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

Participant Handbook

ELEMENTARY CORE ACADEMY • ELEMENTARY CORE ACADEMY • ELEM

3RD GRADE

2007

UTAH STATE OFFICE OF EDUCATION

ELEMENTARY CORE ACADEMY

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Organizations:

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

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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

Funding Sources

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

Major funding for the Academy comes from the following sources:

Federal/State Funds:

Utah State Office of Education
- Staff Development Funds
- Special Education Services Unit

ESEA Title II

Utah Math Science Partnership

District Funds:

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

School Funds:

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 have assisted in the development and delivery of resources in the Academy.

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

Goals of the Elementary CORE Academy

Overall

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

The Academy will provide elementary teachers in Utah with:

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

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

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Utah Elementary Mathematics Core Curriculum

Introduction

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

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

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

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

The Elementary Mathematics Core describes what students should know and be able to do at the end of each of the K-6 grade levels. It was developed and revised by a community of Utah mathematics

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

Organization of the Elementary Mathematics Core

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

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

Guidelines Used in Developing the Elementary Mathematics Core

The Core is:

Consistent With the Nature of Learning

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

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 Core is designed to encourage a variety of interactive learning opportunities. Instruction should include recognition of the role of mathematics in the classroom, school, and community.

Comprehensive

By emphasizing depth rather than breadth, the Elementary Mathematics Core seeks to empower students by providing a comprehensive background in mathematics. Teachers are expected to teach all the standards and objectives specified in the Core for their grade level, but may add related concepts and skills.

The Core is:

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

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 handbook is also available for teachers and has sample lessons on each topic for each grade level. The 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. The 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.

Based Upon the National Council of Teachers of Mathematics Curriculum Focal Points

In 2006, the National Council of Teachers of Mathematics (NCTM) published *Curriculum Focal Points for Prekindergarten through Grade 8 Mathematics* (NCTM, 2006). This document is available online at http://www.nctm.org/focalpoints. This document describes three focal points for each grade level. NCTM's focal points are areas of emphasis recommended for the curriculum of each grade level. The focal points within a grade are ***not the entire curriculum*** for that particular grade; however, Utah's Core Curriculum was designed to include these areas of focus.

Intended Learning Outcomes for Third through Sixth Grade Mathematics

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

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

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

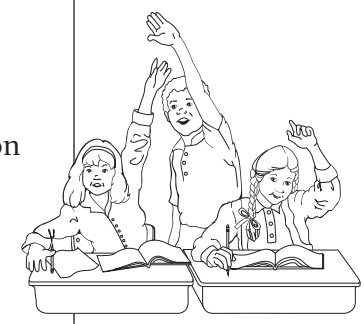
ILOs for mathematics:

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

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

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

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



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

   Problem solving is the cornerstone of mathematics. Mathematical knowledge is generated through problem solving

as students explore mathematics. To become effective problem solvers, students need many opportunities to formulate questions and model problem situations in a variety of ways. They should generalize mathematical relationships and solve problems in both mathematical and everyday contexts.

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

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

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

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

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

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

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

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

Third Grade Mathematics Core Curriculum

By the end of grade three, students develop understandings of multiplication and division of whole numbers. They use properties to develop increasingly more sophisticated strategies to solve problems involving basic multiplication and division facts. They relate division to multiplication. Students understand fraction equivalence for simple fractions; they recognize that the size of a fractional part is relative to the size of the whole. They understand meanings of fractions to represent parts of a whole, parts of a set, or distances on a number line. They compare and order simple fractions by using models, benchmark fractions, or common denominators.

Students investigate, analyze, and classify two-dimensional shapes by their sides and angles. They decompose, combine, and transform polygons to understand properties of two-dimensional space and use those properties to solve problems. Students construct and analyze frequency tables, bar graphs, picture graphs, and line plots and use them to solve problems.

Standard I:

Students will understand the base-ten numeration system, place value concepts, simple fractions and perform operations with whole numbers.

Standard I: Students will understand the base-ten numeration system, place value concepts, simple fractions and perform operations with whole numbers.

Objective 1: Represent whole numbers up to 10,000, comprehend place value concepts, and identify relationships among whole numbers using base-ten models and symbolic notation.

a. Read, write, and represent whole numbers using standard and expanded form.

b. 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).

c. Identify the place and the value of a given digit in a four-digit numeral and round numbers to the nearest ten, hundred, and thousand.

d. Order and compare whole numbers on a number line and use the symbols <, >, ≠, and = when comparing whole numbers.

e. Identify factors and multiples of whole numbers.

Objective 2: Use fractions to describe and compare parts of the whole.

a. Identify the denominator of a fraction as the number of equal parts of the unit whole and the numerator of a fraction as the number of equal parts being considered.

b. Define regions and sets of objects as a whole and divide the whole into equal parts using a variety of objects, models, and illustrations.

c. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, sixths, and eighths.

d. Place fractions on the number line and compare and order fractions using models, pictures, the number line, and symbols.

e. Find equivalent fractions using concrete and pictorial representations.

Objective 3: Model problems involving addition, subtraction, multiplication, and division.

a. Demonstrate the meaning of multiplication and division of whole numbers through the use of a variety of representations (e.g., equal-sized groups, arrays, area models, and equal jumps on a number line for multiplication, partitioning and sharing for division).

b. Use a variety of strategies and tools, such as repeated addition or subtraction, equal jumps on the number line, and counters arranged in arrays to model multiplication and division problems.

c. Demonstrate, using objects, that multiplication and division by the same number are inverse operations (e.g., 3 x = 12 is the same as 12 ÷ 3 = and = 4).

d. Demonstrate the effect of place value when multiplying whole numbers by 10.

e. Write a story problem that relates to a given addition, subtraction, or multiplication equation, and write a number sentence to solve a problem related to the students' environment.

Objective 4: Compute and solve problems involving addition and subtraction of 3- and 4-digit numbers and basic facts of multiplication and division.

a. Use a variety of methods to facilitate computation (e.g., estimation, mental math strategies, paper and pencil).

b. Find the sum or difference of numbers, including monetary amounts, using models and strategies such as expanded form, compensation, partial sums, and the standard algorithm.

c. Compute basic multiplication facts (0-10) and related division facts using a variety of strategies based on properties of addition and multiplication (i.e., commutative, associative, identity, zero, and the distributive properties).

Mathematical language and symbols students should use:
sum, difference, expanded form, factor, product, array, multiple, numerator, denominator, halves, thirds, fourths, sixths, eighths, divisor, dividend, quotient, greater than, less than, equal to, <, >, =

Exploratory Concepts and Skills

- Extend multiplication and division to larger-digit numbers.
- Use concrete objects and visual models to add and subtract common decimals.
- Investigate the distributive property of multiplication over addition for single-digit multipliers (e.g., 7 x 15 is equivalent to 7 x (10 + 5) is equivalent to (7 x 10) + (7 x 5).

Standard II:

Students will use patterns, symbols, operations, and properties of addition and multiplication to represent and describe simple number relationships.

Standard II: Students will use patterns, symbols, operations, and properties of addition and multiplication to represent and describe simple number relationships.

Objective 1: Create, represent, and analyze growing patterns.

a. Create and extend growing patterns using objects, numbers, and tables.

b. Describe how patterns are extended using manipulatives, pictures, and numerical representations.

Objective 2: Recognize, represent, and simplify simple number relationships using symbols, operations, and properties.

a. Represent numerical relationships as expressions, equations, and inequalities.

b. Solve equations involving equivalent expressions (e.g., 6 + 4 = Δ + 7).

c. Use the >, <, and = symbols to compare two expressions involving addition and subtraction (e.g., 4 + 6 3 + 2; 3 + 5 16 - 9).

d. Recognize and use the commutative, associative, distributive, and identity properties of addition and multiplication, and the zero property of multiplication.

Mathematical language and symbols students should use:
growing patterns, expressions, equations, <, >, =

Exploratory Concepts and Skills

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

Standard III: Students will describe and analyze attributes of two-dimensional shapes.

Objective 1: Describe and compare attributes of two-dimensional shapes.

a. Identify, describe, and classify polygons (e.g., pentagons, hexagons, octagons).

b. Identify attributes for classifying triangles (e.g., two equal sides for the isosceles triangle, three equal sides for the equilateral triangle, right angle for the right triangle).

c. Identify attributes for classifying quadrilaterals (e.g., parallel sides for the parallelogram, right angles for the rectangle, equal sides and right angles for the square).

d. Identify right angles in geometric figures, or in appropriate objects, and determine whether other angles are greater or less than a right angle.

Objective 2: Demonstrate the meaning of congruence through applying transformations.

a. Demonstrate the effect of reflection, translation, or rotation using objects.

b. Determine whether two polygons are congruent by reflecting, translating, or rotating one polygon to physically fit on top of the other.

Mathematical language and symbols students should use:
polygon, attribute, quadrilateral, equilateral triangle, isosceles triangle, right triangle, pentagon, hexagon, octagon, parallel, right angle, reflect, translate, rotate, slide, flip, turn, congruent

Exploratory Concepts and Skills

- Explore line symmetry and rotational symmetry.
- Investigate two-dimensional representations of three-dimensional objects.
- Explore properties of equality in number sentences (e.g., when equals are added to equals, then the sums are equal; when equals are multiplied by equals, then the products are equal.

Standard III:

Students will describe and analyze attributes of two-dimensional shapes.

Standard IV:

Students will select and use appropriate units and measurement tools to solve problems.

Standard IV: Students will select and use appropriate units and measurement tools to solve problems.

Objective 1: Select and use appropriate tools and units to estimate and measure length, weight, capacity, time, and perimeter of two-dimensional figures.

a. Describe the part-whole relationships (e.g., 3 feet in a yard, a foot is 1/3 of a yard) between metric units of length (i.e., centimeter, meter), and among customary units of length (i.e., inch, foot, yard), capacity (i.e., cup, quart), and weight (i.e., pound, ounce).

b. Measure the length of objects to the nearest centimeter, meter, half- and quarter-inch, foot, and yard.

c. Measure capacity using cups and quarts, and measure weight using pounds and ounces.

d. Identify the number of minutes in an hour, the number of hours in a day, the number of days in a year, and the number of weeks in a year.

e. Describe perimeter as a measurable attribute of two-dimensional figures, and estimate and measure perimeter with metric and customary units.

Objective 2: Solve problems involving measurements.

a. Determine simple equivalences of measurements (e.g., 30 inches = 2 feet and 6 inches; 6 cups = 11/2 quarts; 90 min. = 1 hr. 30 min.).

b. Compare given objects according to measurable attributes (i.e., length, weight, capacity).

c. Solve problems involving perimeter.

Mathematical language and symbols students should use:

measure, unit, metric system, customary system, length, pound, ounce, centimeter, meter, inch, foot, yard, capacity, weight, perimeter

Determine elapsed time in hours (e.g., 7:00 a.m. to 2:00 p.m.)

Exploratory Concepts and Skills

- Determine the value of a combination of coins and bills.
- Count back change from a single purchase.

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

Objective 1: Collect, organize, and display data to make predictions.

a. Collect, read, represent, and interpret data using tables, graphs, and charts, including keys (e.g., pictographs, bar graphs, frequency tables, line plots).

b. Make predictions based on a data display.

Objective 2: Identify basic concepts of probability.

a. Describe the results of events using the terms "certain," "likely," "unlikely," and "impossible."

b. Conduct simple probability experiments, record possible outcomes systematically, and display results in an organized way (e.g., chart, graph).

c. Use results of simple probability experiments to describe the likelihood of a specific outcome in the future.

Mathematical language and symbols students should use:
data, table, chart, graph, frequency table, line plot, pictograph, bar graph, likely, certain, outcome, impossible outcome

Exploratory Concepts and Skills

- Predict outcomes of simple experiments.

Utah Elementary Science Core Curriculum

Introduction

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

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

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

Organization of the Elementary Science Core

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

The Science Core Curriculum's organization:

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

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

Guidelines

- 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

Eight Guidelines Were Used in Developing the Elementary Science Core

Reflects the Nature of Science

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

As described in these ILOs, students will:

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

Coherent

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

students to understand and use more complex science concepts and skills as they advance through their science learning.

Developmentally Appropriate

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

Third Grade Science Core Curriculum

In third grade students learn about interactions, relationships, relative motion, and cause and effect. They study the movement of Earth and the moon. They begin to learn of forces that move things; they learn of heat and light. Third graders observe, classify, predict, measure, and record.

Third graders should be encouraged to be curious. They should be helped and encouraged to pose their own questions about objects, events, processes, and results. Effective teachers provide students with hands-on science investigations in which student inquiry is an important goal. Teachers should provide opportunities for all students to experience many things. Third graders should use their senses as they feel the warmth of the sun on their face, watch the moon as it seems to move through broken clouds, sort and arrange their favorite rocks, look for patterns in rocks and flowers, observe a snail move ever so slowly up the side of a terrarium, test materials for slipping and sliding, measure the speed of rolling objects, and invent ways to resist gravity. They should come to enjoy science as a process of learning about the world.

- 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.

Third grade 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. 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 third 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 third grade; Sci-ber Text – an electronic science text book specific to the Utah Core; and the science test item pool. This pool includes multiple-choice questions, performance tasks, and interpretive items aligned to the standards and objectives of the third grade curriculum. These resources are all available on the Utah Science Home Page at: http://www.usoe.k12.ut.us/curr/science

SAFETY PRECAUTIONS:

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

Intended Learning Outcomes for Third Grade Science

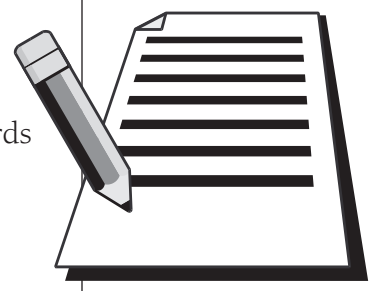
The Intended Learning Outcomes (ILOs) describe the skills and attitudes students should learn as a result of science instruction. They are an essential part of the Science Core Curriculum and provide teachers with a standard for evaluation of student learning in science. Instruction should include significant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

- 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 third grade students will be able to:

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



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

Third Grade Science Standards

Science Benchmark

Earth orbits around the sun, and the moon orbits around Earth. Earth is spherical in shape and rotates on its axis to produce the night and day cycle. To people on Earth, this turning of the planet makes it appear as though the sun, moon, planets, and stars are moving across the sky once a day. However, this is only a perception as viewed from Earth.

Standard I: Students will understand that the shape of Earth and the moon are spherical and that Earth rotates on its axis to produce the appearance of the sun and moon moving through the sky.

Standard I: Students will understand that the shape of Earth and the moon are spherical and that Earth rotates on its axis to produce the appearance of the sun and moon moving through the sky.

Objective 1: Describe the appearance of Earth and the moon.

a. Describe the shape of Earth and the moon as spherical.

b. Explain that the sun is the source of light that lights the moon.

c. List the differences in the physical appearance of Earth and the moon as viewed from space.

Objective 2: Describe the movement of Earth and the moon and the apparent movement of other bodies through the sky.

a. Describe the motions of Earth (i.e., the rotation [spinning] of Earth on its axis, the revolution [orbit] of Earth around the sun).

b. Use a chart to show that the moon orbits Earth approximately every 28 days.

c. Use a model of Earth to demonstrate that Earth rotates on its axis once every 24 hours to produce the night and day cycle.

d. Use a model to demonstrate why it seems to a person on Earth that the sun, planets, and stars appear to move across the sky.

Science language students should use:

model, orbit, sphere, moon, axis, rotation, revolution, appearance

Science Benchmark

For any particular environment, some types of plants and animals survive well, some survive less well and some cannot survive at all. Organisms in an environment interact with their environment. Models can be used to investigate these interactions.

Standard II: Students will understand that organisms depend on living and nonliving things within their environment.

Standard II: Students will understand that organisms depend on living and nonliving things within their environment.

Objective 1: Classify living and nonliving things in an environment.

a. Identify characteristics of living things (i.e., growth, movement, reproduction).

b. Identify characteristics of nonliving things.

c. Classify living and nonliving things in an environment.

Objective 2: Describe the interactions between living and nonliving things in a small environment.

a. Identify living and nonliving things in a small environment (e.g., terrarium, aquarium, flowerbed) composed of living and nonliving things.

b. Predict the effects of changes in the environment (e.g., temperature, light, moisture) on a living organism.

c. Observe and record the effect of changes (e.g., temperature, amount of water, light) upon the living organisms and nonliving things in a small–scale environment.

d. Compare a small–scale environment to a larger environment (e.g., aquarium to a pond, terrarium to a forest).

e. Pose a question about the interaction between living and nonliving things in the environment that could be investigated by observation.

Science language students should use:

environment, interaction, living, nonliving, organism, survive, observe, terrarium, aquarium, temperature, moisture, small–scale

Science Benchmark

Forces cause changes in the speed or direction of the motion of an object. The greater the force placed on an object, the greater the change in motion. The more massive an object is, the less effect a given force will have upon the motion of the object. Earth's gravity pulls objects toward it without touching them.

Standard III: Students will understand the relationship between the force applied to an object and resulting motion of the object.

Standard III: Students will understand the relationship between the force applied to an object and resulting motion of the object.

Objective 1: Demonstrate how forces cause changes in speed or direction of objects.

a. Show that objects at rest will not move unless a force is applied to them.

b. Compare the forces of pushing and pulling.

c. Investigate how forces applied through simple machines affect the direction and/or amount of resulting force.

Objective 2: Demonstrate that the greater the force applied to an object, the greater the change in speed or direction of the object.

a. Predict and observe what happens when a force is applied to an object (e.g., wind, flowing water).

b. Compare and chart the relative effects of a force of the same strength on objects of different weight (e.g., the breeze from a fan will move a piece of paper but may not move a piece of cardboard).

c. Compare the relative effects of forces of different strengths on an object (e.g., strong wind affects an object differently than a breeze).

d. Conduct a simple investigation to show what happens when objects of various weights collide with one another (e.g., marbles, balls).

e. Show how these concepts apply to various activities (e.g., batting a ball, kicking a ball, hitting a golf ball with a golf club) in terms of force, motion, speed, direction, and distance (e.g. slow, fast, hit hard, hit soft).

Standard IV: Students will understand that objects near Earth are pulled toward Earth by gravity.

Objective 1: Demonstrate that gravity is a force.

a. Demonstrate that a force is required to overcome gravity.

b. Use measurement to demonstrate that heavier objects require more force than lighter ones to overcome gravity.

Objective 2: Describe the effects of gravity on the motion of an object.

Standard IV: Students will understand that objects near Earth are pulled toward Earth by gravity.

a. Compare how the motion of an object rolling up or down a hill changes with the incline of the hill.

b. Observe, record, and compare the effect of gravity on several objects in motion (e.g., a thrown ball and a dropped ball falling to Earth).

c. Pose questions about gravity and forces.

Science language students should use:
distance, force, gravity, weight, motion, speed, direction, simple machine

Science Benchmark

Light is produced by the sun and observed on Earth. Living organisms use heat and light from the sun. Heat is also produced from motion when one thing rubs against another. Things that give off heat often give off light. While operating, mechanical and electrical machines produce heat and/or light.

Standard V: Students will understand that the sun is the main source of heat and light for things living on Earth. They will also understand that the motion of rubbing objects together may produce heat.

Standard V: Students will understand that the sun is the main source of heat and light for things living on Earth. They will also understand that the motion of rubbing objects together may produce heat.

Objective 1: Provide evidence showing that the sun is the source of heat and light for Earth.

a. Compare temperatures in sunny and shady places.

b. Observe and report how sunlight affects plant growth.

c. Provide examples of how sunlight affects people and animals by providing heat and light.

d. Identify and discuss as a class some misconceptions about heat sources (e.g., clothes do not produce heat, ice cubes do not give off cold).

Objective 2: Demonstrate that mechanical and electrical machines produce heat and sometimes light.

a. Identify and classify mechanical and electrical sources of heat.

b. List examples of mechanical or electrical devices that produce light.

c. Predict, measure, and graph the temperature changes produced by a variety of mechanical machines and electrical devices while they are operating.

Objective 3: Demonstrate that heat may be produced when objects are rubbed against one another.

a. Identify several examples of how rubbing one object against another produces heat.

b. Compare relative differences in the amount of heat given off or force required to move an object over lubricated/ non–lubricated surfaces and smooth/rough surfaces (e.g., waterslide with and without water, hands rubbing together with and without lotion).

Science language students should use:

mechanical, electrical, temperature, degrees, lubricated, misconception, heat source, machine

Facilitated

Activities

New Math Core Curriculum
Elementary CORE Academy 2007

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

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

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

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

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

E-D-P Model

Elementary CORE Academy 2007

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

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

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

Evaluation

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

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

Diagnosis

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

Prescription

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

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

Citations

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

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

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

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

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

Prescription:

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

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

Prescription:

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

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

Prescription:

E-D-P Assessment Form

Evaluation: ____________________

Name ____________________

Date ____________________

Task/Objective ____________________

( ) Individual ( ) Partner ( ) Group

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

Prescription:

E-D-P Assessment Form

Evaluation: _____

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

E-D-P Assessment Form		
Diagnosis:		Prescription:

*Copy to a label and place on student work.

E-D-P Assessment Form

Evaluation: _____

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

E-D-P Assessment Form		
Diagnosis:		Prescription:

*Copy to a label and place on student work.

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

Mathematical Proficiency
Elementary CORE Academy 2007

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

Mathematical proficiency includes five strands:

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

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

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

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

Citation

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

Building Academic Vocabulary
Elementary CORE Academy 2007

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

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

The Six-Step Process for Teaching Academic Vocabulary:

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

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

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

Citation

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

Math I-4

Activities

Problem Solving

Fiddle Dee Diddle – It's Time For A Riddle

Standard I:

Students will understand the base-ten numeration system, place value concepts, simple fractions, and perform operations with whole numbers.

Objective 4:

Compute and solve problems involving addition and subtraction of 3-and 4-digit numbers and basic facts of multiplication and division.

Intended Learning Outcomes:

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
3. Reason logically, using inductive and deductive strategies and justify conclusions.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.

Content Connections:

Language Arts VIII-6; writing in different forms and genres

Math Standard I

Objective 4

Connections

Background Information

Students need to have a basic understanding of addition, subtraction, and multiplication operations. They must be aware of the math vocabulary that relates to each of these operations. Students should to be familiar with the story problem process. First, they must understand what the problem is asking. Second, they must locate all the facts within the word problem. As students look for the facts they need to pay particular attention to the vocabulary that is being used. Finally, students must decide upon a plan of attack. This is the time when a student chooses what facts are vital, what operation is needed, and if their solution makes sense.

Research Basis

Hiebert, J., Carpenter, T.P., Fennema, E., Fuson, K., Human, P., Murray, H., Olivier, A., & Wearne, D. (1996). *Problem solving as a basis for reform in curriculum and instruction: The case of mathematics*. 25(4), 12-21.

The authors examine the benefits of applying John Dewey's notion of reflective inquiry into mathematics. This theory encourages students to identify problems, study out the problem, and then come to a conclusion. By following these steps students can potentially gain a greater understanding. To apply this theory in the classroom, tasks need to be picked that allow students to use prior knowledge and wrestle with key concepts.

DeYoung, M.J., (2001). Challenge problems: Love them or hate them, but learn from them. *Mathematics teaching in the middle school*, 6(8), 484-488.

Challenging math problems give students valuable experience. Students learn how to communicate mathematical ideas to their peers as they discuss problems. Questioning skills are enhanced as they start asking why a solution might be correct. Students start to recognize how math concepts are connected with each other.

Invitation to Learn

Materials

- ❑ Arithme Tickle
- ❑ Riddle Problems
- ❑ Riddle Time (10 copies)
- ❑ Scissors
- ❑ Glue

Students are placed into groups of four or five. Each group is given five numbered cards. The numbers on the cards will range from 0 to 99. Write any number between 0 and 99 on the overhead. Instruct students that this number will be the answer and each group must use their number cards to get this answer. They can add, subtract, multiply, or divide these numbers any way they want. When a group has reached the answer they must ring the bell that will be located by the overhead.

Instructional Procedures

1. Use the book *Arithme Tickle* to introduce what a math riddle is and how to solve one. After reading each page, solve the riddles together by using the *Riddle Time* worksheet.
2. Hand out a copy of *Riddle Problems* to each student. Have students cut one riddle out.
3. Hand out a copy of *Riddle Time* to each student. Have students glue the riddle they previously cut out in the correct place on this paper.
4. Students need to be assigned a partner. Each partnership must read and discuss the riddle together. They need to work together to fill out the top two boxes on the *Riddle Time* worksheet.
5. Students will return to their individual seats to complete the Riddle Time worksheet on their own.
6. Once the whole class completes a riddle, have students share why they feel their answer is correct and the steps they took to come to that conclusion.
7. When all ten riddles are completed then the papers are bound together to form a riddle book.

Assessment Suggestions

- As students work together on the *Riddle Time* worksheet observe their conversations. Ask questions about the thoughts they're

sharing with each other. This type of assessment will show a student's true understanding of math concepts.

- Have students pick one of the riddles they feel the most confident about. Create a math rubric that will help assess the riddle that they did.

Curriculum Extensions/Adaptations/ Integration

- Advanced learners can write math riddles for the class to solve. These can be added to the math riddle book.
- Special needs learners can draw a picture to show their plan on the *Riddle Time* worksheet. They can describe to another student why they feel the answer is correct.
- Here is the answer so what is the question? Give students an answer, for example, eight snowmen. Instruct students to come up with a question that has the answer of eight snowmen.
- Use the book *Each Orange Had 8 Slices* to create challenging problems. For every page create one to two story problems. After the story problems have been produced have your students read this book. Once the story has been read, students need to start working on the problems.

Family Connections

- Give students a challenging riddle to do at home with their parents.
- Have students write a riddle about their family.

