play?

Will you:

1. Buy a book and read about how to play softball.
2. Watch a video about softball.
3. Ask a friend who plays to grab a ball, bat, and glove and teach you.

Which way will help you learn the game the best? Choice 3 is the best way for most people because they actually get to try the game and learn the rules as they play. They learn in a hands-on way.

Hands-on learning is good for both children and adults. The learner is actively involved instead of just sitting and listening. This is the way we want our children to learn and we know that research backs us up. In order to learn best, children must be actively involved in hands-on activities every day. (Susan Jindrich)

Instructional Procedures

Materials

- Music – “Getting to Know You” from “The King and I”,
- Device to play music
- Labeled zip lock Bags with counters precounted into them (handout with possible Numbers To Use)
- 11x18 Construction Paper
- Scissors
- Magazines
- Newspaper Ads/Circulars
- Markers
- Crayons
- Hundreds charts
- Number lines
- Grid paper
- Balance
- Counters
- Getting To Know You*
- Comparing 2 Numbers, and Comparing 3 Numbers worksheets* (copy back to back)
- Rubric for Getting to Know You* (2 per page)
- How to Fold a Book*

Book or Poster

Each child will be given a bag of counters (the teacher will record who has what number on the numbers to use sheet), and a *Getting to Know You* worksheet. Students are to count and record the number of items in each bag in the following ways.

- A. Where can you find the number, how is it used?
- B. Show other forms of your number (pictures, drawings, patterns).
- C. Show the place value of number.
- D. Show addition/subtraction families for the number.
- E. Show multiplication/division families for the number.
- F. Write a story problem using the number, include the number sentence to go along with it.
- G. Why is the number important?
- H. How will knowing this number help in math? Help you know math better? Understand other problems?
- I. Write a riddle for your number.
- J. With the information they have learned they are to make a book (*Instructions for Folding a Book*) with explanations below pictures or diagrams, or make a poster (pictures on front, on back paragraphs answering questions), sharing the information.

Venn Diagram

Hand out - Comparing 2 Numbers and Comparing 3 Numbers worksheets



1. Have students pair up. Using your number, label one of the circles, your partner will label the other circle with his number. Discuss, and then fill in the diagram with the similarities and differences for the numbers.
2. Form new groups of three. Repeat the above process using a three circle Venn.
3. As a class discuss discoveries made.

Assessment Suggestions

RUBRIC for “Getting to Know You”

	0	1	2	3	4
Number BOLDLY displayed	Made no effort to complete the project.	There, but had to be pointed out	Hard to see	Easy to see	Easy to see, stands out
Ways that the # is shown		1 way	2 ways	3-4 ways	5 or more ways
Neatness		Unreadable, sloppy	Hard to read, 5- 8 mistakes or extra marks	Easy to read, 2-4 mistakes or extra marks	Easy to read, no erasures or scribbling ready to be published.
Activities completed		1-2	3-4	5-6	7-8
Paragraph Convention, No Name, will take away 1 point.					Thoughts are clear and easy to understand. Correct conventions.
Punctual			3 or more days late	2 days late	1 day late

Curriculum Extensions/Adaptations/Integration

- Extension for advanced learners – Give a higher number that involves more thought processing. Give two different numbers,

have them come up with ways that the two numbers are related, how they can use one of the numbers to understand or work with the other number. A Prime/composite activity could be added.

- Adaptations for learners with special needs – give a lower number.
- Integration Language Arts—write a paper or picture story book describing the number and its adventures.
- Graphing – as a class have them create a graph to record what the numbers have in common.
- Money – Your number is the amount of allowance you get, what would you buy? Or if you saved your money what could you buy?

Family Connections

- Learning at home – *Numbers At Home*, where can they be found? How are they used? Why are they important?

Additional Resources

Books

Investigation in Number, Data, and Space Arrays and Shares, by Economopoulos, Karen, Tierney, Cornilia, Russell, Susan Jo; ISBN 1-57232-744-8

Articles

Teaching Children Mathematics: Focus Issue Computational Fluency Volume 9, Number 6

Web sites

Jindrich, Susan How do Children Develop <http://www.gdrc.org/kmgmt/learning/child-learn.html>

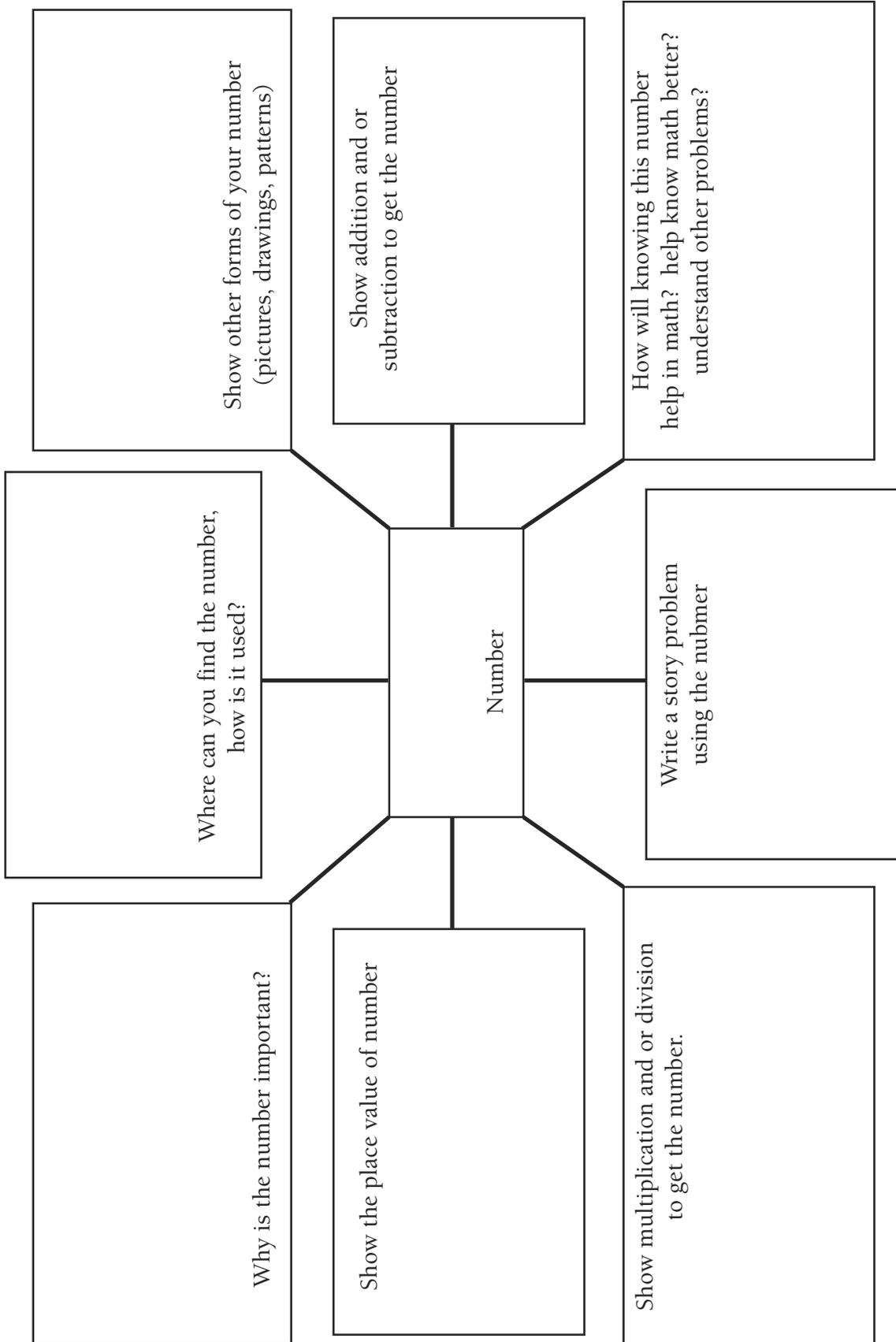
National Library of Virtual Mathematics http://nlvm.usu.edu/en/nav/grade_g_1.html
specific- 3rd thru 5th grade, numbers and operations http://enlvm.usu.edu/ma/nav/toc.jsp?sid=nlvm&cid=2_1

Numbers to Use

Bag Labeled	# of objects in bag	Student Name
A	14	
B	15	
C	16	
D	18	
E	20	
F	21	
G	24	
H	25	
I	27	
J	28	
K	30	
L	32	
M	35	
N	36	
O	40	
P	42	
Q	45	
R	48	
S	49	
T	54	
U	56	
V	63	
W	64	
X	72	
Y	80	
Z	81	
AA	92	
BB	95	
CC	99	
DD	100	

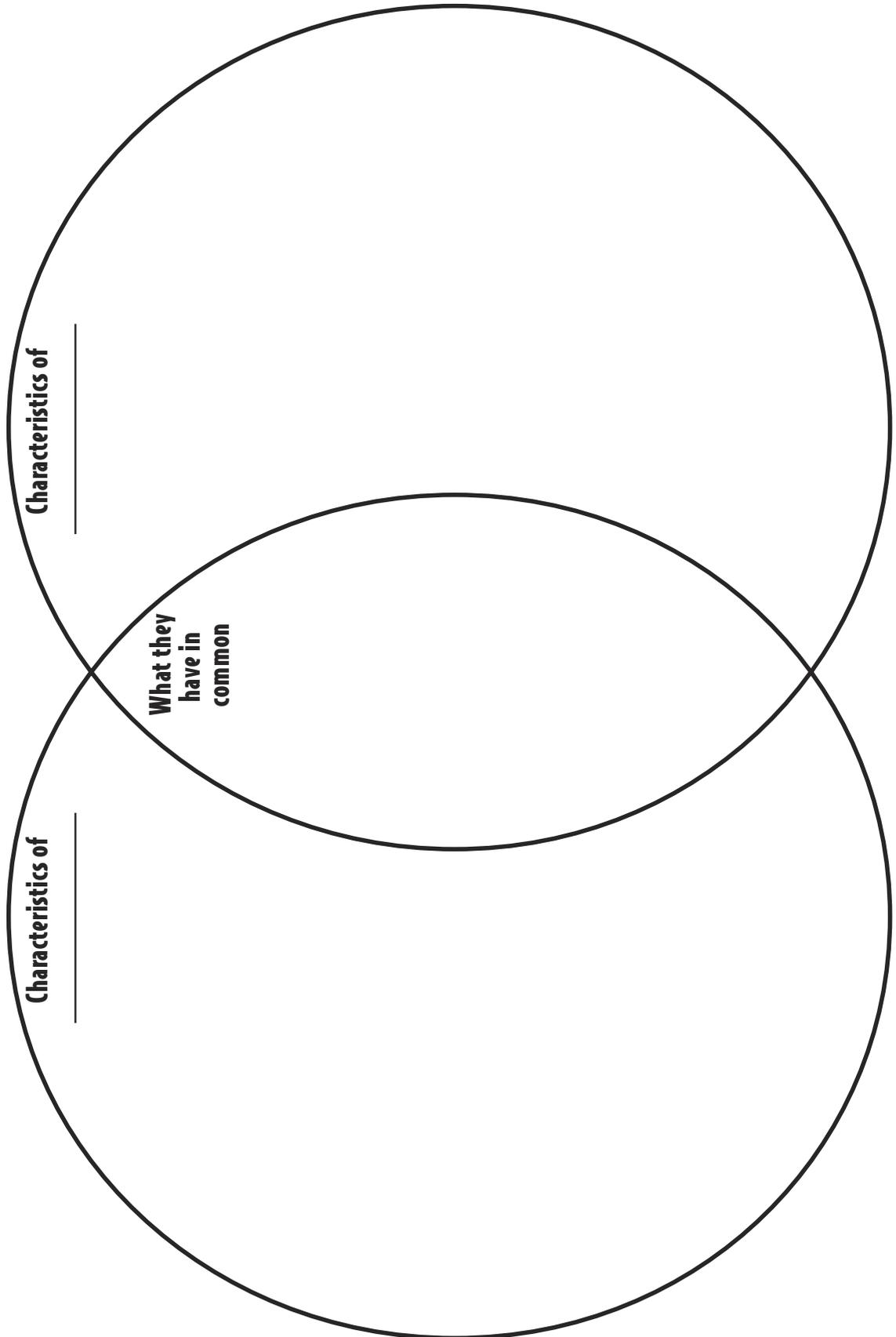
Name _____

Getting to Know You



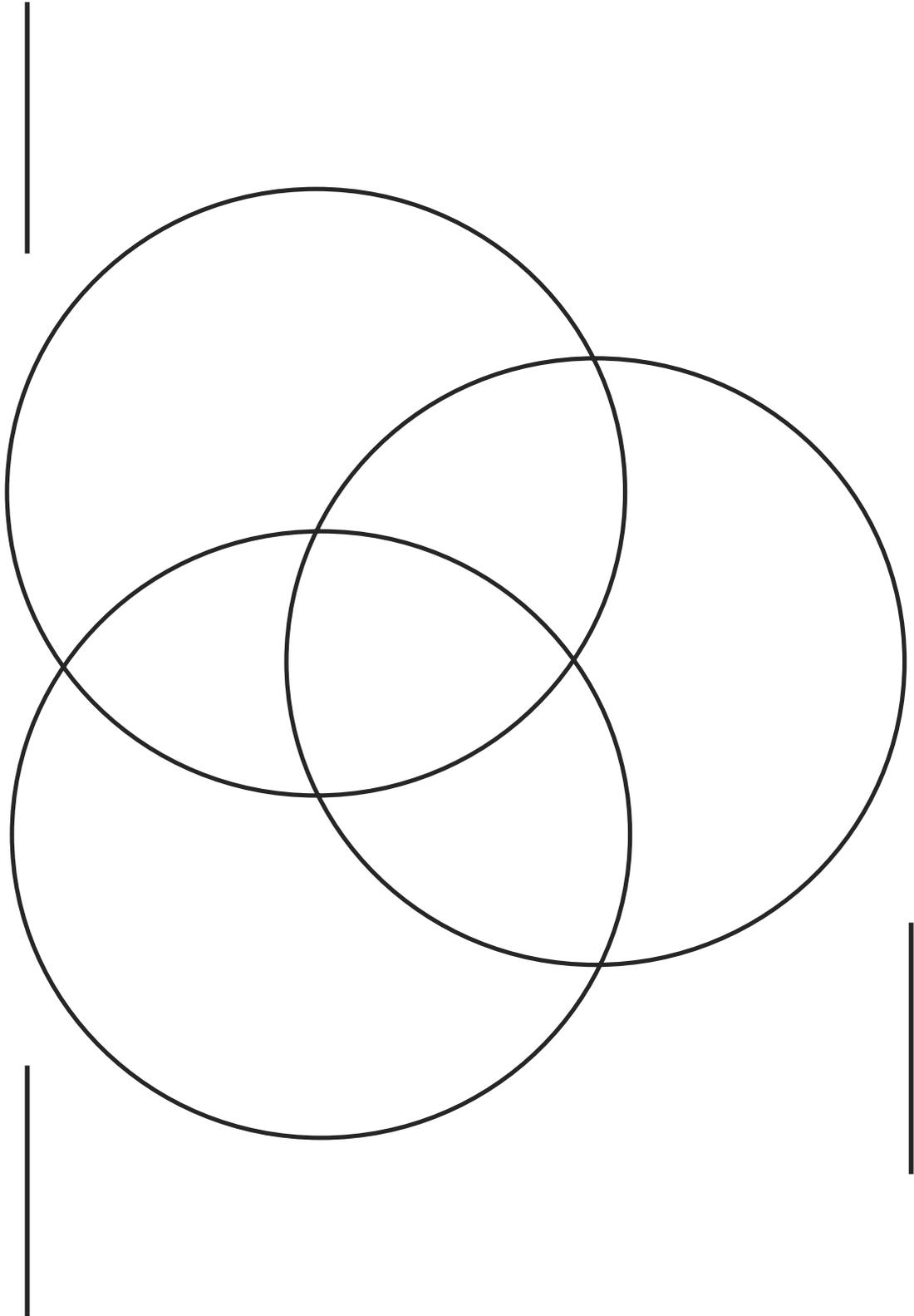
Name _____

Comparing 2 Numbers



Name _____

Comparing 3 Numbers

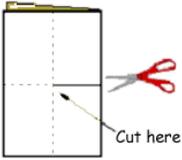
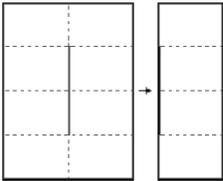
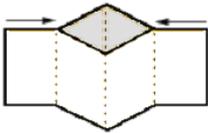


Name _____

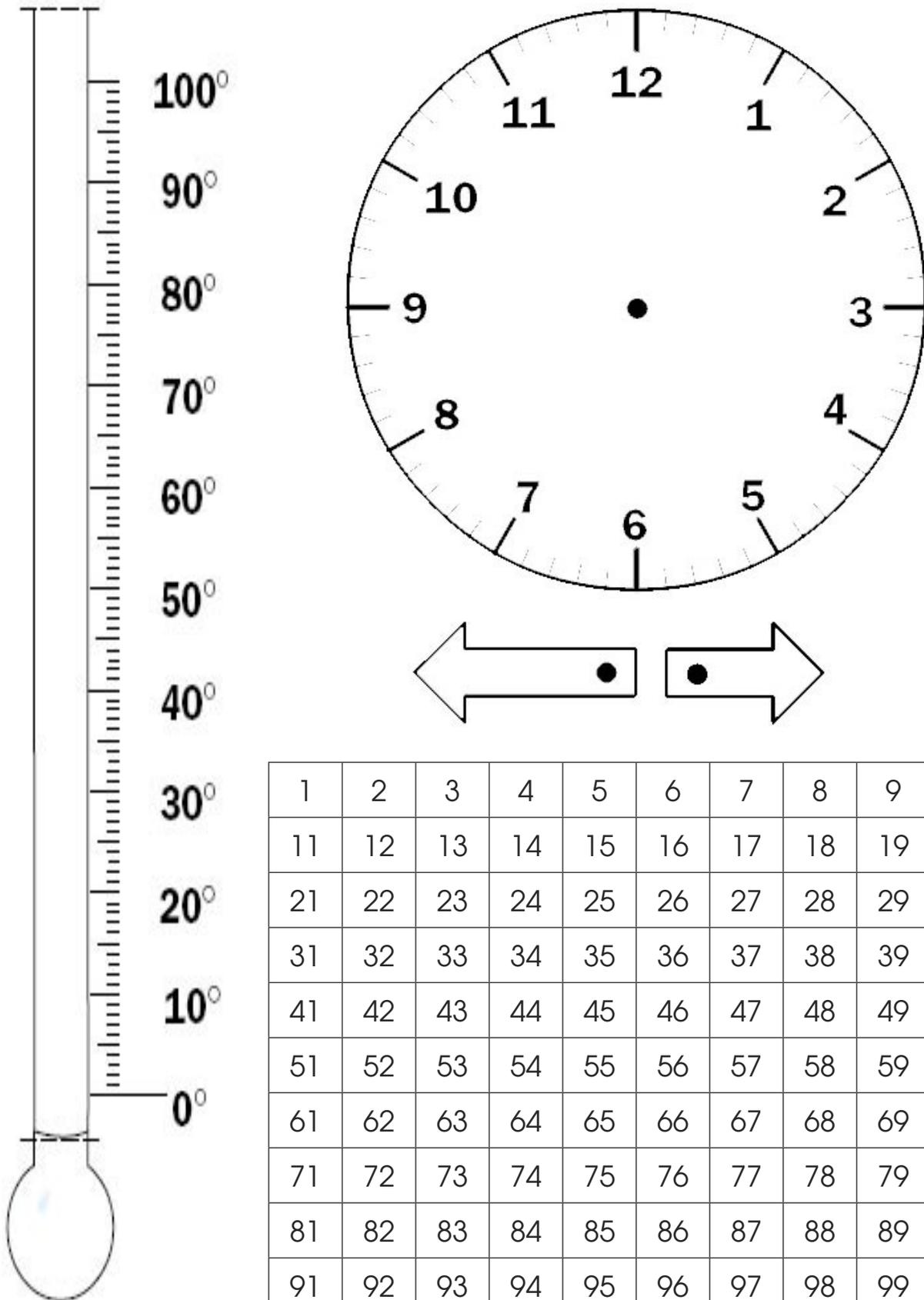
RUBRIC for "Getting to Know You"

	0	1	2	3	4
Number BOLDLY displayed	Made no effort to complete the project.	There, but had to be pointed out	Hard to see	Easy to see	Easy to see, stands out
Ways that the # is shown		1 way	2 ways	3-4 ways	5 or more ways
Neatness		Unreadable, sloppy	Hard to read, 5- 8 mistakes or extra marks	Easy to read, 2-4 mistakes or extra marks	Easy to read, no erasures or scribbling ready to be published.
Activities completed		1-2	3-4	5-6	7-8
Paragraph Convention, No Name, will take away 1 point.		Many grammatical, spelling, or punctuation errors.	3-5 grammatical, spelling or punctuation errors.	1 or 2 grammatical, spelling or punctuation errors.	Thoughts are clear and easy to understand. Correct form: grammatical, spelling and punctuation.
Punctual		3 or more days late	2 days late	1 day late	On time

Instructions for Folding Book

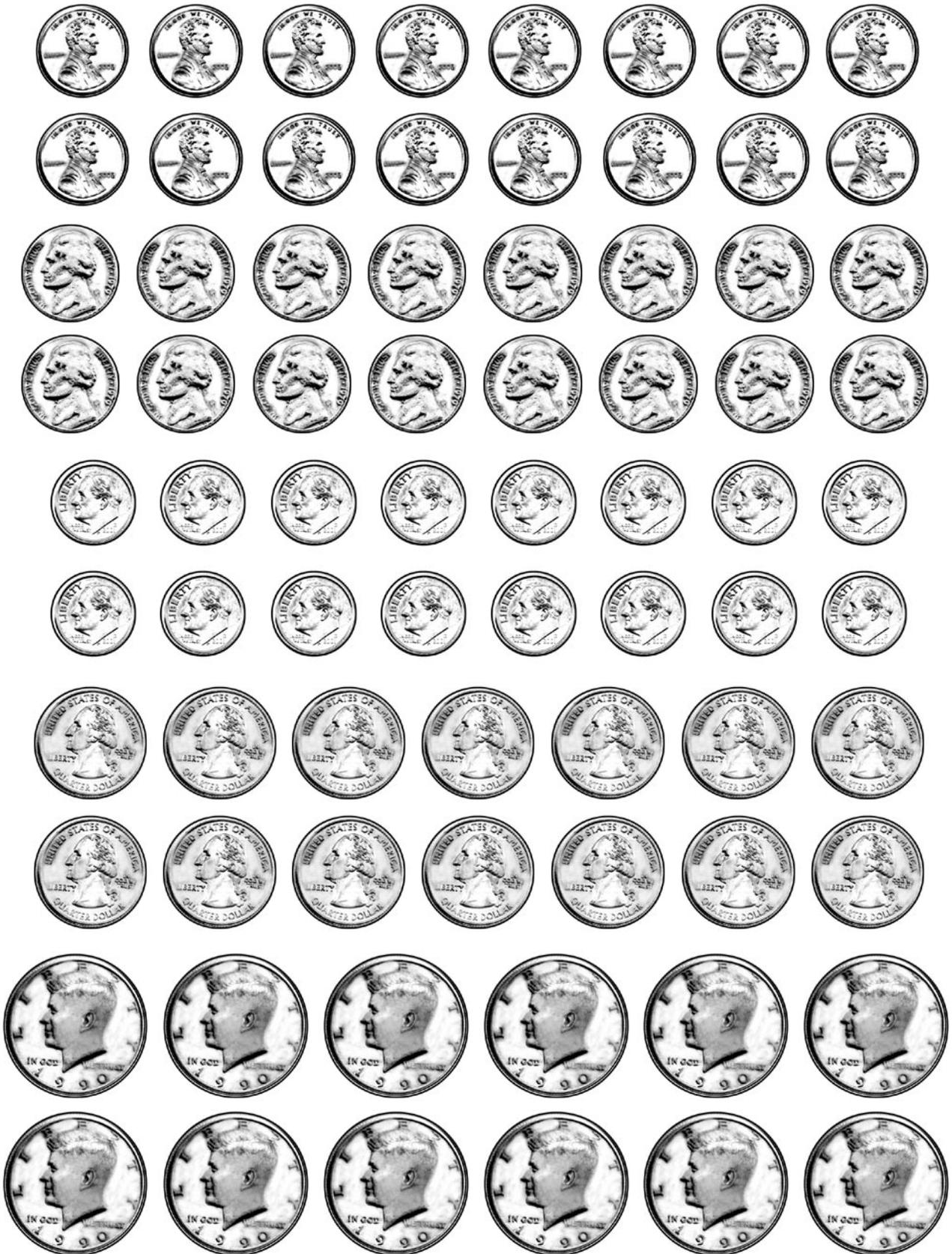
	1 – Fold paper into 8 sections
	2 – Along the long side of the paper, fold symmetrically in half. Cut along the center line until you reach the first vertical fold
	3 - Open the paper so that eight sections are showing. Fold the page over horizontally.
	4 - Hold on to each side and gently push the ends together to form the pages of the book.
	5 - Fold the front and back covers around so that the corners meet. Crease well.

