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

ELEMENTARY CORE ACADEMY • ELEMENTARY CORE ACADEMY • ELEM

5TH GRADE

2005

PARTICIPANT HANDBOOK

UTAH STATE OFFICE OF EDUCATION

UtahState UNIVERSITY

ELEMENTARY CORE ACADEMY

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

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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 CORE Academy. I hope your involvement helps you to sustain a laser-like focus on student achievement.

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

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

Sincerely,

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

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Major funding for the Academy comes from the following sources:

Federal/State Funds:

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

ESEA Title II

Utah Math Science Partnership

WestED Eisenhower Regional Consortium

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Utah State Office of Education Special Education Services

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

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

Goals of the Elementary CORE Academy

Overall

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

The Academy will provide elementary teachers in Utah with:

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

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

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Fifth Grade Mathematics Core Curriculum

Utah Elementary Mathematics Core Curriculum

Introduction

Most students enter school confident in their own abilities; they are curious and eager to learn more. They make sense of the world by reasoning and problem solving. Young students are active, resourceful individuals who construct, modify, and integrate ideas by interacting with the physical world as well as with peers and adults. They learn by doing, collaborating, and sharing their ideas. Students' abilities to communicate through language, pictures, sound, movement, and other symbolic means develop rapidly during these years.

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

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

The most important observation about the five strands of mathematical proficiency is that they are interwoven and interdependent. This observation has implications for how students acquire mathematical proficiency, how teachers develop that proficiency in their students, and how teachers are educated to achieve that goal. At any given moment during a mathematics lesson or unit, one or two strands might be emphasized. But all the strands must eventually be addressed so that the links among them are strengthened. The integrated and

balanced development of all five strands of mathematical proficiency should guide the teaching and learning of school mathematics. Instruction should not be based on extreme positions that students learn solely by internalizing what a teacher or book says or solely by inventing mathematics on their own.

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

Organization of the Elementary Mathematics Core

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

- The INTENDED LEARNING OUTCOMES (ILOs) describe the goals for mathematical skills and attitudes. They are found at the beginning of each grade level, are an integral part of the Core, and should be included as part of instruction.
- A STANDARD is a broad statement of what students are expected to understand. Several Objectives are listed under each Standard.
- An OBJECTIVE is a more focused description of what students need to know and be able to do at the completion of instruction. If students have mastered the Objectives associated with a given Standard, they have mastered that Standard at that grade level. Several Indicators are described for each Objective.
- An INDICATOR is a measurable or observable student action that enables one to assess whether a student has mastered a particular Objective. Indicators are not meant to be classroom activities, but they can help guide classroom instruction.

Guidelines Used in Developing the Elementary Mathematics Core

The Core is:

Consistent With the Nature of Learning

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

Coherent

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

Developmentally Appropriate

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

Reflective of Successful Teaching Practices

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

Comprehensive

The Elementary Mathematics Core does not cover all topics that have traditionally been in the elementary mathematics curriculum; however, it provides a comprehensive background in mathematics. By emphasizing depth rather than breadth, the Core seeks to empower students rather than intimidate them with a collection of isolated and eminently forgettable facts. Teachers are free to add related concepts

The Core is:

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

and skills, but they are expected to teach all the standards and objectives specified in the Core for their grade level.

Feasible

Teachers and others who are familiar with Utah students, classrooms, teachers, and schools have designed the Core. It can be taught with easily obtained resources and materials. A Teacher Handbook is also available for teachers and has sample lessons on each topic for each grade level. The Teacher Handbook is a document that will grow as teachers add exemplary lessons aligned with the new Core.

Useful and Relevant

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

Reliant Upon Effective Assessment Practices

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

Engaging

In the early grades, children are forming attitudes and habits for learning. It is important that instruction maximizes students' potential and gives them understanding of the intertwined nature of learning. Effective elementary mathematics instruction engages students actively in enjoyable learning experiences. Instruction should be as thrilling an experience for a child as seeing a rainbow, growing a flower, or describing a toad. In a world of rapidly expanding knowledge and technology, all students must gain the skills they will need to understand and function responsibly and successfully in the world. The Core provides skills in a context that enables students to experience the joy of learning.

Intended Learning Outcomes for Fifth Grade Mathematics

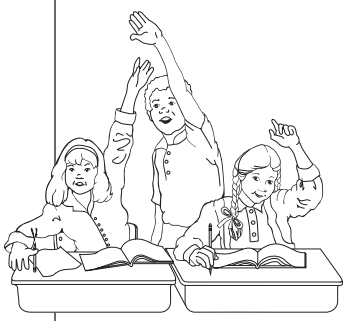
The main intent of mathematics instruction is for students to value and use mathematics and reasoning skills to investigate and understand the world.