Additional Resources

Books

Arithme-Tickle: An Even Number of Odd Riddle-Rhymes, by J. Patrick Lewis; ISBN 0152164189

Math Potatoes, by Greg Tang; ISBN 0439443903

Each Orange Had 8 Slices, by Paul Giganti; ISBN 068813985X

Articles

The Answer Is 20 Cookies. What is the Question?, *Teaching Children Mathematics;* January 2007, Volume 13, Issue 5, Page 252

Web sites

http://www.teach-nology.com/web_tools/rubrics/maths/ www.mathstories.com

Riddle Time

Place Riddle Here	
Explain to me what they are asking.	**What are the facts? Are there any important words?**
What is your plan? Show me.	**Why do you feel your solution is correct?**

Riddle Problems

A grocery store has a sale on oranges. If you buy five oranges you get the sale price. If the grocer has 169 oranges, how many bunches of five can he sell at his sale price? How many will be left to be sold at the regular price?	There are 24 people in a room. 11 people are wearing socks, seven people are wearing shoes, and four people are wearing both. How many people are in bare feet?
How many addition signs should be put between the digits of the number 987654321 and where should we put them to get a total of 198?	The Riddler has left clues for Batman. These are the clues: 1) There is a 1 in the thousands place. 2) The digit in the tens place is 8 times the digit in the thousand place. 3) The digit in the ones place is a hand without a pinkie. 4) The digit in the hundreds is 4 less than the number in the tens. Solve the riddle to help Batman stop the Riddler.
I have 12 stamps. The stamps are either 3-cent or 5-cent stamps. All together the stamps equal 40 cents. How many 3-cent stamps and how many 5-cent stamps do I have?	Fill in the blanks with these numbers so the story makes sense. 4 12 9 10 7 14 It is January right now. My birthday is ___ months away. I am going to turn ___ on July ___. My sister is three years older than me. She is going to turn ___ in about ___ months.
Brynne, Delaney, JD, Mckayla, and Shane have to read 85 pages in a book. ▪ Brynne has 30 pages left. ▪ Delaney has 5 more pages to read than Brynne. ▪ JD has 10 fewer pages to read than Delaney. ▪ McKayla has read 4 more pages than JD. ▪ Shane has read 8 more pages than Brynne. What page is each person on?	Susan, Kristine, Kathryn, Erin, and JoDee had five dozen stickers. ▪ Each person had at least 6 stickers. ▪ Kathryn had 6 more stickers than Kristine. ▪ Erin had twice as many stickers as Susan. ▪ JoDee had 6 fewer stickers than Erin. How many stickers did each person have?
▪ Heather -Do Dishes ▪ Shane -Make Beds ▪ Josie - Vacuum Floor ▪ Jed -Empty Garbage These are the chores that Heather, Shane, and Josie have to do on Monday. Each does a different chore every day. Tuesday Heather will empty the garbage and Jed will vacuum. What job will each child have to do this Sunday?	14, 15, 21, 22, 38, 41 Adding together each or some of these numbers as many times as you want, how do you reach a sum of exactly 100?

Shooting For A Solution

Math Standard I

Objective 4

Connections

Standard I:

Students will understand the base-ten numeration system, place value concepts, simple fractions, and perform operations with whole numbers.

Objective 4:

Compute and solve problems involving addition and subtraction of 3-and 4-digit numbers and basic facts of multiplication and division.

Intended Learning Outcomes:

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

Content Connections:

Social Studies VI-1; examine maps and globes

Background Information

Students need to have a basic understanding of addition, subtraction, and multiplication operations. They must be aware of the math vocabulary that relates to each of these operations. Students should also learn that in the United States we use miles to measure the distance between two destinations. Students will use this knowledge and their map skills to figure out the distance that the Jazz team travels throughout a basketball season.

Research Basis

Hunter, J., & Turner, I., (1993). Mathematics and the real world. *British Educational Research Journal*. 19, 17-27.

Students were asked to give everyday examples of when people use computation skills. The majority of students struggled in transferring their math knowledge to the real world. There needs to be a link between classroom learning and everyday experiences. Students not only need to memorize basic computation rules but also see how to apply them in life.

Thorson, A., (2000). Mathematics and science in the real world. *ENC Focus: A Magazine For Classroom Innovators,* [7(3)], 23-24.

Many students stop taking math classes as soon as possible because they do not see the relevance of it in their lives. Students must realize that the math skills they are learning will be useful to them. Math activities must give students the chance to wonder, question, and communicate thoughts and ideas.

Invitation to Learn

A map of the United States will be displayed. On the map there will be a star on every city that an opponent of the Utah Jazz is found. As students look at the map, they will be told how many miles it is across the United States from the Pacific to the Atlantic Ocean. Based on these facts that have been given, students will be asked to make estimations on how many miles they think the Utah Jazz travel throughout the basketball season. Students will write their estimation on a transparency that will be shared with the class.

Instructional Procedures

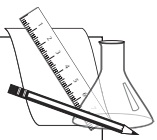
Are We There Yet?

Materials

- ❑ Map of the United States
- ❑ *Planes, Trains, and Automobiles*

1. Students will record in their math journals how many miles per hour on average an airplane, train, and automobile travel. The information students will record is as follows:
   - A passenger airplane on average travels 600 miles per hour.
   - An Amtrak train travels 70 miles per hour.
   - An automobile on average travels 72 miles per hour.
2. Everyday students will look on the map to see where the Utah Jazz will be traveling to from Salt Lake City. They will locate the total miles it is to that city on their *Planes, Trains, and Automobiles* worksheet.
3. Students will use their computation skills to figure out how long it will take the Jazz to reach their destination by plane, train, and automobile. Students will record their answers on their *Planes, Trains, and Automobiles* worksheet under the appropriate column.
4. Students will then calculate how many total miles and hours it will be if the Jazz travel back to that city several times throughout the basketball season. The amount the Jazz travels to that city is found on the *Planes, Trains, and Automobiles* worksheet.

Time To Rumble



Materials

- ❑ 3 Ziploc bags
- ❑ Markers
- ❑ *Basketball*
- ❑ *Rumble Time*

1. Using a marker, label the outside of the Ziploc bags with the following: Players, Basketball Terms, and Math Vocabulary. Cut and sort out the words found on the Basketball worksheet.
2. Have students pick one card from all three bags.

3. Give students a copy of the Rumble Time worksheet. Students need to record the information that was picked from the bags onto this paper.
4. On the overhead students need to locate the information on the chart for the basketball term that was picked.
5. Using their computation skills, students must now solve the problem.
6. Have students share their solutions and what they did to get them.

Assessment Suggestions

- Have students describe to the class the process they went through to calculate how long it would take them to get to any city found on the *Planes, Trains, and Automobiles* worksheet.
- Give students different basketball players, basketball terms, and math vocabulary terms. Have them write a story problem for the class to solve using those items.

Curriculum Extensions/Adaptations/ Integration

- Hand out the nutritional guides and price lists of items from McDonald's, Wendy's, and Subway. Have students plan a meal from each of these restaurants. As they plan what to eat have students calculate how many calories and total fat the different meals contain. Compare the students' meals. Find out who has the best and worst nutritional meal from each restaurant. Discuss the importance of good nutrition with the students. Have students create several different meals that would cost under five dollars.
- Advanced learners could calculate how long it would take to get to the hometown of a Utah Jazz player that is from another country.
- Special needs learners could be given a partner to work with as the class does these activities.

Family Connections

- Students need to find out how many miles it is to a relative's home. Have them calculate how long it would take for them to get there by driving a car.

- Students need to find the final score of a sporting event attended by their family or watched on TV. Instruct them to find the difference between the two team's scores.

Additional Resources

Web sites

www.nba.com

www.mcdonalds.com

www.wendys.com

www.subway.com

www.mapquest.com

Planes, Trains and Automobiles

From Salt Lake to...	#	Miles			
Atlanta, Georgia	1	1,933			
Boston, Massachusetts	1	2,368			
Charlotte, North Carolina	1	2,052			
Chicago, Illinois	1	1,400			
Cleveland, Ohio	1	1,729			
Dallas, Texas	2	1,404			
Denver, Colorado	2	533			
Detroit, Michigan	1	1,665			
Oakland, California	2	731			
Houston, Texas	2	1,644			
Indianapolis, Indiana	1	1,519			
Los Angeles, California	3	690			
Memphis, Tennessee	2	1,592			
Miami, Florida	1	2,540			
Milwaukee, Wisconsin	1	1,441			
Minneapolis, Minnesota	2	1,310			
East Rutherford, New Jersey	1	2,168			
Okalahoma City, Oklahoma	2	1,202			
New York City, New York	1	2,174			
Orlando, Florida	1	2,316			
Philadelphia, Pennsylvania	1	2,144			
Phoenix, Arizona	2	702			
Portland, Oregon	2	767			
Sacramento, California	2	650			
San Antonio, Texas	2	1,440			
Seattle, Washington	2	841			
Washington D.C.	1	2,085f			

Basketball

Tim Duncan San Antonio Spurs	Tony Parker San Antonio Spurs	Manu Ginobili San Antonio Spurs	Brent Barry San Antonio Spurs	Michael Finley San Antonio Spurs
Bruce Bowen San Antonio Spurs	Fabricio Oberto San Antonio Spurs	Beno Udrih San Antonio Spurs	Francisco Elson San Antonio Spurs	Matt Bonner San Antonio Spurs
Robert Horry San Antonio Spurs	Eric Williams San Antonio Spurs	Jackie Butler San Antonio Spurs	Jacque Vaughn San Antonio Spurs	Kobe Bryant Los Angeles Lakers
Lamar Odom Los Angeles Lakers	Luke Walton Los Angeles Lakers	Smush Parker Los Angeles Lakers	Kwame Brown Los Angeles Lakers	Andrew Bynum Los Angeles Lakers
Brian Cook Los Angeles Lakers	Maurice Evans Los Angeles Lakers	Vladimir Radmanovic Los Angeles Lakers	Jordan Farmar Los Angeles Lakers	Ronny Turiaf Los Angeles Lakers
Sasha Vujacic Los Angeles Lakers	Shammond Williams Los Angeles Lakers	Aaron McKie Los Angeles Lakers	Carlos Boozer Utah Jazz	Deron Williams Utah Jazz
Mehmet Okur Utah Jazz	Maft Harpring Utah Jazz	Derek Fisher Utah Jazz	Andrei Kirilenko Utah Jazz	Paul Milisap Utah Jazz
Gordan Giricek Utah Jazz	Ronnie Brewer Utah Jazz	C.J. Miles Utah Jazz	Jarron Collins Utah Jazz	Dee Brown Utah Jazz
Rafael Araujo Utah Jazz	Roger Powell Utah Jazz	Minutes	Steals	Blocks
Assists	Points	Rebounds	Sum	All
Together	Total	In All	Together	Difference
FewerThan	Left	Great Than	Less Than	More Than
How many more?	How many less?			

Rumble Time

Players	Basketball Category & Information
Vocabulary	**Solution**

Rumble Time

Players	Basketball Category & Information
Vocabulary	**Solution**

Science II-2

Activities

Living Things

The Ant Attack

Science Standard II

Objective 2

Connections

Standard II:

Students will understand that organisms depend on living and nonliving things within their environment.

Objective 2:

Describe the interactions between living and nonliving things in a small environment.

Intended Learning Outcomes:

Science

1. Use science process and thinking skills.
2. Manifest science interests and attitudes.
6. Understand the nature of science.

Math

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

Content Connections:

Lang. Art VIII-1; Prepare to write by gathering and organizing information and ideas.

Math V-1 Collect; organize and display data to make predictions.

Background Information

Ants are one of Earth's oldest residents and play an important role by maintaining a balance in nature. Ants are insects (six legs and three body parts) that live and work together. There are over 8,000 species of ants. Ants provide food for birds, other insects, and mammals. They are scavengers that clean up dead plants and animals. Some large animals live entirely on ants and other insects for their survival. Ants help aerate soil by digging their many tunnels which in turn help us.

In some ways, ants and people are alike. Both ants and people take care of their young, live together, have different jobs, and depend on each other. Ants have all the senses that humans have but use different body parts to achieve the same goals. Ants don't have ears; instead they use their legs and antennae to feel vibrations. They use antennae to hear, smell, and touch things. They talk or communicate by tapping their antennae together. Ants have an exoskeleton (outer covering), but have sensory structures all over their body so they know when something is touching them. Ants don't have a tongue, but they have finger like pulps around their mouths that have the ability to taste.

Unlike humans, ants have two stomachs; the second stomach is filled and used to feed other ants. Ants have two types of eyes; one set has many lenses, while the other set of eyes called "simple eyes",

allows them to judge light levels in the environment. Ants don't chew their food, instead they use their powerful jaws to squeeze the juices out of their prey and also to defend themselves. Each ant colony has their own scent and can recognize an intruder. The soldier ants (larger ants) defend those who try to invade. They also use this scent to track food that their sisters have found.

An ant's reproduction goes like this: The queen fertilizes the eggs creating all females. Ants that are fed more in the larva stage are called soldier ants. Once a year, the queen creates a male by not fertilizing that egg and fertilizes other eggs to create females, one which will become a princess. The eggs hatch within eight to 10 weeks. At this time, the male ant and Princess ant, both having wings, fly away and mate during flight. (Mating happens around the end of June until early August and the female can mate with more than one male.) After mating, the princess ant looses her wings, becoming a queen and begins her own nest or colony. Male ants are created only as needed for reproductive purposes and die shortly after mating.

Research Basis

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

The authors explored the methodologies and barriers in motivating young learners to enjoy and participate in classroom science research and learning. They concluded that a standard-based curriculum provides information on what students should learn concluding that teachers make the curriculum accessible to students through their choice of instructional materials, lessons, homework, and types of assessment.

Louckes, S.H., Hewson, P.W., Love, N., & Stiles, K. (Eds.) (1998). ***Designing professional development for teachers of science and mathematics***. Thousand Oaks, CA: Corwin Press.

In this study the authors identified three components of effective professional development that nurture continuous improvement: context, process and content. Professional development requires careful planning with the needs of teachers being an integral part of the process.

Invitation to Learn

- Ask, "What do you think it is like to be an ant?"
- Ask, "How do ants impact our lives and our environment?"
- Say, "Today we are going to read, *Hey Little Ant* by Phillip and Hannah Hoose"

Instructional Procedures

Materials

- ❑ Ant Farm Habitat
- ❑ Journal
- ❑ *Measuring Ants* (ruler)
- ❑ *Ant Math Attack*

1. Order ants from the link below.
2. After receiving the ants, place ants in their new environment (ant farm habitat).
3. Have students predict the changes that will occur as the ants spend more time in their new environment with one another.
4. Have students record their predictions in their Ant Journals.
5. Have students observe, draw, and record in an Ant Journal what they see (at least every other day) and write at least one question they want to know about ants.
6. Have a class discussion about ants and answer any questions the students have about ants from their Ant Journal entries. (See website for ant information.)
7. Have students share their observations and what they find interesting about ants to their classmates.
8. Have students take time to write answers to their own questions in their Ant Journals and ask any other question that they might want to know for the next class discussion about ants.
9. When ending the ant unit, have students go back and reflect upon their predictions and observations and write a revision of what they know.
10. For a math activity use *Measuring Ants* and *Ant Math Attack* allowing the students to explore fractions like thirds and using addition, subtraction, and multiplication by cutting them up and creating their own math problems. (Some examples are on *Ant Math Attack*)

Assessment Suggestions

- Ant Journal entries-KWL- Response to ant farm observations.
- Check to see if student's Ant Journal drawings change as ant habitat changes.
- Students will self reflect upon their predictions and observations and write a revision of what they see.

Curriculum Extensions/Adaptations/ Integration

Research the websites given on next page on ants.

Check out books and magazines on the subject.

Make your own ant habitat.

Do a written/oral report about ants.

Family Connections

Read about ants from different resources.

Have your family observe an ant hill and place three different foods a few feet away from the ant hill (e.g. a cube of sugar, a cracker, and a cookie). Predict which food they will go to first. Watch what the ants will do and which food they seem to like the best.

Have your family build an ant farm.

Additional Resources

Into the Forest card game (Nature's Food Chain Game) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Onto the Desert card game (A Game of Survival) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Predator card game (The Forest Food Chain Game) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Books

One Hundred Hungry Ants, by Elinor J Pinczes

A Remainder of One, by Elinor J. Pinczes

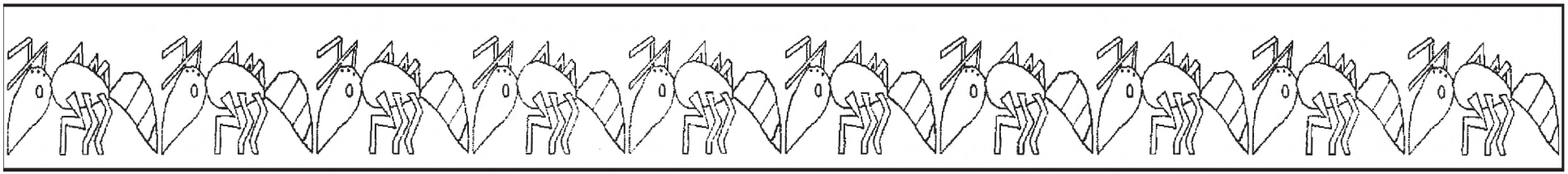
The 512 Ants on Sullivan Street, by Carol A. Losi

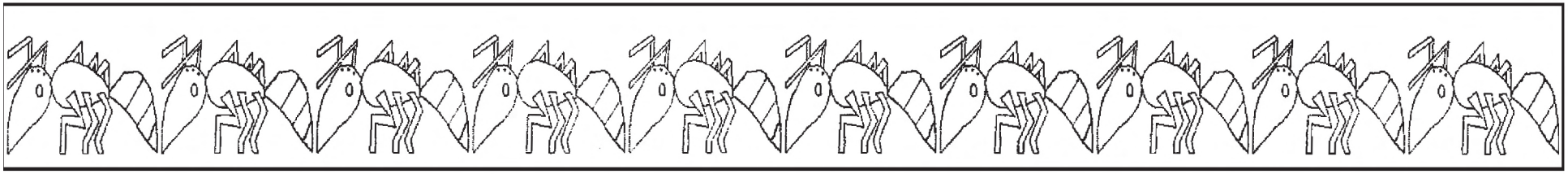
Web sites

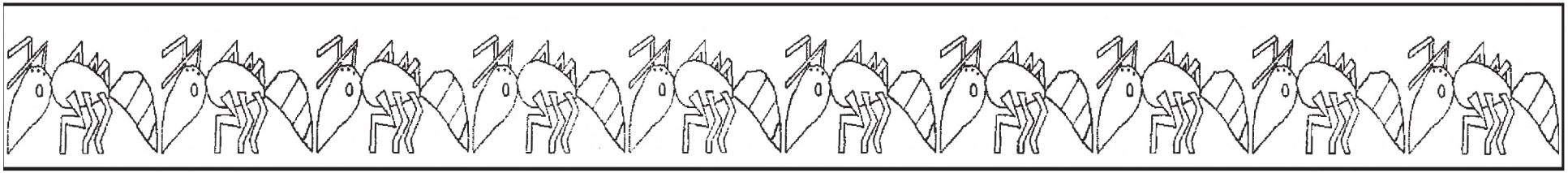
Enchanted Learning's web site has a multitude of pages with different topics and activities on ants.

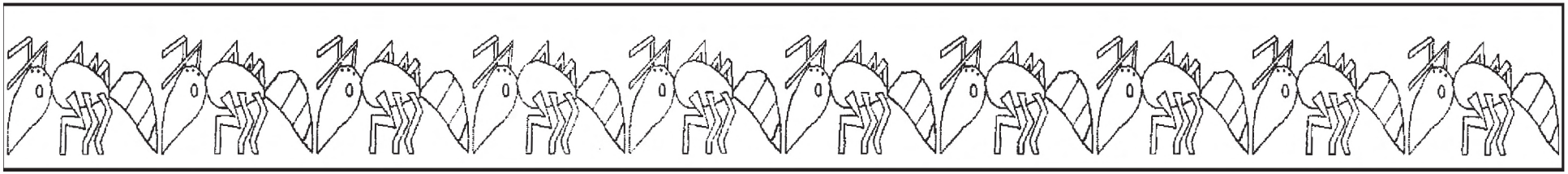
http://www.enchantedlearning.com/subjects/insects/ant

Measuring Ants









Ant Math Attack

- Have students measure different items with their ant rulers.
- Have students cut out ants from the ruler and make arrays.
- Have students create their own math problems by cutting out the ants and making problems with addition, subtraction and multiplication.
- Have students create story problems with the ants cut outs.
- Have students experiment with fractions using the ant cutouts (as they are exactly an inch, with each section being 1/3 inch).

Arrays

5x = 10

2X

3x = 12

4X

Ant Anatomy and Life Cycle:

Cloze Activity Answers

Fill in the blanks below using words from the word bank.

Word Bank:

abdomen	**exoskeleton**	**metamorphoses**
stages	**adult**	**acid**
male	**cycle**	**egg**
three	**jaws**	**jointed**

Ants, like all insects, have _____ legs, _____ body parts (the head, thorax, and _____), a pair of antennae, and a hard exoskeleton. The _____ is made up of a material that is very similar to our fingernails. Ants range in color from yellow to brown to red to black.

Some ants have a stinger and some can even inject poisonous _____ from the stinger (the stinger is at the tip of the abdomen, the rear body segment). Ants can also bite using their _____ (mandibles). Ants range in size from about 0.08 inch (2 mm) to up to about 1 inch (25 mm) long.

The life cycle of the ant has four _____: _____, larva, pupa, and _____. Fertilized eggs produce female ants (queens, workers, or soldiers); unfertilized eggs produce _____ ants. The worm-like larvae have no eyes and no legs; they eat food regurgitated by adult ants. The larvae molt (shed their skin) many times as they grow. After reaching a certain size, they spin a silk-like cocoon (against a solid object, like the wall of the chamber) and pupate. During this time the body _____ (changes) into its adult form. The pupa emerges as an adult. The entire life _____ usually lasts from six to 10 weeks. Some queens can live over 15 years, and some workers can live for up to seven years.

What's Different About These Worms?

Science Standard II

Objective 2

Connections

Standard II:

Students will understand that organisms depend on living and nonliving things within their environment.

Objective 2:

Describe the interactions between living and nonliving things in a small environment.

Intended Learning Outcomes:

Science

1. Use science process and thinking skills.
2. Manifest science interests and attitudes.
4. Communicate effectively using science language.

Math

1. Develop a positive learning attitude toward mathematics.
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Content Connections:

Students will compare, classify, infer, identify, predict, measure, and record
Lang. Art 8-1 Prepare to write by gathering and organizing information and ideas.
Math V-1 Collect, organize and display data to make predictions.

Background Information

Earthworms are incredibly useful to our environment. Without the aid of earthworms, every living thing that dies would just keep piling up and we would be trying to push through it. Talk about a recycling problem! Earthworms (often called night crawlers or fish worms) are invertebrates (without a backbone). There are around 4,400 species of worms on our Earth and 2,700 different kinds of earthworms. Earthworms are very important animals that aerate the soil and mix the top rotting materials with the ground below. Earthworms like other living things can not live without food, water, shelter, and space. They eat soil and the organic material in it such as insect parts and bacteria like e-coli and enrich the soil with their worm castings or worm "poop." They can eat their own body weight each day and their castings make humus, "a moist, dark, nutritious material perfect for plants.

Earthworms have no ears, eyes, teeth, or legs, but have a tiny brain and five hearts. Many earthworms can grow new body segments and body parts if they get hurt. Earthworms have muscles and hairy bristles called setae (see tee) that help them move. Earthworms rely on sensory devices near their mouths and sensory receptors in their skin to detect light and feel vibration. Earthworms are hermaphrodites (possess both male and female reproductive organs but it cannot mate

with itself). They double their population about every six to eight weeks. Some things that earthworms are found to like are oatmeal, old bread, vegetable scraps, leftovers, shredded newspaper, grass, mulched leaves, ripe fruits, etc. Some things that they try to avoid are: acidic and spicy foods, salt, and vinegar products. Their size ranges from less than an inch to over 22 feet long. The largest earthworms are found in South Africa and Australia.

This activity will allow the students to observe three different worm models. The students will identify what is living and nonliving with the *Worm Model Characteristics*. After discussing similarities and differences, the students will predict how the threee worm models will react when using a flashlight, a heat source (the sun), and water for moisture on the second part of this activity. The students will discuss and conclude their findings on the *I Noticed* worksheet.

Research Basis

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

A hands-on approach to the observation of simple objects and patterns facilitate children's ability to report their findings. When combined with inquiry it peaks children's natural curiosity and allows them a wide range of investigative and science-process skills. Teachers can enhance this learning with well-placed guiding questions.

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

Engaging students in classroom conversation is a catalyst to reflective thinking. As they seek to understand the world around them, conversations full of thought-provoking questions becomes the connection between their inquiries and their comprehension.

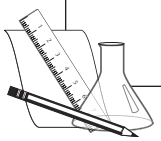
Invitation to Learn

Provide a plastic worm, a gummy worm, and a live worm, for each student to observe. Students should use a hand lens (magnifying glass) to observe and illustrate (draw) the three different models. Have the students observe the three models and discuss with their partners all the things that are alike and different. Then pass out Activity *Worm Model Characteristics* and have students complete this worksheet. After giving sufficient time, ask students to turn Activity *Worm Model Characteristics* over to *I Noticed!* and have them list any additional characteristics they noticed.

What's different about these worms? Administer equipment, one for each pair of students unless otherwise indicated.

Materials

- ❑ *Inchworm And A Half*
- ❑ *Worm Model Characteristics*
- ❑ *I Noticed*
- ❑ Pencil
- ❑ Colored pencils
- ❑ Magnifying glass
- ❑ Ruler (inches and centimeters)
- ❑ Fraction ruler
- ❑ Paper towels
- ❑ Popsicle stick
- ❑ Plastic gloves
- ❑ Plastic worm
- ❑ Gummy worm
- ❑ Live earthworm
- ❑ *How do these Worms React?*
- ❑ 3 bowls
- ❑ Light source
- ❑ Heat source
- ❑ Water



Instructional Procedures

Using the Science Method

1. Compare- The students will share with a partner how the three worm models (plastic worm, gummy earthworm, and live earthworm) are alike and different. Compare, sort, and identify living and nonliving worm models and explain to their partner what makes an organism living or nonliving.
2. Classify- The students will each draw the three models of worms and write what is alike and different about each of these models using *Worm Model Characteristics* worksheet.
3. Infer- Using the KW L– the students will each write what they *know* about worms and what they want to know (on paper or science journal or "Worm Journal").
4. Predict- Students will predict how all three worm models will react to; a light source (flashlight), a heat source (sun), and to moisture (water) one model at a time. Each student will write his/her prediction to the three sources on his/her paper or journal.
5. Observe- Students will observe and discuss with their partner the effect of change on the live model.
6. Record- Each student will record the effect of change that the light source, heat source and moisture had on the live worm model.

Curriculum Extensions/Adaptations/ Integration

Research the websites given on next page on worms.

Check out books and magazines on the subject.

Make your own worm habitat. (See website on next page.)

Do a written/oral report about earthworms.

Family Connections

- Read, *How To Eat Fried Worms*, by Thomas Rockwell with your family.
- Have your family see the movie, *How To Eat Fried Worms*

- Have your family build a worm bin and recycle their leftovers.