Thermometer



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Coins



Dominos At Play

Standard I:

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

Objective 3:

Model and illustrate meanings of the four operations and describe how they relate.

Intended Learning Outcomes:

1. Demonstrate a positive learning attitude toward mathematics and represent mathematical situations.

Content Connections:

Science IV; fossil formation, Language Arts

Math
Standard
I

Objective
3

Connections

Background Information

This activity will help students investigate, analyze, invent, critique, develop number sense, and deepen their mathematical thinking. Using visual and conceptual models can help reveal mathematical ideas. Problems that can be solved in a variety of ways should be provided. Allow students time to share, explain, and compare their work.

Refer to the Mathematics Glossary in the Core Curriculum for definitions of the following terms.

addend	algorithm
array	Associative Property
Commutative Property	dividend
divisor	expanded form
exponent	expression
factors	Identity Property of Addition
Identity Property of Multiplication	numeral
product	Quotient
Remainder	Rules of Divisibility
Sum	whole number
Zero Property of Multiplication	

Research Basis

Burns, Marilyn, (1999) ARITHMETIC The three-legged stool. *The Newsletter for Math Solution Participants* – Number 25 (Online version) Spring/Summer 1999, retrieved January 7, 2006 from http://www.mathsolutions.com/mb/print/newsletter/spring_99_nl_1_p.html

Materials

- Set of double nine dominos
- Overhead of double nine dominoes
- Double Nine Dominos*
- Blank dominos*
- Scissors
- Bag or envelope to keep dominos in
- Dominos at Play*
- Manipulatives



Memorization should follow, not lead instruction that build's children's understanding. The emphasis of learning concepts and relationships in mathematics must always be on thinking, reasoning, and making sense.

Foy, P., Martin, M.O., Mullis, Ina V. S. (2005). IEA's TIMSS 2003 international report on achievement in the mathematics cognitive domains - *Findings from a Developmental Project*, TIMSS & PIRLS International Study Center, Chestnut Hill, MA, (pg 65), retrieved January 7, 2006, from http://timss.bc.edu/PDF/t03_download/T03MCOGDRPT.pdf ISBN: 1-889938-38-6

Students need to be familiar with the mathematics content being assessed, but they also need to draw on a range of cognitive skills. The first domain—knowing facts, procedures, and concepts—covers what the student needs to know, while the second—applying knowledge and conceptual understanding—focuses on the ability of the student to apply what he or she knows to solve problems or answer questions. The third domain—reasoning—goes beyond the solution of routine problems to encompass unfamiliar situations, complex contexts, and multi-step problems.

Ma, L. (1999). *Knowing and teaching elementary mathematics*. Mahwah, NJ: Erlbaum. Pg 35, 112

Developing fluency requires a balance and connection between conceptual understanding and computational proficiency. On the one hand, computational methods that are over-practiced without understanding are often forgotten or remembered incorrectly. On the other hand, understanding without fluency can inhibit the problem-solving process.

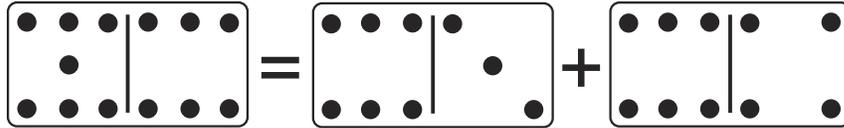
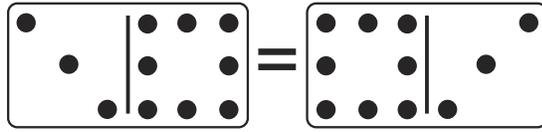
Being able to calculate in multiple ways means that one has transcended the formality of the algorithm and reached the essence of the numerical operations--the underlying mathematical ideas and principles. The reason that one problem can be solved in multiple ways is that mathematics does not consist of isolated rules, but connected ideas. Therefore being able to and tending to solve a problem in more than one way, therefore, reveals the ability and the predilection to make connections between and among mathematical areas and topics.

Invitation to Learn

Have dominos set up on end, when you are ready to start the lesson, start a chain reaction. Math is a process of chain reactions and basic numeration. Start adding and building onto the concepts and facts. [Commutative property ($a \times b = b \times a$)]



Distributive property $(6 \times 7 = 6 \times (3 + 4) = (6 \times 3) + (6 \times 4) = 18 + 24 = 42)$



Instructional Procedures

Dominos At Play

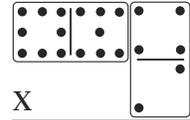
1. Have each child select a domino from a face down pile.
2. Using their worksheet, figure out the product of their domino, according to the two factors (numbers).
3. Solve the problem using the commutative property and at least one other way. Provide a variety of manipulatives for them to use.
4. Within their group have them compare the numbers. Are any equal? Whose is greater? Less?
5. In groups, they are to line up their dominos from biggest to smallest, according to the product of the two factors (numbers) on the domino. Then they are to record what they see.
6. What do you notice about the factors and the products? Describe the patterns you see.
7. Write a story problem using your factors.
8. Gather together the dominos. Once again mix them up and have students pick one domino from the pile (higher students should pick two).
9. Have all students stand. If the product of your domino is greater than 25, sit down. If it is greater than 10 sit down. Repeat until you have the student with the lowest product.
10. Have the student that is left standing read their story problem aloud.
11. The person that has the answer will stand and tell the number sentence. They will then read aloud the story problem they wrote. Repeat until all students have had a turn.

Assessment Suggestions

- Check the Dominoes at Play worksheet for understanding
- Observe students as they participate in the activity.

Curriculum Extensions/Adaptations/Integration

- Extension for advanced learners – Use two dominos and find the product of a three digit number times a one-digit number.



- Adaptations for learners with special needs – use only one domino and multiply those two numbers together.
- Dominos can also be used for place value, addition/subtraction, division and fractions, perimeter, and area.
- Start with a number line long enough to handle the times tables you're learning. Take a domino and place it over the answer on the number line; practice until you can do it quickly. Make sure you've got the right answer by checking a times tables chart. Say the times table and the answer. See if you notice any patterns as you do this. Take away the number line and do the same thing. You might want to do them in order first (A Hundreds chart could also be used).
- Language arts – research the history of dominoes. Learn some of the vocabulary related to dominoes: bones, cards, tiles, ranks, suits, singles, doubles, layout, chain, line, weight, heavy, light, sniff, spinner, open ends, block, draw, crosswise, sprouted, block, draw, boneyard, forfeit, posed, muggins, abutted, etc.
- Social Studies/Measurement—Asia: create a representation of the Great Wall of China, one domino equals how many miles?

Family Connections

- Learning at home –Domino Games: Domino War, Good Times, Climb the Ladder, Windows
- Create a game as a family using dominoes.

Additional Resources

Web sites

Multiplication: An Adventure in Number Sense <http://naturalmath.com/multi/indoex.html>

Teaching & Learning About Whole Numbers - Mental and Written Computation
– Multiplication <http://online.edfac.unimelb.edu.au/485129/wnproj/multily/main.html>
<http://www.multiplication.com/index.htm>

Attacking The Multiplication Facts http://www.shsu.edu/~ret_hjb/facts.html

Math Cats <http://www.mathcats.com/contents.html> (has a nice set of Fact Family Cards under Exploring)

Enrich Domino Activities
<http://nrich.maths.org/public/freeseach.php?PHPSESSID=28aea5c2f6f051ce203c10830ee6dd18&search=dominoes&ct=0&cl=0&dl%5B0%5D=1&dl%5B1%5D=1&dl%5B2%5D=1>

<http://www.domino-games.com/>

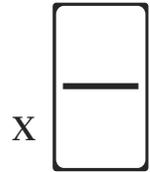
Domino Plaza http://www.xs4all.nl/~spaanszt/Domino_Plaz.html

Rules for playing <http://www.dominorules.com/dominorules.aspx>

Name _____

Dominos at Play

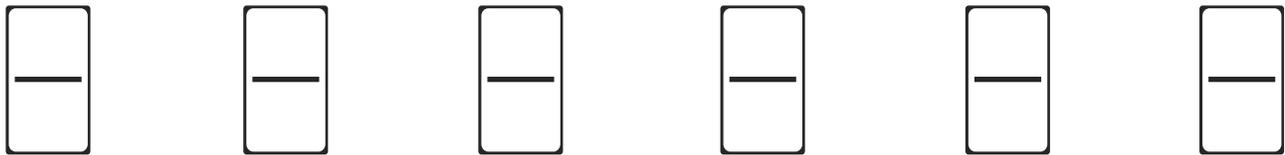
Write down what is shown on our domino. Multiply the two numerals together. Write a division sentence that belongs to the fact family.



Make an array to show your problem.

Solve your problem using the Commutative Property, and at least one other way.

Compare your product to the others in your group, using the =,<,>, signs.



Line up your group's dominos according to the product, least to greatest.



What do you notice about the factors and the products? Explain the pattern.

Write a story problem that uses your factors.

Domino War

Number of Players: Two

Mathematical Objective: To compare products

Object: To win the most dominos

The Deck: A set of double nine dominos. (For students just learning the facts, you may want to provide only the zero through five dominos. For the students needing practice on certain tables, you may want to use only those numbers.)

The Deal: The dominos are shuffled face down and each player alternately picks one till all are gone.

The Play: The students place their dominos face down. Together, they turn over a domino. Each player multiplies his or her numbers and announces the product. The one with the higher product collects the dominos and places them face down with the rest. (You may wish to provide calculators so students can check responses for correctness.)

Scoring: At a given signal, or when a specified time is up, the players count the cards they are holding. The one with the most cards wins that round.

Good Times

Number of Players: Three to four

Mathematical Objective: To multiply double-digit numbers

Object: To acquire the most dominos

The Deck: A set of double nine dominos, remove the blank.

The Deal: The dominos are placed face down in an 11 x 5 array.

The Play: The first player turns up two dominos in the array. The player then multiplies the numbers showing. If the answer is correct, he or she keeps both dominos. If it is not, the player turns the dominos face down, and the play moves to the left. [The correctness may be checked by another player or with a calculator or a multiplication table.]

Scoring: When the array is empty, the players count their dominos. The player with the most wins that round.

Climb the Ladder

Number of Players: Four

Mathematical Objective: To multiply single-digit number by a three digit number

Object: To gain points by generating a product greater than a given number

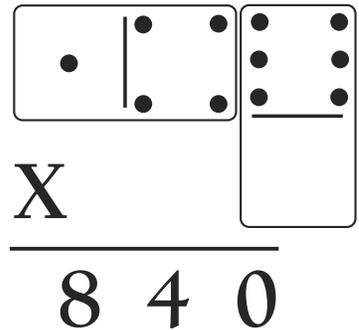
The Deck: A set of double nine dominos.

The Deal: The dominos are shuffled and each player is dealt eight. The remaining ones make up the draw pile.

The Play: A domino from the draw pile is turned up, and the number is recorded as the first rung of the ladder. The domino is returned to the middle of the draw pile.

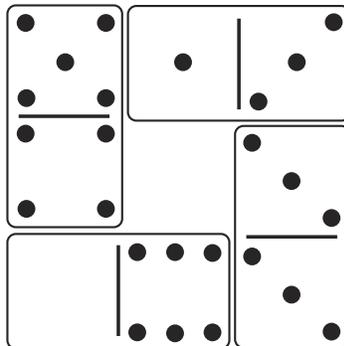
The first player turns up domino from the draw pile. Then he or she chooses a domino from his or her hand so that the product of the number on that domino and the turned up domino is greater than the first rung. If the product is greater, it is recorded as the next rung, and the player receives a point. If it is not, it is the next player's turn. The second player turns up another domino from the draw pile and chooses a domino from his or her hand so that, if possible, the product will be greater than the last rung. Play continues until all players have had four turns.

Scoring: When four turns have been played, the players add their scores. The one with the most points wins that round.

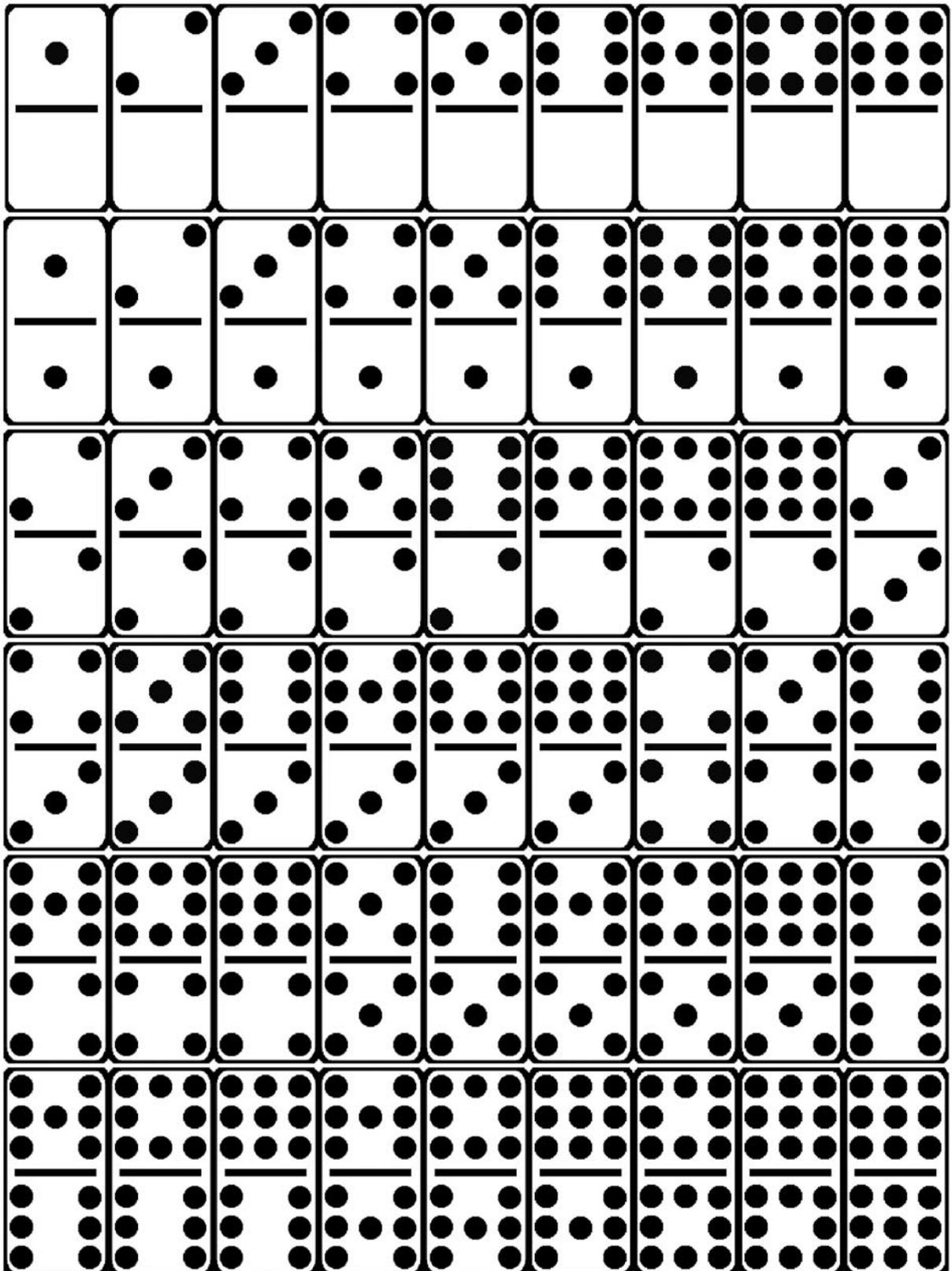


Windows

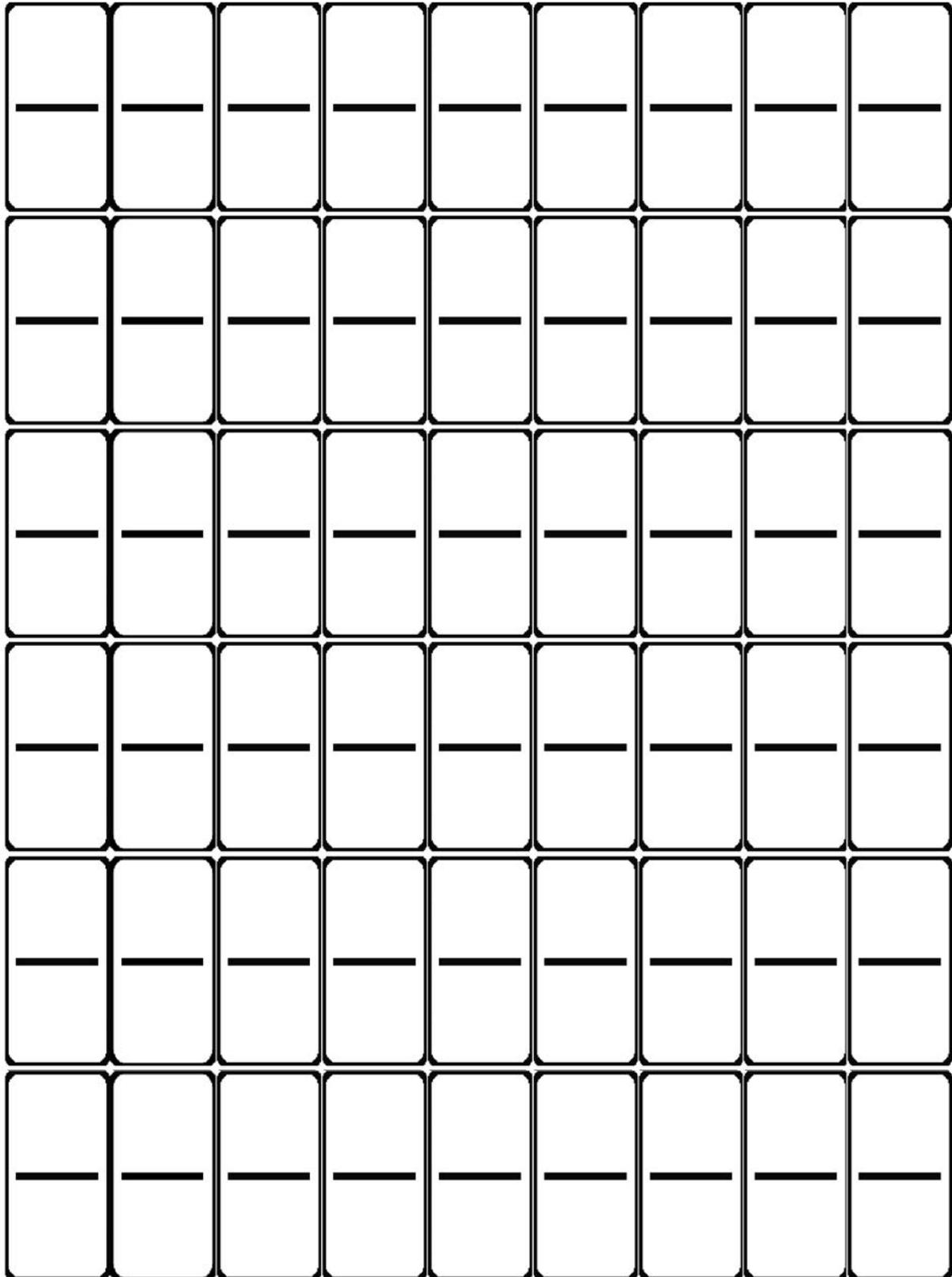
This is a challenge that you might like to take on by yourself or with a group of friends, using a set of double six dominos. In this diagram the four dominoes make a 'window' with one empty space. The spots on each side total nine. Can you make seven windows like this using all 28 dominos so that each window has the same spot-sum for each side? One window need not have the same spot-sum as another.



Dominos



Blank Dominos



Math II-2

Activities

Patterns & Symbols

Iguana Algebra

Standard II:

Students will use patterns and relations to represent mathematical situations.

Objective 2:

Recognize, represent, and solve mathematical situations using patterns and symbols.

Intended Learning Outcomes:

1. Demonstrate a positive learning attitude toward mathematics.
2. Communicate mathematically.

Content Connections:

Growing patterns show equations

*Math
Standard
II*

*Objective
2*

Connections

Background Information

The focus of this lesson is patterns. Students should be familiar with input and output patterns to make the connections in this lesson easier to make. Students need to know that a variable is a quantity that varies, and that symbols such as x , t , and n are used to represent variables. It doesn't always have to equal only one number. Sometimes it could have multiple representations. Students need to see patterns to solve equations.

Research Basis

Weiss, D. F. (2005). Keeping it real: The rationale for using manipulatives in the middle grades. *Mathematics Teaching in the Middle Grades*, Volume 11 (Issue 5), Page 238-242.