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

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

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

- **Demonstrate a positive learning attitude toward mathematics**
- **Become mathematical problem solvers**
- **Reason mathematically**
- **Communicate mathematically**
- **Make mathematical connections**
- **Represent mathematical situations**



h. Recognize that there may be multiple ways to solve a problem.

i. Persevere in developing alternative problem-solving strategies if initially selected approaches do not work.

3. Reason mathematically.

a. Draw logical conclusions and make generalizations.

b. Determine the approach, materials, and strategies to be used in solving problems.

c. Use models, known facts, and relationships to explain reasoning.

d. Make precise calculations and check the validity of the results in the context of the problem.

e. Make conjectures based on observation and information and test mathematical conjectures and arguments.

f. Follow and construct logical arguments and judge their validity.

g. Analyze mathematical situations by recognizing and using patterns and relationships.

h. Justify answers and solution processes.

4. Communicate mathematically.

a. Represent mathematical ideas with objects, pictures, and symbols.

b. Express mathematical ideas to peers, teachers, and others through oral and written language.

c. Engage in mathematical discussions through brainstorming, asking questions, and sharing strategies for solving problems.

d. Explain mathematical work and justify reasoning and conclusions.

e. Analyze, evaluate, and explain mathematical arguments and conclusions presented by others.

5. Make mathematical connections.

a. Use one mathematical idea to extend understanding of another.

b. Recognize the role of mathematics in the classroom, school, and community.

c. Explore problems and describe and confirm results using various representations.

d. Recognize the connections between mathematics and other content areas and apply mathematical thinking and problem solving in those areas.

6. Represent mathematical situations.

a. Create and use representations to organize and communicate mathematical ideas.

b. Represent mathematical concepts using concrete, pictorial, and symbolic models.

Fifth Grade Math Standards

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

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

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

a. Model, read, and write numerals from hundredths to one millions.

b. Write a *whole number* up to 999,999 in *expanded form* (e.g., 876,539 = 8 hundred-thousands, 7 ten-thousands, 6 thousands, 5 hundreds, 3 tens, 9 ones or 8x100,000 + 7x10,000 + 6x1,000 + 5x100 + 3x10 + 9).

c. Demonstrate multiple ways to represent whole numbers by using models and symbolic representations (e.g., 108=2x50+8; 108=102 + 8).

d. Classify whole numbers from 2 to 20 as prime or composite and 0 and 1 as neither prime nor composite, using models.

e. Represent repeated factors using exponents up to three (e.g., 8=2x2x2=23).

Objective 2: Identify relationships among whole numbers, fractions, decimals, and percents.

a. Order and compare *whole numbers*, fractions (including mixed numbers), and decimals using a variety of methods and symbols.

b. Rewrite mixed numbers and improper fractions from one form to the other.

c. Find the least common denominator for two fractions.

d. Represent commonly used fractions as decimals and percents in various ways (e.g., objects, pictures, calculators).

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

a. Identify the *dividend*, *divisor*, and *quotient* regardless of the division symbol used.

b. Determine whether a whole number is divisible by 2, 3, 5, 9, and/or 10, using the *rules of divisibility*.

c. Represent remainders as *whole numbers*, decimals, or fractions and describe the meaning of remainders as they apply to problems from the students' environment (e.g., If there are 53 people, how many vans are needed if each van holds 8 people?).

d. Model addition, subtraction, and multiplication of fractions and decimals in a variety of ways (e.g., using objects and a number line).

e. Model strategies for whole number multiplication (e.g., partial product, lattice) or division (e.g., partial quotient).

f. Select or write the number sentences that can be used to solve a two-step problem.

g. Describe the effect of place value when multiplying and dividing whole numbers and decimals by 10, 100, and 1,000.

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

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

b. Name and write a fraction to represent a portion of a unit whole for halves, thirds, fourths, fifths, sixths, eighths, tenths, and twelfths.

c. Represent the simplest form of a fraction in various ways (e.g., objects, pictorial representations, symbols).

d. Represent mixed numbers and improper fractions in various ways (e.g., rulers, objects, number lines, symbols).

e. Rename *whole numbers* as fractions with different denominators (e.g., 5=5/1, 3=6/2, 1=7/7).

f. Model and calculate equivalent forms of a fraction and describe the process used.