Additional Resources

Into the forest (into the forest food game) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Onto the forest card game - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Onto the desert card game (game of survival) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Predator card game (game of) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Books

How to Eat Fried Worms, by Thomas Rockwell ISBN 0440445450

Inchworm And A Half, by Elinor J. Pinczes ISBN 068311017

Interesting Invertebrates, by Elaine Landau ISBN 0-531-20036-1

Worms, by Jill Bailey ISBN 157572665-3

I Wonder What It's Like to Be an Earthworm, by Erin M. Hovanec ISBN 0-8239-5454-4

Diary of a Worm, by Doreen Cronin and Harry Bliss ISBN 006000150X

The Important Book, by Margaret Wise Brown ISBN 0-06-443227-0

Media

How to Eat Fried Worms, by Thomas Rockwell; New Line Cinema: Distributors; Item # 42231

Web sites

http://www.cityfarmer.org/wormowrmingloss82.html glossary words

http://www.urbanext.uiuc.edu/worms/facts/index.html worm facts

http://www,urbanext.uiuc,edu/worms/gettingabin.html getting a bin

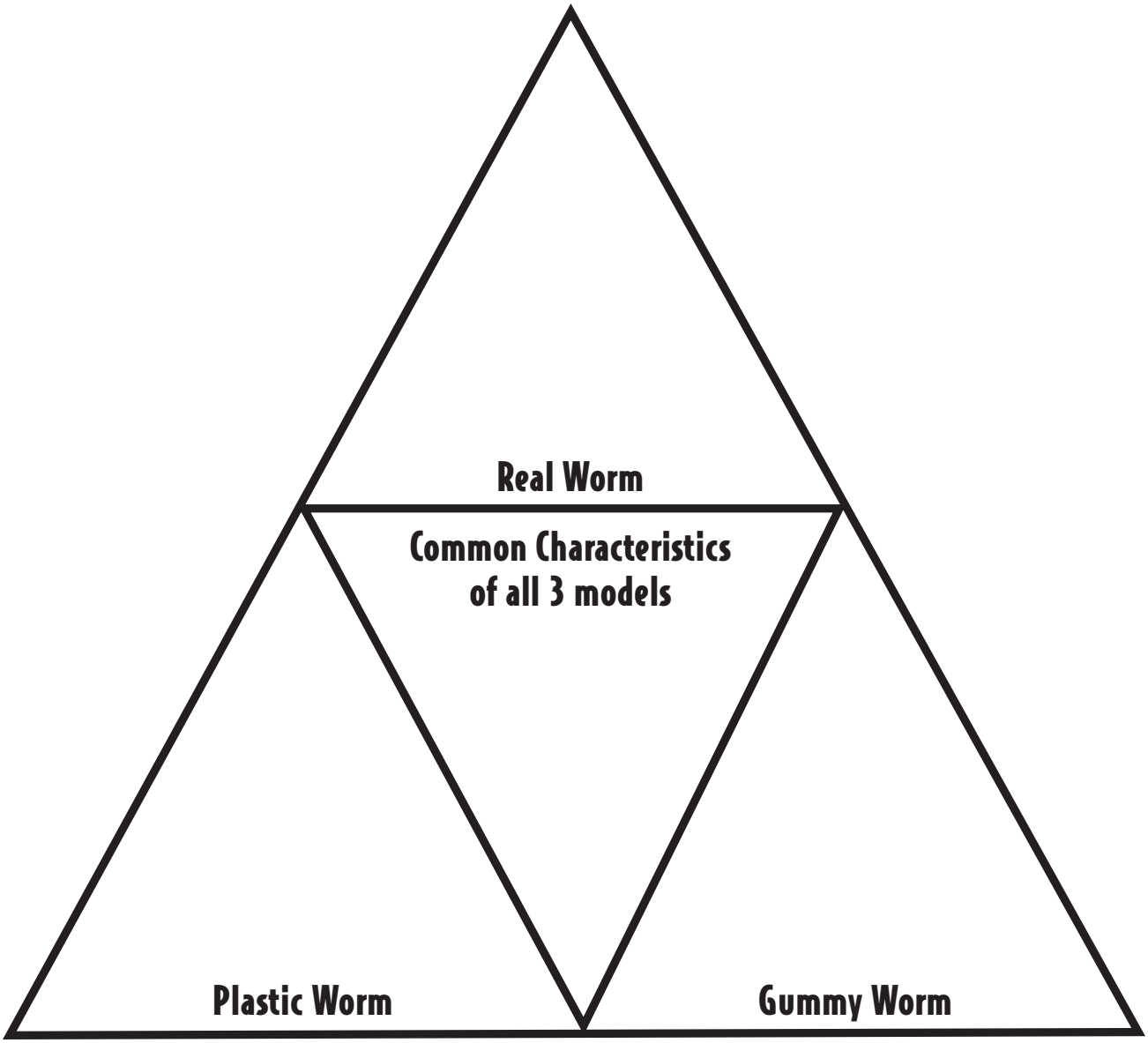
http://enchantedlearning.com/subjects/invertebrates/earthworms.html earthworms

http://wormdigest.org/content/view/2002 earthworm biology

http://heyne.com.au/gardencentre/factsheets/factsheet.php/earth fact sheet earthworms

Name _____ Date _____

Worm Model Characteristics



I observed: _____

_____

_____

_____

_____

Name _____ Date _____

I Noticed!

Observation	Compare Worm Models In Detail

Plastic Worm

1. Color
2. Shape
3. Length/size
4. Texture
5. Segments/rings
6. Eyes (y,n) ears (y,n)
7. Legs (y,n) mouth (y,n)
8. Does it move? (y,n)
9. Does it grow? (y,n)
10. Does it breathe? (y,n)

Gummy Worm

1. Color
2. Shape
3. Length/size
4. Texture
5. Segments/rings
6. Eyes/ (y,n) ears (y,n)
7. Legs (y,n) mouth (y,n)
8. Does it move? (y,n)
9. Does it grow? (y,n)
10. Does it breathe? (y,n)

Live Earthworm

1. Color
2. Shape
3. Length/size
4. Texture
5. Segments/rings
6. Eyes (y,n) ears (y,n)
7. Legs (y,n) mouth (y,n)
8. Does it move? (y,n)
9. Does it grow? (y,n)
10. Does it breathe? (y,n)

Name _____ Date _____

"How do these Worms React?"

Experiment	Plastic Worm	Gummy Worm	Live Worm
Light (Shine a flashlight on the worms, what do you observe)	Prediction	Prediction	Prediction
	Conclusion	Conclusion	Conclusion
Heat from the Sun (Expose the worm to heat from the sun or use a heat lamp.)	Plastic Worm	Gummy Worm	Live Worm
	Prediction	Prediction	Prediction
	Conclusion	Conclusion	Conclusion
Water for moisture (Place the worm in a bowl and slowly add water in small increments, observing the worm as it becomes saturated.)	Plastic Worm	Gummy Worm	Live Worm
	Prediction	Prediction	Prediction
	Conclusion	Conclusion	Conclusion

Making a Mini Worm Habitat

Science Standard II

Objective 2

Connections

Standard II:

Students will understand that organisms depend on living and nonliving things within their environment.

Objective 2:

Describe the interactions between living and nonliving things in a small environment.

Intended Learning Outcomes:

Science

1. Use science process and thinking skills
2. Manifest science interests and attitudes
6. Understand the nature of science

Math

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

Content Connections:

Lang. Art 8-1 Prepare to write by gathering and organizing information and ideas in science journals.

Math V-1 Collect, organize and display data to make predictions.

Background Information

There are around 4,400 species of worms on Earth and 2,700 different kinds of earthworms. Earthworms are incredibly useful to our environment. Without the aid of earthworms, every living thing that dies would just keep piling up and we would be trying to push through it. Talk about a recycling problem! Earthworms eat soil and the organic material in it, such as insect parts and bacteria (e-coli). They aerate the soil, mix the top rotting materials with the ground below, and enrich the soil with their worm castings or worm "poop". They can be so tiny that you can barely see them. Their size ranges from less than an inch to over 22 inches long and some can live as long as 15 years!

Earthworms (often called night crawlers or fish worms) are invertebrates (without a backbone). They have no ears, eyes, teeth, or legs, but have a small brain and five hearts. Earthworms can grow new body parts if they get hurt. Many earthworms can regenerate almost half of their body's length. Earthworms like other living things cannot live without food, water, shelter, and space. Earthworms rely on sensory devices near their mouths and sensory receptors in their skin to detect light and feel vibration. Earthworms have two layers of muscles in each segment the outer one is circular and the inner one is longitudinal. They have four pairs of setae "see-tee" or hairy bristles like legs on each of their segments except the first and last.

Earthworms are hermaphrodites ("her-Ma-fre-daits") which means they have both male and female reproductive organs. When two earthworms huddle together with their heads pointing in different directions, they fertilize each other's eggs. The clitellum (saddle) secretes a cocoon to protect their fertilized eggs. Later on, they lay the egg case in the soil and leave it unattended. The hatching time can vary anywhere from one to five months—depending on environmental conditions—but on an average, earthworm eggs hatch within six to eight weeks. Earthworms can eat the equivalent of their own body weight daily.

Observations indicate that earthworms enjoy eating oatmeal, old bread, vegetable scraps, leftovers, shredded newspaper, grass, mulched leaves, ripe fruits, etc. Things they try to avoid include acidic and spicy foods, salt, and vinegar products.

This activity, making a mini-worm habitat, will allow the students to understand the process of converting organic waste into usable fertilizer. Students will observe how living and nonliving things interact with one another.

Research Basis

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

The authors explored the methodologies and barriers in motivating young learners to enjoy and participate in classroom science research and learning. They concluded that a standard-based curriculum provides information on what students should learn concluding that teachers make the curriculum accessible to students through their choice of instructional materials, lessons, homework, and types of assessment.

Loucks, S.H., Hewson, P.W., Love, N., & Stiles, K. (Eds.) (1998). *Designing Professional Development for Teachers of Science and Mathemetics*. Thousand Oaks, CA; Corwin Press.

In this study the authors identified three components of effective professional development that nurture continuous improvement; context, process, and content. Professional development requires careful planning with the needs of teachers being an integral part of the process.

Invitation to Learn

1. Read *Diary of a Worm* to the student.

2. Ask the students to write in their journals- KWL (What they know about worms, want to know about worms and later write what they have learned.)
3. Ask students to raise their hands to share what they know about worms. The instructor may want to jot them on the board so they don't repeat something said previously, even writing down incorrect facts.
4. Review what living and nonliving things are and have the students give examples.
5. Discuss how worms interact with living and nonliving things.
6. Ask the students how earthworms affect our living conditions, or what they think earthworms do. Ask them if they feel earthworms help or hurt our environment.

Materials

- ❑ *Diary of a Worm*
- ❑ *Inchworm Cutouts*
- ❑ *K-W-L About Earthworms*
- ❑ *Comparing Temperatures*
- ❑ *Inchworms and Fraction Rulers*
- ❑ 3-4 quart clear container
- ❑ Gravel
- ❑ Soil or Organic All Purpose Potting Soil
- ❑ Course sand
- ❑ Newspaper
- ❑ Earthworms 12-25
- ❑ Organic matter
- ❑ Cheese cloth
- ❑ Rubber band
- ❑ Black paper/plastic
- ❑ Tape
- ❑ Spray bottle
- ❑ Measuring tape
- ❑ Science journal
- ❑ Magnifying glass
- ❑ Metric scale - optional
- ❑ Thermometers - optional

Instructional Procedures

Please keep in mind that when making your mini-worm habitat, you should keep it for three to four weeks to give the class enough time to observe the changes that go on. Students will enjoy this opportunity to assist you in measuring with this hands-on activity. You may want to make two identical habitats a control group.

1. Begin by covering the bottom of container with gravel in a nice even layer (about 1 cup).
2. Cover gravel with 4 cups of soil (do not pack down soil).
3. Add 2 cups of course sand and again lightly smooth it out.
4. Add 3 more cups of soil on top of the course sand (again making a nice layer look). Then spray a mist of water to moisten the soil.
5. Measure and cut a piece of 12" x 22" newspaper. Now, tear the newspaper in strips, then saturate with water, and wring out so that the newspaper is moist (not dripping.)
6. Next, break more pieces of the wet newspaper and separate by placing the pieces around the inside of container uniformly.
7. Add 1/2 more cup of soil (give it a little moisture).
8. Optional - You may want to have students measure the worms for fun and use *Worm Rulers*. You also may want to weigh the worms and divide that in half to determine how much organic food your worms will enjoy feasting on.

9. Now, place a little organic matter (e.g., about two 1/4" slices of ripened banana or other ripened fruit will do) in the worm mini habitat. Place the food on the side of the container, pushing in the soil just enough to cover the top of the food with soil. * Don't worry too much about accuracy right now, because the worms have newspaper to eat and that weighs approximately what they do.
10. Add your worms and watch them go. (Observe how they avoid the light.)
11. After observing the worms, ask students to draw their new worm habitat with the different layers. Have students draw the worms and organic matter too! Then have them write in their journals or use *The KWL About Earthworms* worksheet.
12. Wrap cheese cloth around the top of the container. Place a rubber band around to hold it in place.
13. Have students measure the width and length of the container with a measuring tape. Students will then measure and cut black paper to fit, making sure that they have a little extra to overlap and tape together. Optional - Use *Worm Rulers*, to measure width and length.
14. Then, place the worm habitat in a dark place and observe daily (preferably at the same time). Have students note any changes and inferences in their journals.

Assessment Suggestions

- Check each student's journal or *KWL About Earthworms* to see what they have learned.
- Check earthworm activity worksheets for understanding.
- Look for student's self reflection upon their predictions and observations.
- Have each student write a revision of what they observed in their journal, checking for science vocabulary terms , etc.
- Check students understanding of measurement with *The Inchworm Cutouts* worksheet,
- *Comparing Temperature* and *Worm Rulers*.

Curriculum Extensions/Adaptations/ Integration

- Have students keep a journal to write any additional knowledge they have gleaned from magazines, books, websites, etc.
- Have students measure several of the earthworms using inches, centimeters, and fraction rulers, *Worm Rulers*.
- Have students use *Inchworm Cut Outs* to make mathematical *Arrays*. (eg. 2 x 5, 2 boxes down and 5 across or 5 x 2, 5 boxes down and 2 across.) Students can do all kinds of math problems using these inch worms.
- Have students observe and measure the temperature of the room next to the worm habitat (preferably at the time as they take off the black paper every day), and check the temperature of the worm habitat by simply placing a thermometer (slowly and carefully) in the middle of the container. Then the students can record these two temperatures daily using the *Comparing Temperatures* worksheet and note any changes in their journal.
- Have students make two identical worm habitats and use one habitat as a control group. (The students will place worms in one container and none the other.) When you do a control group, you just place the same amount of food in both containers and observe what happens.
- Students can research more about worms or how to make a worm bin (see website on next page).
- Students can check out other animals that interest them and write or give and oral report.

Family Connections

- Read, *How To Eat Fried Worms*, by Thomas Rockwell with your family.
- Have your family see the movie, *How To Eat Fried Worms*
- Have your family build a worm bin and recycle their leftovers.

Additional Resources

Into the Forest, (food chain card game) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263.

Onto the desert, (game of survival) - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Predator, - 2-6 players, age 7 and up. Ampersand Press 1-800-624-4263

Books

How to Eat Fried Worms, by Thomas Rockwell ISBN 0440445450

Interesting Invertebrates, by Elaine Landau ISBN 0-531-20036-1

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Diary of a Worm, by Doreen Cronin and Harry Bliss ISBN 006000150X

The Important Book, by Margaret Wise Brown ISBN 0-06-443227-0

Worms Eat Our Garbage: Classroom Activities for a Better Environment by Mary Applehof, Mary F. Fenton, & Barbara L. Harris ISBN 0-942256-05-0

The Worm Café: Mid-scale Vermicomposting of Lunchroom Wastes by Binet Payne ISBN 0-942256-11-5

Media

How to Eat Fried Worms, by Thomas Rockwell; New Line Cinema: Distributors; Item # 42231

Web sites

http://www.cityfarmer.org/wormowrmingloss82.html glossary words

http://www.urbanext.uiuc.edu/worms/facts/index.html worm facts

http://www,urbanext.uiuc,edu/worms/gettingabin.html getting a bin

http://enchantedlearning.com/subjects/invertebrates/earthworms.html earthworms

http://wormdigest.org/content/view/2002 earthworm biology

http://heyne.com.au/gardencentre/factsheets/factsheet.php/earth fact sheet earthworms

Name _____ Date _____

K-W-L About Earthworms

What do I know about earthworms?

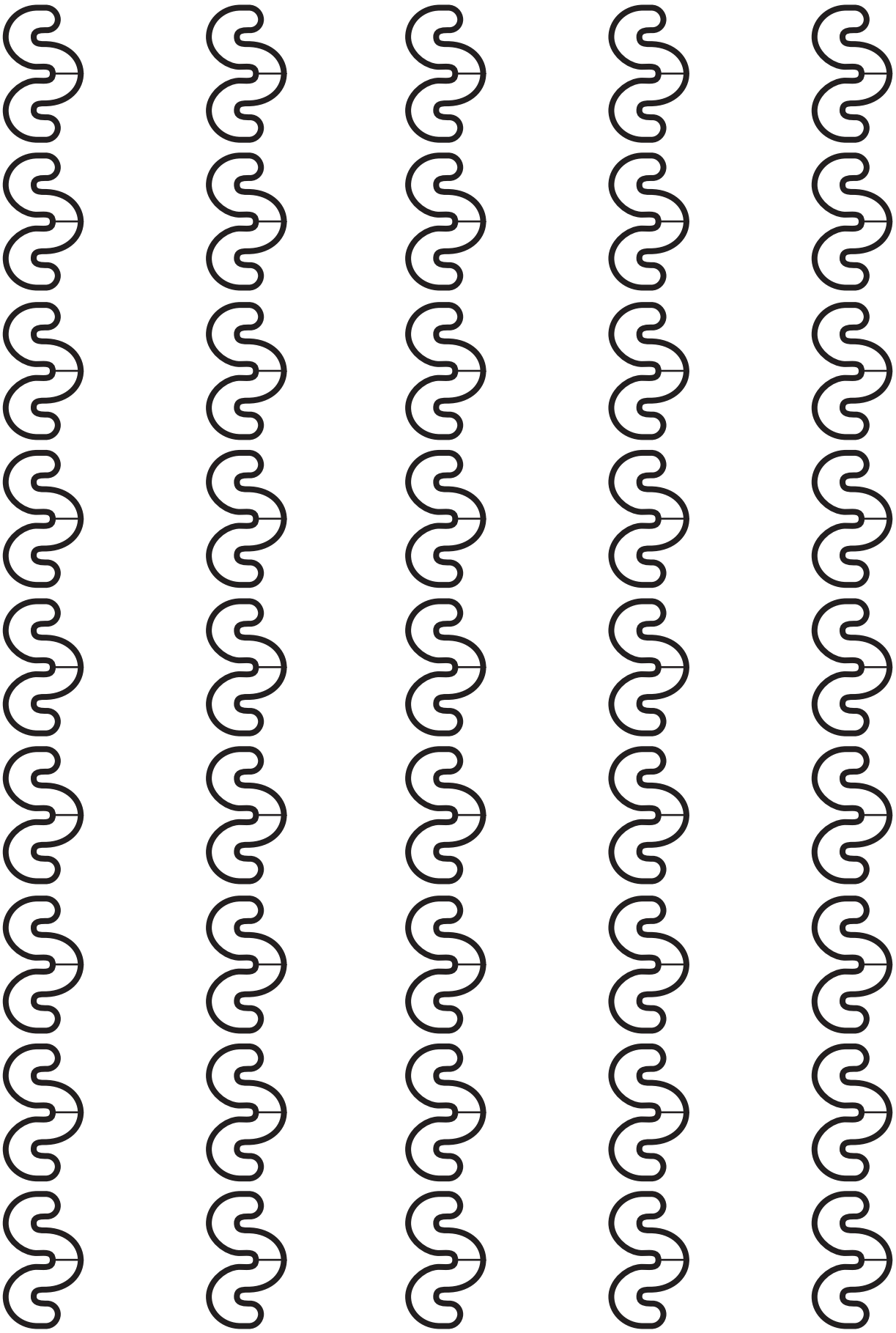
What do I want to know about earthworms?

What did I observe or learn today about earthworms? (Draw and tell.)

Did I use math in my learning about worms today? Give examples (Draw and tell.)

What do I infer will happen?

Inchworm Cutouts



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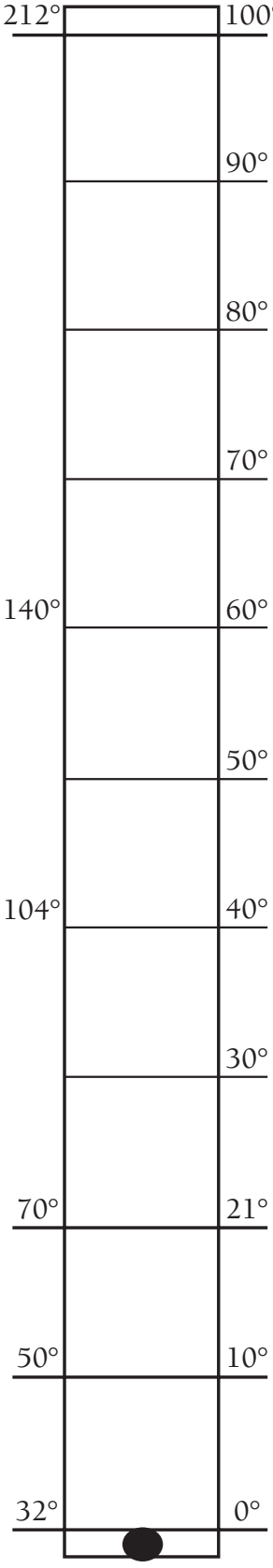
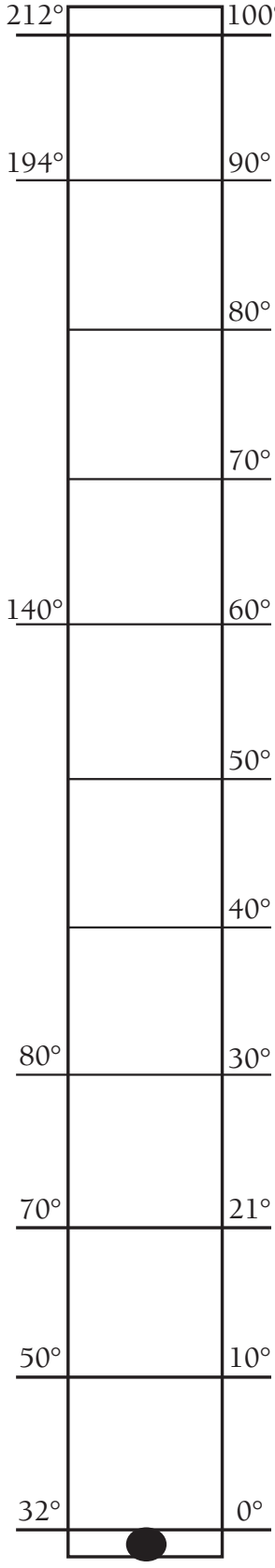




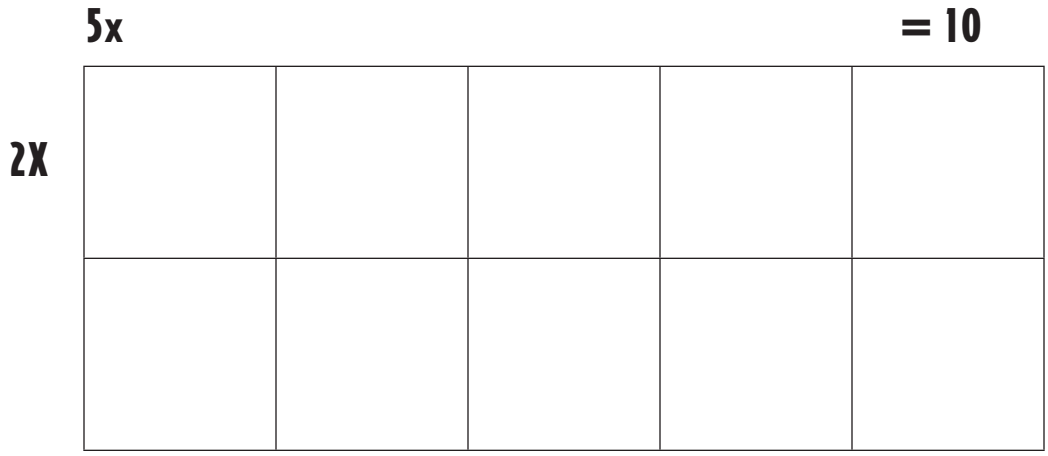
F°	=	C°
212°	=	100°
100°	=	38°
98.6°	=	37°
90°	=	32°
80°	=	27°
70°	=	21°
60°	=	15°
50°	=	10°
40°	=	5°
32°	=	0°

Key

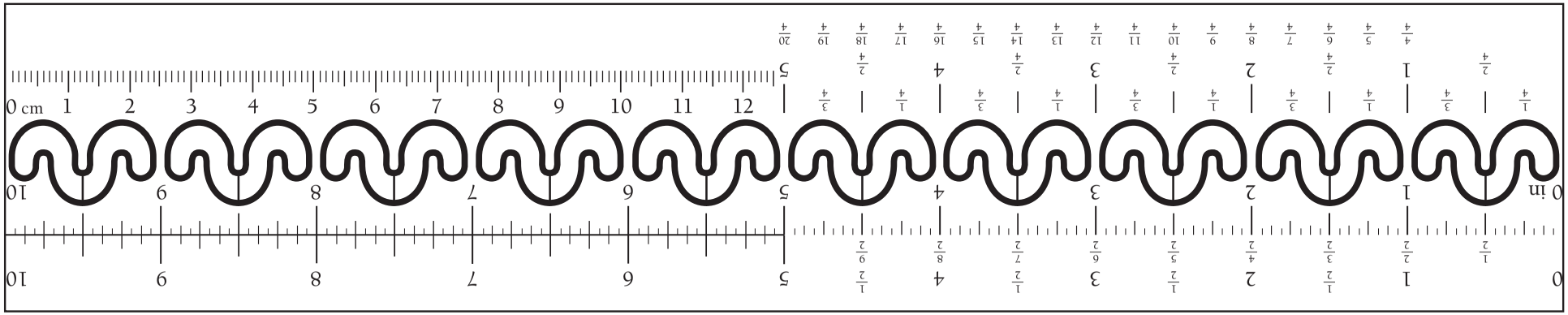
A Worm Math Attack

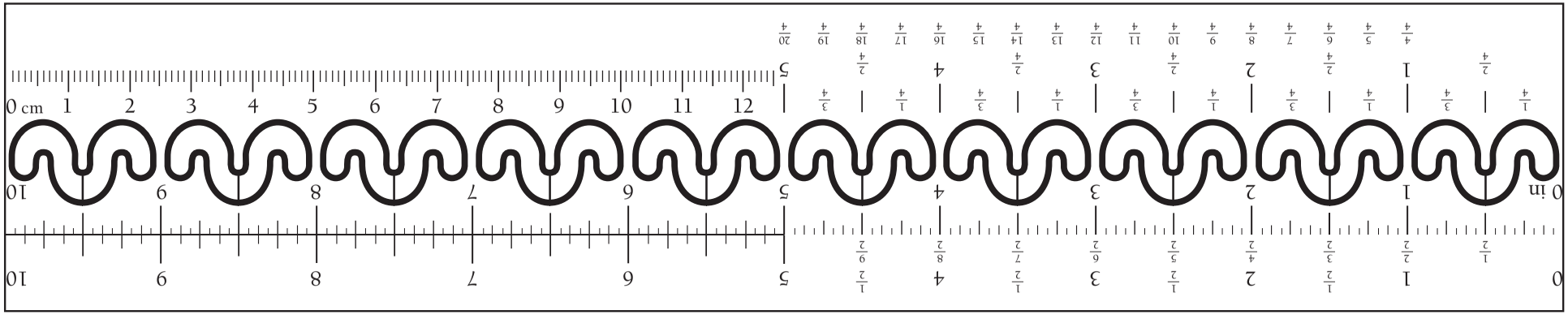
- Have students measure different items with their worm rulers.
- Have students cut our worms from the ruler and make arrays.
- Have students create their own math problems cutting out the worms and making problems with addition, subtraction and multiplication.
- Have students create story problems with the worms cut outs.
- Have students experiment with fractions using the worm cut outs (as they are exactly an inch, with each section being 1/2 inch).