Learning is social. Students need to be given the opportunity to talk about the processes they are learning. As they answer and ask questions, explain their thinking, and articulate their thought processes, students create a new understanding of how math works, and what is right and wrong. This communication can even positively shift their understanding.

Smith, B.L., & MacGregor, J.T. (1998). What is collaborative learning? In K.A. Feldman and M.B. Paulsen (eds.) *Teaching and Learning in the Classroom* (2nd. ed., pp.585-596). Boston, MA: Pearson Custom Publishing

As students work in small groups, the use of manipulatives will stimulate conversation. It allows students who cannot think abstractly yet to see what is happening. Manipulatives can be an effective tool for students to use in constructing ideas and communicating with each other.

Invitation to Learn

Ask the students to close their eyes and think about any animal. Then have them think of the animal as a baby. What did it look like? What does it look like as it grows? What does your animal look like as an adult? Have students open their eyes and explain that today they are going to use patterns to explore how a certain animal changes.

Instructional Procedures

Session 1

Materials

- Pattern Blocks (enough for each group to have some).
- Chart paper
- Patterning Practice*



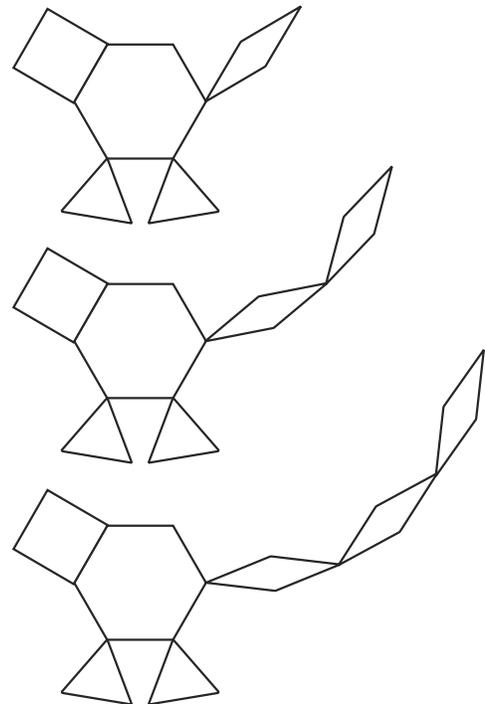
1. Create an iguana using pattern blocks on the overhead projector (hexagon for the body, one square for the head, two triangles for the legs, and a parallelogram for the tail). Ask students to guess what animal this represents. Explain that if they use their imagination they can see the pattern is an iguana.

2. Label the pattern as stage one and ask students what they think the iguana will look like at stage two. Allow students to guess and try a few of them out. Then add one more block to the tail and label it as stage two.

3. Ask the students to identify what is the same about stage one and two. Guide students to see that the number of blocks in the body is the same. Then ask students to identify what is different.

4. As students identify the block on the tail as being the only thing different, use the words *varies* and *variable* to explain how the tail changes at each stage.

5. Create stage three of the iguana by adding another block to the tail. Have students identify what stays the same. The Body. Have the students identify how many blocks are in the body. Then introduce the word *constant* to describe the body. Point out that the body always has four blocks.



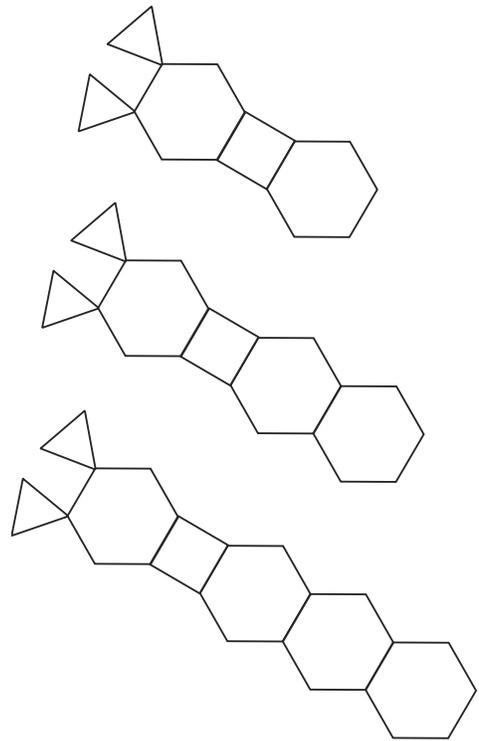
6. Draw the three stages on the board. Explain to the students that their group will be creating what they think stage four looks like. Take time to explain the rules of using the manipulatives and working together.
7. Answer students' questions and allow students to get to work. As they work circulate the room and encourage students to discuss what they are thinking and doing with each other. As groups show they can correctly make stage four, instruct them to make stages five and six as well.
8. Record the Information. Explain to students that every time they make a new stage they have to count up how many blocks are in each stage. Instead of counting the number of blocks each time, ask the students to look for a pattern in the number of blocks so they can predict how many blocks will be used in future stages.
9. Set up a three column recording sheet. Label the first column as Stage #, the second column as Body and Tail, and the third column as Total # of Blocks. Fill in the information in the correct column as students explain the numbers for each. Fill in the information for the first five stages.
10. Discuss with the students about the patterns. Guide students to identify that the body number stays the same; label it with the word constant. Pose the question of how many blocks it would take to build stage ten and how do students know. Have them talk with their group.
11. Assign groups to describe what the hundredth stage looks like and how many blocks it would take to build it. Have the group write their thoughts down and then share with the class.
12. Make sure students know how to generalize the problem. Continue to ask groups to describe and find the number of blocks for different stages.
13. Once students can generalize the patterns, introduce the variable. Explain to students that they don't need to count the blocks every time. The pattern can be written using a variable to describe what happens each time.
14. Write the equation $t = 4 + s$. Explain that s = the stage number and t = the total number of blocks (or you can use shapes—squares and triangles). Write the symbols that represent the variables above their corresponding columns. Explain to students that if they know the stage number they can find the total number of blocks. Relate the equation to the previous equations that were done.

15. Now ask the students how they could find the stage number if all they knew was the total number of blocks. Write the problem $t = 4 + s$ and $t = 50$. Give students time to work with their group to find what s equals (the stage number). Encourage students to write down what they figure out and how they do it.

16. Ask students to share with the class their answers and how they solved it. Listen to hear if students can identify the process of solving an equation. Give students a few more

problems to practice and test. Give the students a caterpillar pattern using two triangles for ears, hexagon for the head, a square for the neck and add a hexagon to the tail for each stage (show them the first three stages and follow the same process as above). Then ask the students to draw what the next two stages would look like, the chart or equation that shows how many blocks are needed each time, and explain what the hundredth stage would look like and how many blocks are needed. Allow them to work in groups and be ready to present their findings to the class.

17. Ask questions and monitor to make sure students are using the patterns to solve the future stages.



Assessment Suggestions

- Allow students to create their own patterns and chart to correlate with them. You might want to put some parameters on the project: body needs a constant of four and the stage number and number of new blocks need to be the same.
- Pose similar problems to have students solve using patterns.
- Have students describe the pattern in their math journal and include the equation.

Journal Prompt

Describe what is an equation and how it is used in math

Journal Rubric	1	2	3	4
Use of Vocabulary	Student does not use math vocabulary.	Student uses some math vocabulary, not necessarily related to topic.	Students use most of the related math vocabulary.	Students use all math vocabulary that relates to the topic.
Logical Order	Student cannot express the math process.	Student can express some of the steps involved in the related process, it might not be in order.	Student can express most of the steps in the process and they are in a logical order.	Student can express all steps in a logical order.
Mathematical Ideas	Student does not know how to relate math and cannot express any of the math ideas.	Student knows some math ideas, but cannot relate them to other math ideas. Student cannot express these ideas very clearly.	Student has a good knowledge of math and how it relates to other ideas. They might not always be able to express it.	Student has a knowledge of math ideas, how they relate to each other, and how to express those relations.

Curriculum Extensions/Adaptations/Integration

- Show students how to plot the stage number and total number of blocks on a grid. They can use the line graph to look at patterns in a new way.
- Have students create creature patterns with the blocks that tessellate a surface. They can color the blocks in or cut them from colored paper.
- Describe the animals in terms of fractions; the hexagon is the whole and the smaller pieces are fractions of it. The students can find the worth of their pattern.

Family Connections

- Students can create their own patterns at home and share them with their family.
- Have students complete the patterning practice sheet at home.

Additional Resources

Books

Lesson for Algebraic Thinking, by Maryann Wickett, Katharine Kharas, and Marilyn Burns; ISBN 0-941355-48-9

Web sites

<http://www.elcerritowire.com/4/algebra.htm>

Name _____

Patterning Practice

Directions: Fill in the missing information from each table.

Stage	Body + Tail	Total # of Blocks
1	$5 + 1$	6
2	$5 + 2$	
4	$5 + 4$	
6		11
		13
	$5 + 65$	
100		

Read through the information in the table below.

S	$7 + S$	T
1	$7 + 1$	8
2	$7 + 2$	9
3	$7 + 3$	10
4	$7 + 4$	11
5	$7 + 5$	12
6	$7 + 6$	13
7	$7 + 7$	14

Using complete sentences, explain what the pattern for this creature is.

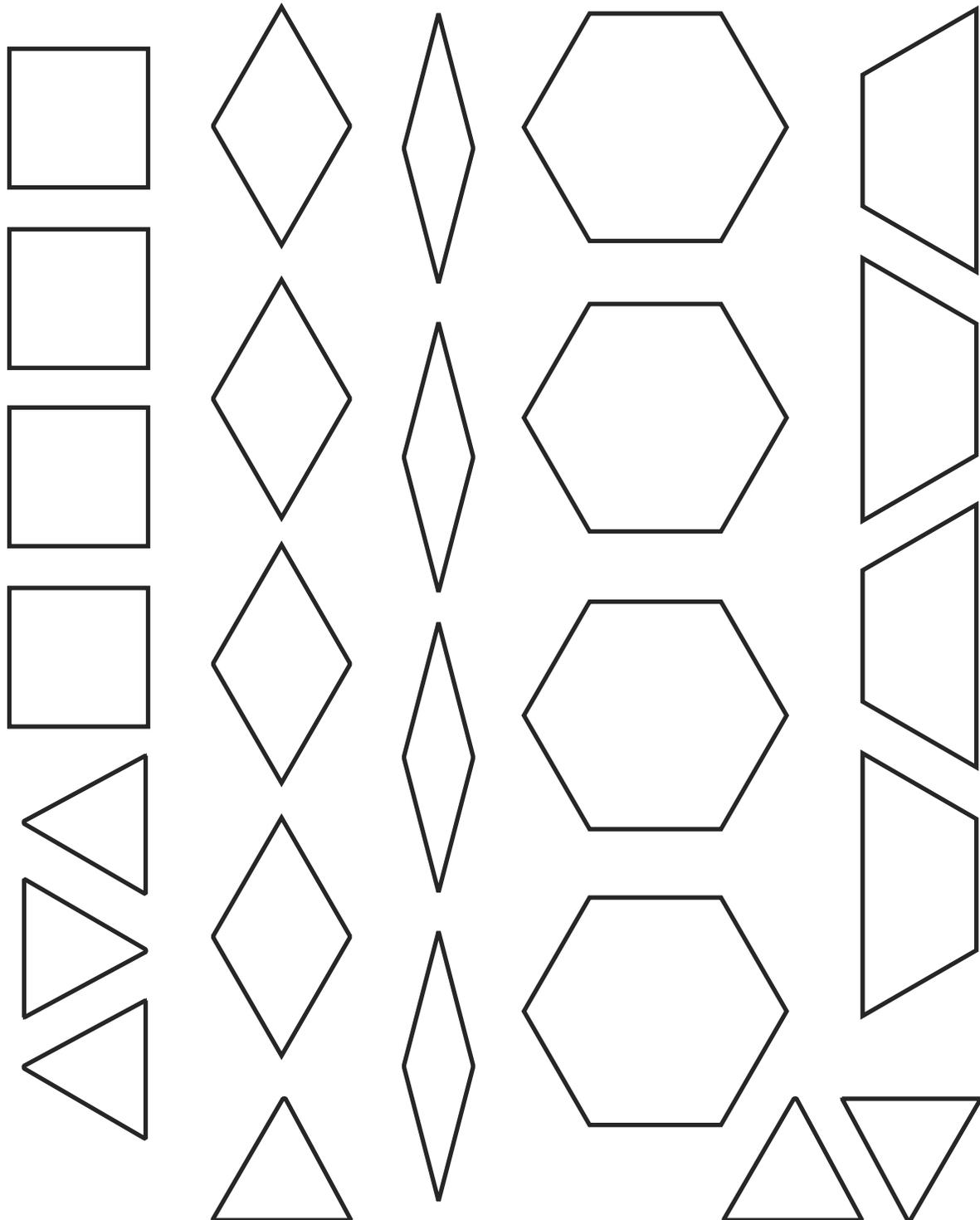
Stage	Constant + Variable	Total # of Blocks
2		10
	$8 + 6$	
10		18
25		
		52
73		
100		

Tell how many blocks you will need to complete the 100th stage. Explain how you know.

Stage	Constant + Variable	Total # of Blocks
		15
3		17
10		
24		
		63
74		88
101		

Patterns for Pattern Blocks

Make at least two copies of this page for each set of pattern blocks. Color the hexagons yellow, squares orange, triangles green, trapezoids red, and rhombuses blue. For durability, make copies at 100% on cardstock and laminate after coloring.



Equations

Math Standard II

Objective 2

Connections

Standard II:

Students will use patterns and relations to represent mathematical situations.

Objective 2:

Recognize, represent, and solve mathematical situations using patterns and symbols.

Intended Learning Outcomes:

1. Demonstrate a positive learning attitude toward mathematics.
2. Reason mathematically.
3. Make mathematical connections.

Content Connections:

Solving Equations

Background Information

In order to solve equations a student must understand that an equation includes an equal sign and two expressions (that may involve a math operation) of equal value. Teach your students to identify unknowns as missing information. It can be the same information, many different numbers, or just one value. A variable is a way to explain a value that students are not sure of.

Research Basis

Moyer, P.S. (2000). Communicating mathematically: Children's literature as natural connection. *The Reading Teacher*, Volume 54 (Issue 3), Page 246-255.

Monroe, E. E. & Panchyshyn, R. (1995-96). Vocabulary considerations for teaching mathematics. *Childhood Education*. Volume 72 (Issue 2), Page 80-83.

Monroe, E. E. & Orme, M. P. (2002). Developing mathematical vocabulary. *Preventing School Failure*, Volume 46 (Issue 3), Page 139-142.

Because vocabulary is an essential part of reading comprehension, we should incorporate it into our math comprehension. By using literature and vocabulary organizers we can help students incorporate abstract and unfamiliar math terms into useful daily language.

Students need to be exposed to the vocabulary through direct instruction and meaningful activities. Literature and group provide those opportunities.

Invitation to Learn

Explain to students that you need their help because your calculator is broken. Tell the students that you are trying to get the answer of 35, but the three and five keys are not working. Ask the

Materials

- Safari Park* by Stuart J. Murphy
- Story price sheet
- Sticky notes
- Chart paper
- Correct Equation*



students how they can get an answer of 35. You can limit it to sums if your students aren't comfortable with multiplication yet.

Instructional Procedures

1. Begin by reading the book *Safari Park*, and share the price list for the tickets so that students can follow the logic in the book. (It is recommended to read it once to introduce the book to the students and then use the organizer for the second read through. It might also be nice to allow students to talk about what rides they would go on). As book is read, stop and discuss the equations. Write them on the board and have students write the equations in their journal (this is a note taking strategy).
2. Review the vocabulary that was introduced from the Iguana activity. Help students identify the variable. Write the word on chart paper. Have the students work in pairs to give you an example of *variable* from the book. Leave this chart posted and refer to it through out the lesson.
3. By this point you should have been using the word *equation* often. Write it on the chart. Discuss what the definition of equation is. Have students give you essential characteristics (numbers, operation symbol, and equal sign). Then have them create an example and synonyms (number sentence, math problem) to be added to the chart.
4. Remind students that they will be using these words through out the lesson and they need to know what they mean. Refer to the equations from the book and make sure they know how the words apply to them.
5. Point out one of the equations from the book ($12 + 6 + 2 = 20$) and write both forms on the board (one with the variable and one without). Then rewrite the equation, but replace one of the numbers with a number that would imbalance the equation ($12 + 8 + 2 = 20$).
6. Ask students to evaluate whether each number sentence is an equation, and does it match our definition or not. They should identify the last one as not an equation and the middle one as either, depending on the number the symbol represents.
7. Have students explain why each is or is not an equation. (You will talk about the variable later.)

8. Post more number sentences on the board. Have groups discuss whether they are equations and how they know (encourage students to think aloud).
9. Create a T-chart. Label the whole chart equations, the left side yes and the right side no. Give students two sticky notes. Have them write two number sentences. Allow students to work in partners if they can't think of anything. Then allow students to place their sticky notes in the chart under the correct column that they go in. You can review the equations by keeping the poster up and classifying a few equations and non-equations every day.
10. Pick one of the equations and write it on the board. Ask what would happen if they didn't know one of the numbers. Could the students still figure out what it is? Rewrite the problem, changing one of the numbers to a symbol. Ask the students to talk with their partners to explain how they would find the unknown number. Then call on a student to explain the process to the class.
11. Explain that this is an open equation because we don't know if it is correct until we substitute the variable for a number. Show students that it could be true or false, but point out that we are always looking for true equations in mathematics.
12. Tell the students that if that process really works, they should be able to solve the following equation ($62 + \square = 85$). Ask students to solve the equation and find out what box equals. Allow time to work and then have them describe to a neighbor what they were able to do. Call on students to describe what they did to solve the problem. Encourage students to explain their strategies.
13. Assign students to create their own list of open equations (tell them to keep it simple: only one operation, one variable and two or three numbers). Instruct students to also include the value of the variable.
14. Have students share their equations with a partner. Explain that the partner must check to make sure their equations and answers are correct by solving them.

Assessment Suggestions

- Ask students to create a definition and example for the vocabulary words used that day to go in their math journal as a tool.

- Have students complete the *Correct Equations* sheet.
- Give students a few problems everyday from the equations chart. Assign students to write in their journal if the equation is true or false and why.

Curriculum Extensions/Adaptations/ Integration

- Research where numbers, equations, and variables came from. Have students write a small how-to paper for other students to use when they need help.
- Input/Output patterns

Family Connections

- Students teach the game to a family member.
- Students complete true or false sheet.
- Students create equations and then teach their family members how to solve.

Additional Resources

Books

Lesson for Algebraic Thinking, by Maryann Wickett, Katharine Kharas, and Marilyn Burns;
ISBN 0-941355-48-9

Math Matters: Understanding the Math You Teach Grades K-6, by Suzanne H. Chapin and Art
Johnson; ISBN 0-941355-26-8

Web Sites

<http://www.eduplace.com/math/mw/tools>

<http://www.eduplace.com/kides/mw>

Name _____

Correct Equations

Directions: Write the number sentences in the table under the correct group.

$4 \times 5 = 20$	$9 + 5 = 10$	$6 \times 3 = 12$	$3 \times 3 = 9$	$5 - 3 = 2$
$6 + 6 = 12$	$3 - 1 = 1$	$9 + 3 = 12$	$8 + 8 = 17$	$10 - 3 = 4$
$12 - 8 = 4$	$13 + 2 = 15$	$14 - 9 = 6$	$20 - 8 = 12$	$30 - 10 = 20$
$35 - 17 = 15$	$23 - 9 = 14$	$34 + 12 = 46$	$27 + 6 = 30$	$4 \times 3 = 10$
$5 \times 5 = 25$	$9 \times 1 = 9$	$40 - 14 = 20$	$46 + 14 = 60$	$33 - 11 = 22$

Equation	Not an Equation

Explain how you know if number sentence is an equation.

Safari Park Rides

Jungle Kings	Rhino Rides	Monkey Games	Tiger Treats
4 Tickets Each	2 Tickets Each	1 Ticket Each	1 Ticket Each
Wilderness Cars	Hippo-Dome	Rock Toss	Cotton Candy
Treetop Coaster	Elephant Twirl	Giraffe Ball	Popcorn
River Raft	Bat Tunnel	Snake Charmer	Pretzel
Tiger Wheel	Rope Swing	Sebra Run	Soda

Terrible Tarantula – 6 Tickets

Following the Order

Math Standard II

Objective 2

Connections

Standard II:
Students will use patterns and relations to represent mathematical situations.
Objective 2:
Recognize, represent, and solve mathematical situations using patterns and symbols.
Intended Learning Outcomes:
<ol style="list-style-type: none"> 1. Demonstrate a positive learning attitude toward mathematics. 2. Reason mathematically. 3. Make mathematical connections.
Content Connections:
Balancing and Solving Equations

Background Information

The order of operations is key in solving multi-stepped equations. Students need to see that the result of a calculation depends on the order in which the operations are preformed. Teach students to solve the parenthesis first, then multiplication, division, addition, and subtraction. Students can also use the order of operations to look at balancing equations. They need to know that equations can be written differently but still be equal.

Research Basis

- Hildebrandt, C. (1998). Developing mathematical understanding through invented games. *Teaching Children Mathematics*, Page 388-393.
- Smith, B.L., & MacGregor, J.T. (1998). What is collaborative learning? In K.A. Feldman and M.B. Paulsen (eds.) *Teaching and Learning in the Classroom* (2nd. ed., pp.585-596). Boston, MA: Pearson Custom Publishing

Games provide students repeated practice that challenges them on their level, along with providing informal assessment for teachers. Games are a way to motivate students without overwhelming them. By working in small groups or with partners students solidify their mathematical understanding and learn from each other.

Invitation to Learn

Now draw students' attention to the board. Write three numbers on the board (3, 5, 8). Explain that even when we know all of the numbers in an expression the answer might be tricky to find. Ask the students to guess what the answer to this a computation using these numbers is. Take guesses for awhile (if students want a hint explain that you are using two operations, addition and multiplication). After

collecting a variety of answers explain that you got the answer 23. Ask students how they could get so many answers. Allow students to talk and discuss.

Instructional Procedures

1. After students have discussed in small groups, ask students to share their thoughts and write these down on the board. I like to write their ideas in complete sentences to set the standard for students' work.
2. If students haven't brought up the idea of parentheses, introduce that now. Share with the students how you make this expression equal 23. $(3 \times 5) + 8 = 23$.
3. Explain that mathematicians have agreed on an order to evaluating expressions. They always use this order. The Order of Operations states that number expressions inside parentheses need to be done first.
4. Give students an example and have them tell which operation to do first.
5. Explain to students that today they will be playing a game that requires them to use the order of operations to create expressions. Take a moment to make sure students know what an expression is and what it looks like.
6. Turn over a number card and explain to students that they need to create an expression that equals this amount. Now turn over six cards and tell students to pick four of the numbers to create the expression. Have students work in their groups to come up with their expression.
7. After students are finished record their expressions on the board.
8. Have students check to make sure the expressions are true (mathematicians always want true equations).
9. Pull out another target amount, then discard the four used cards and draw four new ones. Again have the students create an expression using four of the cards. After working in groups have students share expressions and check their work.
If students need more practice follow the steps above until students are comfortable.
10. Introduce the game and score sheet. Show the students how to record their work on the sheet. Emphasize that they must write a complete equation.
11. Divide students into partners or groups of three and give students time to play.