Objective 5: Solve problems using the four operations with whole numbers, decimals, and fractions.

a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator.

b. Use estimation strategies to determine whether results obtained using a calculator are reasonable.

c. Multiply up to a three-digit *whole number* by a one- or two-digit whole number.

d. Divide up to a three-digit *dividend* by a one-digit divisor.

e. Add and subtract decimals with digits to the hundredths place (e.g., 35.42+7.2; 75.2–13.45).

f. Add, subtract, and multiply fractions.

g. Simplify *expressions*, without *exponents*, using the *order of operations*.

Objective 6: Model and illustrate integers.

a. Identify, read, and locate *integers* on a number line.

b. Describe situations where integers are used in the students' environment.

Standard II: Students will use patterns and relations to represent and analyze mathematical situations using algebraic symbols.

Objective 1: Recognize, analyze, and use patterns and describe their attributes.

a. Analyze and make predictions about patterns involving *whole numbers*, decimals, and fractions using a variety of tools including organized lists, tables, objects, and variables.

b. Extend patterns and describe a rule for predicting the next element.

Objective 2: Represent, solve, and analyze mathematical situations using algebraic symbols.

a. Recognize a variety of symbols for multiplication and division including x, i, and * as symbols for multiplication and ∏, e, and a fraction bar (/ or -) as division symbols.

b. Recognize that a variable (Ø, n, x) represents an unknown quantity.

c. Solve one-step equations involving *whole numbers* and a single variable (e.g., n∏7=3).

d. Recognize that the answer to a multiplication problem involving a factor of zero is equal to zero (e.g., 0x45=0).

e. Use expressions or one-step equations to represent real-world situations.

f. Use the *associative*, *commutative*, and *distributive properties* to compute with whole numbers.

Standard II: Students will use patterns and relations to represent and analyze mathematical situations using algebraic symbols.

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

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

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

a. Identify and draw *perpendicular lines*.

b. Draw, label, and describe rays and describe an angle as two rays sharing a common endpoint.

c. Label an angle as *acute*, *obtuse*, *right*, or *straight*.

d. Identify and describe *equilateral*, *isosceles*, *scalene*, *right*, *acute*, and *obtuse* triangles.

e. Identify the *vertex* of an angle or the *vertices* of a polygon.

f. Compare *corresponding angles* of two triangles and determine whether the triangles are *similar*.

g. Identify and describe *pyramids* and *prisms*.

Objective 2: Specify locations and describe spatial relationships using coordinate geometry.

a. Locate points defined by ordered pairs in the first *quadrant*.

b. Write an ordered pair for a point in the first quadrant.

c. Specify possible paths between locations on a *coordinate grid* and compare distances of the various paths.

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

a. Identify a *slide* (*translation*) or a *flip* (*reflection*) of a shape across a line.

b. Demonstrate the effect of a *turn* (*rotation*) on a figure using manipulatives.

c. Relate *pyramids* and *prisms* to the *two-dimensional* shapes (nets) from which they were created.

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

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

a. Describe the relationship among *metric* units of length (i.e., millimeter, centimeter, meter, kilometer).

b. Describe the relationship among *customary* units of weight (i.e., ounce, pound).

c. Identify the correct units of measurement for *volume*, *area*, and *perimeter* in both metric and customary systems.

d. Estimate length, volume, weight, and area using metric and customary units.

e. Convert units of measurement within the metric system and convert units of measurement within the customary system.

Objective 2: Determine measurements using appropriate tools and formulas.

a. Measure length to the nearest 1/8 of an inch and to the nearest centimeter.

b. Measure *volume* and weight using *metric* and *customary* units.

c. Measure angles using a protractor.

d. Calculate *elapsed time* within a.m. or p.m. time periods.

e. Read and record the temperature to the nearest degree (above and below zero) when using a thermometer with a Celsius or Fahrenheit scale.

f. Calculate the *perimeter* of rectangles and triangles.

g. Calculate the *area* of squares and rectangles using a formula.

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

Standard V:
Students will collect, analyze, and draw conclusions from data and apply basic concepts of probability.

Standard V: Students will collect, analyze, and draw conclusions from data and apply basic concepts of probability.

Objective 1: Formulate and answer questions using statistical methods to compare data.

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

b. Collect, compare, and display data using an appropriate format (i.e., line plots, bar graphs, pictographs, circle graphs, line graphs).

c. Identify minimum and maximum values for a set of data.

d. Identify or calculate the mean, mode, and range.

e. Propose and justify inferences based on data.

Objective 2: Apply basic concepts of probability.

a. Describe the results of investigations involving random outcomes using a variety of notations (e.g., 4 out of 9, 4/9, 4:9).

b. Recognize that outcomes of experiments and samples are fractions between 0 and 1.

c. Predict the probability of an outcome in a simple experiment.