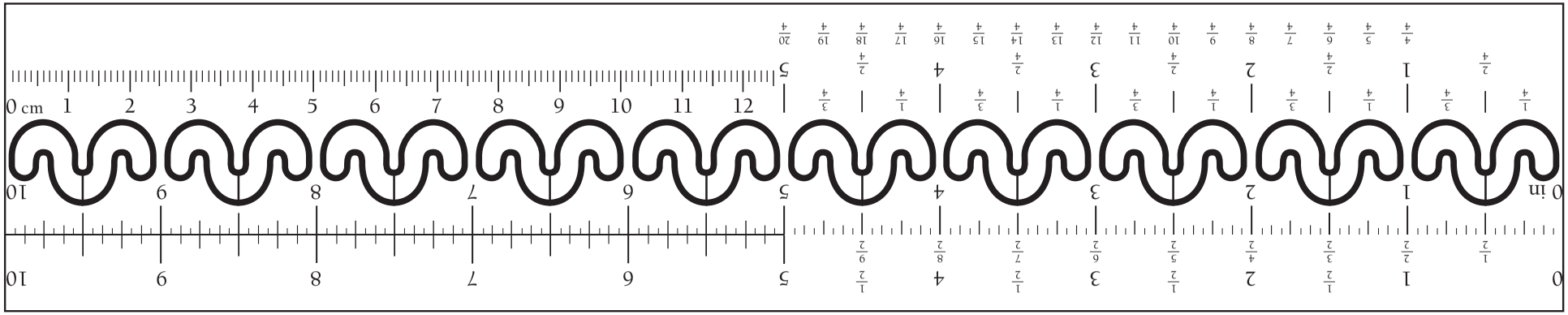
Arrays example



Worm Rulers


0 cm 1 2 3 4 5 6 7 8 9 10 11 12
0 in 1 2 3 4 5


0 cm 1 2 3 4 5 6 7 8 9 10 11 12
0 in 1 2 3 4 5


0 cm 1 2 3 4 5 6 7 8 9 10 11 12
0 in 1 2 3 4 5

Math V-1
Activities

Data Collection

Collecting Data

Standard V:

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

Objective 1:

Collect, organize, and display data to make predictions.

Intended Learning Outcomes:

3. Reason logically, using inductive and deductive strategies and justify conclusions.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Content Connections:

Social Studies VI-1; Use grids, scales, and symbols.

Math Standard V

Objective 1

Connections

Background Information

Students should be taught specific vocabulary relating to the lesson before you begin, which should include: tally marks, bar graphs, pie charts, grid, intersecting lines, coordinates. It would be very helpful if you could show them pictures or examples of each of the vocabulary words listed above. They should be taught and understand how data is used in the world and why it is important we learn to collect data and make predictions. Through this lesson students will learn to use tally marks and to take that information and create a bar graph and a pie chart. Students will also learn to create their own grid with coordinates then learn to find a specific coordinate on their grid.

Research Basis

Suydam, M. N., (1985). Recent Research on Mathematics Instruction. ERIC/SMEAC *Mathematics Education Digest No. 2*. ERIC Digests (ERIC Identifier: ED266019). Retrieved November 24, 2006, from http://www.thememoryhole.org/edu/eric/ed266019.html

What have we learned from research about how to teach mathematics more effectively? By the early 1980s, a number of publications, designed for teachers, discussed research finding which have implications for classroom practice. They found that better teacher questioning practices lead to better learning by all students. The foundation of good questioning is strong content knowledge, which is critical factor in enabling teachers to understand and respond appropriately to students' questions.

Klein, K., Jones, R., (2003). *How teachers phrase discussion questions. Studies of teaching 2003 Research digest,* Wake Forest University Leah P. McCoy, Editor.

Classroom discussion is one of the most important teaching techniques used to help students learn and understand the information they are being taught. Discussion allows the students to become engaged with the material by formulating their own opinions, listening to other students' opinions, and applying specific information to a broader situation.

Invitation to Learn

This activity is called "Roll the Dice." Each pair of students should have two dice and a journal. Students will roll the dice and add the two dice together. The answer to the addition problem is then recorded in a journal using a line plot. At the end of 12 rolls the students can see what the most popular sum and least popular sum were by examining their line plot. They can then share their results with another group. An extension to this activity would be to use multiplication instead of addition. This would be great for your advanced learners. Give students a piece of graph paper and have them make their own graph to use for multiplication.

Materials

- ❑ Dice
- ❑ Journal
- ❑ *Snacks Survey Chart*
- ❑ *Snack Survey Bar Graph*
- ❑ Colored paper
- ❑ Roll of yarn

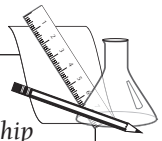
Instructional Procedures

Snacks Survey

1. Each student should receive a *Snacks Survey Chart*.
2. As a class, come up with five different snacks to go on the chart. (This can change each time you do this activity.)
3. Students then walk around the room, a table at a time, and ask their classmates which of these snacks are their favorites.
4. Fill in the tally table to show their answers.
5. Once they have completed the tally chart then they can fill in the blank bar graph to show the results of their snack survey. Use color pencils to color each snack on tally chart and bar graph.
6. As a table—or class—you can then have students answer the questions on the *Snacks Survey Chart* to find out what they have learned from their graph.
7. They then can share their results with another table.
8. To extend this activity, have students form a body pie graph with the results of their survey.

9. Give a color name to each of the five different snacks on their chart. For example, yellow is peanuts, blue is cookies, red is pretzels, pink is crackers, and green is candy bars.
10. Call out each of the snacks and divide students into their favorite snacks.
11. Give students a piece of colored paper to represent their snack.
12. Then have students stay together with their group, but form a big circle with the class.
13. Put a chair in the middle of the circle.
14. Wrap a piece of yarn around each group and attach it to the chair.
15. Examine the body pie graph with the class.
16. Ask questions about the graph such as: Which snack is most liked by the class? Which snack does the class least like?

Valentine Battleship



Materials

- ❑ *Valentine Battleship Grid*
- ❑ Conversational hearts
- ❑ Folder

1. On your grid label the vertical axis on the left from the bottom starting with A, B, C, etc.
2. On the horizontal axis, number from left to right starting with 1, 2, 3, etc.
3. Pair up students each working on a grid of their own.
4. Give each pair of students a box of conversational hearts.
5. Have students pick out five conversational hearts each and place them on the intersections of the lines.
6. Put a folder between the pair to cause a barrier so they cannot see each other's hearts.
7. Each player takes turns calling out a coordinate to see if they've "hit" one of the conversation hearts on the other person's chart. When they call out a coordinate, have them call out a letter, then a number (e.g., B, 3 or D, 5). Students should plot the coordinate their partner has given them so they can tell their partner if they have used that coordinate.
8. When they make a "hit" they then take their opponent's heart.
9. The object is to get all of your opponent's hearts.
10. After they have played the battleship game they can throw away the hearts they have been playing with and then they can eat the other hearts in the box.

Assessment Suggestions

- Teacher should walk around and assess each student's bar graphs and tally marks to see if they have completed them correctly.
- Another way to assess is to have the students work together and to assess each other's tally marks and bar graphs.
- Have each student hand in their *Snacks Survey Chart* and *Bar Graph* with the questions answered. This will be a great way to see if they really understood how to make a bar graph from tally marks and also help the teacher assess if they understood the results by how they answered the questions.
- Before students begin the *Valentine Battleship* game they should check with their partner to see if their grid has been completed correctly. Teachers should also walk around and assess the student's grids.
- When students place their hearts on their grid make a visual assessment to see if they have placed their heart on the intersecting lines.

Curriculum Extensions/Adaptations/ Integration

- Using different items, such as conversational hearts, M&Ms, or Skittles, can change the snack survey. Students can tally up the number of different colors that are in each package. They can fill in a bar graph and make a body pie graph for each package they graphed.
- For learners with special needs, have them pair up with a partner and work together on the *Snacks Survey* and *Valentine Battleship*.
- For advanced learners have them come up with their own original battleship grid. They can call out an addition, subtraction or multiplication problem to their partner and their partner would have to solve the problem to find the coordinate.
- Students can be taught latitude and longitude and how this activity can connect with mapping skills in social studies. Each student can use a map that has latitude and longitude markings on it for their grid.
- Instead of using hearts on their grid you can use other items such as beans, buttons, M&Ms, Skittles, etc.

- Instead of using numbers and letters for their coordinates they can use their sight words and numbers, or vocabulary words and letter sounds.

Family Connections

- Students can survey their family and friends outside of the classroom and have them complete the tally chart and bar graph. They can ask them about their favorite snacks, food, restaurants, games, or toys.
- Students can come up with their own original survey and share it with the class.
- Students can take home grids to play *Valentine Battleship* with their family.
- Students can go home and explore with their family other ways to create their own original grid for a battleship game. They can bring it back to school and share with the class.

Additional Resources

Web sites

http://www.lessonplanspage.com

http://www.edhelper.com/

http://pbskids.org

http://www.ed.arizona.edu

Games

Battleship game by Milton Bradley

Name _____ Date _____

Snacks Survey Chart

Names of Snacks	Tally	Number of Students

How many more people chose _____ than _____?

_____

What was the most popular snack?

_____

What was the least popular snack?

_____

How many people answered the survey?

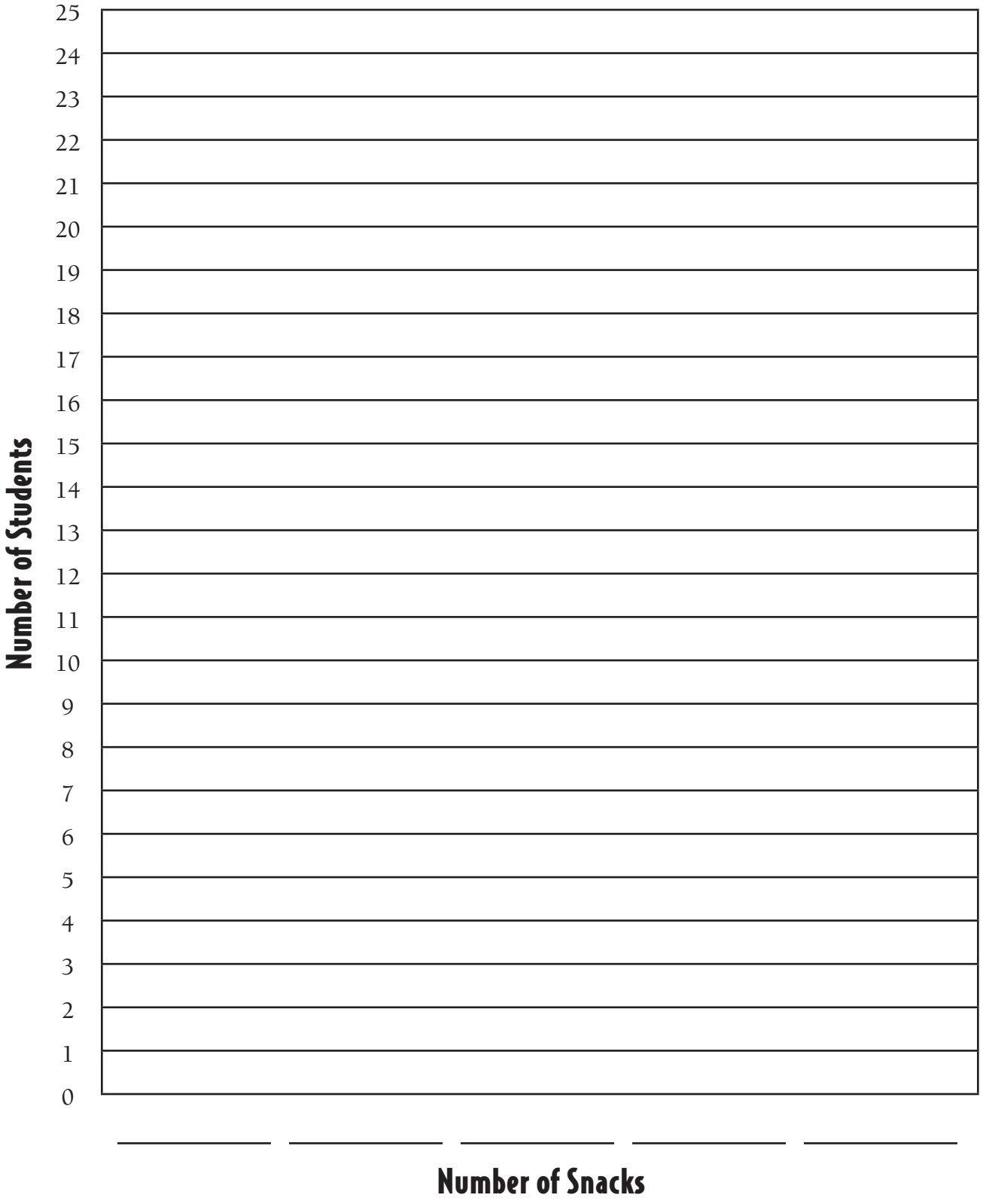
_____

Did more people chose _____ or _____?

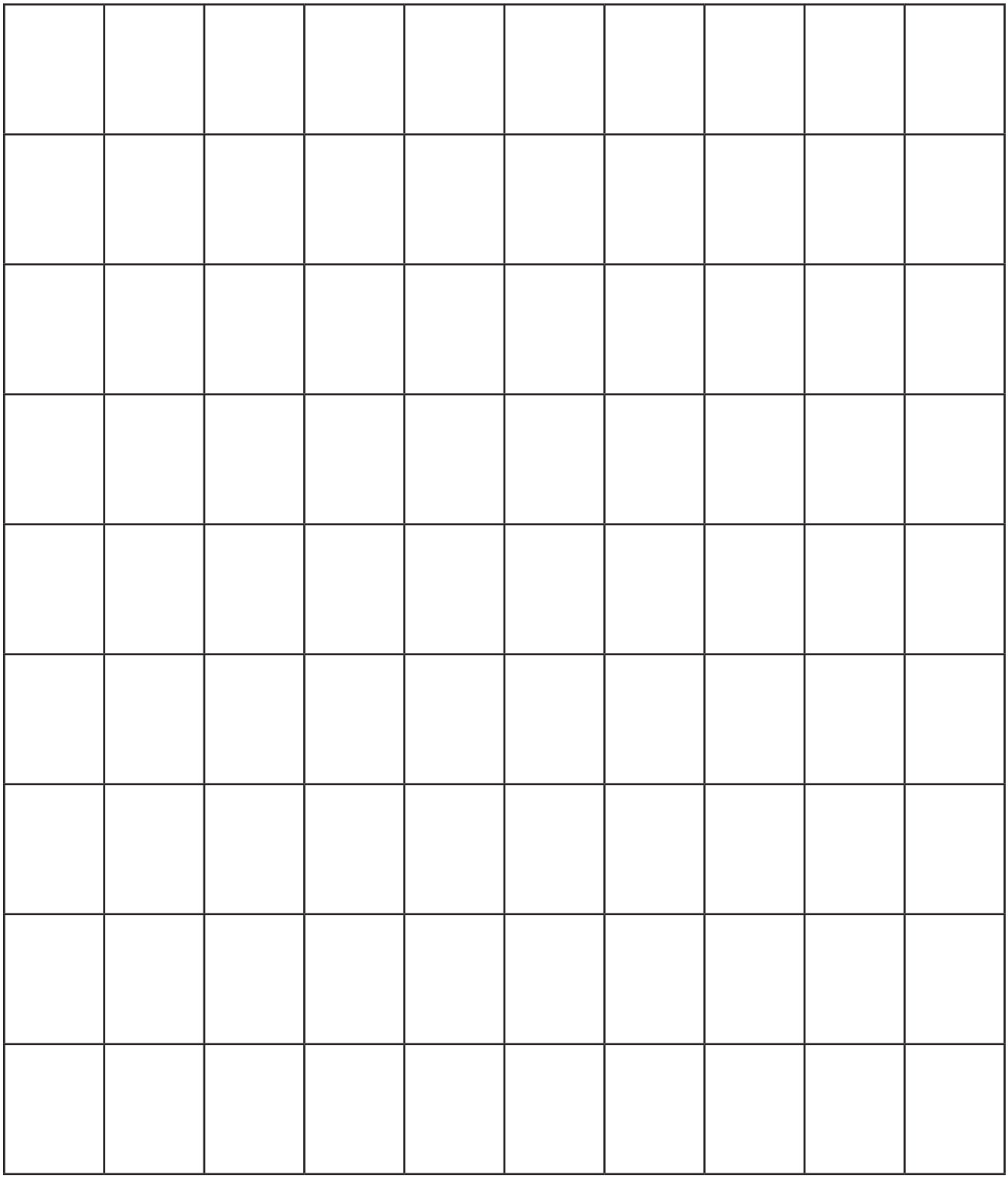
_____

Name _____ Date _____

Snacks Survey Bar Graph



Valentine Battleship Grid



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Collecting Data

Standard V:

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

Objective 1:

Collect, organize, and display data to make predictions

Intended Learning Outcomes:

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Content Connections:

Language Arts VII-2; Comprehension of text, listening skills

Math Standard V

Objective 1

Connections

Background Information

Students should be involved in collecting and describing data. Students will learn to predict information and then find the actual amount. They will compare their findings with their predictions. Students should be taught and very familiar with the following graphs: Bar graphs, line graphs, and pictographs. Students will choose and construct their own graphs. The Tiger Math activity is a great review and assessment of how well they have learned each of the graphs.

Research Basis

Baxter, J.A., Woodward, J., & Olson, D. (2001). *Writing in mathematics: An alternative form of communication for academically low-achieving students*.

In this study, they analyze how one teacher used writing to support communication in a seventh-grade, low-track mathematics class. For one school year, they studied four low-achieving students in the class. Students wrote in journals on a weekly basis. Using classroom observations and interviews with the teacher, they developed profiles of the four students, capturing their participation in class discussions. The profiles highlighted an important similarity among the four students: marginal participation in both small-group and whole class discussions. However, their analysis of the students' journals identified multiple instances where the students were able to explain their mathematical reasoning, revealing their conceptual understanding, ability to explain, and skill at representing a problem.

Stepanek, J., Jarrett, D. (1997). *Assessment strategies to inform science and mathematics instruction it's just good teaching*. (ERIC Identifier: ED415114) Retrieved November 24, 2006.

Using assessment to inform instruction is one of the most powerful tools a teacher has to improve her teaching. It is also one of the most overlooked. Teachers routinely use assessments for a variety of reasons, most often to assign grades and to report students' progress to their parents. However, assessment's real power is its ability to shape and direct classroom instruction.

Invitation to Learn

This activity is called Drops on Pennies. Ask students how many drops of water they can fit on a penny. They make a prediction. On their chart they will then predict how many drops of water they can fit on a penny. Then have them put their penny on top of a paper towel and fill their water dropper with water. Tell them to begin dropping water on their penny. Have them count how many drops of water they were able to hold on one penny and write it down on their chart. They do this three times and then figure out the medium of the three pennies. To figure out the median cross off the highest and lowest number. The middle number is the median. Have them compare their prediction with the actual number and see if they were close. They share their results with their table. Next, they'll try it with a quarter. They make a prediction. Have them use what you know about how many drops of water the penny held. They keep adding drops to see how their prediction turns out. They do this three times and then figure out the medium of the three quarters. They compare the number of drops the penny held to the quarter. Have them share their results with their table. They can then try this with a dime and a nickel. Compare the number of drops with the other coins. Then have students come up with their own questions. For example, do all pennies hold the same amount of water? What other things besides size affect the number of drops each coin can hold? Will salt water make a difference? Have them write down their predictions first then what really happened. Share your results with their table.

Materials

- ❑ Various coins
- ❑ Paper towels
- ❑ Water dropper
- ❑ Water in a cup
- ❑ *Drops of Pennies Data Chart*
- ❑ Math Journal
- ❑ *Tigers*
- ❑ *Tiger Math Learning to Graph From A Baby Tiger*
- ❑ Tiger Math overheads (pgs. 8, 14, 16, 26)
- ❑ *Rubric for Graphs*

Instructional Procedures

Tiger Math

In this activity you will give students the opportunity to read a graph and then transfer their knowledge to make a different kind

of graph. This can be done in their journals and it is a great way to assess their knowledge of graphing different types of graphs.

1. Read the book *Tiger Math Learning to Graph From A Baby Tiger.*
2. Explain to students that they are going to make different graphs from this book. Hand out the *Rubric for Graphs* to put in their journals and go over each of the requirements for each graph.
3. Make an overhead of page 8 in the *Tiger Math* book. It shows a pictograph of tigers in the wild. Go over this graph with your students. Explain the categories and how they would read this graph.
4. Have students make a bar graph from the information given to them in the pictograph. This should be done in their journals.
5. Have them share their bar graphs with their tables.
6. Make an overhead of page 14 in the *Tiger Math* book. It shows a bar graph of T.J.'s weight. Go over this graph with your students. Explain the categories and how they would read this graph.
7. Have students make a pictograph from the information given to them in the bar graph.
8. Have them share their pictograph with their tables.
9. Make an overhead of page 16 in the *Tiger Math* book. It shows a bar graph and compares Matthew and T.J.'s weight in time. Go over this graph with your students. Explain the categories and how they would read this graph.
10. Have students make a line graph from the information given to them in the bar graph. Explain that lines graphs can only be used to graph if you are graphing something over time.
11. Have them share their line graphs with their tables.
12. Make an overhead of page 26 in the *Tiger Math* book. It shows a line graph and compares Matthew and T.J.'s weight in time. Go over this graph with your students. Explain the categories and how they would read this graph.
13. Have students make a bar graph from the information given to them in the line graph.
14. Have them share their bar graphs with their tables.

Assessment Suggestions

- When students are sharing their different graphs with their tables the teacher should walk around and make a quick

assessment to see if each student understands the graphing assignment.

- Students should hand in their journals and the teacher will assess their graphs to see if they have included all the information needed to complete each of their graphs. This assessment should be done by using the rubric given to the students at the beginning of the lesson.

Curriculum Extensions/Adaptations/ Integration

- For advanced learners, have students come up with more than one different type of graph for each overhead presented.
- For learners with special needs, have them work with a partner at their table.
- An extension to this lesson is to have students do a pictograph of the tigers in the wild by using small plastic tigers. Get a plastic clear tarp and draw and label the axis and place the tigers on the plastic to form a pictograph.
- An extension you could use with the graph on page 22 would be to show the different weight and sizes of T.J. To do this you would need four different-sized stuffed tigers that represent each of the different weights T.J is throughout the 14 weeks. You could use the same plastic tarp used above, but change the graph to represent T.J.'s weight.
- Another way to use line graphs would be to grow a plant in your class and graph the size of the plant over time.

Family Connections

- Students should take home their journals and share with their family the different graphs they used throughout this activity.
- Students could construct a graph of their own that shows their growth over time. They could do a line graph of their weight throughout the first few weeks of their life.
- Students could be assigned a graph that they would make at home that would have to do with something about their family. They could then bring this to school to share with everyone.