Materials

- Index cards
- Chart paper
- Expressions
- Equation Concentration Cards
- Equation Organizer



12. While students are playing walk around and question students about their work. Have them explain to you why they created equations the way they did or explain another way to do it. Help students to see that there are always many ways to create an equation.

If students are struggling, have them use only three cards or make them use all six cards if they need a challenge. After letting them play for awhile, have students use multiplication and division in each equation.

13. After playing for awhile, gather the class for discussion on what they learned. Ask students to explain what strategies they learned that helped them win. Have them be very specific when describing their process. I would also follow up with a journal entry about what they learned and what they will do next time.
14. Assign students to take the equations sheet home for practice.

Day 2

15. To review the order of operations by writing the following equation on the board. $5 \times 4 + 2 = 40$. Ask students if this is a correct equation and to explain why. Hopefully students will point out that the problem needs parentheses in order to make it correct. If not guide them to do so. Remind students that when there are parentheses it indicates what to do first in a computation.
16. Explain that today students will be learning about different expressions that equal the same thing. Write the number 20 on the board. Show students that there are many different ways to create an expression that equals 20 ($10 + 10$, 4×5 , etc.) and have the students start giving ideas as well.
17. Pass out index cards, give students a target number, and have groups of students come up with two different expressions that equal the target number.
18. Take two expressions and tape them on the board. Remove the 20 and put an equal sign between both equations. Ask students if this is a true equation and why. Help students to see that even though the expressions are different they are equal because they both equal the same number.
19. Pass out the equation organizer and four index cards to partners. Have students each write two expressions that equal each other (or balance), put them on the organizer and draw an equal sign between the two. You can continue to practice this if students are not ready for independent practice.
20. Pass out the equation concentration cards to the partners. Have them use the same equation organizer to put their cards on.

21. Model how to turn two cards over, put them on their organizer and see if they balance. If the cards balance they can be set aside and collected. The person who receives the most cards wins.
22. Have students take another copy of the concentration game home to play with their family.

Assessment Suggestions

- Have students complete the *Expressions* sheet.
- Use performance rubric to check their understanding of expressions and equations.
- Listen to students explanation of evaluating expressions

Performance Rubric

Performance Rubric	1	2	3	4
Use of Vocabulary (e.g. expression vs. equation)	Student does not use math vocabulary.	Student uses some math vocabulary, not necessarily related to topic.	Students use most of the related math vocabulary.	Students use all math vocabulary that relates to the topic.
Logical Processing	Student cannot express the math process.	Student can express some of the steps involved in the related process, it might not be in order.	Student can express most of the steps in the process and they are in a logical order.	Student can express all steps in a logical order.
Interaction	Student does not interact with group when it relates to math.	Student talks with the group, but mostly about other topics. The student does not participate in discovering the process	The student talks with the group about some of the math topics and helps occasionally to discover new processes.	Student talks openly about math and is very active in discovering the new process.
Listening Skills	Student does not listen to learn.	Student will listen occasionally, but not enough to repeat what was discussed.	Student listens most of the time and can repeat what was heard.	Student can listen attentively, repeat things, and apply what was discussed.

Curriculum Extensions/Adaptations/ Integration

- Research where numbers, equations, and variables came from. Have students write a small how-to paper for other students to use when they need help.
- Input/Output patterns
- Balance equations using the order of operations and variables.

Family Connections

- Students teach one of the games to a family member.
- Students complete Expressions sheet.

Additional Resources

Books

Lesson for Algebraic Thinking, by Maryann Wickett, Katharine Kharas, and Marilyn Burns;
ISBN 0-941355-48-9

Every Day Counts Partner Games, by Janet Gillespie and Patsy Kanter: ISBN 0-669-51944-8

Web sites

<http://www.eduplace.com/math/mw/tools>

<http://www.eduplace.com/kis/mw>

Name _____

Expressions

Find the value of each expression.

1. $(6 + 3) \times 4$

5. $(7 - 5) \times 6$

9. $(13 + 8) \times 2$

2. $8 + (5 \times 3)$

6. $9 - (21 \div 7)$

10. $3 \times (12 - 8)$

3. $7 + (6 \times 3) - 10$

7. $30 - (3 \times 3)$

11. $(18 - 3) \div 5$

4. $(6 + 5) \times (4 - 7)$

8. $18 + (9 \times 7) - 13$

12. $5 \times (6 + 3)$

Rewrite the expression using parenthesis to make it equal 10.

$30 + 20 \div 5$

$3 + 14 \div 2$

$6 \times 3 - 8$

$1 + 27 \div 3$

$9 - 7 \times 5$

$35 \div 7 + 5$

Equation Concentration Cards

2×3	$4 + 2$	$(6 \times 8) + 2$	5×10	$(7 \times 5) + 5$
4×10	$5 + 8 + 2$	3×5	$(5 \times 4) + 4$	6×4
$(12 + 4) \div 2$	2×4	$27 \div 9$	$(10 - 9) + 2$	$30 - 20$
$(2 \times 3) + 4$	$10 + 3$	$(30 \div 2) - 2$	$100 \div 10$	$5 + 5$
50×4	$100 + 100$	$45 \div 3$	3×5	10×6
5×12	5×11	$(9 \times 5) + 10$	4×12	$(5 \times 10) - 2$

Equation Concentration Cards cont.

3×3	$4 + 5$	$(8 \times 8) + 2$	$(6 \times 10) + 4$	$(5 \times 5) + 5$
3×10	$4 + 8 + 4$	4×4	$(5 \times 4) + 5$	5×5
$(10 + 4) \div 2$	$4 + 4$	$27 \div 9$	$(11 - 9) + 1$	$40 - 30$
$(2 \times 4) + 2$	$12 + 4$	$(30 \div 2) - 1$	$100 \div 10$	$55 - 45$
30×3	$(10 \times 10) - 10$	$35 \div 7$	1×5	10×6
$(15 + 15) + 30$	5×11	$(7 \times 5) + 20$	3×12	$(4 \times 10) - 4$

Equation Organizer

Equation #1	=	Equation #2

Target Number

2-3 players

Materials: Number cards or dice, score sheet, pencil

Rules: Players are trying to create an expression that equals the target number before their partner.

1. First draw one card to be the target number.
2. Then each player draws six cards and then picks four of those cards to create an expression to equal the target amount. The target amount, cards used, and expression are recorded.
3. Put the used cards on the bottom of the deck. Keep the two that were not used.
4. Pick a new target amount and draw four more cards so that you have a total of six cards.
5. Repeat the process of creating an expression.
6. Play ten rounds.
7. If an expression cannot be made the player may trade two of their cards for two new ones by placing the old cards on the bottom of the pile and picking two new ones from the top.

Target Number Score Sheet

Round	Target	Cards	Expression
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Science II-All

Activities

Air Pressure

Discovering Earth's Air Pressure

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 3:
Evaluate weather predictions based upon observational data
Intended Learning Outcomes:
1- Use Science Process and Thinking Skills
3- Understand Science Concepts and Principles
Content Connections:
Language Arts, Writing

Science
Standard
II
Objective
3

Connections

Background Information

The air at sea level is about 15 pounds of air pressure per square inch. The higher we go above sea level on Earth's surface, like on a high mountain in Utah, the weaker the air pressure is, resulting in an air pressure that is below 15 pounds per square inch. As you can probably figure out, as air gets higher and higher above Earth's surface, it is less dense. There are fewer gas molecules in a given volume as we go up in elevation, therefore, making the air pressure less and less. Finally, at the edge of the air and space there is no hardly any air pressure at all.

Our atmosphere goes up about 70 miles above Earth. From 70 miles above Earth to the surface of Earth there are air molecules that occupy volume in the air. These air molecules create more and more weight on the air molecules under each one, pushing them closer together causing a significant amount of air pressure at Earth's surface. Think of five people stacked on top of each other, each weighing 100 pounds. The top person wouldn't feel any weight at all because nothing is on top of him, so he feels no pressure. The 2nd person from the top feels the weight of the one person, feeling 100 pounds of pressure. The third person from the top feels the weight of two people, feeling 200 pounds of pressure. The fourth person would feel 300 pounds of pressure. Finally, the bottom person would feel 400 pounds of pressure as a result of four people being on top of him.

The air molecules stacked on top of each other react the same way. The air molecules at the top of the atmosphere (70 miles up) do not have much weight on them, resulting in very little air pressure. The air molecules at Earth's surface (the bottom of the pile) are being

pushed together by all the weight of the air molecules from top to bottom resulting in 15 pounds of pressure per square inch.

Research Basis

Townsend, J., Bunton, K., (2006). Indicators for inquiry. *Science and Children*, Volume 43 (Number 5), Page 37

The National Science Education Standards specifically state that students should be able to observe simple objects and patterns and report their observations. When inquiry is involved with a hands-on approach, the topics cater to the natural curiosity of children and allow them to use a wide range of investigation and science-process skills. As children explore, the teacher can provide some guiding questions that may lead the way.

Heuser, D., (2005). Inquiry, science workshop style. *Science and Children*, Volume 43 (Number 2), Page 32

A good science workshop inquiry mode should be in three parts:

- Exploration—hands-on experiences to produce interest and knowledge of desired science ideas to generate student questions.
- Investigation—experiments based on student questions
- Reflection—Reflective activities including discussion and writing to be unified in the results of the experiments. What did we learn?

Ketch, A., (2005). Conversation: the comprehension connection. *The Reading Teacher*, Vol. 59 (Number 1), Page 8

Students who engage in conversation in the classroom become reflective thinkers. Conversation brings meaning to life 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.

Invitation to Learn

The Case of the Leaky Bottle

Put four pinholes in a two-liter bottle vertically in straight line starting at the bottom and ending at the curve, equally distant from each other. Put masking tape over the holes. Put water in the bottle to the very top. With the bottle over a tote tray to catch the water, take the top piece of tape off.

Materials

- Water
- 2-liter bottle
- Masking tape
- Empty tote tray



- Ask, “What do you see?” (Water is coming out of the hole.)
- Ask, “What do you think will happen when the second tape is taken off?” (The water will come out of this hole too.)
- Take the second tape off. Ask, “What are you observing now? (The water from the second hole is flowing out farther than the water from first hole.)
- Tell them, “Predict what is going to happen when the third piece of tape is taken off.” (They are probably catching on that water will shoot out of the third hole and go farther than the first and second streams of water.) Take off the third piece.
- Ask, “What will happen when the fourth piece of tape is taken off the bottle?” (They will probably predict that the water will flow out farther than the other three.) Take off the fourth piece.
- Ask the students, “Why is the water flowing out farther from the bottom hole than the other three holes?” (Have them give their answers of what they think.)
- Continue to tell them that there is more weight at the bottom of the bottle than at the top of the bottle causing more pressure to push the water out stronger at the bottom than at the top. Tell them the example of the people stacked on each other from the “Background Knowledge” how the bottom person feels more weight and pressure than the other four on top.

Instructional Procedures

Pushing Air to the Limit

Tell the students that our air has about 15 pounds of pressure at Earth surface for the same reason the water had pressure to push the water out farther at the bottom of the bottle than at the top of the bottle. The difference is that there are air molecules stacked on each other causing the air pressure and not water molecules causing the air pressure. We are going to actually see the air pressure actively pressing against something today. (As you show this experiment have the students write down their predictions and what they observe in their journals.)

1. Get a large V-8 sized can and punch a hole in it with a hammer and nail.
2. Put a piece of masking tape over the hole.
3. Fill the can with water. Hold the can over an empty tote tray.

Materials

- Water
- Large V-8 can
- Tote tray
- Nail and hammer
- 12” balloon
- Scissors
- Masking tape



4. Ask the students, “What do you think will happen when I take the tape off the can?” (The water is going to flow out.) Take off the tape to see the water flow out.
5. Tell the students that they will be shown this experiment again, but this time before the tape is taken off we are going to stretch a balloon across the top of the can.
6. Dump the water out of the can. Wipe the water off over the hole where the tape was and put some more tape over the hole. Fill the can up with water. Dry off the lip of the can so the balloon that you are going to stretch over the top won’t slip off.
7. With scissors, cut off the neck of a 12” balloon. While someone is holding the can, stretch the balloon over the opening of the can.
8. Tell the students, “Predict what you think is going to happen now that there is a balloon on the can.” (Have them tell their predictions.)
9. Tell the students to observe the balloon and the hole in the can closely. Take off the tape.
10. Ask, “What happened?” (The water ran out of the can for a little while but stopped running out. The balloon started to sink into the can and then stopped. As the balloon was actively sinking down into the can that is when the water was running out. As soon as the balloon stopped sinking down, the water stopped.)
11. Ask, “What pushed the balloon down into the can?” (Air pressure.) “What was the water doing with while the balloon was being pushed down?” (Water was coming out of the hole.) “Why did the water stop coming out?” (The air couldn’t push the balloon down anymore and the water stopped coming out.)

Assessment Suggestions

1. Divide the class into groups of three or four students and ask them to discuss and answer these questions in their journals or on paper. (See Worksheet *What Is It With Air Pressure?*)
 - a. What causes air pressure on Earth?
 - b. Why isn’t there as much air pressure higher in the sky as there is on Earth?

- c. Describe the experiment with the V-8 can and the balloon. Explain how this shows that air pressure exists.
 - d. What do you think would happen if the balloon was taken off the top of the can?
 - e. Would these experiments work up in the atmosphere? Explain your answer.
 - f. How are the water in the bottle experiment and the water in the can similar?
 - g. Thinking question: Why do you need air pressure to drink water from a straw?
2. Have the students draw a picture of the “air pressing on the balloon” experiment. Have them label the parts and show where the air pressure is with arrows. Have them write a caption of what is happening in the experiment.
 3. Have the students replicate the experiment at their desks in groups of three or four. Then ask them to investigate further ways to show that air pressure exists with the materials they have.

Curriculum Extensions/Adaptations/Integration

- For advanced learners, have them investigate other ways of showing that air pressure exists.
- For learners of special needs, have them replicate the experiments that they were shown and describe what is happening to a classmate.
- Have the students draw a picture of what the air molecules look like bunched up together near the surface of Earth and how they gradually get further apart the higher the air molecules go out near the edge of space. (Visual Arts: Standard III, Objective 2)

Family Connections

1. Send home a list of materials needed for the students to show their families the two experiments they were shown or did in class. Have them explain the reasons behind the results of the two experiments.

2. Have the student go to the library and check out books about more experiments that can be done with air and pressure. Have them do them as families to learn more about the properties of air.

Additional Resources

Books

Weather, Gail Gibbons 082340952X

Weather Words, Seymour Simon, 0060884398

Handy Weather Answer Book by Walter A. Lyons 0760757674

Videos

Heat, Wind and Pressure, VH, 2001 United Learning

Weather, VH, 2001 United Learning

What Is It About Air Pressure?

I. Gather together in groups of three, four, or five. Discuss these questions as a group. Write down the answers with help of the discussion.

1. What causes high air pressure on Earth?

2. Why isn't there as much air pressure higher in the sky as there is on Earth?

3. Describe the experiment with the V-8 can and the balloon. Explain how this shows that air pressure exists.

4. What do you think would happen if the balloon were taken off the top of the can?

5. Would this experiments work higher up in the atmosphere? Explain your answer.

6. How are the water in the bottle and water in the can experiments similar?

7. Thinking question: Why do you need air pressure to drink water from a straw?

II. Draw pictures of the "leaky water can" experiment. Label the different parts and show where the air pressure is with arrows. Write captions under each picture of what is happening in the experiment.

The Changing Life of Air Pressure

Science
Standard

II

Objective

3

Connections

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 3:

Evaluate weather predictions based upon observational data.

Intended Learning Outcomes:

- 1- Use Science Process and Thinking Skills
- 3- Understand Science Concepts and Principles

Content Connections:

Language Arts, Writing

Background Information

Depending on how many air molecules there are in a given space depends on how much air pressure there will be in that space. As stated previously, the air pressure on Earth's surface (at sea level) is about 15 pounds per square inch. However, the air pressure above Earth's surface gradually gets less and less the higher the air is because there are fewer air molecules packed together in the same amount of space. The weight of the molecules stacked on each other are not as great in the upper atmosphere as they are on Earth's surface.

But, can air pressure in a given area be reduced at or near Earth's surface? If it can, what is the outcome? Whenever something gets hot (such as by the sun, a burner or, a flame) it—in turn—heats the air and the air rises. The reason it rises is the air molecules spread out causing fewer air particles existing in that given area. When there are fewer air particles in a given area a low pressure is created. The air rises like a bubble in water because the air is now lighter. The air farther out that is not being affected by the heat has a higher pressure than the air around the candle. Therefore, this outside air having more pressure moves into the lower pressure. Whenever a high-pressure area meets a low-pressure area, the high pressure will always move into the low area. These differences in air pressure are what cause air masses to move and create weather.

Research Basis

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report their observations. When inquiry is involved with a hands-on approach, the topics cater to the natural curiosity of children and allow them to use a wide range of investigation and science-process skills. As children explore, the teacher can provide some guiding questions that may lead the way.

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Invitation to Learn

The Soda Bottle Crush

Explain to the students that air pressure at any location changes over time. Sometimes air can be a high pressure area and sometimes it can be in a low pressure area depending on how much air is in a given area. As stated in the background information, heating air will cause the air to rise and become a low-pressure area.

Show the following experiment to the students. Tell the students to observe what is happening. The only words that will be spoken are by the teacher telling what he/she is doing. The students are to write in their journals what the teacher is doing and write down what they are observing.

1. Fill up a graduated pouring container with 500 ml of very hot water. (Don't use boiling water because it might melt the two-liter bottle.)
2. With a funnel in a two-liter bottle, pour the hot water into the

Materials

- Two-liter bottle with lid
- Hot water
- Funnel
- Graduated pouring container (ml)



bottle.

3. Keep the hot water in the bottle for about a minute, then pour it out.
4. After pouring it out, quickly put the lid on so no cold air can get into the bottle.
5. Set it down on the table and tell the students to observe and write down what happens during the next couple of minutes. (The bottle will begin to crush.)
6. Have the students write down a conclusion why the bottled was crushed, but don't discuss it at this time. (The hot water caused the air to heat up and created a low pressure. After the hot water was pushed out and the lid put on the air began to cool and sink, but the low pressure was still in the bottle. The high pressure outside the bottle pushed in on the bottle, crushing it.)

Instructional Procedures

Materials

- 20 oz bottle (glass) that juice comes in with the opening about the size of an egg (you can usually find it in the nutrition section of a grocery store)
- Piece of paper towel
- Matches or fireplace lighter
- Medium sized balloon filled with water about the size of an egg



Activity One—Pop Goes the Balloon

With the following experiment, we want to show that when a low pressure area is created, a high pressure area surrounding the low pressure will rush into that area. We are actually going to see the air pressure actively pushing into a low pressure area.

1. Have the students take notes and answer the teacher questions in their journals.
2. Get a glass juice bottle that has an opening about the size of a medium or large egg.
3. Ask the students what is in the bottle. (Air)
4. Put the egg-sized balloon on the opening of the bottle and try to push it in with your index finger. Ask, "What is happening?" (It won't go in.) Ask, "Why won't the balloon go in?" (Because the air in the bottle is full of air and it won't let the balloon in. It has the same amount of air pressure in the bottle that is outside the bottle.)
5. Tell the students that today they are going to see air pressure push the balloon into the bottle. Ask the students, "What is going to have to happen to get the balloon inside the bottle." (The air pressure inside the bottle needs to be less than the air pressure on the outside of the bottle.)

6. Ask, “What do we need to do to the air to lessen the air pressure in the bottle?” (Heat the air somehow.)
7. Tell the students how you are going to do to lower the pressure inside the bottle with heat. Tell them that you want them to observe your every move and observe carefully what is happening in the experiment. Before you start make sure they are all attentive because they are going to observe things with their eyes, ears, and nose.
8. Tell the students of the following steps you are going to take to get the egg into the bottle.
 - Tear off a small piece of paper towel (2”x 2”) and roll it up.
 - Light the piece of paper at one of the ends and drop it into the bottle.
 - Quickly put the egg-sized balloon on the bottle. Tell the students to watch carefully. They might see the balloon dance around on top of the bottle for a few seconds.
9. Do the three directions that are listed in the bullets above in number seven. Have the students observe.
10. When the experiment is over, ask, “What is the final thing that happened in the experiment?” (The balloon went into the bottle.)
11. Ask, “What are some of the things you saw happening during the experiment before the egg went into the bottle? (The flame burned inside the bottle. When the egg was on the bottle, it jumped around for a few seconds. The flame went out in just a few seconds. When the flame went out the egg dropped in.)
12. Ask a few questions:
 - What was the flame doing to the air inside the bottle? (It was heating the air.)
 - Why was the egg dancing on top of the bottle? (The hot air was rising and escaping from the bottle through the bottle opening making the egg go up and down.)
 - Once air left the bottle what was created in the bottle? (A low pressure area because now there was less air in the bottle in the same sized space.)
 - Why did the flame go out? (There was no more oxygen to burn.)

- Why did the egg pop into the bottle? (When the flame went out, the air gathered together. Since there was less air in the bottle there was now a low pressure area in the bottle. The high pressure wanted to go into bottle, but it had to push the egg in first to get into the bottle.)
 - Remember, when a high pressure area meets a low pressure area, the high pressure will always go into the low pressure area.
13. Now, pull the balloon out of the bottle by the tied end. What do you observe? (There was a popping sound.) What caused the sound? (With to balloon in the bottle, it took up space in the bottle. Once the balloon is pulled out, more air must go in the bottle to fill up the empty space the balloon once occupied. The popping sound in the sound of rushing air—high pressure to low pressure.)

Assessment Suggestions

1. Divide the class into groups of three or four students and ask them to discuss and answer these questions in their journals or on paper.
 - a. In the juice jar/balloon experiment, what caused the air pressure to change in the bottle?
 - b. When heat is causing a pressure change, where does the hot air go? Explain.
 - c. Describe the experiment with juice jar/balloon. Explain how a low pressure was created and what showed that the high pressure wanted to go into the low-pressure area.
 - d. When the balloon went into the bottle, what did you hear? Explain.
 - e. When the balloon was pulled out of the bottle, what sound did you hear? Explain.
 - f. Explain other times you hear high pressure rushing in to low pressure areas.
2. Have the students draw pictures of one or both experiments. Have them label the parts and show where the high pressures and the low pressures are. Have them write a caption of what is happening in the experiment(s).

Curriculum Extensions/Adaptations/ Integration

- For advanced learners, have them investigate other ways of showing that high pressure wants to go into a low pressure area.
- For learners of special needs, have them explain verbally to a classmate what happened in each experiment. Possibly the teacher could replicate the experiment(s) for the special needs learner letting him/her explain what is happening.
- Have the students draw pictures of the two bottles used to create a low pressure. Have them show on these bottles what the air molecules look like in the high pressure area and in the low pressure areas. (Visual Arts: Standard III, Objective 2)

Family Connections

1. Send home a list of materials needed for the students to show their families the two experiments they were shown or did in class. Have them explain the reasons behind the results of the two experiments.
2. Have the student go to the library and check out books about more experiments that can be done with air pressure. Have them do them as families to learn more about air pressure.

Additional Resources

Books

Weather, Gail Gibbons 082340952X

Weather Words, Seymour Simon, 0060884398

Handy Weather Answer Book by Walter A. Lyons 0760757674

Videos

Heat, Wind and Pressure, VH, 2001 United Learning

Name _____

The Effects of Air Pressure Change—High to Low

I. Gather together in groups of three, four, or five. Discuss these questions as a group. Write down the answers with help of the discussion.

1. In the juice jar/balloon experiment, what caused the air pressure to change in the bottle?

2. When heat is causing a pressure change, where does the hot air go? Explain.

3. Describe the experiment with juice jar and balloon. Explain how a low pressure was created and what showed that the high pressure wanted to go into the low pressure area.

4. When the balloon went into the bottle, what did you hear? Explain.

5. When the balloon was pulled out of the bottle, what did you hear? Explain.

6. Explain other times you hear high pressure rushing in to low pressure areas.

II. Draw pictures of the “juice bottle/balloon” experiment. Label the different parts and show where the air pressure is with arrows. Write captions under each picture of what is happening in the experiment.

What is a Barometer?

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 3:

Evaluate weather predictions based upon observational data.

Intended Learning Outcomes:

- 1- Use Science Process and Thinking Skills
- 3- Understand Science Concepts and Principles

Content Connections:

Language Arts, Writing

Science
Standard

II

Objective

3

Connections

Background Information

As previously mentioned, Earth's air has pressure because of the air molecules stacked on top of each other from Earth's surface to the edge of space which is about 70 vertical miles. This pressure is greatest at Earth's surface, and gradually this pressure lessens as the air goes vertical toward space. However, as previously mentioned, the air pressure can change at and near Earth's surface. It changes because of more pressure put on these air molecules or less pressure on these air molecules. It is this pressure change at and near Earth's surface that brings us our different weather. It has an effect on the temperature, the movement of the air (wind), the types of clouds that will form, and the type of precipitation. And most of all, the changing air pressure is what makes the water cycle continue to go on and on and on.

There is an instrument that we use to measure the air pressure and it is called a barometer. There are numbers on a barometer that range from 28 to 31. *One misconception that many people have about the barometer is that a barometer measures temperature because of these numbers.* But these numbers measure the air pressure. (The story in Activity One will tell you why we use these numbers.) *Another misconception about the barometer is that people believe that the barometer tells us what the weather is right now. The most fascinating thing about the barometer is that the barometer tells us what that weather is going to be in one or two days. It is a device for predicting the weather.*

Generally, if the needle on a barometer is above 30, our area is going to have nice weather for at least one to two days. The higher the needle is above 30 the nicer the weather will be. Generally, if the needle of a barometer drops below 30 there is going to be change in the weather. The temperature is going to change, clouds will be moving in, there is going to be a change in the air movement (wind),

and we could get some precipitation. The lower the needle moves below 30, the more drastic these changes will be in a couple of days. Generally, if the barometer is at 30 this means we could lose our very nice fair weather to some wind, partly clouded skies, and a slight temperature change, but usually with no storms on the horizon. The 30 means that a storm is nearby, but it isn't going to reach us.

Research Basis

Neufeld, P., (2006). Comprehension instruction in content area classes. *Reading Teacher*, Vol. 59 (Number 4), Page 302

For students to be able to successfully comprehend the texts of social studies and science, teachers need to be teaching comprehension strategies and not leave them alone in finding their own devices.

Ideas to consider in comprehension in content reading are:

- What is the purpose of this reading?
- How is the text organized?
- What are the key words?
- What are the important points?
- What type of graphic organizer can be used?
- What assessments can be used for understanding?

Fisher, D., Ivey, G., (2005). Literacy and language as learning in content-area classes: a departure from "every teacher a teacher of reading". *Action in Teacher Education*, Vol. 27 (Number 2), Page 2

All learning is language based. Including reading and writing regularly as ways for students to gain new information is important. Before, during, and after a prescribed activity, reading, writing, listening, viewing, and discussion should play a larger role than lecture. In the content areas creating the reading and writing experiences should focus on the big ideas.

Invitation to Learn

Materials

- Weather map(s) from the newspaper
- Aneroid barometer



The Highs and Lows of Weather

Pass out to the students a weather map from the newspaper that has many highs (H) and lows (L) on it. They can each have his/her own copy of different days or make a copy so each student gets the same one.

1. Ask, "Do you know what this paper is?" (It is a weather map from the newspaper.)
1. Ask, "Why is this in the newspaper each day?" (It tells us what the weather is going to be for that day.)

2. Ask, “How do weather forecasters (meteorologists) know what the weather is going to be?” (They have weather instruments that help them predict the upcoming weather.)
3. Ask, “What do the capital H’s and L’s mean on a weather map. (They may not know the answer to this, so you may have to tell them. The H’s mean that those places have a high pressure over them and they are going to have nice weather for the next couple of days. The L’s mean that those places have a low pressure over them and they are going to have stormy weather for the next couple of days.)
4. Ask, “What other symbols do you see around the L’s?” (Rain and/or snow.)
5. Ask, “Do you see other symbols around the H’s? (Yes, if there is a sun; no if there is nothing there.) This means they will have a lot of sunshine today.
6. Show the students a barometer. Tell them that this is one of the instruments meteorologists use to predict the weather. This is called an aneroid barometer. This instrument measures the air pressure and shows air pressure changes. It tells us if the air pressure is high (H) or if the air pressure is low (L). But there is something special about a barometer. This instrument tells us what the weather is going to be like in one or two days not what the weather is like today. Today we are going to learn about the barometer and how it helps us predict the weather.

Instructional Procedures

The Discovery of the Barometer (a teacher demonstration)

1. Put on a white lab coat, if possible, so you look like a scientist.
2. Set up a similar situation that Torricelli had when he discovered the mercury barometer.
 - Bowl with colored water in it.
 - Two hollow balloon holders taped together with a 29” mark on it, a 30” mark on it, and a 31” mark on it.
3. Pass out the shared reading of *Torricelli and the First Barometer* (if desired).

Materials

- Overhead projector
- Overheads of the presentation of the “Discovery of the Barometer”
- Shared reading about the barometer discovery
- Hollow balloon holders
- Small bowl
- Food coloring (any color)
- Water
- Lab coat (optional)



4. As you read the story put up the different overheads so the students have a visual idea of what is happening in the reading.

The Story of the First Barometer

Around the time of 1643, there was a young scientist/mathematician by the name of Evangelisti Torricelli who was very interested in air pressure. (Put on the picture of Torricelli.) Scientists at the time knew that air pressure existed and they knew that it changed. They had an idea that when there was an air pressure change there was going to be stormy weather. But, they had no way of measuring the air pressure like they could measure temperature with a thermometer. Torricelli was very interested in finding a way to measure air pressure so he could see air pressure changes.

One day Torricelli got a three-foot glass tube that was closed in at one end and open at the other. (Show the picture of Torricelli with the tube in his hand.) With a suggestion from his friend, Galileo, he filled the glass tube with mercury. (Show the plastic tube.) Mercury is a liquid metal that is much heavier than water. He also had a bowl of liquid mercury. (Show the bowl of colored water.) After filling the glass tube with mercury, he tipped the tube upside down, holding the open end with his finger so the mercury wouldn't run out. (Demonstrate this with the plastic tube.) With his finger on the end he gently put the open end of the tube in the bowl of mercury. He then took his finger off the glass tube. (Put the tube into the water and take your finger off.) At his surprise the mercury dropped about 6 inches to the 30-inch mark. (Point to the 30-inch mark on the tube.) He marked this point as a reference point so he could notice any changes in the level of the mercury inside the tube.

He set his mercury instrument up in a safe place in his laboratory and observed it many times a day. He put marking on the tube so he could see if the mercury level moved inside the tube. (Put on the picture of the two mercury tubes showing the two dates of the low and high mercury markings.) On October eighth he noticed that the mercury dropped below the 30-inch mark. (Point to the mark below the 30-inch mark on the plastic tube.) Then a day later he observed that weather had changed and became stormy. On October eleventh he noticed that the mercury jumped above 30-inch mark. (Point to the mark above the 30-inch mark on the plastic tube.) He observed that the weather was fair a day or two later. (Show the picture of the arrows pressing on the bowl of mercury.) He kept track of the changes of the level of the mercury in the tube.

Torricelli concluded that whenever the level of the mercury was below the 30-inch mark a storm was coming. And, the farther the

mercury level was below the 30-inch mark the worse the storm. This is why we use the word “Low” because the mercury was lower than 30 inches in the tube. (Refer they weather map they looked at in the Invitation to Learn.) He also concluded that whenever the level of the mercury was above the 30-inch mark, fair weather was in its way. And, the farther the mercury level was above the 30-inch mark the better the weather was going to be. This is why we use the word “High” because the mercury was higher than 30 inches in the tube. (Refer they weather map they looked at in the Invitation to Learn.) (Show the picture of a mercury barometer today.) Meteorologists still use the mercury barometer today, because it is the most accurate instrument to use to measure air pressure change.

5. (Show the real aneroid barometer.) Tell them that this barometer does not have mercury inside because we have found out that mercury is very dangerous for everyday use.
6. (Show up the picture of the aneroid barometer.) This barometer has a needle that goes back and forth from the 29 to the 31 by the use of gears inside the barometer. (Point to the needle.)
7. (Put up the picture of the inside of the aneroid barometer.) These gears are attached to a very small “can” that has no air in it. Aneroid means “containing no air.”
8. (Put up picture of the aneroid can.) As a high pressure enters an area, the high pressure will push in on the “aneroid can” (because of the vacuum inside) that in turn moves the gears. These gears move the needle up above the 30-inch mark telling us that we have high pressure around us.
9. As a low pressure enters an area, the low pressure will release pressure on the can making the can not bent in as much. The gears will move the needle below the 30-inch mark telling us that we have low pressure around us.
10. (Show the picture of the barometer on the wall.) We can hang aneroid barometers on our walls at home and watch to see if a storm is coming or if we are going to have nice weather.
11. Put an aneroid barometer in a see-through bowl. Cut off the neck of a balloon and stretch it over the bowl. Push in on the balloon.
12. Ask, “What do you see happening to the barometer?” (The needle went up showing a high pressure.) Ask, “Why do you think it went up when you pressed on the balloon?” (The

air particles packed together in a smaller area creating a high pressure.)

13. Pull up on the balloon. Ask, “What do you see happening to the barometer?” (The needle went down showing a low pressure.) Ask, “Why do you think it went down when you pulled on the balloon?” (The air particles are spread out in a larger area creating a low pressure.)
14. In conclusion, describe that:
 - When high pressure enters the atmosphere, it presses on the “small can” and the barometer goes up.
 - When low pressure enters the atmosphere, it presses on the “small can” and the barometer goes down.
 - The changes in air pressure are what cause our different weather.

Assessment Suggestions

1. As the teacher is asking the questions, the students can be writing in their science journals the answers to the questions. Check their journals for accuracy during the discussion.
2. Use a Cluster Diagram to outline the three types of pressure the barometer measures for us and the results of each of the readings.
2. Have the students draw pictures of the experiments and label the parts. Have them write captions under the pictures of what happened in the experiments.
3. Divide the class into groups of three or four students and ask them to discuss and answer these questions in their journals or on paper.
 - a. What happens to the air molecules near Earth’s surface when a high pressure is approaching?
 - b. What happens to the air molecules near Earth’s surface when a low pressure is approaching?
 - c. Why did the mercury go up in Torricelli’s mercury barometer when there was a high pressure present?
 - d. Why did the mercury go down in Torricelli’s mercury barometer when there was a low pressure present?
 - e. Explain how an aneroid barometer works.

- f. Explain why the barometer needle went up when the balloon was pressed on the bowl.
 - g. Explain why the barometer needle went down when the balloon was pulled on the bowl.
3. Have the students tell how the mercury barometer and the aneroid barometer are the same.
 4. Have the students tell how the mercury barometer and the aneroid barometer are different.

Curriculum Extensions/Adaptations/Integration

- For regular and advanced learners, have them learn more about Torricelli and the discovery of the mercury barometer.
- For learners of special needs, gather them together and show the experiments again giving the simple explanations of what is happening and asking simple questions to answer.
- Have the students draw a picture of what the air molecules look like inside in the glass jar at different stages of the experiment including what the air molecules look like outside the glass jars. (Visual Arts: Standard III, Objective 2)

Family Connections

1. Send home the story about Torricelli's experiment in discovering the mercury barometer. Have them discuss how this knowledge has helped us to cope with the weather.
2. Send home a picture of an aneroid barometer. Have the students tell how this barometer works.
3. Have the students go to an Internet site to read more about the barometer and share with their families what else they learned about the barometer.

Additional Resources

Books

Wind and Air Pressure, by Alan Rodgers and Angella Streleck, ISBN 1403401306

Videos

Forecasting and Weather Instruments VH 2001 United Learning

Weather station: Backyard Science VH 1996 BFA/Phoenix

Weather: Changes and Measurement VH 1999 Educational Videos

Web sites

<http://inventors.about.com/od/tstartinventors/a/Barometer.htm>

<http://www.infoplease.com/ce6/people/A0849103.html>

<http://www.tiscali.co.uk/reference/encyclopaedia/hutchinson/m0013248.html>

Name _____

What Is It About Air Pressure?

I. Gather together in groups of three, four, or five. Discuss these questions as a group. Write down the answers with help of the discussion.

1. What happens to the air molecules near Earth's surface when a high pressure is approaching?

2. What happens to the air molecules near Earth's surface when a low pressure is approaching?

3. Why did the mercury go up in Torricelli's mercury barometer when there was a high pressure present?

4. Why did the mercury go down in Torricelli's mercury barometer when there was a low pressure present?

5. Explain how an aneroid barometer works.

6. Explain why the barometer needle went up on the barometer when the balloon was pressed on the bowl.

7. Explain why the barometer needle went down when the balloon was pulled.

8. Thinking question: If you were to take a barometer with you as you were hiking up a mountainside, what do you think would happen to the reading of barometer?

- II. Draw two pictures of the barometer in the glass bowl—one at high pressure and one at a low pressure. Have the students draw what the air molecules look like inside in the glass jar when the balloon is being pressed on. Have the students draw what the air molecules look like when the balloon is being pulled on. Label the different parts and show with arrows where the air pressure is. Write captions under each picture of what is happening in the experiment.

Evangelisti Torricelli and The Story of the First Barometer

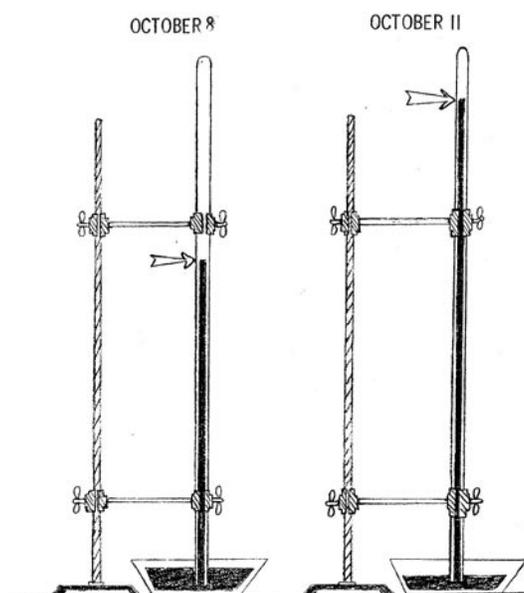


Around the time of 1643, there was a young scientist/mathematician by the name of Evangelisti Torricelli who was very interested in air pressure. Scientists at the time knew that air pressure existed and they knew that it changed. They had an idea that when there was an air pressure change there was going to be stormy weather. But, they had no way of measuring the air pressure like they could measure temperature with a thermometer. Torricelli was very interested in finding a way to measure air pressure so he could see air pressure changes.

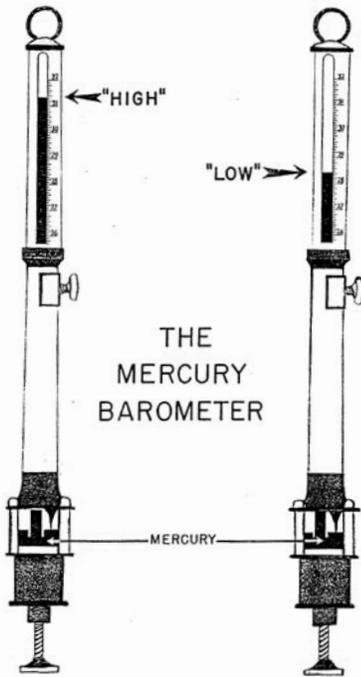
One day Torricelli got a 3-foot glass tube that was closed in at one end and open at the other. With a suggestion from his friend, Galileo, he filled the glass tube with mercury. Mercury is a liquid metal that is much heavier than water. He also had a bowl of liquid mercury. After filling the glass tube with mercury, he tipped the tube upside down, holding the open end with his finger so the mercury wouldn't run out. With his finger on the end he gently put the open end of the tube in the bowl of mercury. He then took his finger off the glass tube. At his surprise the mercury dropped about 6 inches to the 30-inch mark. He marked this point as a reference point so he could notice any changes in the level of the mercury inside the tube.

He set his mercury instrument up in a safe place in his laboratory and observed it many times a day. He put marking on the tube so he could see if the mercury level moved inside the tube. On October 8th he noticed that the mercury dropped below the 30-inch mark. Then a day later he observed that weather had changed and became stormy. On October 11th he noticed that the mercury jumped above 30-inch mark. He observed that the weather was fair a day or two later. He kept track of the changes of the level of the mercury in the tube.

Torricelli concluded that whenever the level of the mercury was below the 30-inch mark a storm was coming. And, the farther the mercury level was below the 30-inch mark the worse the storm. This is why we use the word "Low" because the mercury was lower than 30 inches in the tube. He also concluded that whenever the level of the mercury was above the 30-inch mark, fair weather was in its way. And, the



THE HEIGHT OF THE MERCURY CAN VARY FROM
DAY TO DAY



farther the mercury level was above the 30-inch mark the better the weather was going to be. This is why we use the word "High" because the mercury was higher than 30 inches in the tube.

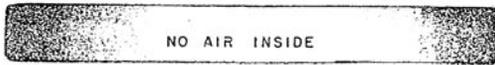
Meteorologists still use the mercury barometer today, because it is the most accurate instrument to use to measure air pressure change.



THE ANEROID CAN

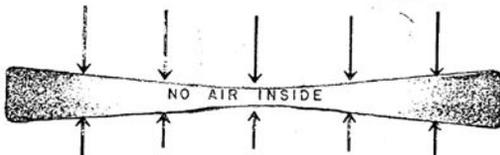
WITHOUT WEIGHT OF AIR

NO AIR OUTSIDE

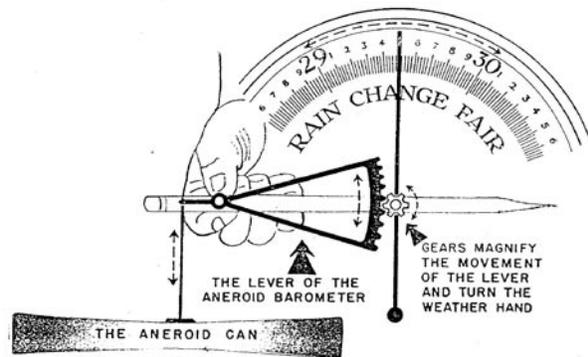


AIR PRESSURE ON THE CAN

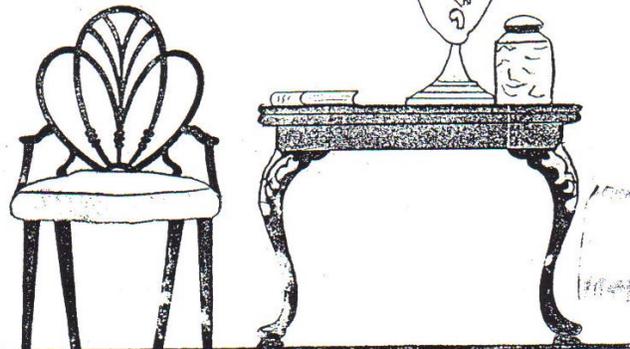
AIR OUTSIDE



Air pushes against the empty can and bends it in. As the air pressure changes, the bending changes too.

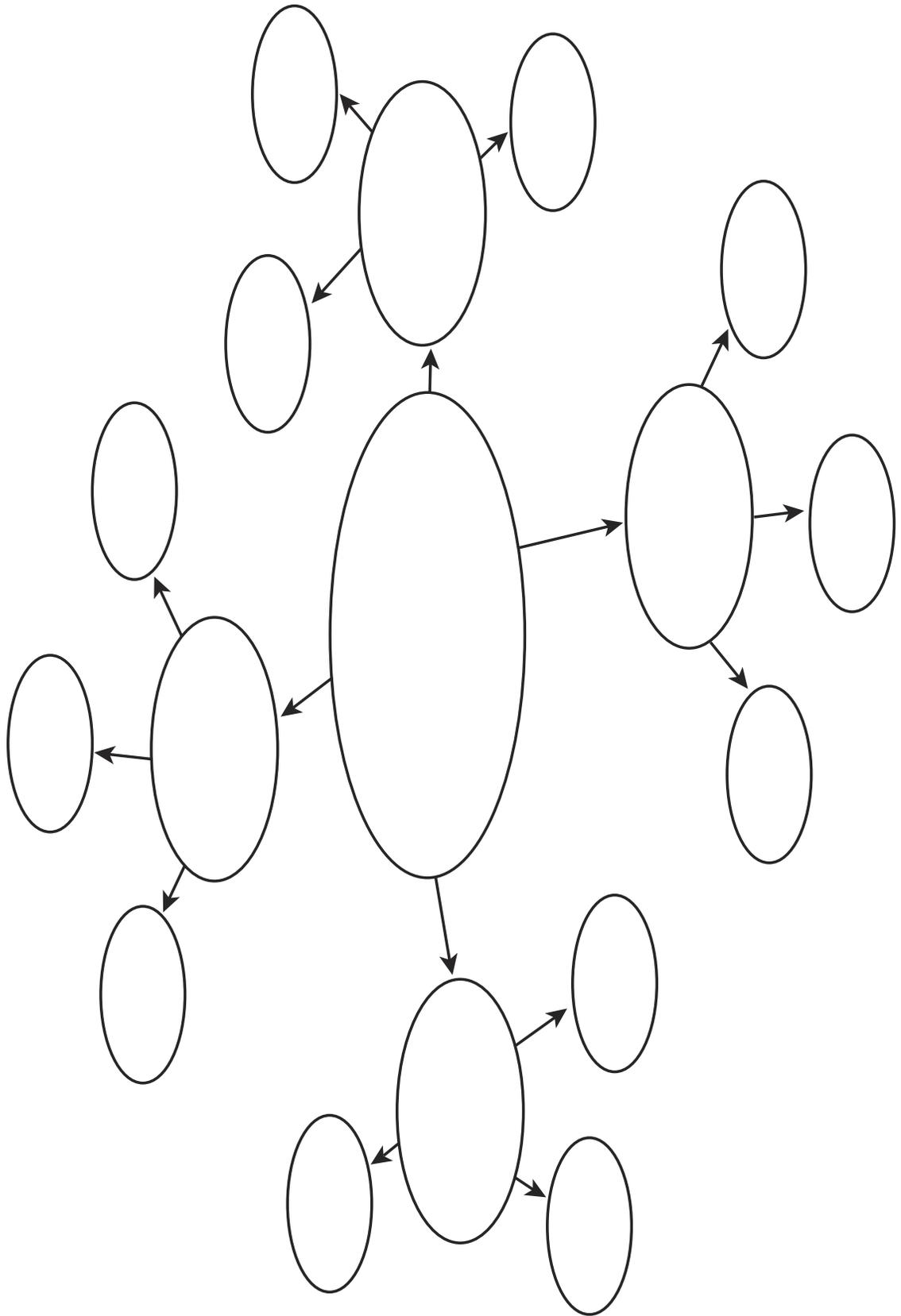


When the air pressure changes, the can top bends or straightens only a little bit; then the hand moves far enough for you to see the change.