Additional Resources

Books

Lemonade for Sale, by Stuart J. Murphy; ISBN 0-06-446715-5

Graph It! by Lisa Trumbauer; ISBN 0736812822

Graphs, by Sara Pistoia; ISBN 1567661203

Graphing Activities, by Joy Evans; ISBN 1557991243

Graphs, by Bonnie Bader; ISBN 0448432374

Web sites

http://www.uen.org

http://www.lessonplanspage.com

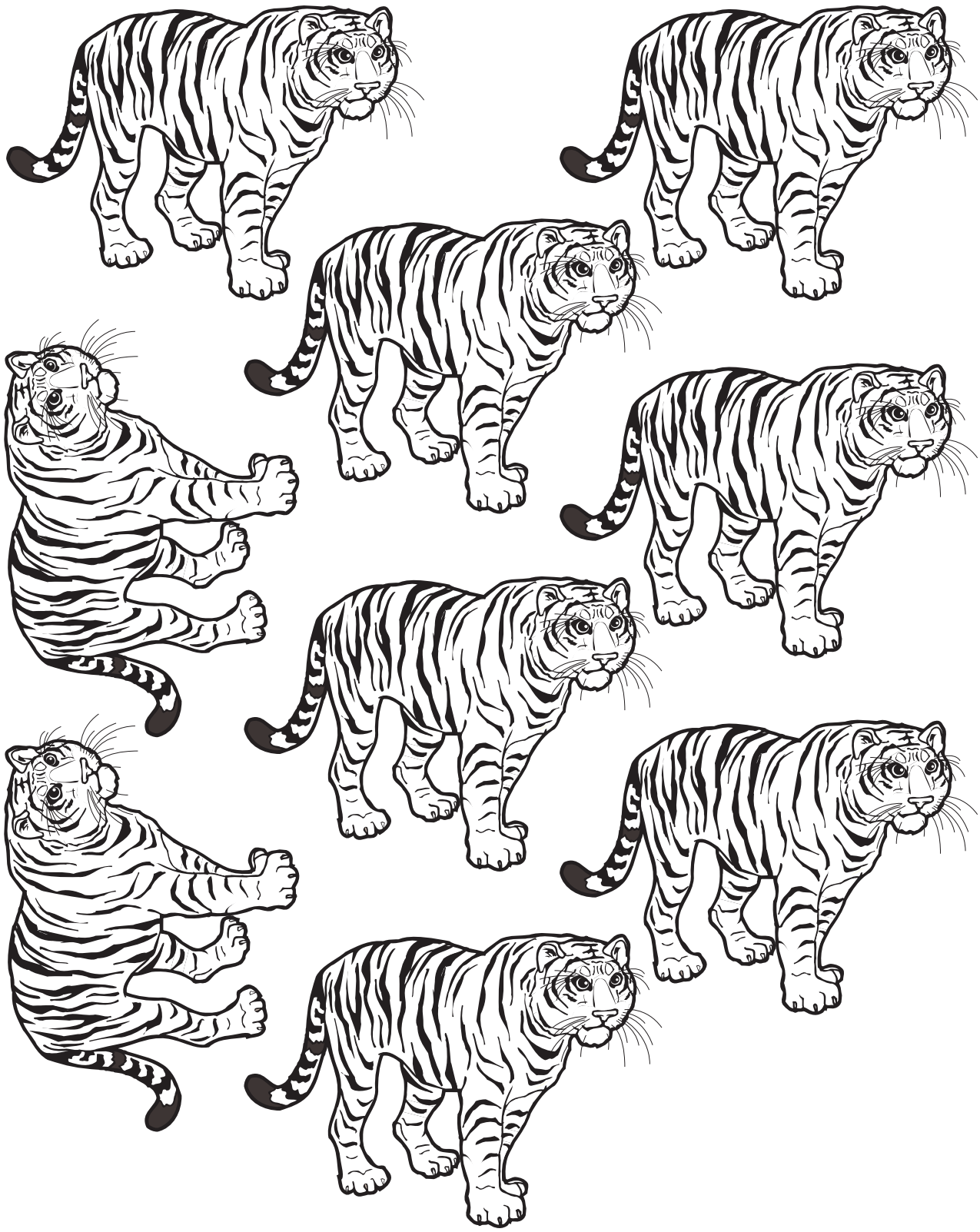
http://www.edhelper.com

Name _____ Date _____

Drops on Pennies Data Chart

Coin	Predicted # of drops	Coin #1 # of drops	Coin #2 # of drops	Coin #3 # of drops	Medium
Penny					
Quarter					
Nickel					
Dime					

Tigers



Name _____ Date _____

Rubric for Graphs

Pictograph

1. Title
2. Legend or Key
3. Information is accurate
4. Same picture throughout
5. Each axis labeled

Rubric

4—Applies to all 5 items
3—Applies to 4 items
2—Applies to 3 items
1—Applies to 2 items

Line Graphs (shows change over time)

1. Title
2. Label horizontal axis
3. Label vertical axis
4. Numbers in a pattern (increments)
5. Numbers labeled on lines
6. Each individual label on the horizontal axis
7. Plotting the points correctly

Rubric

4—Includes all 7 items
3—Includes 5 or 6 items
2—Includes 3 or 4 items
1—Includes 2 items or less

Bar Graphs

1. Title
2. Label horizontal axis
3. Label vertical axis
4. Numbers in a pattern (increments)
5. Numbers must be labeled on the line, not on the space
6. Information is accurate on the bars
7. Bars cannot touch (spaces between each one)

Rubric

4—Includes all 7 items
3—Includes 5 or 6 items
2—Includes 3 or 4 items
1—Includes 2 items or less

Science IV
Activities

Gravity

Tubularastic Roller Coaster

Standard IV:

Students will understand that objects near Earth are pulled toward Earth by gravity.

Objective 2:

Describe the effects of gravity on the motion of an object.

Intended Learning Outcomes:

1. Use Science Process and Thinking skills.
2. Manifest Scientific Attitudes and Interests.
3. Understand Science Concepts and Principles.
4. Communicate Effectively Using Science Language and Reasoning.

Content Connections:

Math V-1; Gather and record data. Language Arts VIII-6 Writing in different forms

Science Standard IV

Objective 2

Connections

Background Information

Gravity is a force that many of us take for granted. We can not see it, touch it, or smell it so how can this force affect us in our day to day lives. When introducing the subject of gravity, the teacher needs to talk about where this concept came from. Discuss Newton and his laws of physics with the students. Newton observed an apple falling from a tree. He developed new ideas about gravity and motion. Gravity is an unseen force that affects all matter. Matter makes up everything and it's the amount of stuff in a material body.

It may also be beneficial to talk about Galileo and Aristotle and how their ideas were different but they each had the right idea about gravity. Gravity not only affects our planet but the whole universe. The adding of this information will help in establishing a science base as well as introducing students to important scientists from the past.

Terms from the State Science CORE that students needs to know when talking about gravity are: distance, force, gravity, weight, motion, speed, direction, and simple machine.

When preparing for the *Tubularastic Roller Coaster* activity you need to make sure that the diameter of the balls is small enough that it will fit in the tubing. If you get a small diameter of tubing, then the balls need to be smaller. You could also use balls such as shot, found at sporting good stores. If using shot, the tubing needs to be about 3/4 in. Be sure to check that the balls roll freely in the tubing. Marbles will probably be your best bet, since you can find marbles of different materials and weights just make sure the balls are all the same diameter. You may want a piece of tubing for each student or use one

piece of tubing per group of students, use whichever works best for you.

Research Basis

Ozgun-Koca, S. A., (2001). ***The graphing skills of students in mathematics and science education,*** Retrieved January 27, 2007 from http://www.stemworks.org/digests/EDO-SE-01-02.pdf

Making representations in math and science plays a very important role in education. Graphs can summarize complex information very effectively. . Although graphs are explicitly taught in mathematics classrooms as an end in themselves, many subject areas such as science or social studies utilize graphs to represent and interpret relationships. So being able to read or make graphical representations is a crucial skill for every student to learn. However, many researchers detected that many students lack graphing skills. The best way for our students to know graphs is to use them in every subject possible. Technology is a great resource for helping teachers in graphing activities. This article gives some great web sites for teachers to use in teaching the subject of graphing.

Haury, D. L. (2001). ***Teaching science through inquiry***. Retrieved January 26, 2007 from http://www.stemworks.org/digests/EDO-SE-01-11.pdf

The move in science education has moved from "learning about" science to "doing" science. Students at all grade levels should have the opportunity to use scientific inquiry and develop the ability to think and act in ways associated with inquiry, including asking questions, planning and conducting investigations. This means using appropriate tools and techniques to gather data, thinking critically and logically about relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments. The article talks about using the World Wide Web as an important tool for achieving success in science, not only for teachers, but students as well. Although experiencing science with hands on is the most critical part of learning science, the web can greatly enrich and extend inquiry approach to science teaching. The article introduces two approaches to using the World Wide Web, (a) through accessing data sets constructed by science projects or agencies, and (b) through collaboration with other school groups to produce data sets (network science projects). It lists many web sites for use in gaining more inquiry into science education.

Invitation to Learn

Begin to read the book*, I Fall Down* by Vicki Cobb. As you read relate the things in the story to real life. For example, when the boy in

the story throws the items up in the air you will do the same thing with your students. When he throws the keys, you will throw the keys you have, when he throws the block, you will throw the A block, etc. Then when it comes to the page where the boy is to take a spoon full of honey or molasses do the same thing but allow the students to watch it close up and hands on. This could be done as a whole group activity or you could break the students into groups and they can do the same things that the character is doing in the book, whichever way you would rather do it is fine. Continue to read the book, using the items that are in the book. Ask questions along the way like why did the things fall back to earth? Why didn't the items stay in the air longer? Have them also make predictions along the way as well. Some students will be familiar with gravity. So use these students to your advantage. This will be a good time to have students write predictions in their journals, then check to see if their predictions were correct.

Tubulartastic Roller Coaster

Here are the steps for making a quick and easy student journal:

1. Take two 1/2 x 11 pieces of white copy paper or another type can be used. Fold both pieces in half hamburger style.
2. Take one piece of paper and cut a 1/4 inch slit on the folded part of the paper at each end of the fold.
3. Take the other piece of paper and on the fold cut a slit on the fold but do not cut the edges of the fold. The slit should be almost the whole length of the fold, however leavie about a 1/4 to 1/2 inch not cut on the edges of the fold.
4. Now take the piece of paper that has the larger slit and open the slit. Put the other paper with the slits on the edge into the large slit on the other piece of paper.
5. Manipulating the paper through the hole, pull the paper smooth so that the folds line up with each other, and straighten them out. They should line up to form a book.
6. You can add more pages by just cutting paper like the first page above and pulling it through the longer slit page. You can also add lined paper or graph paper, just use the same method as above.
7. You may add a cover by gluing a construction paper to the first page or any other type of paper you choose.

Materials

- ❏ *I Fall Down*
- ❏ Set of keys
- ❏ A child's' block
- ❏ Jar of honey or molasses or both
- ❏ Penny
- ❏ Individual key
- ❏ Button
- ❏ Roll of mints
- ❏ Lego block
- ❏ Apple
- ❏ Paper clip
- ❏ Tipsy cup
- ❏ Banana
- ❏ Feather
- ❏ Sponge
- ❏ Bar of soap
- ❏ Rubber bands
- ❏ Weight scale
- ❏ Science journal
- ❏ Clear vinyl tubing
- ❏ Science Journals
- ❏ Poster Board
- ❏ Marbles or balls of:
  Cork
  Wood
  Plastic, etc.
- ❏ Crayons
- ❏ Colored pencils
- ❏ Markers

Making a Science Journal:

Before beginning this activity you may want to have students make a journal. Journals are important tools for students as they do science. A journal provides students with a place to record predictions as they do the activities. The student can write important vocabulary that you want them to know and they can refer to their journals and the notes they have taken. Taking notes will help them develop a tool for gathering important information and then taking that information and writing summaries. The journal can also be used to record the data that will be used later on by the student to create a graph. Journals are important throughout all the subjects.

Instructional Procedures

1. Model for the students (This part of the activity is done as a whole class): Have the students sit around so they can see clearly what you are doing. You can do this activity outside but keep in mind, the tubing works best when it is warm or at room temperature. If the tubing is cold, it does not work as well. Show the students the piece of 10 feet tubing. Ask, "what do you think I am going to do with this piece of tubing? Wait for responses, hopefully someone will link it to gravity. You can write responses on the board or a piece of chart paper.
2. Then show them two marbles of different materials (e.g., one steel, one wood, etc.) Tell the students that you are going to take these two marbles, one is made of steel the other of wood, (or whichever two marbles you decide to choose) and put them in the tubing— each marble at different ends—and send them down the tubing, at the same time, until they reach each other. Place the tubing so it is higher on both ends with the center, about two feet of it, on the floor, with the poster board or butcher paper underneath the tubing that is on the floor. You will need to have a student holding up each end of the tubing as you do this activity.
3. Ask the students, "what is going to happen when I release the marbles?" Wait for responses. Again you may write on the board, if desired. Then tell the students, "Each one of you, with a different color or crayon, marker or colored pencil, will predict where you think the two marbles will meet in the tubing." Try to give each student a different color if possible. "You are going to take your crayon and make a line or mark where you think the two marble will meet."
4. Allow the student to do this. Have the two students that are holding the ends of the tubing switch with other students so they can predict as well. Ask some of the students, "why did you mark it at that spot?" Once every student has marked their spots, have them write their predictions in their journals. "I think the marble will meet right in the middle of the tubing, etc. Then pose this question, "which marble will get to the center of the tubing first?" or "Will they meet in the center at exactly the same time, or will the heavier marble get there first? Will the lighter marble take longer to get there?" You can have them discuss this, but then have them write it in their journals.

5. Once all the writing in their journals is complete, and you have discussed their thinking, send the balls down the tubing. Depending on the tubing and size of the marbles they should reach the middle about the same time. Ask, "what happened? Why did the marbles do what they did?" Have them discuss their reasoning, and look to see who made the correct prediction. Ask the student why he/ she chose that spot to make their mark.
6. Tell the student that the forces of gravity act upon everything. So although the weights of the marbles are different, gravity pulls them down. Just like we read in the book, *I Fall Down* by Vicki Cobb.
7. Now try sending them through again, this time asking the students to really watch the marbles go through. Ask more questions, "can you see how the balls move through the tubing. If the marbles seems to slow up, there maybe some friction inside the tubing to stop the marbles from falling quickly. Explain this to students that although when we drop objects of different weights, sometimes friction or air resistance can affect the objects. Refer to the video, *Gravity Attraction and Squibs* that talks about friction and air resistance that you can share with your students, it's a great video that shows examples.
8. Next, select two different marbles and have the students predict again where the two marbles will meet in the tube. Put down a different piece of butcher paper and again have the students mark on the butcher paper where they think the marbles will stop. Pose the same questions and see if their answers have changed. If they have changed their thinking ask them why they changed their predictions from the first activity? Again have the two students holding the tube switch with other students so they can predict. Write, again in their journals, how they predicted and why.
9. Send the marbles through the tube. Check the results on the butcher paper. Repeat this activity again until you have paired all the marbles up so the students can predict. If you have four marbles then you will have four separate predictions.
10. After you have run all the marbles down the large tubes you can extend the activity. Take another piece of tubing of the same length. Align the two tubes next to each other. Line them up so one end is about two to three feet off the group, the rest of the tube should be laid out flat on the floor. Tell the students they are now going to have races with the marbles. Decide

which two you would like to race first. Again, it is a good idea to race two marbles of different materials and weights.

11. The students predict in their journals which marble will win. Try this again until you have raced all the marbles.
12. Bring all the students back to their desks for a class discussion, or you can leave them around the tubes. Discuss all the things that they just took part in. What happened to the marbles as they came down the tubes? Were all the marbles rolling at the same speed? Why? When we put the marbles in both sides of the tube, was there a difference in having the marbles race down separate tracks? Explain your thinking. Ask anymore questions you would like to pose, to get their minds thinking about how gravity works.
13. After the discussion, have students reflect in their journals, encourage them to draw pictures, or use other ways to express what they have learned.

Tubular Body Coasters

1. Explain to the students that they will be put into partnerships. Each pair will get a smaller piece of tubing (like they used in the other experiment). They will also receive some marbles of different weights and materials. Now model for them how they will wrap the tubing around their arm. Hold one end toward your head and the other one wrapped around your arm, ending at your hand. Their task is to use the tubing and make different types of human roller coasters. They will be predicting in their journals, what they think will happen before they add each marble to the tube.
2. Put the students into pairs, I use pop cycle sticks with the students' names on them. I pull a stick with a students name on it then the next stick I pull is their partner. I continue until everyone has a partner. Or I also have pop-cycle sticks that have paired stickers on them, for example I have two sticks that have a sticker of a yellow smiley face, two sticks that have a purple smiley face, etc. Stickers work great but I also use sticks that have colored circles on the bottom of the sticks, the student finds the other person who has a yellow circle, or blue square etc. You can use whatever works best for you.
3. Explain to the students that one student will become the holder, and the other student will be the one to put marbles in the tube. Tell them this is similar to what they did when the whole class used the larger tubing, however the tubing is smaller. Then the

Materials

- ❑ Five or six feet of clear flexible one inch diameter vinyl tubing, one for each student partnership, or one per group (see back ground information)
- ❑ Marbles of different materials (see above), for each partnership or group
- ❑ Science Journals, one per student

students will switch roles, so that each one will be able to be the human roller coaster.

4. Give each partnership a five to six foot piece of clear vinyl tubing and a set of marbles of different materials and weights. They can start exploring with the tubing and marbles. First, one student holds the tube while the other student drops one marble down the top of the tube. Before they begin, have them predict in their journals. What do you think the marbles will do? Ask about each of the marbles the steel marble. The wood marble, etc. how can you make each marble go down the tube? How can you make the marble go down the tube to the end? They will use their bodies to move the marble through the tube. What did you do with your body to make the marble move?
5. Now make a loop in the tube. Just like on a roller coaster, curve the tube steeply downward into the loop to make the ball go faster. You may have to show the students how to do this part. Try this with each marble and write down the results in their journals. Which marble went down the fastest? Which marble was the slowest? Why did this happen? Tell the students that gravity is pulling the ball. It gives the ball enough momentum, or forward motion, to go around the loop. Note to teacher: Gravity pulls everything toward the center of the earth. Drag pulls against gravity. The straighter and steeper the drop, the faster the ball will roll. Tell the students, that's what makes roller coasters so fun!
6. Ask them, if it make a difference if you raise the other end up instead of going straight down your arm? Try different ways to loop the tube, around your neck, around your waist; let the students explore. You will be amazed at how many ways they can manipulate the tubing. As they are doing this, also remind them to try each marble of different materials.
7. How does the marble travel through the tube? Other questions to pose as the students are exploring, are what happens if you change the direction of the tubing, at a slope, around your waist, etc?" "What happens to the marble of steel, wood, etc? You may think of other questions so please use them.

Assessment Suggestions

- Science Journals
- Discussion questions
- Write reflection in journals

- Answer the questions from above in journals
- *Galileo's Gravity*

Curriculum Extensions/Adaptations/ Integration

- Have the advanced students do more research on Newton, Galileo, Aristotle, and DaVinci compare their theories on gravity. How are they the same and the difference? Which one of the three came the closest to what we know about gravity today? Have them present the information to the class orally, by power point, etc.
- Design and draw a tubular roller coaster.
- Have students write about a time they rode a roller coaster or write what they think it would be like to ride a roller coaster.
- Those students who need special adaptations can be teamed up with a student who they are more comfortable with, a student who perhaps has worked with them in previous partner activity, or team three students together to help with the special need students.
- Watch *Magic School Bus Gains Weight* and go to http://content.scholastic.com/browse/article.jsp?id=1651 to find some activities

Family Connections

- Allow students to check out the tubing to take home and teach their families what they learned about gravity.
- The *Fly Away Moon* Activity.

Additional Resources

Books

I Fall Down, by Vicki Cobb; ISBN; 0-688-17842-1

Media

Gravity is Attractive, by Science FUNdamentals Item #70962902524

Magic School Bus Gains Weight by Scholastic

Squibs, by Ignite Learning ASIN#BOOOBJNUKM

Web site

http://www.bbc.co.uk/schools/gcsebitesize/physics/earthbeyond/universerev2.shtml

http://www.sciencenetlinks.com/Esheet.cfm?DocID=111

http://www.funderstanding.com/k12/coaster/

Galileo's Gravity

Background

A long time ago, there were two scientists: one named Aristotle and one named Galileo. Aristotle thought that the Earth's gravity would pull heavier objects down faster than lighter ones but he never did the experiment. Galileo wanted to find out for sure so he designed an experiment where he dropped a heavy ball and a light ball off a tall tower at the same time. Which one do you think hit the ground first?

What You Need

1 golf ball	1 pair of safety goggles	1 tissue
1 Ping-Pong ball	1 flat pan	sand - get this when needed

What You Do

1. Fill the pan part way with sand to make a soft place for the balls to fall. Which ball is heavier, the Ping-Pong ball or the golf ball?

2. Put the pan on the floor. One partner should put on the safety goggles and get down on the floor so she or he can see which ball hits the ground first.
3. The other partner should hold both balls at shoulder height above the pan. Count to three out loud (so your partner will be ready) and then drop both balls at once. Which one hits first or do they both hit at about the same time?

4. A tissue weighs about the same as a Ping-Pong ball. Which one do you think will land first?

5. Try it and record what happens.

Think About It

What did you learn about gravity from Galileo's experiment?

Fly Away Moon

Background

Gravity holds the Earth and Moon together. What do you think would happen to the moon if there were no gravity?

What You Need

1 piece of string 1 paper towel tape

What You Do

1. Crumple up the paper towel into a ball. Use tape to hold it together.
2. Tape the ball to one end of the string.
3. You will be the Earth, the ball will be the Moon, and the string will be gravity. Make sure you have lots of room around you. Hold the loose end of the string and spin the ball around your head. The Moon will continue to go around the Earth as long as gravity is pulling the two together.

Pretend that there is no gravity by letting go of the string. What happens to the Moon?

Think About It

Every planet and moon has its own gravity. The strength of the gravity depends on the mass of the planet or moon. You will weigh more on a planet that has more gravity. Let's see what you'd weigh in different places.

What is your weight on Earth?	_____ pounds
On the moon, you would weigh much less, about 1/4 of what you weigh on Earth. How much would you weigh on the moon?	_____ pounds
On Jupiter, you would weigh much more, about 2 1/2 times what you weigh on Earth. How much would you weigh on Jupiter?	_____ pounds

Could you actually stand on the moon and on Jupiter?

Mr. and Miss Big Feet

Science Standard IV

Objective 2

Connections

Standard IV:

Students will understand that objects near Earth are pulled toward Earth by gravity.

Objective 2:

Identify the effect of gravity on the motion of an object.

Intended Learning Outcomes:

1. Use Science Process and Thinking skills
2. Manifest Scientific Attitudes and Interests
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning

Content Connections:

Math IV-2; Solve problems involving measurement.

Background Information

Gravity is affected by the magnitude or size of the gravitational force between two objects. It also depends on the masses and distance between them. A larger mass means a stronger gravity, and a shorter distance between objects also means stronger gravity. Gravity accelerates all objects at a constant rate. For example if a penny and a piano were dropped from a tall building at the same time, ignoring friction from the air, they would fall to earth at the same time.

- The force of gravity has an effect on all kinds of matter.
- The force of gravity acts from a distance.
- Gravity is only a one-way force.
- For us on Earth, gravity attracts all objects to at the center of Earth
- Inertia is the resistance to any change in motion.
- Gravity pulls in a path that is straight toward the center of the earth.

Information on *Weighty Wheels*, Ramp for the Matchbox cars—you can use several things to make your ramps, but whatever you choose to use, the track needs to have sides so the cars do not fall off. The track needs to be strong enough so it does not bend. Take a piece of posterboard and put a yard stick on the top of it, bend and then cut the ends so it is wrapped around the posterboard, and tape the edges down so it is securely around the yard stick. If you use this track, be careful not to put too much tape, you do not want bumps on the ramp where the car is going down. You can also buy wood, such as pine, cut into three to four feet lengths about a 3/4 to one inch thick and about

one inch wide approximately just wide enough to fit a Matchbox car. Another possibility is finding the Matchbox ramps that are designed for use with the cars. It is perfect because it fits the car snugly. Any one of these options work, it all depends on what you have available. Door screen trimming also works well for a ramp. It comes in approximately nine foot lengths and can be cut in half to use with students.

A few days before the activity, you want to ask the students to bring in a Matchbox car. Some students will bring them in but have some extras available for those students who do not have them.

Research Basis

Tobin, K. (1987) *the role of wait time in higher cognitive level learning, review of educational research*. JSTOR

Wait time is the duration of pauses separating utterances during oral interaction with the teacher and students. This article states the importance of the wait time. When wait time is greater than three seconds, changes in teacher and student discussions were observed and higher cognitive level achievement was obtained in elementary, middle, and high school science. Wait time appears to facilitate high cognitive level learning by providing teachers and student with additional time to think, thus allowing students to cognitively think about the processes asked of them by the teacher.

Huary, D. (1993). *Assessing student performance in science, ERIC source*. Retrieved January 27, 2007, from htttp://www.stemworks.org/digests/dse93-8.html

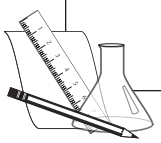
The article discusses how assessment is changing in science education. Assessment in this context must be inconspicuous. It needs to be tailored to measure specific learning outcomes. Assessment is more than testing, multiple choice, short answer, etc., it includes such techniques as systematic teacher observation and so-called "authentic" assessment, in which the tasks assessed more closely parallel the learning activities and outcomes that are desirable in the science classroom (Kober, 1993). Assessment should be context dependent; reflect the nature of the subject matter; and address the unique cultural aspects of class, school, and community among culturally diverse populations (Tippins & Dana, 1992). The article talks about the new assessment that many teachers are using. Among the most promising techniques is the use of scoring rubrics, and students knowing how to achieve the highest level of mastery. Another new assessment is the use of portfolios; these assemble evidence of skill attainment. Some other assessment tools are concept mapping, journal writing (techniques are used to document conceptual change among students), and student presentation and interview techniques (which allow

learners to communicate their understanding in ways that rely less on reading and writing skills).

Invitation to Learn

Materials

- ❑ 12 oz plastic cup
- ❑ Science journal



Ask students to find a place in the classroom where they can stand with their backs up against a wall. If it is problem in your classroom, take them in the hall or somewhere where they can do this activity. Make sure each student has their heels back against the wall. Next set a plastic cup about 20 cm from one of the students' feet. Then ask the student to pick up the cup without bending their knees. Before they perform this activity have them predict, in their journals or orally, what they think will happen. Will they be able to pick up the cup? It is impossible to do. They almost want to fall over. Then have the students move away from the wall about a foot or so and try it again. This time the students should be able to pick up the cup without bending their knees. They can do this because as they push with their back sides away from the wall it keeps their center of gravity right in the center of their bodies.

After this activity ask the students what was happening. Have them answer this question in their science journals or orally.

Responses should be close to or equal to these: the more I lean the more I felt I was going to fall over. I couldn't bend because I was too close to the wall. When I was away from the wall I picked up the cup easily. Have them share their responses with the whole class.

Background info for teacher: The reason this activity works is because the body's center of gravity.

This all has to do with the center of gravity. In order for us to pick something up, the legs and lower body have to move backwards. In order to stay balanced, the center of gravity of our body has to remain above our feet which is the pivot point supporting our body. So staying straight with your back against the wall made it impossible for you to move your lower part of your body backward, forward bending of the upper body shifts the body center of gravity toward the front of the pivot point and the whole body topples or moves forward.

Or in technical terms: center of gravity is the point where an object balances and where all the weight of an object appears to be located.

Materials

- ❑ Science journal
- ❑ Car ramp
- ❑ Matchbox cars
- ❑ Weights/washers
- ❑ Tape
- ❑ Scissors
- ❑ *Weighty Wheels*
- ❑ Tape measure
- ❑ Yard sticks

Instructional Procedures

Weighty Wheels

This activity needs to be done in an area where the cars can move forward freely, such as a gym, a hall or outside as long as the area is flat without any obstacles in the way. A classroom would probably be too small; you want the cars to move freely. Each team will have one car. You can choose how you want to make your groups.