ANEROID BAROMETERS ARE MORE COMPLICATED THAN MERCURY BAROMETERS, BUT THEY ARE HANDY TO HANG ON THE WALL. THEY CAN BE MOVED EASILY BECAUSE THERE IS NO MERCURY TO SPILL. AND THEY ARE CHEAPER.

Cluster Diagram



What is Going to be Happen at Any Given Barometer Reading?

Science
Standard
II
Objective
2 & 3
Connections

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 2: Interpret recorded weather data for simple patterns.
Objective 3: Evaluate weather predictions based upon observational data.
Intended Learning Outcomes: 1- Use Science Process and Thinking Skills 3- Understand Science Concepts and Principles 4- Communicate Effectively Using Science Language and Reasoning.
Content Connections: Language Arts, Writing

Background Information

Changes in air pressure are what cause our different weather. The constant changes of air pressure change the temperature, wind speed, types of clouds, amount of clouds, wind direction, and precipitation. Meteorologists watch for patterns when they measure these items. When they see certain patterns they are able to predict what type of weather is upon us. There are many patterns they need to be aware of. They have put these patterns into their computers. When they give the computer current data of these basic elements the computers are able to compute an upcoming forecast.

Many years ago before computers, meteorologists could look at the combination of patterns and predict fairly well the weather from their own knowledge and looking at data charts. Elementary students, too, are able to observe, measure, and record basic readings of the weather instruments. After keeping track of these basic elements of weather for a few months, they will recognize simple patterns that must exist to be able to predict an oncoming storm or that fair weather is on the horizon. The goal is that each student can take readings of the barometer, air temperature, wind speed, wind direction, precipitation, and cloud type and be able to interpret the information (see a pattern) and predict the weather. The activities in this part are to help you recognize simple weather patterns and be able to teach them to your students.

Research Basis

Gilbert, J., Kotelman, M., (2005), Inquiry, five good reasons to use science notebooks. *Science and Children*, Volume 43 (Number 3), Page 28

There is a need for all students to journal their investigations. Notebooks help in literacy with these ideas:

- Notebooks are thinking tools—Students construct their own conceptual understanding that empowers them to become active in their own learning.
- Notebooks guide teacher instruction—Notebooks give teachers access to students’ thinking: what they do and don’t understand. This will help guide the next teacher lesson.
- Notebooks enhance literacy skills—The ideas students write in their journals enhance their written, visual, and oral communication skills.
- Notebooks support differentiated learning—Notebooks help all learners to achieve.
- Notebooks foster teacher collaboration—Teachers are able to build on others successes. Sharing strategies provide a wider repertoire for each other. Conversation exists between teachers that can bring them together.

Klentschy, M., (2005) Science notebook essentials. *Science and Children*, Volume 43, (Number 3), Page 24

A science notebook is more than a record of data. It is a record of students’ questions, claims, conclusions and reflections all leading to an understanding of a big idea. It is a scientific method of questions/problems/purpose, prediction, planning, observations/evidences, stating what is learned, and next steps/new questions. Journals are the voice of students leading to increased student achievement in science with the tools of reading and writing.

Invitation to Learn

The Orchestrated Weather

Have the students take out their science journals.

- On a new page have the students write as many words they can think of that are related or associated with weather. Don’t have them generalize by writing “wind”. Have them be specific such as “north wind” or “light wind”. This way they will write many words. Give them two to three minutes.

Materials

- Aneroid Barometer
- Science journal and pencil



- Examples:

Rain	Light wind	Hail	Hurricane
Cirrus cloud	North wind	Barometer	Low air pressure
Strong wind	High air pressure	Tornado	Snow
Cold temperature	Hot temperature	Cumulus cloud	Blizzard

- As a class or individually have the students classify these words into groups by putting them in the basic weather areas—wind direction, wind speed, cloud type, cloud cover, air temperature, barometer, precipitation, and severe weather.

Barom.	Temp.	Precip.	Wind Direction	Wind Speed	Cloud Type	Cloud Cover	Severe Weather
High	Warm	Rain	North	Calm	Cirrus	Clear	Hurricane
Low	Hot	Snow	South	Strong	Cumulus	Partly	Blizzard

- Tell the students that the categories they have listed are the weather areas that meteorologist measure. The words they have listed are the types of weather we get when these basic weather areas mixed together in certain ways called patterns. We are going to be learning about these patterns so we can learn to predict the weather.

Instructional Procedures

Activity One—Patterns and Air Pressure

1. In groups of four or five students, for at least a month during any of the months of October through April, have the students take readings in their journals of all the weather areas listed on the chart below. Be sure to read the barometer as falling or rising. (These months bring in cold fronts causing air pressure change.)
2. Using a line graph, graph the results of each of the weather areas, either on the same graph paper or different graph paper. (The graph making can be divided up between the individual groups.)
3. With the graph results, and by looking at only two graphs at a time, list the patterns you see when comparing the two weather areas. (A falling barometer also shows more clouds coming in; high pressure shows hardly any clouds in the sky; 32 degrees and below shows snow precipitation; etc.) Try to compare as many graphs as possible. Be sure they are written in their journals.
4. Compare the barometer reading (observing either a rising or falling barometer) with each of the weather areas. (Low barometer shows precipitation, rising barometer has a light north wind, etc.)

Materials

- Graphic organizer, “Fall, Winter, Spring Scenario Patterns of a Traditional Storm”
- Charts of recorded basic weather elements for 30 to 60 days during the fall, winter, or spring
Temperature, barometric pressure, precipitation, wind direction, wind speed, cloud type, cloud cover
- Graph paper
- Pencil



- Stress that we want to see what the weather is going to be like at different barometer readings. With the data that has been collected from fall, winter, or spring storms, fill in the chart as to the patterns observed connected with the type of air pressure change.

Fall, Winter, Spring Scenario Pattern of a Traditional Storm*

Basic Weather Elements	Dropping Barometer	Low Barometer	Rising Barometer	High Barometer
Cloud Type				
Cloud Cover				
Wind Direction				
Wind Speed				
Temperature				
Precipitation				

*Remember the barometer predicts what is going to happen in a day or two. This is what you would expect to happen a day or two later at each of the barometer readings.

- When done with the chart, write a conclusion for each one of the barometer readings.
- Have the students continue to record the weather data day by day for a week or two. Have them make a prediction as to what the weather will be the next day by using the conclusions they wrote. At noon they can watch a weather TV forecast or read a newspaper forecast to see how close they are to their predictions.
- Look at the weather the next day to see how close you were to you the actual weather.

Instructional Procedures

Activity Two—Low Pressure and Clouds

- Tell the students that they are going to see how a changing air pressure from high to low will make a cloud. A pattern exists for clouds to form.
- Discuss with the students that are three basic elements that must be present for a cloud to form.

- a) Water
 - b) Dust
 - c) A low pressure
3. Ask, "Why is water needed?" (The water will evaporate to put water vapor in the air.)
 4. Ask, "Why is dust needed?" (When the water vapor condenses back to water droplets, the water droplets need something to attach themselves to.)
 5. Ask, "Why is a low pressure needed?" (The low air pressure provides cold air to change the water vapor back to water to form a cloud.)
 6. Let's make a cloud.
 - a. Put some warm water a two-liter bottle. (You may want to put it under a lamp for a while for the water to evaporate.)
 - b. For dust, light a match and blow it out. Quickly stick the match into the two-liter bottle for the smoke to go in, but don't drop the match into the bottle.
 - c. Stick a ball needle in the hole of the rubber stopper.
 - d. Put the rubber stopper on the two-liter bottle.
 - e. Tell the students that we have two out of the three ingredients to make a cloud. All that is needed is a high pressure and change it to a low pressure. Ask, "How do you think we are going to do this?" (With the ball pump.)
 - f. Attach the ball pump onto the ball needle.
 - g. Ask, "What will pumping air into the bottle do?" (It will pack the air molecules together causing a high pressure inside the bottle. The high pressure will produce heat causing more evaporation.)
 - h. Ask, "What do you think will cause a low pressure in the bottle?" (Taking the stopper off the bottle.)
 - i. Ask, "What will happen when the air pressure changes?" (The students probably will not know this answer.) Tell the students that when high pressure suddenly changes to low pressure, cold air is automatically produced.
 - j. Ask, "What will happen when the air in the bottle turns cold?" (The cold air will change the water vapor in the bottle into water droplets forming a cloud.)

- k. Turn out the light and turn the flashlight on and shine it into the bottle.
 - l. Pump air into the bottle (one or two small pumps) causing a high pressure. The air in the bottle should be clear because the high pressure is producing heat evaporating any water droplets in the bottle.
 - m. Quickly take the stopper off the bottle. A cloud will form in the bottle.
 - n. Recap again how the cloud was made.
 - o. Put the stopper back onto the bottle. Ask, “What do you think will happen to the cloud when I pump air back in the bottle causing a high pressure again?” (The cloud will disappear because the high pressure produces heat evaporating the water droplets that formed the cloud.)
 - p. Pump air into the bottle again. Take off the stopper and the cloud will form again.
7. The same thing happens when we have high pressure over us for a while. The temperature rises because the air molecules are being packed together rubbing against each other in a locked in area.
 8. Suddenly low pressure enters in from the northwest carrying a lot of cold air. When the cold air hits our hot air, it changes all the water vapor in the air into water droplets forming a sky full of status clouds. When enough water vapor has changed to water droplets, the water droplets will group together into water drops and it will begin to rain or snow depending on the temperature of the air beneath the clouds.

Assessment Suggestions

1. As the teacher is asking the questions, the students can be writing in their science journals the answers to the questions about making a cloud. Check their journals for accuracy during the discussion.
2. Have the students draw pictures of the cloud experiment and label the parts. Have them write captions under the pictures of what happened in the experiments.
3. Divide the class into groups of three or four students and ask them to discuss and answer these questions about weather patterns in their journals or on paper. Let them use their chart to answer the questions.

- a. What would you expect to happen to the wind speed, wind direction, and temperature when a low pressure is entering an area?
 - b. What would you expect to happen to the wind speed, wind direction, and temperature when a high pressure is forming in an area?
 - c. During what type of pressure is it usually raining or snowing?
 - d. What type of clouds brings rain or snow?
 - e. During what type of pressure are there usually a few or no clouds?
 - f. Which type of clouds usually precedes an approaching storm?
 - g. When the barometer is showing a low pressure which type of clouds should we be expecting to come?
 - h. When the barometer is showing a high pressure which type of clouds should we be expecting to come?
 - i. During what type of pressure is there a strong warm wind blowing from the south?
 - j. During what type of pressure is there a wind blowing from the north?
4. Have the students tell what is needed to make a cloud and how a cloud is made by nature.

Curriculum Extensions/Adaptations/Integration

- Have the students find other ways to make clouds.
- Have the students watch a weather report to see the highs and lows on the weather map.
- Have the students watch a weather report to see where storms are forming, and to see if they are going to come over Utah.
- Have the students watch a weather report to hear the forecast to compare it with their own forecast.
- Have the students continue to watch the weather to see if the patterns they have learned fit the storms that come in.
- For regular and advanced learners, have them learn more about air pressure and storms.

- For learners of special needs, gather them together and show the experiment again giving the simple explanations of what is happening and asking simple questions to answer.

Family Connections

1. Send home the experiment directions on how to make a cloud in a bottle. Have the students do it at home with their parents present and let them explain what is happening in the experiment.
2. Have the students share what they have learned about the patterns of storms.
3. Send home questions about the weather patterns. Have the students ask their parents the questions.
4. Have the students go to an internet site to read more about storms and share what they have learned with their parents.

Additional Resources

Books

Dr. Fred's Weather Watch, by Fred Bortz, ISBN 0071347992

Weather Forecasting, by Mark Breen, Kathleen Friestad, Michael P. Kline, ISBN 1885593392

Videos

Forecasting and Weather Instruments VH 2001 United Learning

Weather Station: Backyard Science VH 1996 United Learning

Weather: Changes and Measurement VH 1999 Educational Videos

All About Clouds VH 2000 Schlessinger Media

Complete Title, by Author Name (source, phone number, URL); Item #1234 OR ISBN 1234567890

Winter Scenario Pattern of a Traditional Winter Storm*

Basic Weather Elements	Dropping Barometer	Low Barometer	Rising Barometer	High Barometer
Clouds	Cirrus clouds were spotted days earlier in the sky. As the barometer drops there will be stratus clouds forming on the horizon.	Stratus clouds will move in and will stay as long as the barometer stays low.	Stratus clouds will break up then gather back and forth until the barometer is high.	Skies will clear. Occasional cumulus clouds will appear and disappear.
Wind Direction	Will come from the south.	Will come from the north.	Will come from the north, if any.	Will come from any direction, if any.
Wind Speed	Will get stronger and stronger as the barometer keeps dropping.	Strong winds will prevail for a while but will turn moderate to light after the front passes.	Will be light to moderate if there is any wind.	Will be calm or light winds.
Temperature	Will get warmer because of the south winds.	Will be cooler or cold as long as the barometer is low.	Will still be cooler or cold.	Will be a gradual warming trend as long as the high pressure is present.
Precipitation	None.	Rain or snow will come according to the air temperature.	Will be off and on of rain or snow.	None

*Remember the barometer predicts what is going to happen in a day or two. This is what you would expect to happen a day or two later at each of the barometer readings.

Fall, Winter, Spring Scenario Pattern of a Traditional Storm*

Basic Weather Elements	Dropping Barometer	Low Barometer	Rising Barometer	High Barometer
Clouds Type				
Cloud Cover				
Wind Direction				
Wind Speed				
Temperature				
Precipitation				

*Remember the barometer predicts what is going to happen in a day or two. This is what you would expect to happen a day or two later at each of the barometer readings.

Name _____

What Is It About Air Pressure?

I. Gather together in groups of three, four, or five. Discuss these questions as a group. Write down the answers with help of the discussion.

1. What would you expect to happen to the wind speed, wind direction, and temperature when a low pressure is entering an area?

2. What would you expect to happen to the wind speed, wind direction, and temperature when a high pressure is forming in an area?

3. During what type of pressure is it usually raining or snowing?

4. What type of clouds brings rain or snow?

5. During what type of pressure are there usually a few or no clouds?

6. Which type of clouds usually precedes an approaching storm?

7. When the barometer is showing a low pressure which type of clouds should we be expecting to come?

8. When the barometer is showing a high pressure which type of clouds should we be expecting to come?

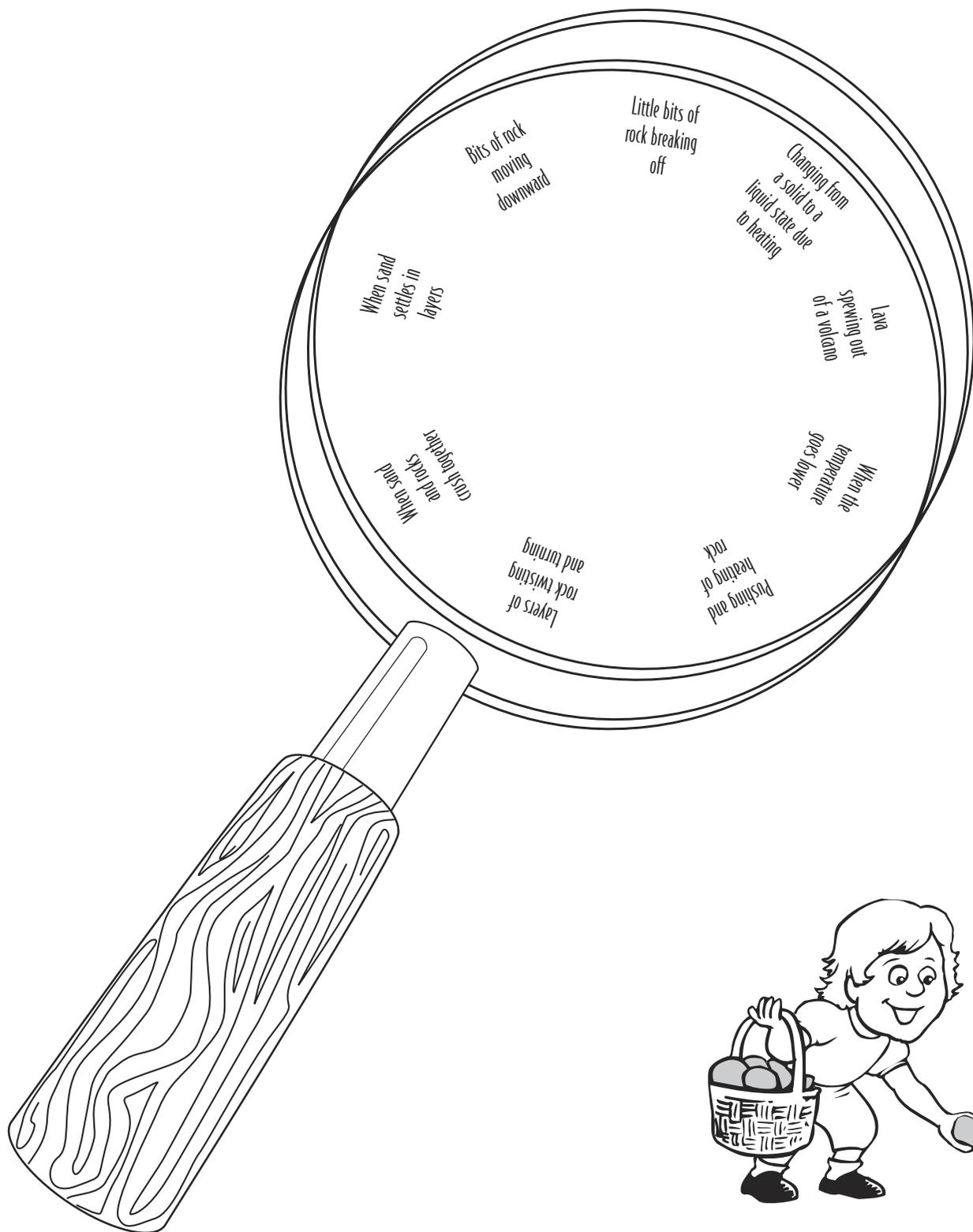
9. During what type of pressure is there a strong warm wind blowing from the south?

10. During what type of pressure is there a wind blowing from the north?

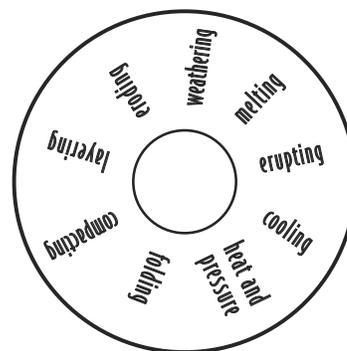
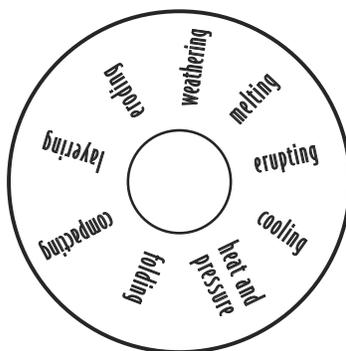
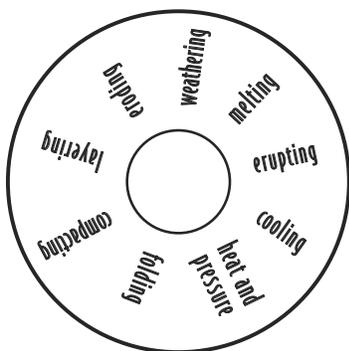
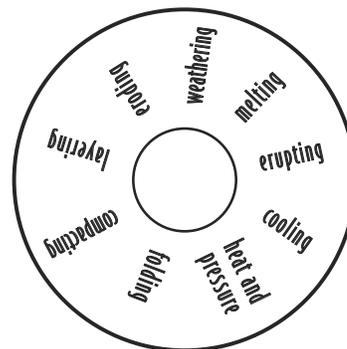
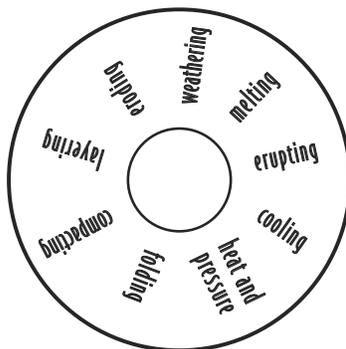
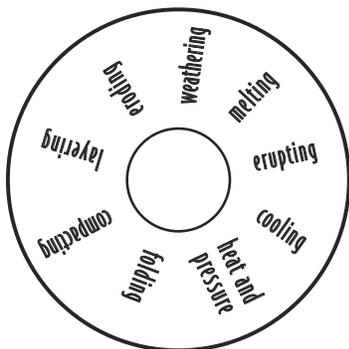
II. Draw a series of pictures of the cloud in the bottle. Show what is happening in each picture with labels and symbols. Show where the high pressure is and the low pressure.

Appendix

Take A Closer Look!!