1. Tell the students that they will be working with a group of other students. They will have a Matchbox car. They will take this car and run it on a ramp. Each time they take a run they will add more weight to the car. Then they will measure the distance their car went. Then each time they will add more weight. Then they will take the information from each run and record the distance traveled. They will use the recording page, *Weighty Wheels Record Sheet,* to write down the distance the car traveled and how much weight was added. Then they will take their information and make a bar graph with their data, following up with a class discussion on their findings. They will also take the median of all three of runs. Teach them how to get a median before you go ahead with the activity. You may have already taught this math concept so perhaps review with the students how to do this. Now model for the students the above, making sure they know how to load their car with weights. If you use any of the ramps above that need to be made, you will want to have them pre-made before you start this activity.
2. Put the students in teams of three to four and assign cooperative roles such as leader, scribe, reporter and materials manager. Give them the record sheet, *Weighty Wheels* and tape measure to measure the distance. Before they start their first run, tell them to write a prediction before each run of the weighted car. So they should have four predictions, first one with no weight, second with one washer, third with two washers, and third with three washers.
3. Have the students begin their task. Students should hold one end of their ramps at 30 cm off the floor. This can easily be accomplished by placing the end of ramp on the top of a 30 cm ruler. Walk around the room monitoring their activity. You can pose questions about some of their predictions, why they thought that, or how did they come up with that information, etc.

4. Once everyone has finished their task bring the students back as a whole class.

Make a large table like the one shown below on the board or chart, have each team report their median distance for each weight. Record their results on the table.

Team Number	No Washers	1 Washer	2 Washer	3 Washer
Median Distance				

5. Which team's car went the furthest? The one with no weight or the one with the most weight?

   Whose car went the shortest distance? Why? As you are going over the class graph, keep asking questions about the activity.

6. On the board or the overhead make a bar graph of the median distance for each weight for the whole class. Have students make the graph in their journals.
7. Lastly, have the students write a reflection about the activity. Also have them answer the questions that you asked earlier.

Assessment Suggestions

- Science Journals
- Discussion Questions
- Graphing Page, *Weighty Wheels*
- *Artificial Gravity Activity*

Curriculum Extensions/Adaptations/ Integration

- Take the same ramps, but use balls instead, use different types of balls and see which ball will roll the furthest distance, then graph the results.
- Pair special needs students with a student who can help them through the activity, as we call it in my classroom, Pair Buds, usually have the same students working together for several projects for assignments. That way the special needs students feel more comfortable with that person and they trust them, but

I switch after a few projects so the paired student can work with others and they do not feel like always being the leader.

- Sing the Song "Gravity" sung to the tune "London Bridges Falling Down."
- Students write a story explaining what would happen if there wasn't any gravity on earth.
- Have students go to http://www.pbs.org/wgbh/nova/pisa/galileo.html where they can do activities like Galileo did when he was learning about gravity.
- Go to http://www.sunblock99.org.uk/sb99/people/RWalsh/gravity/grav1.html and find out what your weight is on other planets.

Family Connections

- Students do the invitation to learn activity with their families, explaining what they learned about gravity.

Additional Resources

Books

101 Science Poems & Songs for Young Learners, by Meish Goldish

The Science Book of Gravity, by Neil Ardley; ISBN 01520062104

Physics for Every Kid, by Janice Van Cleave; ISBN 0471542849

Media

Gravity is Attractive, by Science FUNdamentals Item #70962902524

Squibs DVD In Force, Gravity and Friction ASIN: B000BJNUKM

Web sites

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

http://www.uen.org/3-6interactives/science.shtml

http://www.bbc.co.uk/schools/gcsebitesize/physics/earthbeyond/universerev2.shtml

http://www.sunblock99.org.uk/sb99/people/RWalsh/gravity/grav1.html

Weighty Wheels Recording Sheet

Weights	Run one distance	Run two distance	Run three distance	Median
No Washers				
1 Washer				
2 Washers				
3 Washers				
4 Washers				

Weighty Wheels Recording Sheet

Weights	Run one distance	Run two distance	Run three distance	Median
No Washers				
1 Washer				
2 Washers				
3 Washers				
4 Washers				

Artificial Gravity

What You Need

2 paper plates	1 ruler	1 large bead
1 stick	1 scissors	8 pieces of tape

What You Do

1. First, build your space station. Mark the center of both paper plates. Poke a hole with the stick through the center of each plate.
2. Mark a circle on one paper plate about one inch from the edge. Also draw two lines

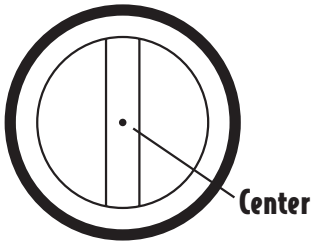


Figure 1

through the middle of that plate about one inch apart as shown in Figure 1.

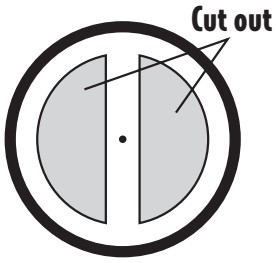


Figure 2

3. Cut out the shaded areas shown above in Figure 2 on just one plate.
4. Put one paper plate upside down on top of the other plate. Tape the edges together in

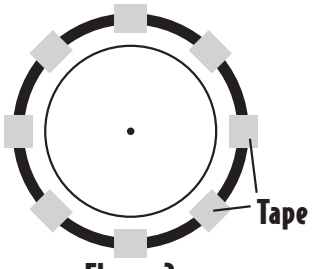


Figure 3

eight places as shown in Figure 3.

5. Put the stick through the two holes in the center and practice spinning your space station while your partner holds the stick.

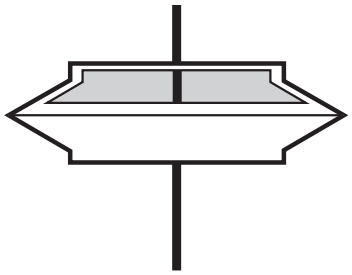


Figure 4

6. Hold your space station so the cut open part of it is facing up. Put the bead in near the middle. We will pretend the bead is an astronaut.

7. Spin your space station and write down what happens to the astronaut. (If the astronaut falls out, put her or him back in and try again. Try spinning a little slower.)

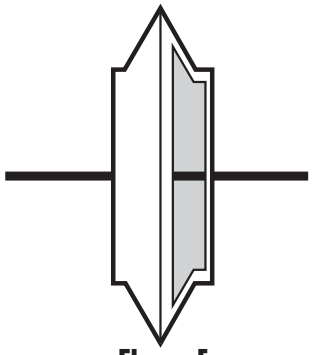


Figure 5

8. What do you think will happen to the astronaut if you tip the space station like in Figure 5 while it is spinning?

9. Try spinning the space station again. While one partner keeps the space station spinning, the other partner should tip the stick. What happens to the astronaut?

Think About It

When the space station was spinning, we created artificial gravity that kept the astronaut from falling out. Which direction is "down" for your astronaut?

Science III
Activities

Forces & Motion

Hammer Time!

Standard III:

Students will understand the relationship between the force applied to an object and resulting motion of the object.

Objective 2:

Demonstrate that the greater the force applied to an object, the greater the change in speed or direction of the object.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills.
2. Manifest Scientific Attitudes and Interests.
3. Understand Science Concepts and Principles.
4. Communicate Effectively Using Science Language and Reasoning.

Content Connections:

Mathematics III-1; Geometric Shapes, Mathematics IV-1; Measurement

Science Standard III

Objective 2

Connections

Background Information

Prior to teaching this lesson, 3rd Grade Science Standard III, Objective 1 should already have been taught. Students will already understand that push and pull are two forces. They will understand how simple machines work. Students should also understand the Math concepts of right angles, and angles that are greater than or less than a right angle. See *Science Standard III Previously Taught at the Elementary CORE Academy* sheet.

Students will already know the following terms: push, pull, forces, motion, acute, obtuse, right, greater, less, simple machines, pulley, wheel & axle, inclined plane, lever, screw, wedge.

Research Basis

MacKenzie, A. H. (2001).The role of teacher stance when infusing inquiry questioning into middle school science classrooms. *School Science and Mathematics.* 101, number 3, 143-153.

This study was done to show how teacher attitude about science affected student attitude about science. Student wonder and "not knowing" is emphasized and valued. Science is not absolute knowledge, but rather contextual. Students learn to synthesize their own knowledge through exploration and experimentation. They are required to use their imagination to solve problems and reach scientific goals. Class discussion is important, as is student inquiry. This article explains how to accomplish this in the classroom.

Caram, C. A., & Davis, P. B. (2005). Inviting student engagement with questioning. *Kappa Delta Pi Record.* Fall, 18-23.

Questioning is important in the classroom. It taps into children's natural curiosity. This article gives a list of strategies to use to encourage questioning. It also has a Thinking Skills Model to give examples of all levels of questioning, so that all learners' needs are met.

Materials

- ❑ Straws
- ❑ 2" x 2" pieces of paper
- ❑ 2" x 2" pieces of cardboard
- ❑ *Science Standard III Previously Taught at the Elementary CORE Academy*
- ❑ *Swinging Hammer Construction Instructions*
- ❑ *Swinging Hammer Diagram*
- ❑ *Hammer Time!* Data Sheets
- ❑ 5 feet of (Schedule 40) 1/2" PVC Pipe
- ❑ 6 non-threaded PVC 1/2" Caps
- ❑ 3 non-threaded PVC 1/2" Standard T's
- ❑ 1 non-threaded PVC 3/4" x 3/4" x 1/2" Bullhead T
- ❑ 2 non-threaded PVC 1/2" Standard 90's (aka Elbows)
- ❑ 1 metal fingernail file or fine sandpaper
- ❑ petroleum jelly
- ❑ 2-3 cotton swabs
- ❑ PVC pipe cutter or PVC saw
- ❑ retractable tape measure
- ❑ pencil
- ❑ 1 40 mm stone/glass/ metal sphere
- ❑ 1 golf ball
- ❑ 1 ping pong ball

Invitation to Learn

When the students come in from recess, have the straw, paper, and cardboard waiting for them on their desk. Tell them to put the paper and the cardboard next to each other on the edge of their desk and try to blow them off. When they've had a chance to try each one, have them set down their straws and ask them which one was easier to blow off their desk. Ask them why. Discuss how some kids can blow harder than others, etc.

Instructional Procedures

1. Construct the swinging hammer according to the directions on the *Swinging Hammer Construction Instructions* sheet prior to the lesson.
2. Have the students get out their journals. Pass out one *Hammer Time! Data Sheet* to each student. Have them write their name on it. It doesn't matter where, because they will be cutting them out later to tape into their journals.
3. Tell the students that you are going to explore forces and motion further today.
4. Find the place in your room on the floor that has the longest straight shot for a ball to roll, then setup the swinging hammer there. Carpet is best so that the ball is less likely to roll away before the hammer hits it. If you only have tile, you can make a tee by punching a hole in a piece of cardboard.
5. Tell the students that we are going to explore different forces first. We'll use the golf ball on each of three swings so that we have the same weight.
6. Have two student volunteers help you by each holding down one side of the stand. This will insure that it doesn't move during the swinging. Arrange the rest of the class around you so that they don't obstruct the path of the ball.
7. Move the hammer back about 30° to form an acute angle. Place the golf ball on the floor exactly in the center of the stand. Ask the students what they think might happen. Tell them to

record their predictions in their journals. Then, let the hammer swing. It will hit the ball, and the resulting movement will be relatively slow, with the golf ball traveling a relatively short distance. Use the measuring tape to measure how far the golf ball went. Have them record it on their data sheet . Remind them to include the units, not just the number.

8. Repeat the procedure with a right angle and an obtuse (about 150˚) angle. Discuss the results with the students. Have them record their observations in their journals.
9. Get out the ping pong ball and the stone sphere. This time, use a right angle for all three swings. Repeat the procedure three more times, using the ping pong ball, golf ball, and stone sphere. Be sure to discuss and record as before.

Assessment Suggestions

- Have the students cut out *Same Weight, Different Force* and *Same Force, Different Weight* from their *Hammer Time! Data Sheet* paper. Students should then tape them into their journals and record their observations in complete sentences, using correct vocabulary.
- As a game or center, use a flat circle (paper works fine) and set it on the ground between one and ten feet away from the swinging hammer (also on the floor). Then students must choose the correct weight of ball and use the correct swinging force to get the ball in the circle without it going past. Each person takes a turn until someone gets it in the circle. Then, move the circle and do it again.

Curriculum Extensions/Adaptations/ Integration

- For advanced learners, find spheres of approximately the same weight, but different material (e.g. rubber, cork, wood, clay, etc.). They don't have to be the same size, just the same weight. Have them use a right angle for each swing, and then observe what happens when each sphere is struck. Have them write down their theories as to why some balls go further than others when they are the same weight and the same force is applied.
- For advanced learners, find objects with the same weight, but not the same shape (e.g. sphere, cone, cube, toy car, rock, candle, etc.). Have them use a right angle for each swing, and

then observe what happens when each object is struck. Have them write down their theories as to why the objects don't respond the same, even though they are the same weight and the same force is applied.

- For advanced learners, ask them how each of the simple machines could be used to alter the swinging hammer. Have them demonstrate if possible.
- Make additional swinging hammers so that students can work in small groups to conduct the activity and further explorations.

Family Connections

- Make additional swinging hammers that students may check out and take home to show family members what they have learned in school by giving a mini lesson.
- Make additional swinging hammers that students may check out to take home. Students would experiment with their family using different balls and then share their findings with the class.

Additional Resources

Web sites

http://www.miamisci.org/www/exhibits/newton/vrtour.html

http://www.usoe.k12.ut.us/CURR/Science/sciber00/8th/forces/sciber/forcmot.htm

http://classroom.jc-schools.net/sci-units/force.htm

Science Standard III Previously Taught at the Elementary CORE Academy

Objective 1 – How forces cause changes in speed or direction

a. Objects at rest **Bump On A Log (2005), Rock-A-Bye Pendulum (2005), It's Un-Can-ny (2005), Peaceful Penny (2004), Peaceful Washers (2003)**

b. Push & pull **It's Un-Can-ny (2005), Moving Possibilities (2004), Riddles and Charades (2003), Zoom Balls (2003)**

c. Simple machines **Simple Machines Song (2003)**

   i. Pulley – lift (flagpole, crane) **Lifting the Load (2005), Flag Raiser – Fixed Pulley (2004)**

   ii. Wheel & axle – spin to move (wheel, doorknob) **Lifting the Load (2005) All Geared Up – Wheels and Axles (Gears) (2004), Rolling Along (2003)**

   iii. Inclined plane – move loads (ramp, slide) **Uphill – Inclined Plane (2004)**

   iv. Lever – lift (seesaw, scissors) **Weighty Mistakes (2003)**

   v. Screw – hold together (screw, drill) **Twirling Helicopter – Screw (2004)**

   vi. Wedge – cut or split (ax, shovel) **Soap Carving – Wedge (2004)**

Objective 2 – greater force = greater change

a. Force applied to object **Rock-A-Bye Pendulum (2005), Peaceful Penny (2004)**

b. Same force, different weight **Move It, Sir Isaac! (2005), Over the Edge (2003)**

c. Different force, same weight **Move It, Sir Isaac! (2005), Rock-A-Bye Pendulum (2005), Sudden Stop! (2004), Wind Wheel (2004), Marshmallow Launcher (2004), What A Load (2003), Straw Rocket (2003)**

Swinging Hammer Construction Instructions

1. Measure and cut the 5' of PVC pipe to the following lengths:

   2 lengths @ 11/2"
   1 length @ 6"
   1 length @ 9"
   2 lengths @ 10"
   4 lengths @ 51/2"

   You should have no excess. Cut the 51/2" lengths last. If one of them is a tad short, cut the other three 51/2" pieces to the same length.

2. Clean the edges of the cut ends with the metal fingernail file. Be sure that any lip is filed off and the ends are smooth.

   NOTE: If you are planning to disassemble and reassemble your swinging hammer, each time you put a fitting together swab both the male and female end with petroleum jelly. If you never want to take it apart again, don't bother with the jelly.

3. Place the Swinging Hammer Diagram where you can see it for a visual during the rest of the directions.

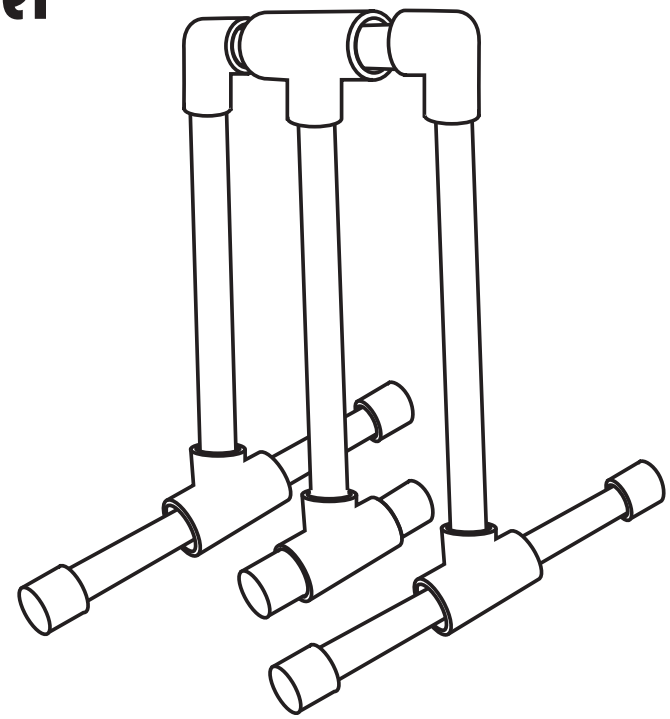
4. Fit one cap on each of the 11/2" lengths, then fit one cap on each of the 51/2" lengths.

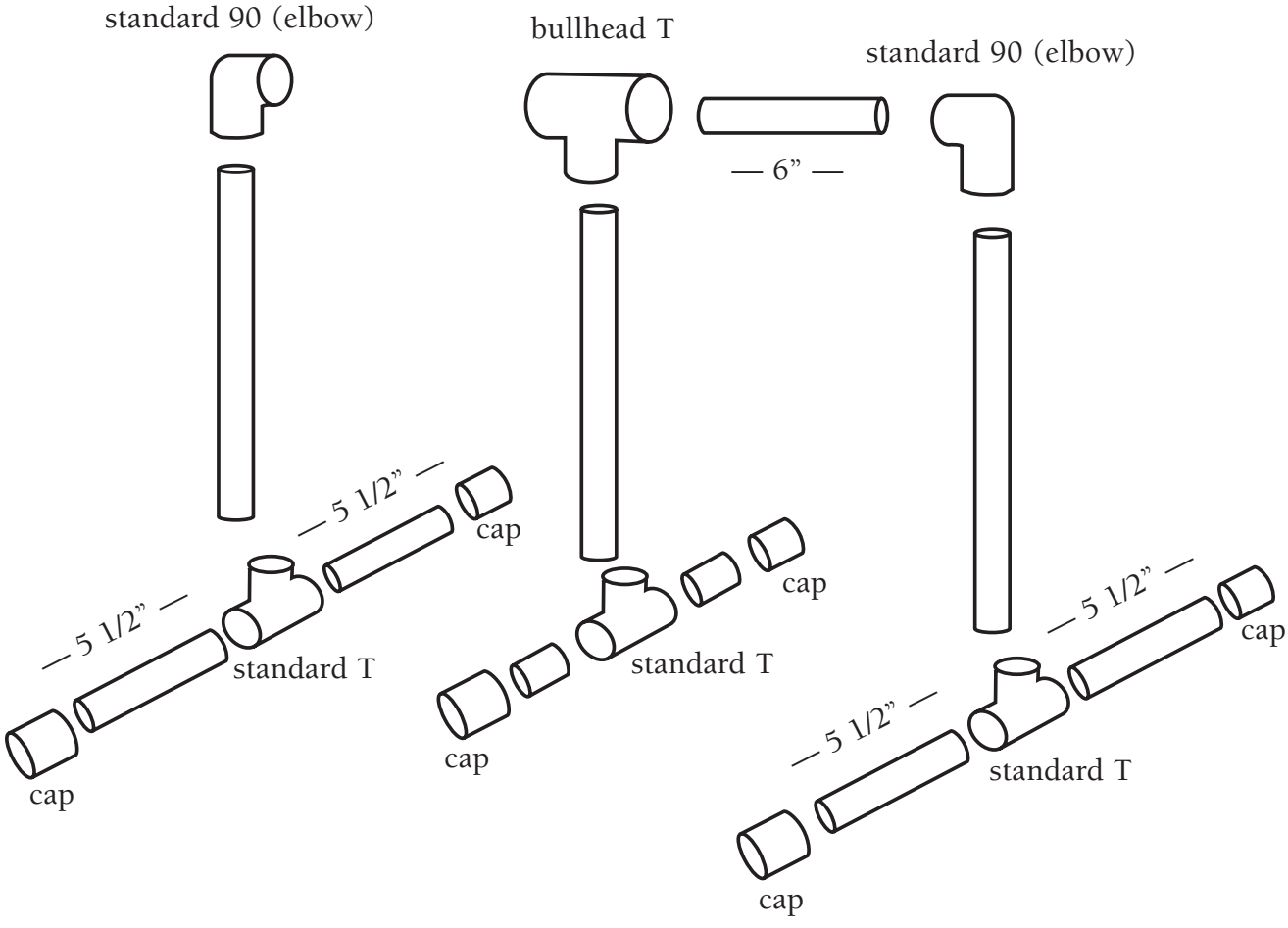
5. Fit the two capped 11/2" lengths into the cross piece of one 1/2" standard T. You should not see any of the 11/2" length of pipe when they are fitted together properly. The standard T and the caps will be flush. Fit the four capped 51/2" lengths into the cross pieces of two 1/2" standard T's.

6. Fit the 9" piece into the standard T with the 11/2" capped pieces. Fit the 10" pieces into the two standard T's with the 51/2" capped pieces.

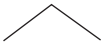
7. Fit the other end of the 9" piece into the bottom portion of the bullhead T. The top of the T and the bottom of the hammer should be perpendicular to each other.

Swinging Hammer Diagram



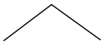


Hammer Time! Data Sheet

Same Weight, Different Force	
Hammer Angle	Distance/Speed
less than right angle weak 	
right medium 	
greater than right angle strong 	

Same Force, Different Weight	
Sphere Weight	Distance/Speed
light ping pong	
medium golf	
heavy stone	

Hammer Time! Data Sheet

Same Weight, Different Force	
Hammer Angle	Distance/Speed
less than right angle weak 	
right medium 	
greater than right angle strong 	

Same Force, Different Weight	
Sphere Weight	Distance/Speed
light ping pong	
medium golf	
heavy stone	

May the Best Force Win

Standard III:

Students will understand the relationship between the force applied to an object and resulting motion of the object.

Objective 2:

Demonstrate that the greater the force applied to an object, the greater the change in speed or direction of the object.

Intended Learning Outcomes:

1. Use Science Process and Thinking Skills
2. Manifest Scientific Attitudes and Interests
3. Understand Science Concepts and Principles
4. Communicate Effectively Using Science Language and Reasoning.

Content Connections:

Physical Education II-2 & III-2; Manipulative Skills

Science Standard III

Objective 2

Connections

Background Information

This activity will be done after all other teaching of 3rd Grade Science Standard III has been taught. Students will already understand push and pull. They will understand that force affects speed and direction.

Research Basis

Lewis, V. K., & Shaha, S. H. (2003). Maximizing learning and attitudinal gains through integrated curricula. *Education. 123*, 537-547.

Three studies were done comparing integrated curriculum versus single subject curriculum. It was shown that integrated curriculum was significantly better for learning and student attitude. Students were engaged, cared about the lesson subjects, and were able to retain learning better. Three different subjects were used during the study.

Fitton, N. (2004, August). Physics on the playground. *Instructor Magazine,* August, 58-61.

This article shows how to integrate physics with physical education. Subjects include gravity, momentum, friction, force, etc. Short activities are listed.

Invitation to Learn

Set a soccer ball on the floor and stare at it. When someone asks you what you are doing, tell them that you are playing soccer. If no one asks, wait until someone says anything at all and say, "Shhhh, I'm doing something." Then they'll ask what you're doing.

Materials

- ❑ Soccer ball
- ❑ *Sports That Push and Pull*
- ❑ *Forces and Motion in Sports*
- ❑ *Class Survey of Forces and Motion in Sports*
- ❑ *Bob Goes Adventuring*
- ❑ 10 sets of sports equipment
- ❑ 10 clipboards
- ❑ 10 pencils
- ❑ Timer
- ❑ Whistle

Of course they will make some sort of argument. Launch into a discussion about what else you would need to do to play soccer.

Instructional Procedures

1. Beforehand, setup 10 stations for the students to go to, each with one sport activity. The equipment can be real or toys. You must include at least two sports from each category on the *Sports that Push and Pull* sheet. You may set up inside or outside. Make sure the stations are numbered in some way, so students know where to go next. Leave instructions for any sport that you think the kids might not be familiar with.
2. In the classroom, divide the students into 10 groups (2-3 students per group). Pass out a pencil, a clipboard, and one *Forces and Motion in Sports* paper to each group. Have the students put their names at the top and listen while you explain the directions.
3. Explain that when they get to a station, they are to write the name of the sport in the left column before they play with the equipment. Then, they are to use the equipment to do the sport. While they are playing, they need to pay attention to what kind of force(s) they use to play. Tell them that they will have three minutes to play with the equipment. When you blow the whistle, they are to take one minute to finish filling out the rest of the row for their station. Then you blow the whistle one more time, and they are to go to the next station.
4. Explain that to fill out the sheet, they must mark either the *pull*, *push*, or *both* box in the middle column. Then they must write a simple phrase to explain the pull/push force that they used. Example for volleyball: push when my hand hit the ball OR my hand pushed the ball.
5. Take the students to where you've setup the stations. Send one group to each station and tell them to start. Time them for three minutes, and then blow the whistle. Make sure they are writing. Give them about one minute to write, and then blow the whistle again so they go to the next station.
6. When each group has been to all the stations, clean up and go back to the classroom. Put *Class Survey of Forces and Motion in Sports* on the overhead projector. Write the sport name in the left column and ask who thought it was push, pull, or both. Tally for each sport.

7. Discuss the results with the class.

Assessment Suggestions

- Give the students each a copy of *Bob Goes Adventuring,* a green crayon, and a purple crayon. Tell them to read the story and put a green circle around the words every place they read about a push, and a purple rectangle every place they read about a pull. Remind them that some places might have both a green circle and purple rectangle. For example, when they read about Bob swimming, they will have a green circle for his legs pushing his body, and a purple rectangle for his hands pulling his body.
- Have the students choose three of the sports they participated in during the activity to write about. In one paragraph for each sport, have students explain how different weight and different amount of force affects the play of that sport.

Curriculum Extensions/Adaptations/ Integration

- Make a list of all the Summer Olympics events. This is especially powerful if it is an Olympics year. Then sort them into push, pull, or both.
- Disabled athletes are able to compete in various sports using assistive devices or other technologies. Have students do research and share their findings. Disabled athletes could be invited to the classroom to talk to students.

Family Connections

- Send home an assignment as homework where the student and their family get together outside and each throws a ball as far as they can. If they don't have older/younger brothers and sisters, other neighborhood folks can join in. Have them record the age of the thrower, and then how far they threw it. Then they must explain to their family how the littler kids didn't throw the ball with as much force as the bigger kids, so it didn't go as far.
- Send home a copy of the *Forces and Motion in Sports* paper for the students to fill out with their family. They may not include any that you had as a station at school.

Additional Resources

Web sites

http://www.tryscience.org/tsadv/world/home.html

http://home.nc.rr.com/enloephysics/sports.htm

http://www.exploratorium.edu/sports/

http://archive.ncsa.uiuc.edu/Cyberia/VideoTestbed/Projects/NewPhysics/newtons_1.html

http://education.lanl.gov/programs/cif/NonNuclear/sports/main.htm

http://www.pocanticohills.org/olympics/summerolympics2.htm

http://news.bbc.co.uk/sport1/hi/olympics2000/paralympics/959701.stm

Sports That Push and Pull

Push

Golf	Club pushes ball
Baseball	Hand pushes ball, bat pushes ball
Football	Hand pushes ball
Basketball	Hand pushes ball
Volleyball	Hand pushes ball
Bowling	Hand pushes ball, ball pushes pins
Cycling	Foot pushes pedal
Soccer	Foot pushes ball
Footbag (hacky sack)	Foot pushes sack
Badminton	Racket pushes birdie
Tennis	Racket pushes ball
Racquetball	Racket pushes ball
Ping-Pong	Paddle pushes ball
Frisbee	Hand pushes Frisbee
Horseshoes	Hand pushes horseshoe
Darts	Hand pushes dart
Croquet	Mallet pushes ball

Pull

Tug-of-war	Hand pulls rope
Fishing	Pole pulls hook and fish
Jump rope	Hand pulls rope

Both

Archery	Hand pulls string, string pushes arrow
Weight lifting	Hand pulls bar, hand pushes bar
Wrestling	Hand pulls body, hands and body pushes body
Rock climbing	Hand pulls rope and rock, foot pushes rock
Kite flying	Hand pulls string, wind pushes kite

Name _____ Date _____

Forces and Motion in Sports

Instructions: Write the name of the sport in the left column. Decide if the force is a push or pull. Put an X in the correct box in the middle column. If you think the sport uses both push and pull, put an X in both boxes. In the right column, write an explanation of how the push and/or pull are used in the sport.

Sport	Force	Explanation
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	

Class Survey of Forces and Motion in Sports

Sport	Push	Pull	Both

Class Survey of Forces and Motion in Sports

Sport	Push	Pull	Both

Bob Goes Adventuring

Once upon a time there lived a little fellow named Bob. He was quite the restless little guy, so one day he decided to go adventuring. He gathered some supplies, loaded his backpack, and off he went.

Bob had never seen the Motion Ocean before, so first he headed to the beach. He didn't have a car, so it took him three days to walk there. When he arrived, he was so hot and tired that he threw down his pack and ran into the waves. He swam about for most of the afternoon, then got out and dried off. That was quite refreshing! Bob was ready for his next destination.

He decided that he would climb the Newton Cliffs. It took him two more days to walk there. When he arrived, he was so excited to see the view from the top that he immediately got out his climbing equipment and made the ascent. It was tough work! He rested at the top overnight. The stars were lovely from up there! Bob rappelled down the cliffs right after lunch the next day.

Bob was wondering where he should go next, when suddenly an idea popped into his head. He could go white water rafting down the River of Force! His excitement tingled all the way to his toes! Bob was so thrilled about his next adventure, that he didn't want to take "forever" walking there. So, he hitched a ride with a farmer pulling a trailer of Holstein cows. Mooooo!

When Bob got to the river, he jumped up and down with anticipation. He joined up with a small group that was ready to launch immediately. They let Bob take one of the oars! Woohoo! Down the river they surged, splashing and laughing all the way! Bob paddled for all he was worth!

At the bottom of the river they disembarked and Bob thanked his group for letting him join them. What a wonderful ride! Bob decided that he had better return home and pay some bills, so he set off immediately. Soon, he was too tired to go on. So, he bought a bicycle from the first kid he came to. He didn't mind that it was pink with purple tassels on the handlebars. He rode it the rest of the way home. When he got to his house, he marked his calendar for another adventure next month and fell right to sleep.

Math I-2&4
Activities

Fractions

Students: Meet Fractions (An Introduction)

Standard I:

Students will understand the base-ten numeration system and place value concepts, and perform operations with whole numbers and simple fractions.

Objective 4:

Use fractions to communicate and compare parts of the whole.

Intended Learning Outcomes:

1. Develop a positive learning attitude toward mathematics.
4. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notation of mathematics.
5. Connect mathematical ideas within mathematics, to other disciplines, and to everyday experiences.

Content Connections:

Mathematics IV-2; Measurement techniques and tools to determine measurement
Language Arts I-1; Effective communication

Math Standard I

Objective 4

Connections

Background Information

A fundamental knowledge of number sense and relationship (greater than, less than, equal to, grouping) needs to be in place as well as the ability to add, subtract, multiply, and divide small numbers. By this time, students should also be able to explore numbers and mathematical concepts and practices in a way that allows them to see that working with numbers is not a scary thing. That seeing more than one way to approach finding a mathematical solution can be fun (yes, I said fun.)

Research Basis

Long, C., (2007). Can We Compete? ***NEAtoday,*** Vol. 25 (Number 4), Page 24

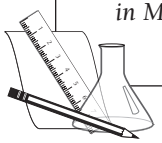
The author examined various sources that have been published in the past few years in which students in America are being compared with students from other countries (primarily India, Singapore and China) in their ability to compete in the fields of science and mathematics. This article shows that many of the works skew findings because studies cited are not accurate or fair. These other countries are sending representatives to American schools to see how we do things here. They have learned that innovation, inventiveness, creativity, curiosity, and ambition are skills taught in America that often outweigh the ability to simply recite rote knowledge on written tests.

Carpenter, T., Fennema, E., Franke, M., (January 1996). Cognitively Guided Instruction: A Knowledge Base for Reform in Primary Mathematics Instruction. *The Elementary School Journal*, Vol. 97 (Number 1), Page 3

The authors of this article explore how the understanding of students' mathematical thinking can provide a framework for the development of teachers' knowledge. They also look at the idea that children come to school with an intuitive knowledge of mathematics that can serve as a basis for developing much of the curriculum in the classroom.

Materials

- ❑ 2 large candy bars
- ❑ bite-size candy bars
- ❑ knife
- ❑ overhead projector
- ❑ brown construction paper (9x12)
- ❑ measuring devices
- ❑ scissors
- ❑ *Fraction Terms*
- ❑ *Journal Fraction Terms*
- ❑ *Let's Explore: Fractions in My World*



Invitation to Learn

Who Wants to Share?

Begin this activity by taking a large candy bar to the front of the room (use one that can be easily cut such as Three Musketeers, Milky Way, or 100 Grand) and tell the students that you want to share this candy bar with someone in the room. Choose a student (I often use name sticks to keep some choices random) and have that student come to the front with you. As you are unwrapping and preparing to cut the bar invite the other students to watch and help decide if you are doing it fairly or not. Cut the candy bar into two unequal parts. If the students don't pretty quickly let you know that you are not dividing it equally (fairly) then ask them what they think of how you did it. Showing this on an overhead projector will allow the classroom to see what the division looks like. Cut the candy bar again and stick the pieces together to make another uneven division (or you could use another candy bar instead.) Through continuing to divide and through questioning get the students to begin to see that the candy bar can be divided in an equal way (using a ruler to measure, etc.) Get a final candy bar and, using the techniques you came up with your students, divide the candy bar into two equal parts. (This activity is the lead-in to individual student practice.) Explain that the class is going to begin exploring how things (including numbers) are divided into equal parts. At this point you can give smaller bite-size candy bars to the rest of the class (make sure there are NO allergies) to share in the joy of chocolate!

Instructional Procedures

1. Divide the students into groups of two, three or four. Use varying sizes of groups so that students can explore how to divide into multiple parts.
2. Explain that the students will now be dividing up paper candy bars instead of real ones. Use sheets of 9" x 12" construction paper that have been cut in half.

3. Give each group of students a single half and ask them to divide their candy bars into parts so that each person in their group has an equal part. Have different measuring tools available for the groups to use. Have each group attach their divided candy bars to a piece of paper. Ask each group to assign a spokesperson to explain to the rest of the class how they did their work.
4. Give some time for each group to work on their problem. After about 10 to 15 minutes have each group's spokesperson come to the front of the room and explain to everyone how they divided up their paper candy bar. Use the overhead, tape, magnets, etc. to display the papers to the rest of the class.
5. As the students are explaining their work make sure you, as the teacher, are leading them to understand the terms **whole**, **halves**, **thirds**, **and fourths**. Cut up the *Fraction Terms* sheet to display these terms during the discussion.
6. If time permits, group the students again (mixing them up so that students who might have done halves are now doing thirds or fourths, etc.) Give each group another paper candy bar and ask them to divide it equally among the students in their group. Again, give 10 to 15 minutes to complete this task (hopefully, the students are beginning to catch on and it won't take as long this time.)
7. As the groups are explaining their work this time, ask them if they found any different ways of dividing the paper. Brainstorm. Get them thinking about other ways to divide (into thirds and fourths, especially).
8. Again, if time permits, divide into groups one more time (there will be some students who are dividing ways they have before, but that's okay.) Have them think about the different ways to divide that which was explored earlier. Hand out another paper candy bar and have the groups work one more time.
9. Pull the students back together as a whole group and discuss how the groups divided their candy bars. The students need to be lead (if they haven't already figured it out) that fourths can be divided up by halving the halves. As this is discussed, show the students another paper candy bar divided into fourths and ask them how we could use our new knowledge to divide this into eighths. Remind them that we need to have eight equal parts. Do the same thing with a paper candy bar divided into thirds and have them divide into sixths. Display the terms **eighths** and **sixths** as you do this.

10. Conclude this lesson/activity with the *Let's Explore* assessment suggestion.

Assessment Suggestions

- **Let's Explore:** Take the class for a walk around the classroom, the building, and outside (weather permitting) to find things that are divided into equal groups. Give each student a copy of the *Let's Explore: Fractions in My World* worksheet to fill out as they do this. Take about 15 to 20 minutes to complete this activity and discuss their findings after you gather them back together in the classroom. This can also be used as a homework extension. Have them go home and spend 15 minutes finding things around their home (inside and out) that are divided into equal parts.
- Have students draw a representation of how they divided their paper candy bars in halves, thirds, fourths, sixths, or eighths. Ask them to explain their work using pictures, words, or numbers (or any combination of these).
- Use *Journal Fraction Terms* to have students cut and glue the terms into their journals. Have them explain (using pictures, words and/or numbers) the terms.

Curriculum Extensions/Adaptations/ Integration

- Use time for another lesson that shows how to divide circular items (such as pizza or cookies) into halves, thirds, fourths, sixths, and eighths.
- Share the book *Apple Fractions* with students.
- For students with special needs (ELL, resource): during assessment, have students represent one or two of the items they found during exploration with manipulatives or drawing. For ELL students you could use an interpreter, if needed.

Family Connections

- Have students find things at home that are divided into equal parts and have them share with their families.
- The next time the family has some kind of food that is rectangular (casserole, cake, etc.) or round (pizza, cookies,

etc.), have the student divide the food into equal parts for the family to share. Have them share the experience at school.

Additional Resources

Books

Apple Fractions, by Jerry Pallotta; ISBN 0-439-38901-1

The Hershey's Milk Chocolate Fractions Book, by Jerry Pallotta; ISBN 0-439-13519-2

Math to Know: A Mathematics Handbook, by Mary C. Cavanagh; ISBN 0-669-47153-4

Fraction Action, by Loreen Leedy; ISBN 0-8234-1244-X

Fraction Fun, by David Adler; ISBN 0-8234-1341-1

Piece=Part=Portion, by Scott Gifford; ISBN 0-439-74054-1

Clean-Sweep Campers, by Lucille Penner; ISBN1-57565-096-7

Inchworm and A Half, by Elinor Pinczes; ISBN 0-618-31101-7

Give Me Half, by Stuart Murphy; ISBN 0-06-446701-8

Games

Pizza Fraction Fun Jr., Learning Resources (LER 5061 is the item number from the catalog; check website or catalog for ordering)

Pie in the Sky Fraction Game, Learning Resources (LER 5054 is the item number from the catalog; check the website or catalog for ordering.)

Auntie Pasta's Fraction Game, Learning Resources (LER 5053 is the item number from the catalog; check website or catalog for ordering.)

Web sites

http://www.learningresources.com

http://www.themailboxcompanion.com

http://greatsource.com

http://amazon.com

http://www.scholastic.com

Fraction Terms

whole
halves
thirds

Fraction Terms

fourths
sixths
eighths

Journal Fraction Terms

whole	halves
thirds	fourths
sixths	eights

Name _____ Date _____

Let's Explore: Fractions in My World

What I saw	How many parts

Fun with Fractions

Math Standard I

Objective 2

Connections

Standard I:

Students will understand the base-ten numeration system and place value concepts, and perform operations with whole numbers and simple fractions.

Objective 2:

Use fractions to communicate and compare parts of the whole.

Intended Learning Outcomes:

1. Develop a positive learning attitude toward mathematics.
2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
6. Represent mathematical ideas in a variety of ways.

Content Connections:

Language Arts VIII: 6; Writing in different forms and genres
Social Studies V: 1; Demonstrate basic citizenship skills

Background Information

A fundamental knowledge of number sense and relationship (greater than, less than, equal to, grouping) needs to be in place as well as the ability to add, subtract, multiply and divide small numbers. In addition, students should understand what the numerator and denominator of a fraction represents and that halves, thirds, fourths, sixths, and eighths are represented with the symbols 1/2, 1/3, 1/4, 1/6, and 1/8. And, don't forget—keep up the attitude of curiosity, creativity, and fun!

Research Basis

Wood, T., (January 1996). Events in Learning Mathematics: Insight from Research in Classrooms. *Educational Studies in Mathematics*, Vol. 30 (Number 1), Page 85

The author shows evidence that learning, and therefore teaching, mathematics involves more than efficient calculations; it should emphasize constructing mathematical meaning. This involves, among other things, processes of conflict with previous knowledge leading to the desire to resolve that conflict as children engage in what is referred to as reflective thinking. It is discussed heavily that the classroom environment is a critical factor in creating an atmosphere conducive to students learning.

Kelley, K., (October 2003). Cultivating Classrooms with Heart. *Classroom Leadership*, Vol. 7 (Number2), Page 1

The need for a classroom that offers students a place to feel accepted and safe is discussed in this article. The author presents

examples that support her idea that "…what our students see and remember of us is not what we do, but who we are. Our students will also remember how well we helped them become who they are." Though the author teaches high school students, the concepts are easily transferred to an elementary setting.

Invitation to Learn

Divide Us! Divide Us!

Take your class outside and tell them that we are going to explore dividing us up into parts. When you get them outside explain that what we are going to do requires them to work together well and quickly and that sometimes you will remove a student or two from the group in order to facilitate correctly dividing the group. Begin by asking the students how many there are in the **whole** class (at this point you have already chosen a number you are going to divide into halves, thirds, fourths, sixths, or eighths, e.g., 24). If you have had to pull any students aside have them help you check for accuracy of the work done by the others. Now ask the students to divide themselves into halves. Make sure the students move far enough apart that the division is clear. Use your white board and marker to have the students help you figure out how many that fraction is equal to after you have divided them (i.e., 1/3 of 24 is 6). Continue to do this using student numbers of a few (6-12) to the entire class, having them continue to divide into halves, thirds, fourths, sixths, and eighths. You could extend this activity by asking one fraction of the group to do something such as jump up and down, pat their stomachs, or sit down.

Materials

- ❑ white board
- ❑ white board markers
- ❑ color gel paper
- ❑ overhead projector
- ❑ scissors
- ❑ *Letter to My Friend*

Instructional Procedures

1. Have students return to desks after Divide Us! Divide Us! activity.
2. Explain to students that they are now going to make some fraction strips that show how we can divide the whole into equal parts and compare them.
3. Give each student six **different** colored strips of color gel paper (1 inch x 12 inches).
4. Take one colored strip and label it **whole** (make sure all students are using the same color—it will help as you continue to work with the strips.)

5. Take a second strip and have students divide the strip in half. Have them label each part with 1/2.
6. Continue doing this with each different colored strip until students have divided and labeled **whole**, **1/2**, **1/3**, **1/4**, **1/6**, and **1/8**. This should take about 15 minutes.
7. Explain that you are going to take a look at the sizes of each fraction compared to each other.
8. Have students explore the relative sizes of each fraction strip by asking them questions such as "Which is larger: 1/2 or 1/3? 1/6 or 1/8?" It is important that as you ask questions you should also have students explain their reasoning for which is larger.
9. As you work with students on these comparisons have them notice the denominators of these fractions. Ask the question, "Look at the denominator. Why, if the number is bigger, do we have smaller pieces of the whole?" As a class, explore this and lead the students to the understanding that the larger the denominator the more (and thus, smaller) parts the whole is being divided into.
10. Finish this lesson with the assessment activity *A Letter to My Friend.*

Assessment Suggestions

- **A Letter to My Friend:** Using the paper *A Letter to My Friend,* have each student explain why 1/3 is larger than 1/4. Make sure that students write the letter so that their friend understands what they are writing. Have them use pictures, words and numbers (or any combination of these).
- Pair students up and give them handfuls of items such as beans, plastic coins, or small cubes. Have them show each other their solutions that you give them to problems such as: make a pile of 30. Show me how you divide the pile into halves. Show me thirds. Sixths. Use any total that you can divide into halves, thirds, fourths, sixths, or eighths.

Curriculum Extensions/Adaptations/ Integration

- Extend this lesson by having students compare different sized fractions with each other. For example: what is bigger 1/2 or 2/3? Is 3/4 bigger than 2/3? How many fourths are there in 1/2? How many sixths are there in 1/2? In 3/4?

- Share the book *Fraction Action* with students.
- Play the game *Pizza Fraction Fun Jr.* (see additional resources for ordering option.)

Family Connections

- Check books or games out to students and allow them to take them home to share with their families.
- Find items around the house that students can divide into groups (beans, cereal, coins, noodles, stickers, etc.) Have them quiz older family members and check for accuracy. Have family members quiz the students and check for accuracy. This could be given as a homework assignment.

Additional Resources

Books

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The Hershey's Milk Chocolate Fractions Book, by Jerry Pallotta; ISBN 0-439-13519-2

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Web sites

http://www.learningresources.com

http://www.themailboxcompanion.com

http://greatsource.com

http://amazon.com

http://www.scholastic.com

Name _____ Date _____

A Letter to My Friend

Some people think that 1/4 is larger than 1/3.

Some people think that 1/3 is larger than 1/4.

Which do you think is larger?

Write a letter to a friend telling why you are right.

Use pictures, letters, numbers, or all of these to explain your thinking.

Remember, your friend must understand what you write.

Appendix

Riddle Time

Place Riddle Here	
Explain to me what they are asking.	**What are the facts? Are there any important words?**
What is your plan? Show me.	**Why do you feel your solution is correct?**

Riddle Time

Place Riddle Here	
Explain to me what they are asking.	**What are the facts? Are there any important words?**
What is your plan? Show me.	**Why do you feel your solution is correct?**

Riddle Time

Place Riddle Here	
Explain to me what they are asking.	**What are the facts? Are there any important words?**
What is your plan? Show me.	**Why do you feel your solution is correct?**

Riddle Time

Place Riddle Here	
Explain to me what they are asking.	**What are the facts? Are there any important words?**
What is your plan? Show me.	**Why do you feel your solution is correct?**

Riddle Problems

A grocery store has a sale on oranges. If you buy five oranges you get the sale price. If the grocer has 169 oranges, how many bunches of five can he sell at his sale price? How many will be left to be sold at the regular price?	There are 24 people in a room. Eleven people are wearing socks, seven people are wearing shoes, and four people are wearing both. How many people are in bare feet?
How many addition signs should be put between the digits of the number 987654321 and where should we put them to get a total of 198?	The Riddler has left clues for Superman. These are the clues: 1) There is a 1 in the thousands place. 2) The digit in the tens place is 8 times the digit in the thousand place. 3) The digit in the ones place is a hand without a pinkie. 4) The digit in the hundreds is 4 less than the number in the tens. Solve the riddle to help Superman stop the Riddler.
I have 12 stamps. The stamps are either 3 cent or 5 cent stamps. All together the stamps equal 40 cents. How many 3 cent stamps and how many 5 cent stamps do I have?	Fill in the blanks with these numbers so the story makes sense. 4 12 9 10 7 14 It is January right now. My birthday is ___ months away. I am going to turn ___ on July ___. My sister is three years older than me. She is going to turn ___ in about ___ months.
Brynne, Delaney, JD, Mckayla, and Shane have to read 85 pages in a book. ▪ Brynne has 30 pages left. ▪ Delaney has 5 more pages to read than Brynne. ▪ JD has 10 fewer pages to read than Delaney. ▪ McKayla has read 4 more pages than JD. ▪ Shane has read 8 more pages than Brynne. What page is each person on?	Susan, Kristine, Kathryn, Erin, and JoDee had 5-dozen stickers. ▪ Each person had at least 6 stickers. ▪ Kathryn had 6 more stickers than Kristine. ▪ Erin had twice as many stickers as Susan. ▪ JoDee had 6 fewer stickers than Erin. How many stickers did each person have?
▪ Heather -Do Dishes ▪ Shane -Make Beds ▪ Josie - Vacuum Floor ▪ Jed -Empty Garbage These are the chores that Heather, Shane, and Josie have to do on Monday. Each does a different chore every day. Tuesday Heather will empty the garbage and Jed will vacuum. What job will each child have to do this Sunday?	14, 15, 21, 22, 38, 41 Adding together each or some of these numbers as many times as you want, how do you reach a sum of exactly 100?

Planes, Trains and Automobiles

From Salt Lake to...	#	Miles			
Atlanta, Georgia	1	1,933			
Boston, Massachusetts	1	2,368			
Charlotte, North Carolina	1	2,052			
Chicago, Illinois	1	1,400			
Cleveland, Ohio	1	1,729			
Dallas, Texas	2	1,404			
Denver, Colorado	2	533			
Detroit, Michigan	1	1,665			
Oakland, California	2	731			
Houston, Texas	2	1,644			
Indianapolis, Indiana	1	1,519			
Los Angeles, California	3	690			
Memphis, Tennessee	2	1,592			
Miami, Florida	1	2,540			
Milwaukee, Wisconsin	1	1,441			
Minneapolis, Minnesota	2	1,310			
East Rutherford, New Jersey	1	2,168			
Okalahoma City, Oklahoma	2	1,202			
New York City, New York	1	2,174			
Orlando, Florida	1	2,316			
Philadelphia, Pennsylvania	1	2,144			
Phoenix, Arizona	2	702			
Portland, Oregon	2	767			
Sacramento, California	2	650			
San Antonio, Texas	2	1,440			
Seattle, Washington	2	841			
Washington D.C.	1	2,085f			

Rumble Time

Players	Basketball Category & Information
Vocabulary	**Solution**

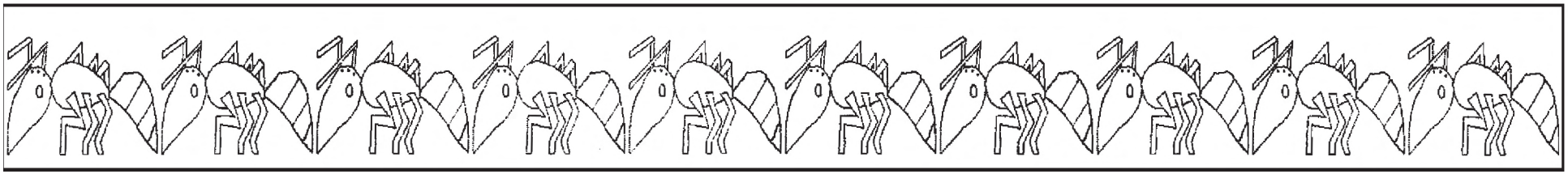
Rumble Time

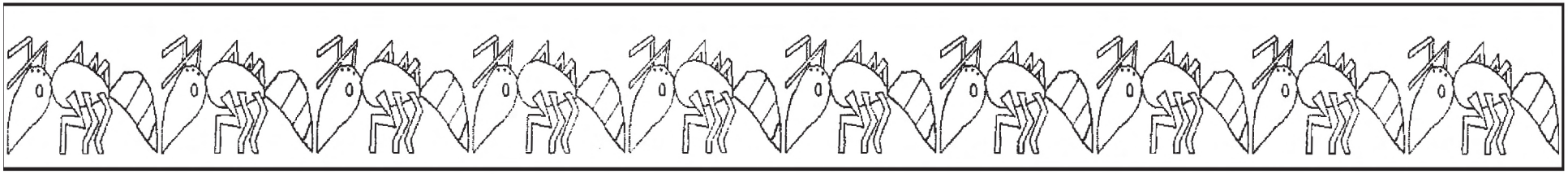
Players	Basketball Category & Information
Vocabulary	**Solution**

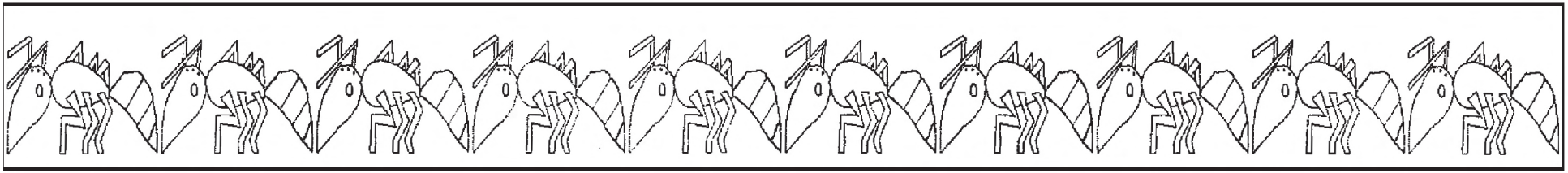
Basketball

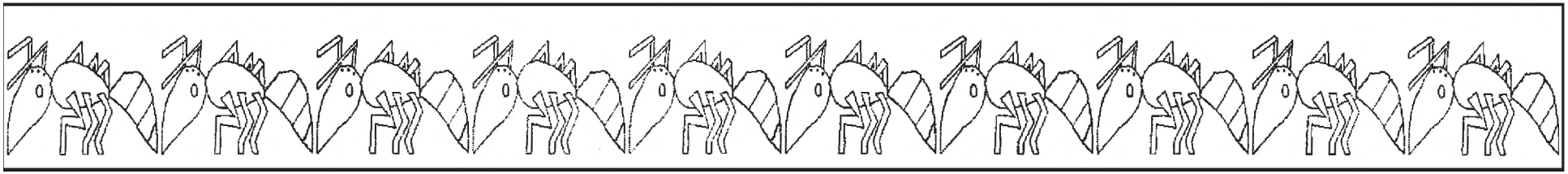
Tim Duncan San Antonio Spurs	Tony Parker San Antonio Spurs	Manu Ginobili San Antonio Spurs	Brent Barry San Antonio Spurs	Michael Finley San Antonio Spurs
Bruce Bowen San Antonio Spurs	Fabricio Oberto San Antonio Spurs	Beno Udrih San Antonio Spurs	Francisco Elson San Antonio Spurs	Matt Bonner San Antonio Spurs
Robert Horry San Antonio Spurs	Eric Williams San Antonio Spurs	Jackie Butler San Antonio Spurs	Jacque Vaughn San Antonio Spurs	Kobe Bryant Los Angeles Lakers
Lamar Odom Los Angeles Lakers	Luke Walton Los Angeles Lakers	Smush Parker Los Angeles Lakers	Kwame Brown Los Angeles Lakers	Andrew Bynum Los Angeles Lakers
Brian Cook Los Angeles Lakers	Maurice Evans Los Angeles Lakers	Vladimir Radmanovic Los Angeles Lakers	Jordan Farmar Los Angeles Lakers	Ronny Turiaf Los Angeles Lakers
Sasha Vujacic Los Angeles Lakers	Shammond Williams Los Angeles Lakers	Aaron McKie Los Angeles Lakers	Carlos Boozer Utah Jazz	Deron Williams Utah Jazz
Mehmet Okur Utah Jazz	Maft Harpring Utah Jazz	Derek Fisher Utah Jazz	Andrei Kirilenko Utah Jazz	Paul Milisap Utah Jazz
Gordan Giricek Utah Jazz	Ronnie Brewer Utah Jazz	C.J. Miles Utah Jazz	Jarron Collins Utah Jazz	Dee Brown Utah Jazz
Rafael Araujo Utah Jazz	Roger Powell Utah Jazz	Minutes	Steals	Blocks
Assists	Points	Rebounds	Sum	All
Together	Total	In All	Together	Difference
FewerThan	Left	Great Than	Less Than	More Than
How many more?	How many less?			