Rock Processes



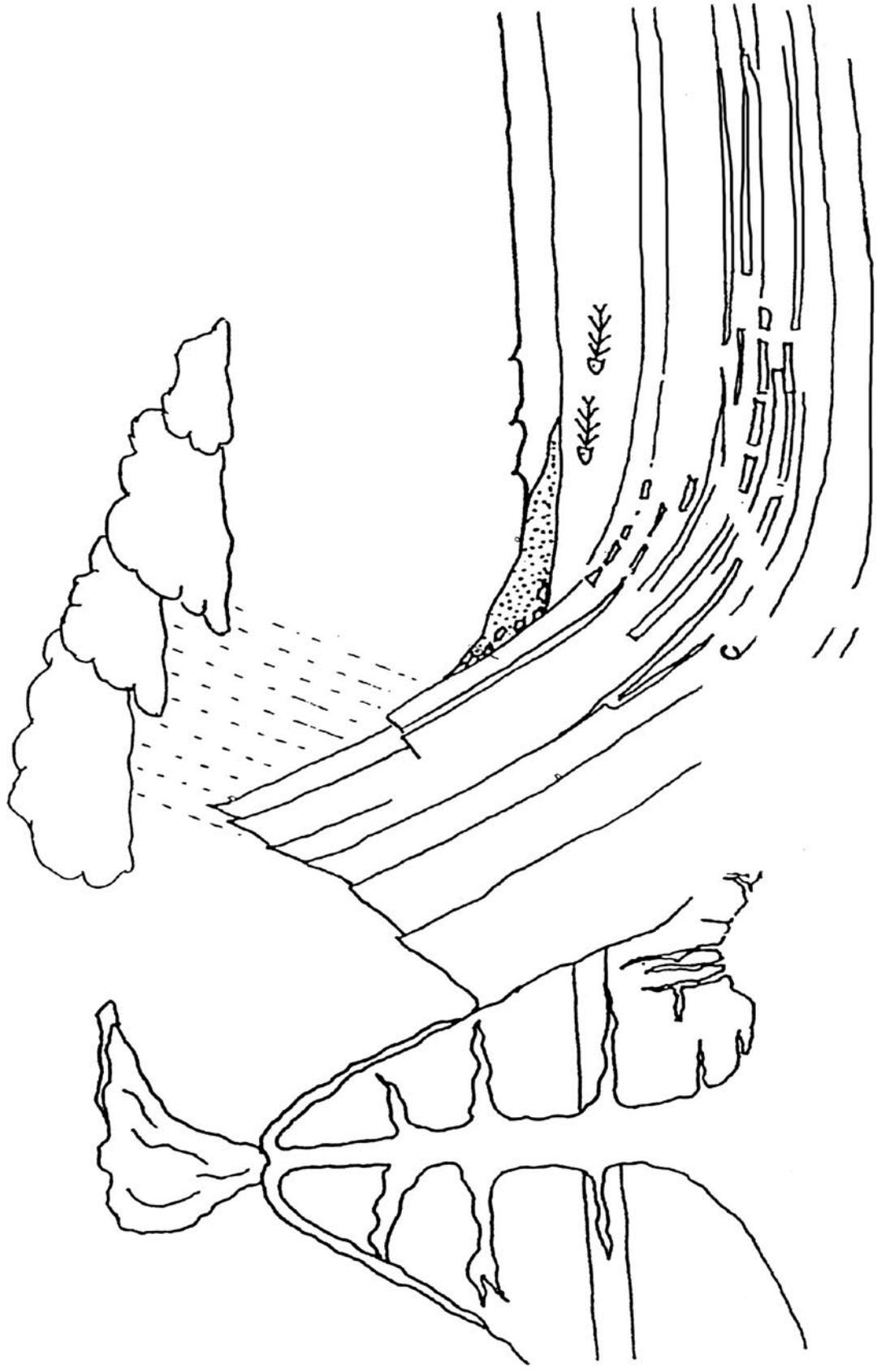
What's This Rock: Reference Sheet

IGNEOUS: Cools very fast = glassy with holes
 Cools fast = glassy
 Cools slow = small crystals
 Cools very slow = large crystals

SEDIMENTARY: Layers
 Loosely compacted
 Distinct particles
 Dull
 Light colored and light weight

METAMORPHIC: Thick Layers
 Blended colors
 Tightly compacted
 Blurred particles
 Shiny

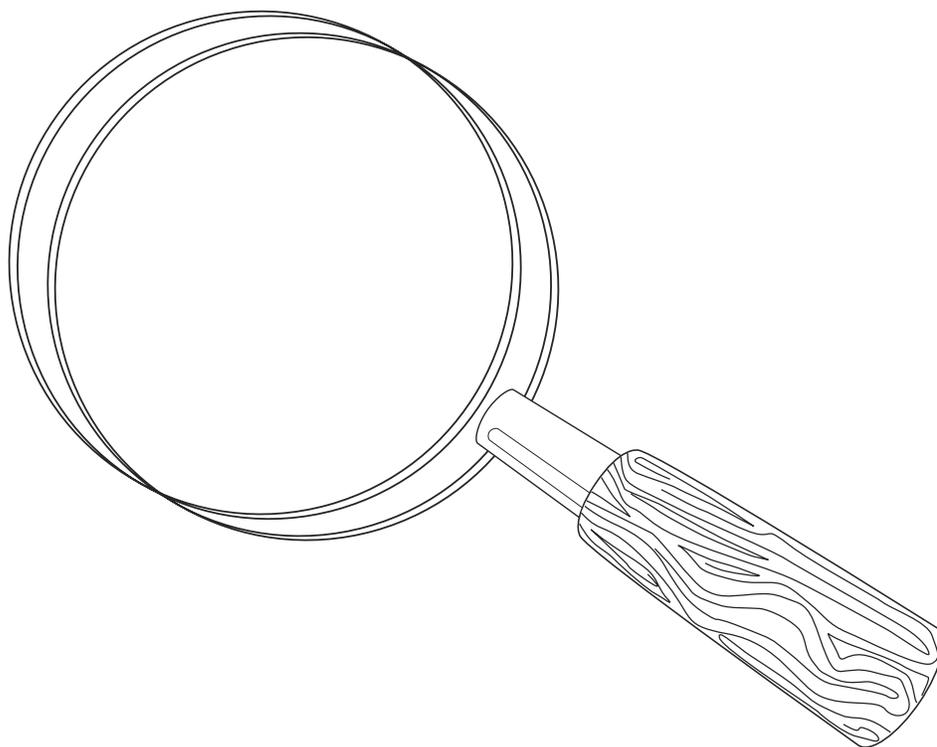
Rock Formations



What's This Rock-Cards

 <p>Limestone Limestone - contains a lot of calcite, sugary texture, blue-grey</p>	 <p>Conglomerate Conglomerate - rounded rock fragments cemented together</p>	 <p>Sandstone Sandstone - grains are visible, has patterns, common</p>	 <p>Shale Shale - small grains, thin, flaky layers</p>
 <p>Granite Granite - very hard, large crystals, mostly grey, glossy when polished</p>	 <p>Obsidian Obsidian - grains too small to see, shiny and black</p>	 <p>Pumice Pumice - very light, grayish, air bubbles, small grains</p>	 <p>Basalt Basalt - small holes, dark blue or black, rough</p>
 <p>Marble Marble - can be sugary or smooth, hard, calcite crystals</p>	 <p>Gneiss Gneiss - lightly compacted, sparkly</p>	 <p>Schist Schist - thin bands, flaky and crumbles, grey</p>	 <p>Slate Slate - usually grey, breaks in smooth, flat sheets</p>
 <p>Quartz Quartz - glassy and clear, crystals easy to see, common</p>			

My Rock Discovery Field Guide



Rock Cycle Song

(Sing to the tune of "Row, Row, Row, Row Your Boat")

Sedimentary rock

Has been formed in layers

Often found near water sources

With fossils from decayers

Then there's Igneous rock

Here since Earth was born

Molten lava, cooled and hardened

That's how it is formed

These two types of rocks

Can also be transformed

With pressure, heat, and chemicals

Metamorphic they'll become

(Don't forget to sing this as a "round";

after all, it is the Rock "Cycle")

Name: _____ Date: _____

Rock Number: _____

Name of Rock: _____

Color: _____

Shape: _____

Size: _____

Where I found the Rock: _____

My Notes/Drawings:

Name: _____ Date: _____

Rock Number: _____

Name of Rock: _____

Color: _____

Shape: _____

Size: _____

Where I found the Rock: _____

My Notes/Drawings:

Name _____

Metric Measures

For each item, circle the most appropriate measure, then measure each object or distance and record your results.

Object	Most Appropriate Measure	Actual Measurement
1. Height of student chair	mm cm m	
2. Length of thumb nail	mm cm m	
3. Height from knee to hip	mm cm m	
4. Distance across classroom	mm cm m	
5. Length of eraser	mm cm m	
6. Width of chalkboard	mm cm m	
7. Distance from your desk to door	mm cm m	
8. Height of teacher desk	mm cm m	
9. Length of arm	mm cm m	
10. Width of pencil	mm cm m	

Which would be the best unit for measuring the height of your bedroom door?
Explain your reasoning.

Name _____

Inch, Foot, and Yard

Select eight objects or distances from the class list to measure. Measure each item using inches, feet, and yards, then circle what you think is the most appropriate measure.

Object	Length in Inches	Length in Feet	Length in Yards	Most Appropriate Measure
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.
				in. ft. yd.

Name _____

Appropriate Measures

For each item, circle the most appropriate measure, then measure each object or distance and record your results.

Object	Most Appropriate Measure	Actual Measurement (to nearest $\frac{1}{4}$ unit)
1. Height of student chair	in. ft. yd.	
2. Length of table	in. ft. yd.	
3. Height from knee to hip	in. ft. yd.	
4. Distance across classroom	in. ft. yd.	
5. Length of eraser	in. ft. yd.	
6. Width of chalkboard	in. ft. yd.	
7. Distance from your desk to door	in. ft. yd.	
8. Height of teacher desk	in. ft. yd.	
9. Length of arm span	in. ft. yd.	
10. Width of hand	in. ft. yd.	

Which would be the best unit for measuring the depth of water in a swimming pool? Explain your reasoning.

Name _____

Filled to Capacity

1. Would you drink a gallon of milk at dinner? What unit would you use to measure the amount of milk you would have at dinner?

Explain your reasoning.

2. Which is a more reasonable measure of the capacity of a bathtub, 2 quarts or 25 gallons?

Explain your reasoning.

3. You want to buy a juice box for lunch. Do you think you will buy 1 quart or 1 cup of juice?

Explain your reasoning.

4. Your family car needs gas. What unit would you use to measure the amount of gas needed to fill your car?

Explain your reasoning.

5. For breakfast, a family of five drank some orange juice. Do you think it would be more appropriate to measure the amount in cups or quarts?

Explain your reasoning.

6. How much does your class drink with their lunch? Would you measure the amount using pints or quarts?

Explain your reasoning.

Name _____

Gram Hunt

Select six objects from the classroom. Estimate the weight of each object in grams. Then record the actual weight.

Object	Estimated Weight (g)	Actual Weight (g)

How did you make your estimates?

Name _____



Kilogram Hunt



Work with your group. Find at least five objects in the classroom that fit under each heading of the chart. Then weigh each object to see if your predictions were correct.

Less than 1 kilogram	About 1 kilogram	More than 1 kilogram
Object 1: Actual Weight:	Object 1: Actual Weight:	Object 1: Actual Weight:
Object 2: Actual Weight:	Object 2: Actual Weight:	Object 2: Actual Weight:
Object 3: Actual Weight:	Object 3: Actual Weight:	Object 3: Actual Weight:
Object 4: Actual Weight:	Object 4: Actual Weight:	Object 4: Actual Weight:
Object 5: Actual Weight:	Object 5: Actual Weight:	Object 5: Actual Weight:

Nonsense Cards - Set A

TC

CGA

AU

UBN

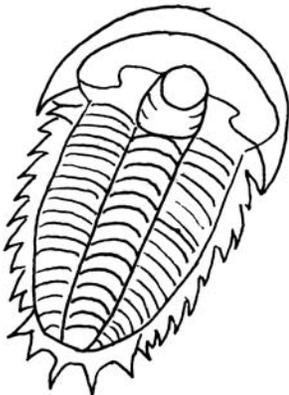
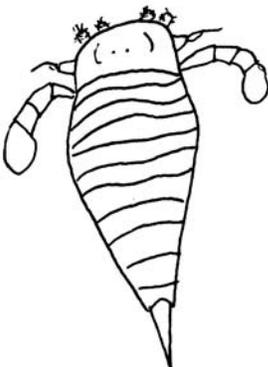
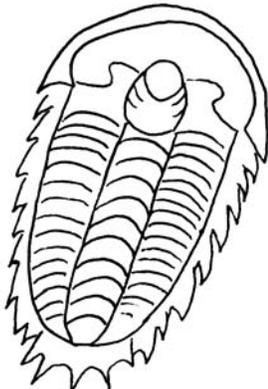
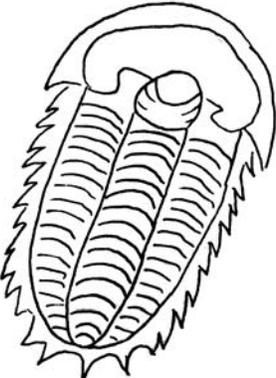
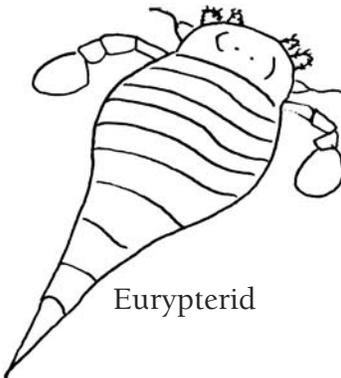
BN

NO

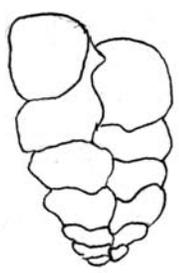
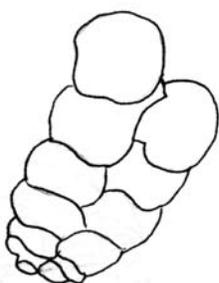
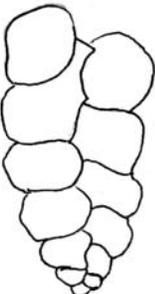
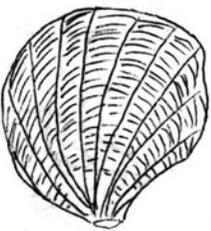
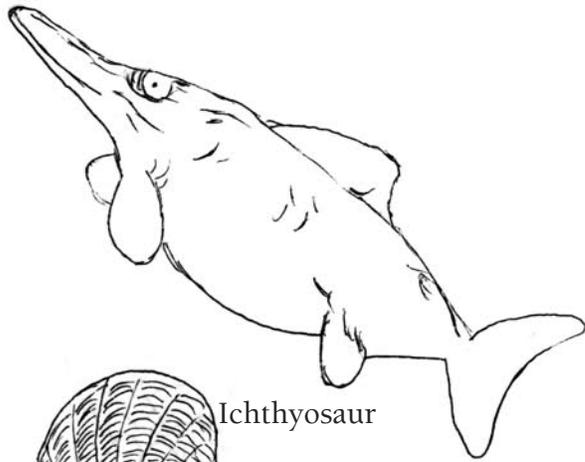
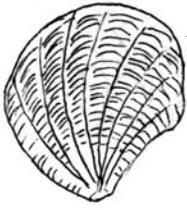
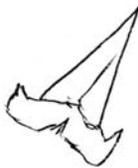
OXD

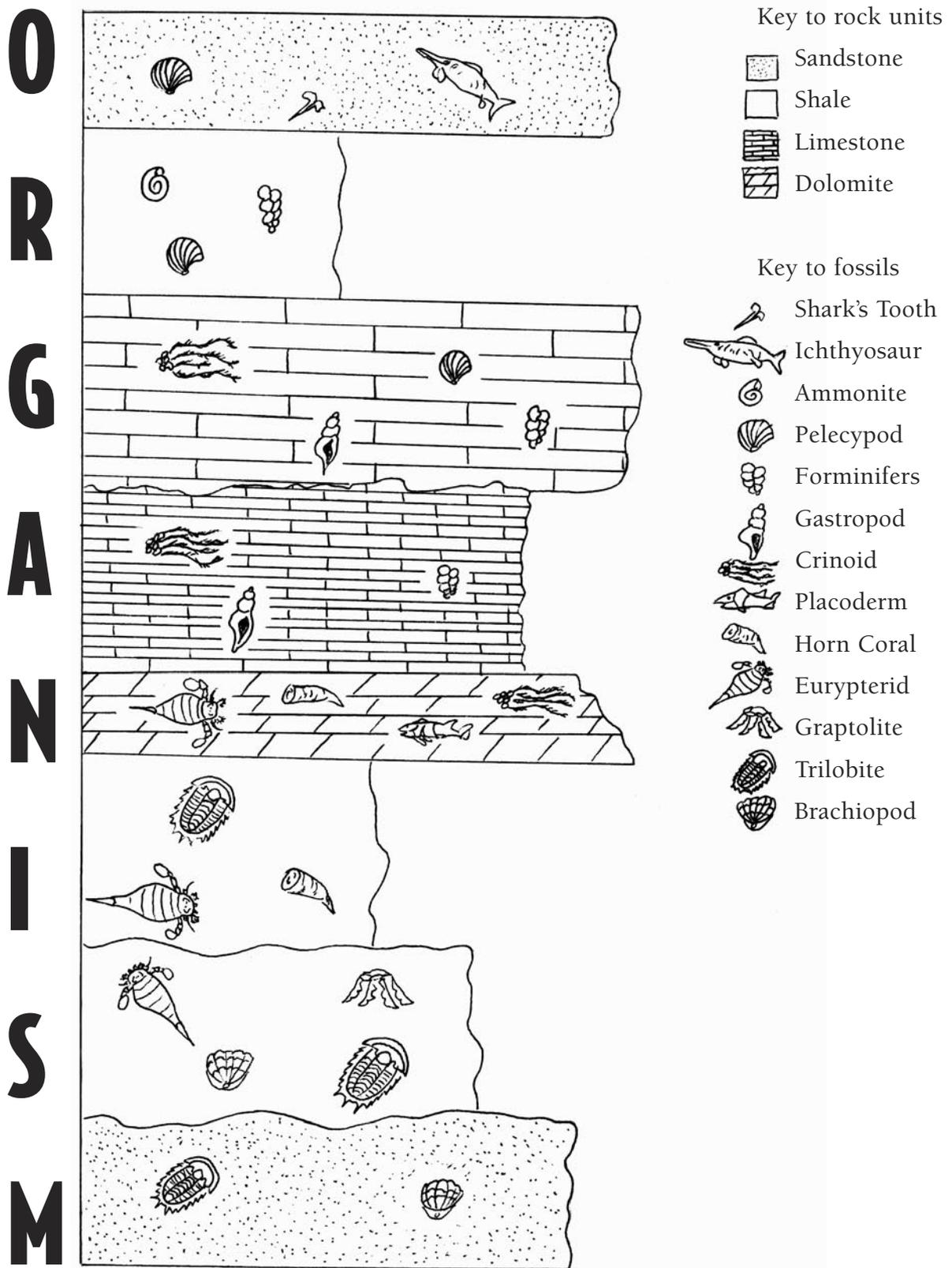
DM

Fossil Cards - Set B (1)

<p>M</p>  <p>Trilobite</p>  <p>Brachiopod</p>	<p>S</p>  <p>Eurypterid</p>  <p>Brachiopod</p>  <p>Trilobite</p>  <p>Graptolite</p>
<p>I</p>  <p>Horn Coral</p>  <p>Eurypterid</p>  <p>Trilobite</p>	<p>N</p>  <p>Eurypterid</p>  <p>Horn Coral</p>  <p>Crinoid</p>  <p>Placoderm</p>

Fossil Cards - Set B (2)

<p> Crinoid</p> <p> Gastropod</p> <p> Foraminifer</p> <p>A</p>	<p> Gastropod</p> <p> Foraminifer</p> <p> Pelecypod</p> <p> Crinoid</p> <p>G</p>
<p> Ammonite</p> <p> Foraminifer</p> <p> Pelecypod</p> <p>R</p>	<p> Ichthyosaur</p> <p> Pelecypod</p> <p> Shark's Tooth</p> <p>O</p>



Fossils - Figure 2

Fossils for grid spaces 1 through 10. (Modified from Moor, Lalicker, and Fischer)

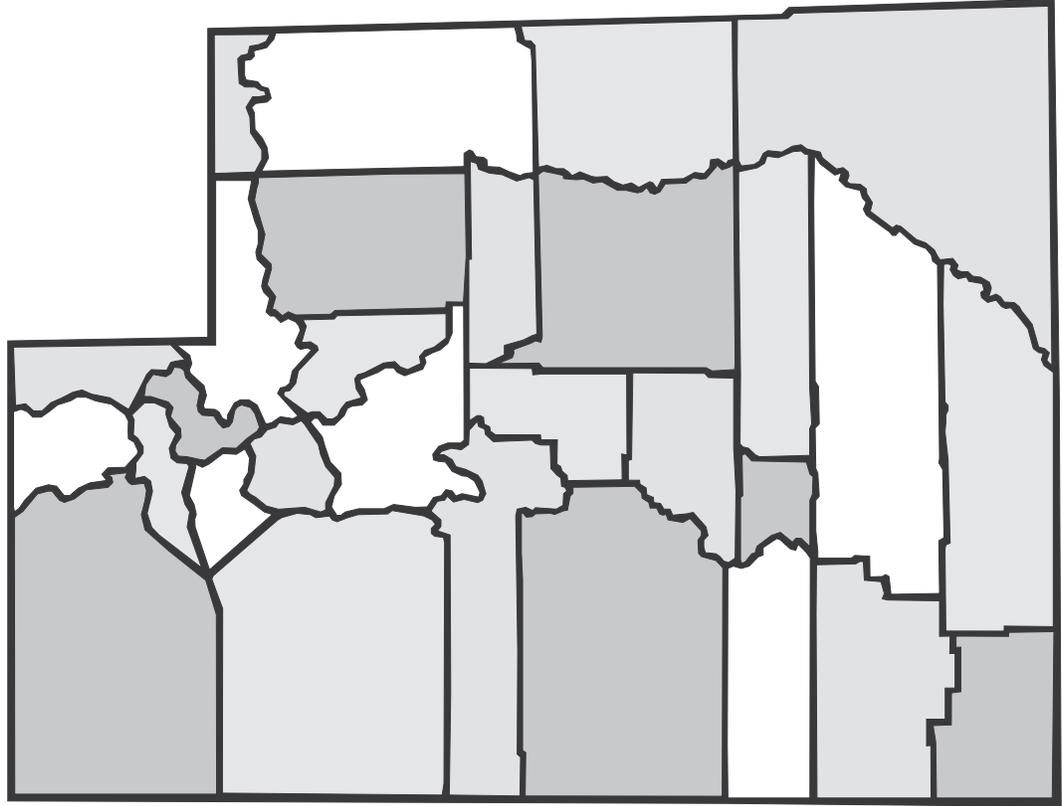
1  Allosaurus claw	2  dinosaur eggs	3  Brachiosaurus backbone	4  sea urchin	5  Mackeral Shark tooth
6  dinosaur track	7  Tyrannosaurus foot	8  Allosaurus tooth	9  clam	10  fish scale