Measuring Ants



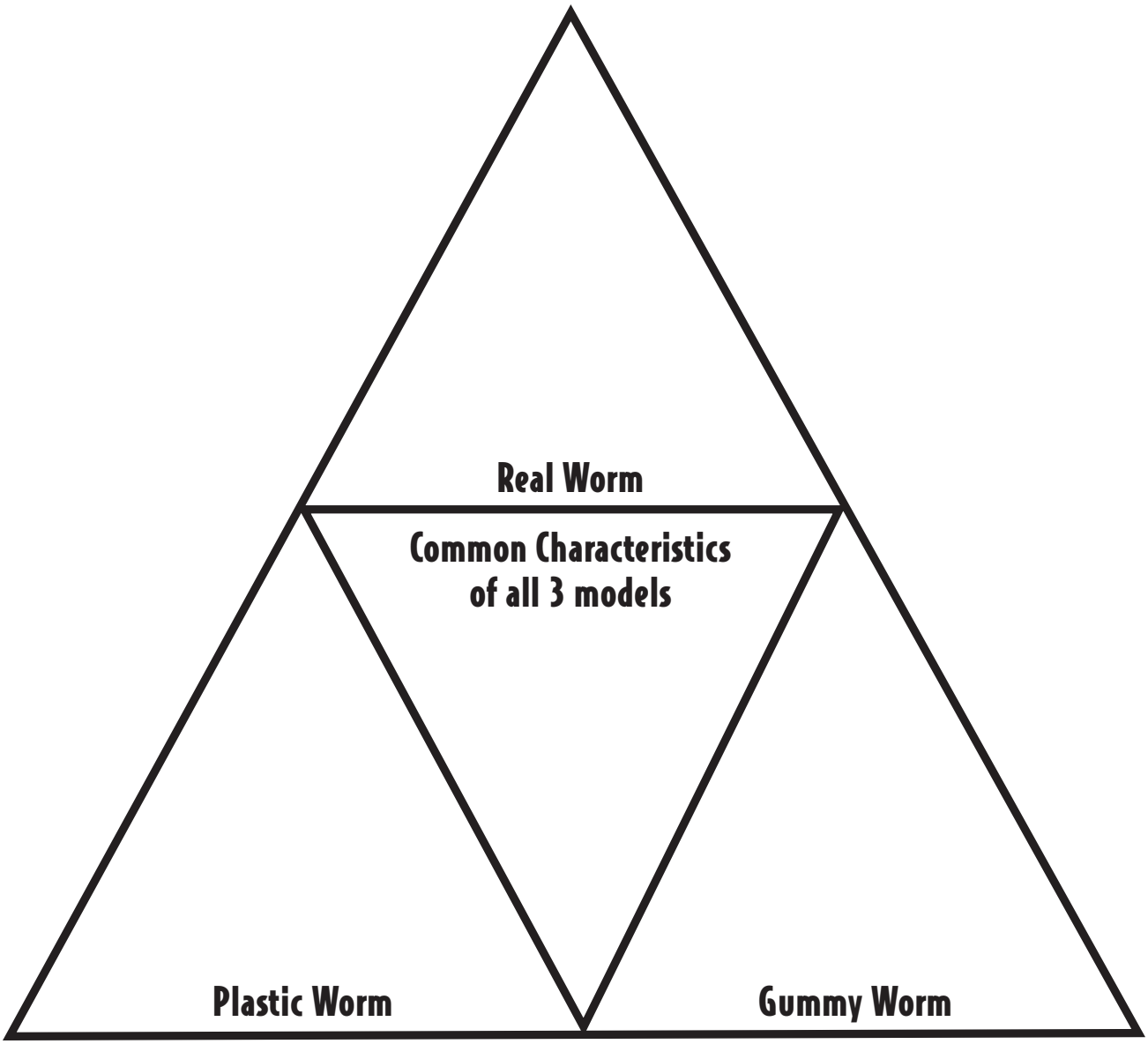






Name _____ Date _____

Worm Model Characteristics



I observed: _____

_____

_____

_____

_____

Name _____ Date _____

I Noticed!

Observation	Compare Worm Models In Detail
Plastic Worm	
1. Color 2. Shape 3. Length/size 4. Texture 5. Segments/rings 6. Eyes/ (y,n) ears (y,n) 7. Legs (y,n) mouth (y,n) 8. Does it move? (y,n) 9. Does it grow? (y,n)	
Gummy Worm	
1. Color 2. Shape 3. Length/size 4. Texture 5. Segments/rings 6. Eyes/ (y,n) ears (y,n) 7. Legs (y,n) mouth (y,n) 8. Does it move? (y,n) 9. Does it grow? (y,n)	
Live Earthworm	
1. Color 2. Shape 3. Length/size 4. Texture 5. Segments/rings 6. Eyes/ (y,n) ears (y,n) 7. Legs (y,n) mouth (y,n) 8. Does it move? (y,n) 9. Does it grow? (y,n)	

"How do these Worms React?"

Experiment	Plastic Worm	Gummy Worm	Live Worm
Light (Shine a flashlight on the worms, what do you observe)	Prediction	Prediction	Prediction
	Conclusion	Conclusion	Conclusion
Heat from the Sun (Expose the worm to heat from the sun or use a heat lamp.)	Plastic Worm	Gummy Worm	Live Worm
	Prediction	Prediction	Prediction
	Conclusion	Conclusion	Conclusion
Water for moisture (Place the worm in a bowl and slowly add water in small increments, observing the worm as it becomes saturated.)	Plastic Worm	Gummy Worm	Live Worm
	Prediction	Prediction	Prediction
	Conclusion	Conclusion	Conclusion

Name _____ Date _____

K-W-L About Earthworms

What do I know about earthworms?

_____

_____

_____

What do I want to know about earthworms?

_____

_____

_____

What did I observe or learn today about earthworms? (Draw and tell.)

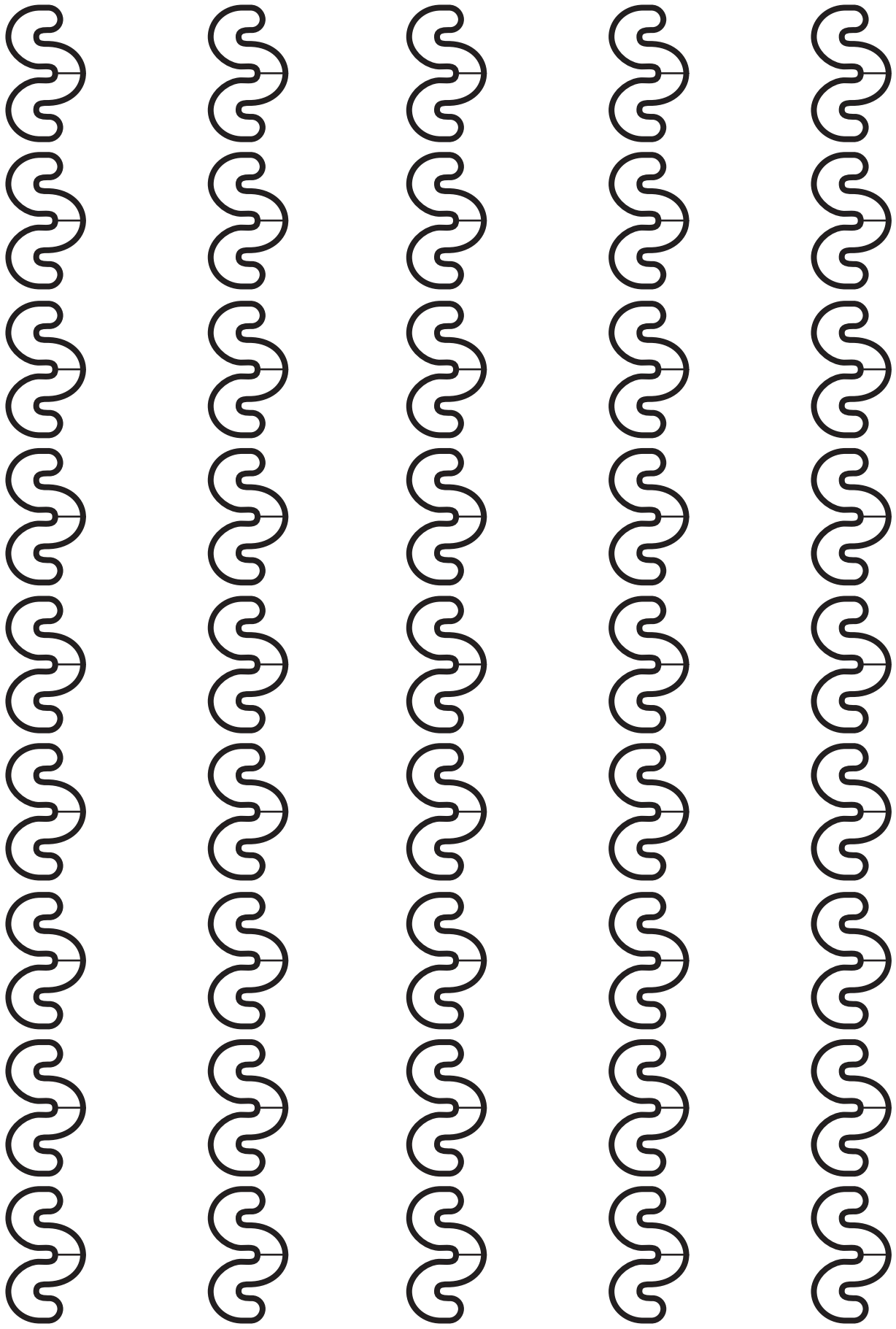
_____

_____

_____

Did I use math in my learning about worms today? Give examples (Draw and tell.)

Inchworm Cutouts



Name _____ Date _____

Snacks Survey Chart

Names of Snacks	Tally	Number of Students

How many more people chose _____ than _____?

_____

What was the most popular snack?

_____

What was the least popular snack?

_____

How many people answered the survey?

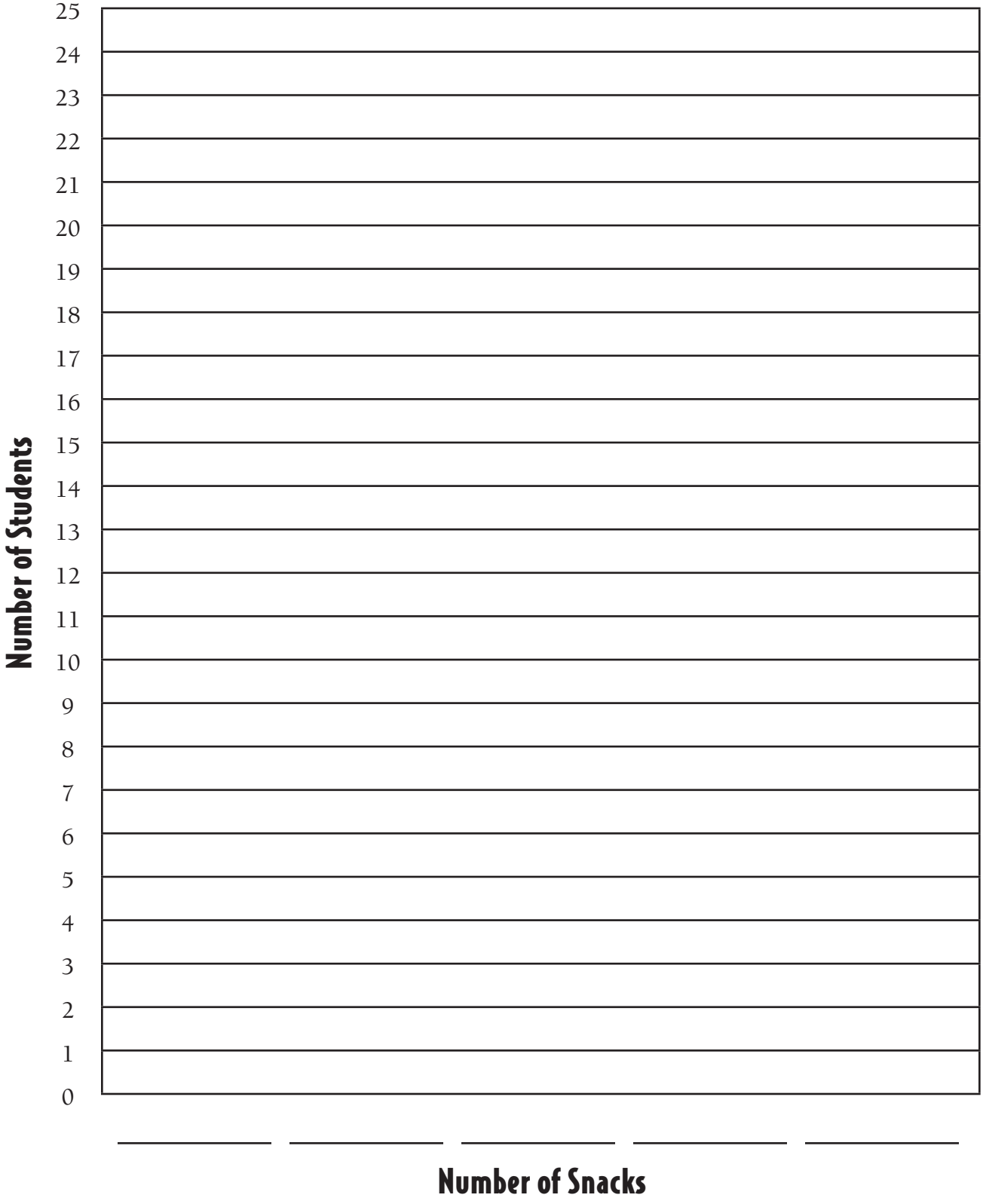
_____

Did more people chose _____ or _____?

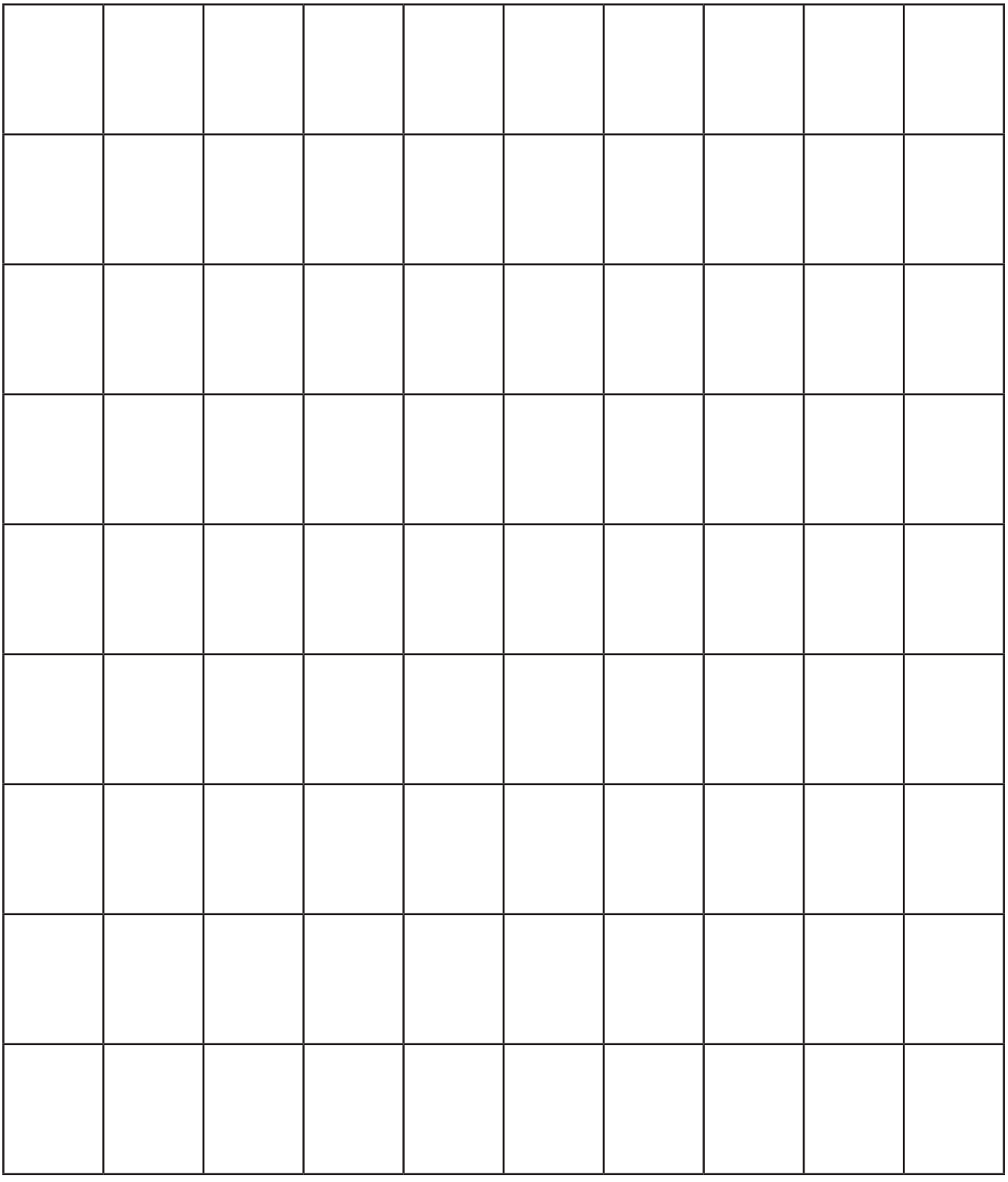
_____

Name _____ Date _____

Snacks Survey Bar Graph



Valentine Battleship Grid



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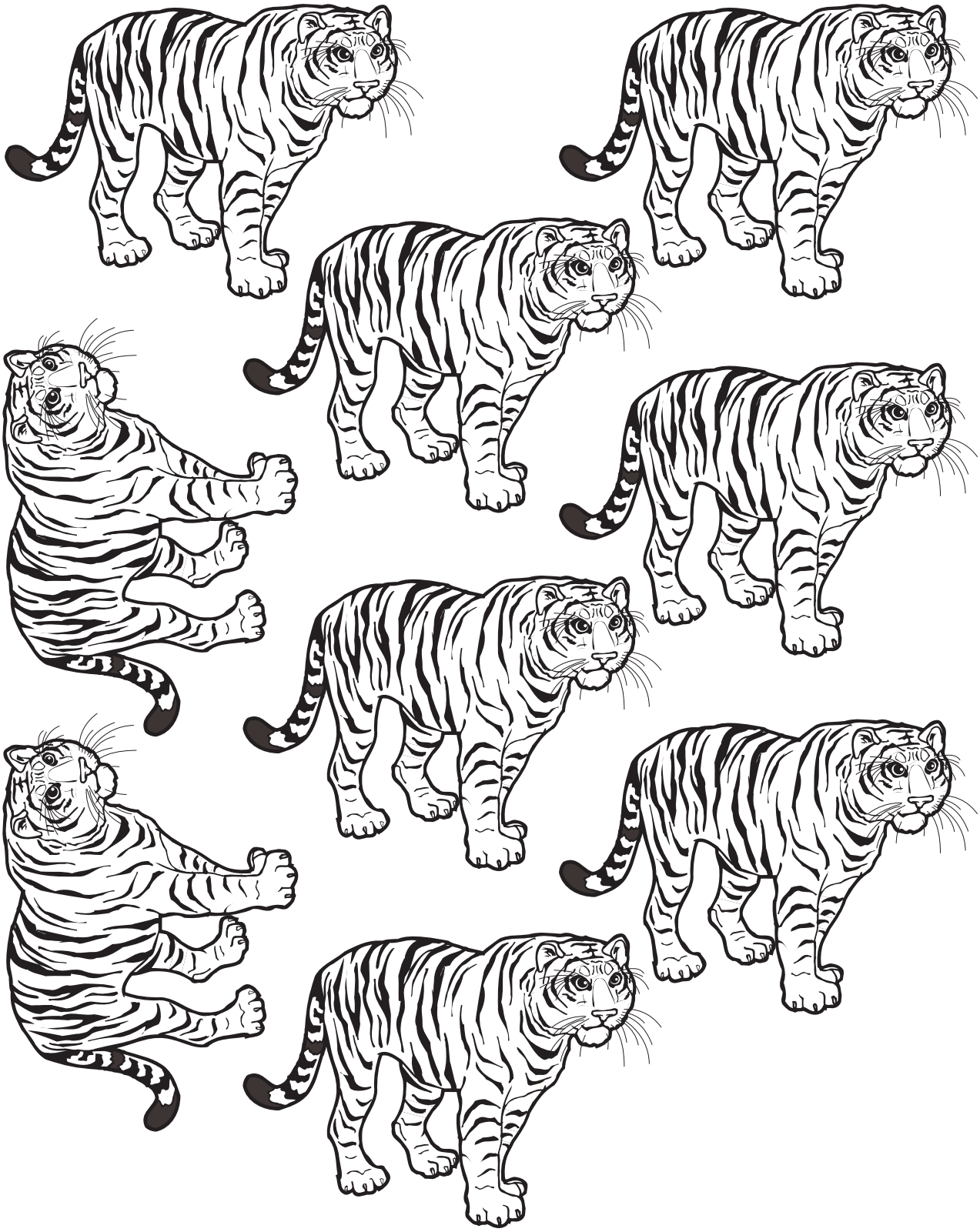
Name _____ Date _____

Drops on Pennies Data Chart

Coin	Predicted # of drops	Coin #1 # of drops	Coin #2 # of drops	Coin #3 # of drops	Medium
Penny					
Quarter					
Nickel					
Dime					

Tigers



Name _____ Date _____

Rubric for Graphs

Pictograph

1. Title
2. Legend or Key
3. Information is accurate
4. Same picture throughout
5. Each axis labeled

Rubric

4—Applies to all 5 items
3—Applies to 4 items
2—Applies to 3 items
1—Applies to 2 items

Line Graphs (shows change over time)

1. Title
2. Label horizontal axis
3. Label vertical axis
4. Numbers in a pattern (increments)
5. Numbers labeled on lines
6. Each individual label on the horizontal axis
7. Plotting the points correctly

Rubric

4—Includes all 7 items
3—Includes 5 or 6 items
2—Includes 3 or 4 items
1—Includes 2 items or less

Bar Graphs

1. Title
2. Label horizontal axis
3. Label vertical axis
4. Numbers in a pattern (increments)
5. Numbers must be labeled on the line, not on the space
6. Information is accurate on the bars
7. Bars cannot touch (spaces between each one)

Rubric

4—Includes all 7 items
3—Includes 5 or 6 items
2—Includes 3 or 4 items
1—Includes 2 items or less

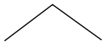
Weighty Wheels Recording Sheet

Weights	Run one distance	Run two distance	Run three distance	Median
No Washers				
1 Washer				
2 Washers				
3 Washers				
4 Washers				

Weighty Wheels Recording Sheet

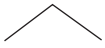
Weights	Run one distance	Run two distance	Run three distance	Median
No Washers				
1 Washer				
2 Washers				
3 Washers				
4 Washers				

Hammer Time! Data Sheet

Same Weight, Different Force	
Hammer Angle	Distance/Speed
less than right angle weak 	
right medium 	
greater than right angle strong 	

Same Force, Different Weight	
Sphere Weight	Distance/Speed
light ping pong	
medium golf	
heavy stone	

Hammer Time! Data Sheet

Same Weight, Different Force	
Hammer Angle	Distance/Speed
less than right angle weak 	
right medium 	
greater than right angle strong 	

Same Force, Different Weight	
Sphere Weight	Distance/Speed
light ping pong	
medium golf	
heavy stone	

Name _____ Date _____

Forces and Motion in Sports

Instructions: Write the name of the sport in the left column. Decide if the force is a push or pull. Put an X in the correct box in the middle column. If you think the sport uses both push and pull, put an X in both boxes. In the right column, write an explanation of how the push and/or pull are used in the sport.

Sport	Force	Explanation
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	
	☐ Push ☐ Pull	

Journal Fraction Terms

whole	halves
thirds	fourths
sixths	eights

Name _____ Date _____

Let's Explore: Fractions in My World

What I saw	How many parts

Name _____ Date _____

A Letter to My Friend

Some people think that 1/4 is larger than 1/3.
Some people think that 1/3 is larger than 1/4.

Which do you think is larger?
Write a letter to a friend telling why you are right.
Use pictures, letters, numbers or all of these to explain your thinking.
Remember, your friend must understand what you write.