Fossils - Figure 3

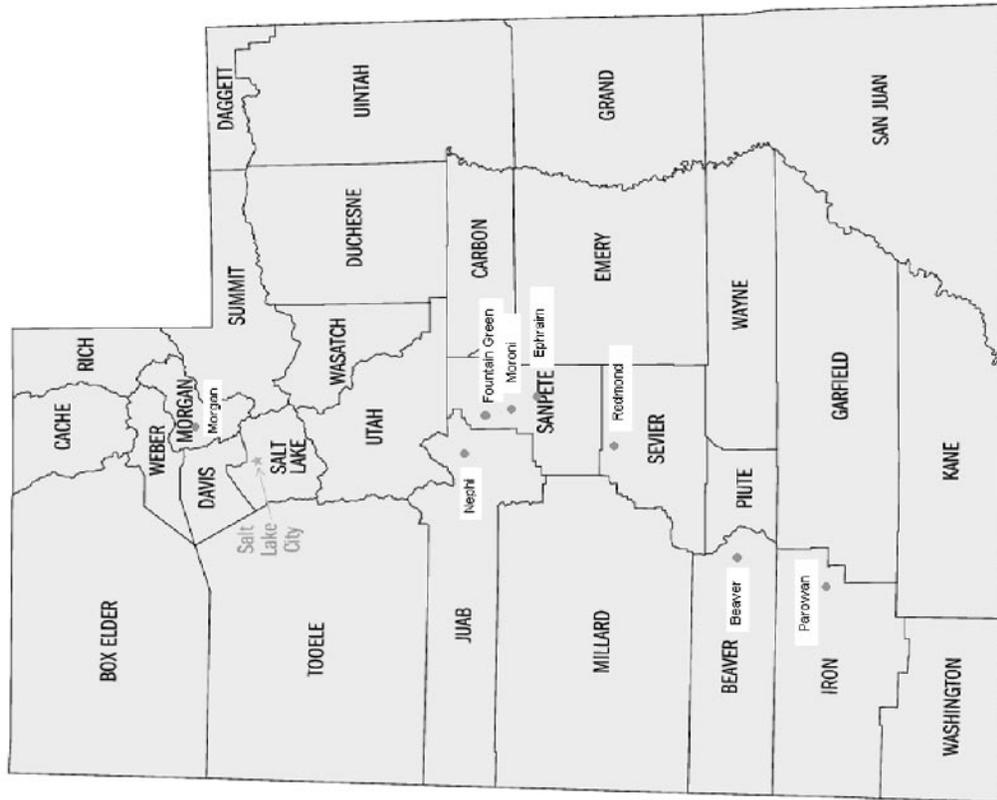
Fossils for grid spaces 11 through 20. (Modified from Moor, Lalicker, and Fischer)

11  tyrannosaur jaw	12  cycad tree	13  Porosaurolophus skull	14  burrows	15  Plesiosour skull
16  ginkgo tree	17  dinosaur footprint from China	18  oyster	19  lobster	20  nautilus

Utah Counties - 2

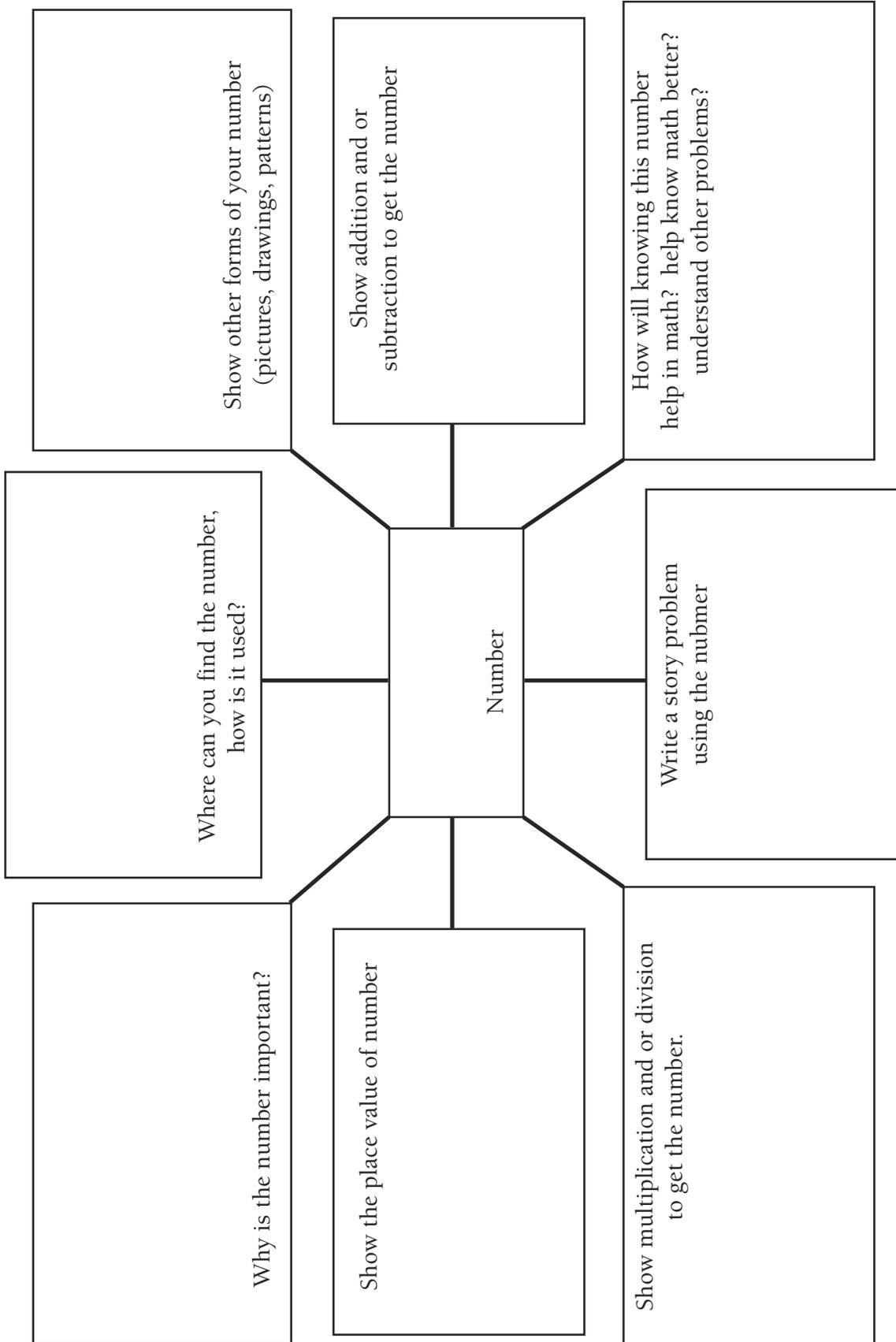


Utah Counties - 1



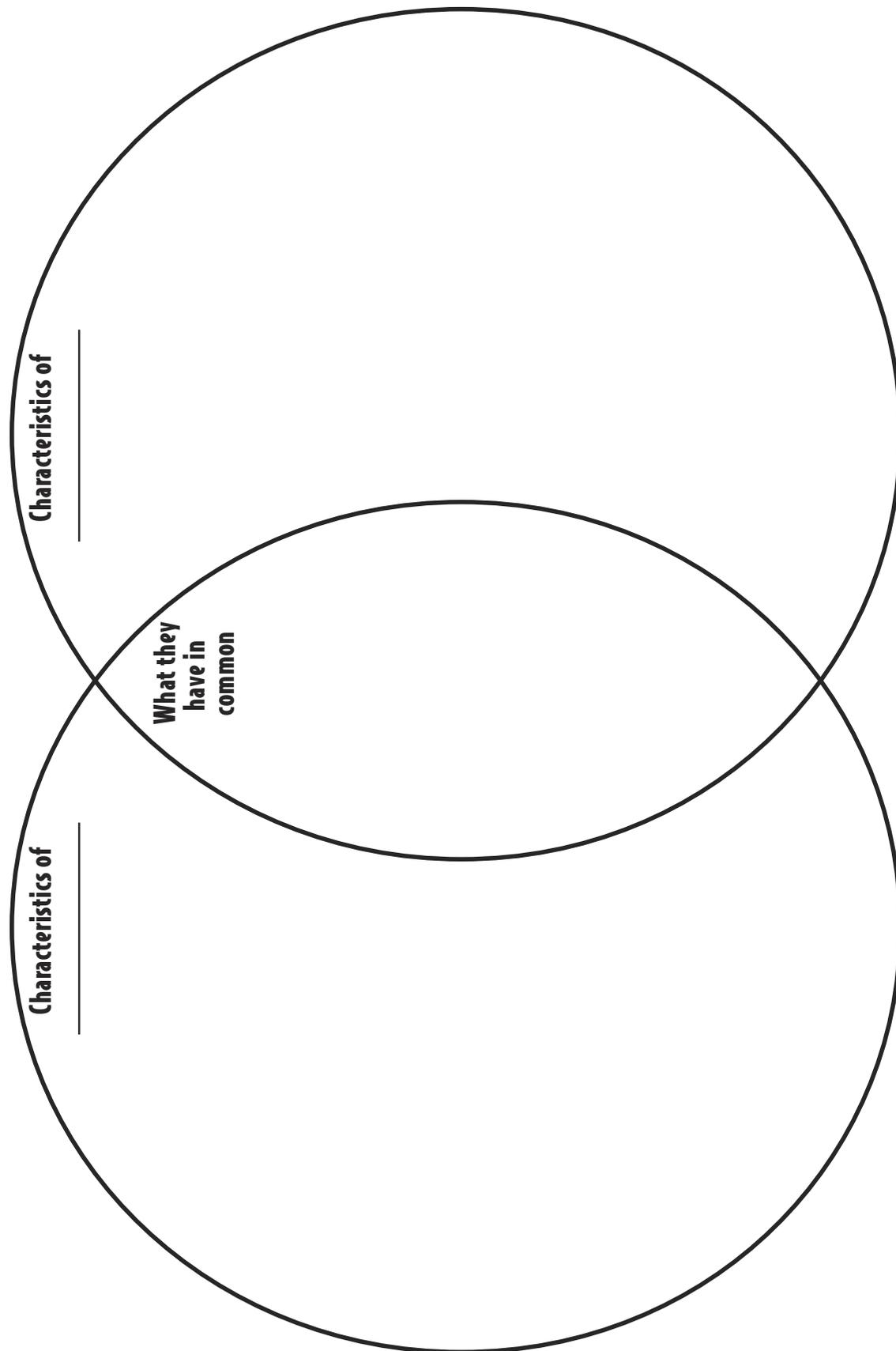
Name _____

Getting to Know You



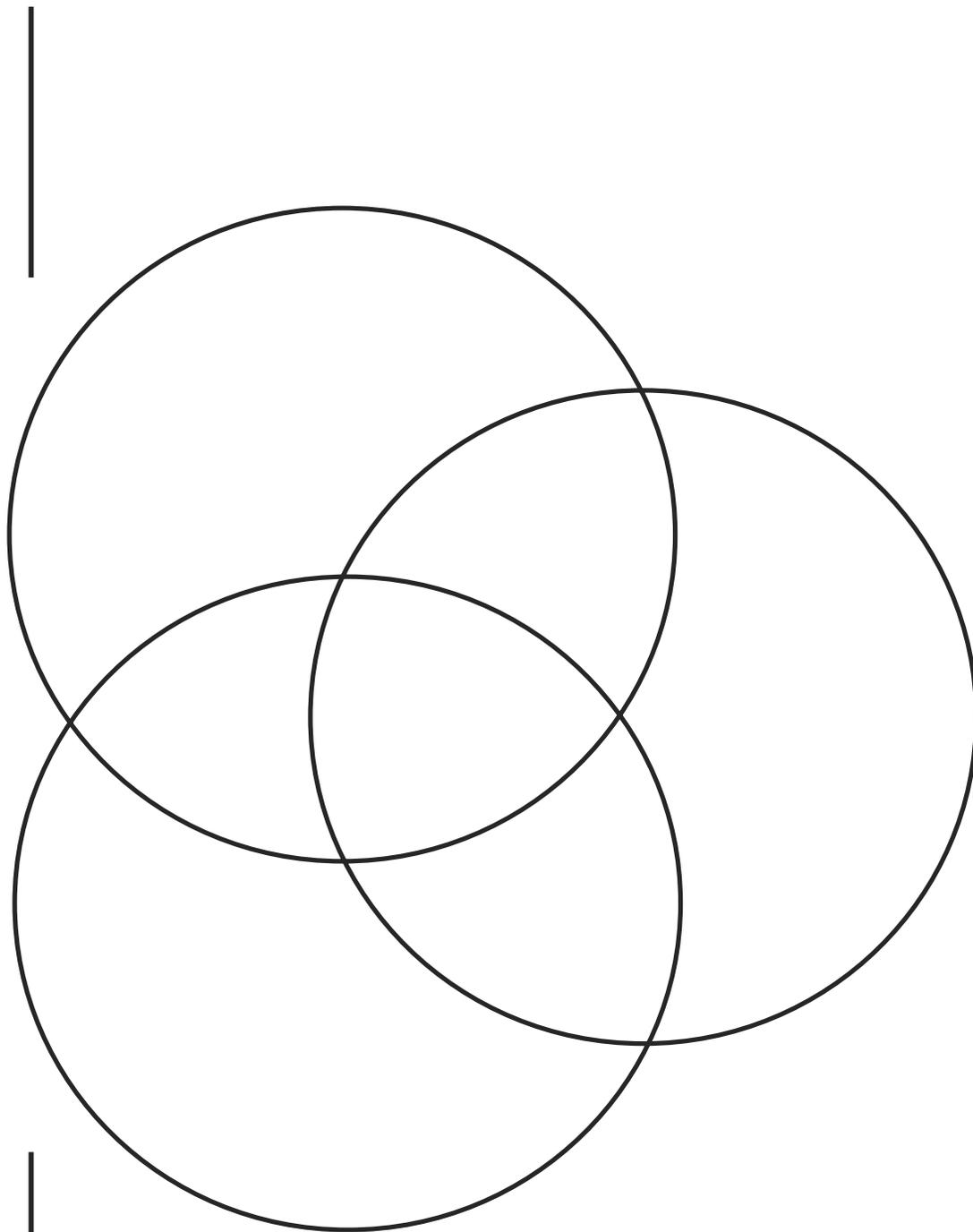
Name _____

Comparing 2 Numbers



Name _____

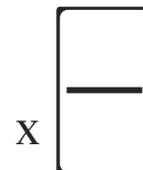
Comparing 3 Numbers



Name _____

Dominos at Play

Write down what is shown on our domino. Multiply the two numerals together.
Write a division sentence that belongs to the fact family.



Make an array to show your problem.

Solve your problem using the Commutative Property, and at least one other way.

Compare your product to the others in your group, using the =,<,>, signs.



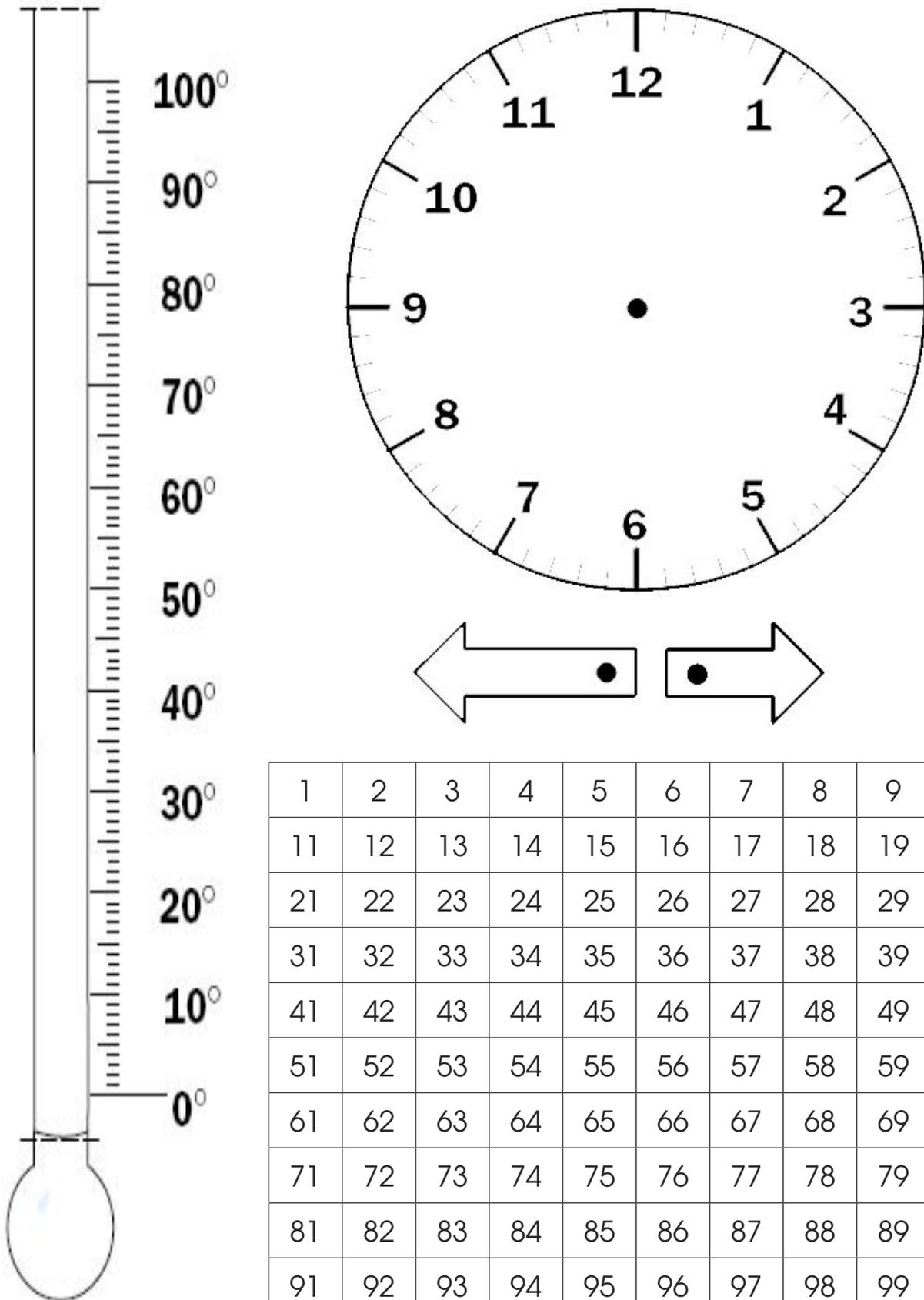
Line up your group's dominos according to the product, least to greatest.



What do you notice about the factors and the products? Explain the pattern.

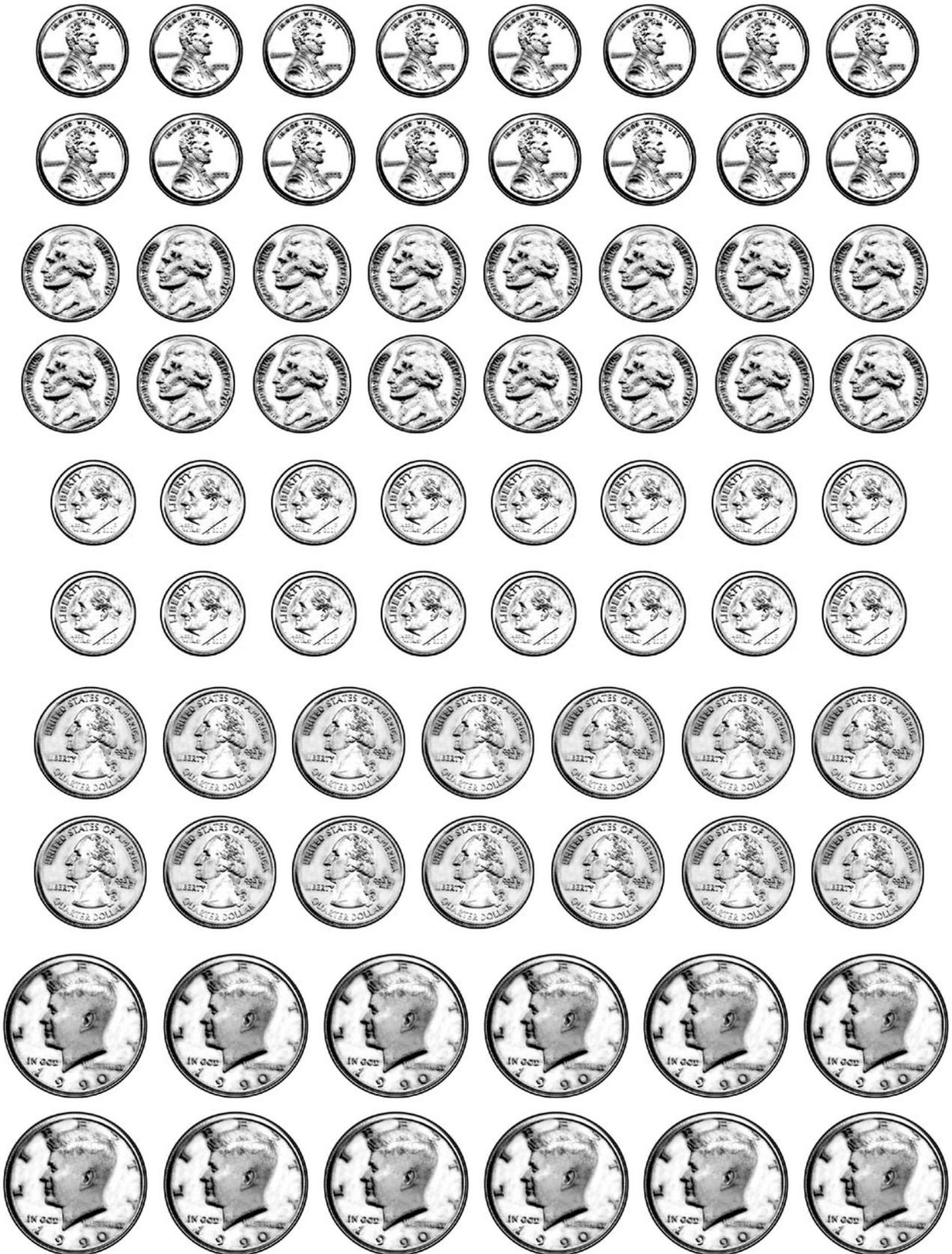
Write a story problem that uses your factors.

Thermometer



1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Coins



Equation Organizer

Equation #1	=	Equation #2

Target Number

2-3 players

Materials: Number cards or dice, score sheet, pencil

Rules: Players are trying to create an expression that equals the target number before their partner.

1. First draw one card to be the target number.
2. Then each player draws six cards and then picks four of those cards to create an expression to equal the target amount. The target amount, cards used, and expression are recorded.
3. Put the used cards on the bottom of the deck. Keep the two that were not used.
4. Pick a new target amount and draw four more cards so that you have a total of six cards.
5. Repeat the process of creating an expression.
6. Play ten rounds.
7. If an expression cannot be made the player may trade two of their cards for two new ones by placing the old cards on the bottom of the pile and picking two new ones from the top.

Target Number Score Sheet

Round	Target	Cards	Expression
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			