K-6 Elementary Mathematics Core Curriculum in Table Format

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Standard I: **Students will understand simple number concepts and relationships.**	**Standard I:** **Students will acquire number sense and perform simple operations with whole numbers.**	**Standard I:** **Students will acquire number sense and perform operations with whole numbers.**	**Standard I:** **Students will acquire number sense and perform operations with whole numbers and simple fractions.**	**Standard I:** **Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.**	**Standard I:** **Students will acquire number sense and perform operations with whole numbers, simple fractions, and decimals.**	**Standard I:** **Students will acquire number sense and perform operations with rational numbers.**
Objective 1: **Identify and use whole numbers.** a. Relate a *numeral* to the number of objects in a set (e.g., ☐ ☐ ☐ = 3). b. Construct models of numbers to 10 with physical objects or manipulatives. c. Make pictorial representations of numbers to 10 (e.g., draw four circles, draw six squares). d. Recognize and write numerals from 0 to 10. e. Manipulate objects to demonstrate and describe multiple ways of representing a number (e.g., 5 can be 3 and 2 more, 5 can also be 2 and 2 and 1).	**Objective 1:** **Represent whole numbers in a variety of ways.** a. Relate number words to the *numerals* that represent the quantities 0 to 10. b. Sort objects into groups of tens and ones and write the numeral representing the set. c. Represent *whole numbers* up to 100 in groups of tens and ones using objects. d. Write a numeral when given the number of tens and ones. e. Write a numeral to 99 in *expanded form* (e.g., 39 is 3 tens and 9 ones or 30+9). f. Use zero to represent the number of elements in the empty set or as a placeholder in a two-digit numeral.	**Objective 1:** **Represent whole numbers in a variety of ways.** a. Relate number words to the *numerals* that represent the quantities 0-100. b. Represent *whole numbers* up to 1,000 in groups of hundreds, tens, and ones using base ten models, and write the numeral representing the set. c. Read and write a three-digit numeral, relating it to a set of objects and a pictorial representation. d. Write a numeral to 999 in *expanded form* (e.g., 539 is 5 hundreds, 3 tens, 9 ones or 500+30+9). e. Identify the place and the value of a given digit in a three-digit numeral (e.g., the two in 281 means 2 hundreds or 200). f. Demonstrate multiple ways to represent numbers using symbolic representations (e.g., thirty is the same as two groups of 15, the number of pennies in three dimes, or 58-28).	**Objective 1:** **Represent whole numbers in a variety of ways.** a. Model, read, and write *whole numbers* up to 10,000 using base ten models, pictures, and symbols. b. Write a *numeral* when given the number of thousands, hundreds, tens, and ones. c. Write a number up to 9,999 in expanded form (e.g., 6,539 is 6 thousands, 5 hundreds, 3 tens, 9 ones or 6000+500+30+9). d. Identify the place and the value of a given digit in a four-digit numeral. e. 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).	**Objective 1:** **Represent whole numbers and decimals in a variety of ways.** a. Model, read, and write numerals from tenths to 100,000. b. Write a *whole number* up to 99,999 in *expanded form* (e.g., 76,539 is 7 ten-thousands, 6 one-thousands, 5 hundreds, 3 tens, 9 ones or 70,000+6,000+500+30+9). c. Identify the place and the value of a given digit in a five-digit numeral, including decimals to tenths. d. Demonstrate multiple ways to represent numbers by using models and symbolic representations (e.g., 36 is the same as the square of six, three dozen, or 9x4). e. Identify *square numbers* using models.	**Objective 1:** **Represent whole numbers and decimals in a variety of ways.** a. Model, read, and write numerals from hundredths to one millions. b. Write a *whole number* up to 999,999 in *expanded form* (e.g., 876,539 = 8 hundred-thousands, 7 ten-thousands, 6 thousands, 5 hundreds, 3 tens, 9 ones or 8x100,000 + 7x10,000 + 6x1,000 + 5x100 + 3x10 + 9). c. Demonstrate multiple ways to represent whole numbers by using models and symbolic representations (e.g., 108=2x50+8; 108=10^2 + 8). d. Classify whole numbers from 2 to 20 as *prime* or *composite* and 0 and 1 as neither prime nor composite, using models. e. Represent repeated factors using *exponents* up to three (e.g., 8=2x2x2=2^3).	**Objective 1:** **Represent whole numbers and decimals in a variety of ways.** a. Change *whole numbers* with *exponents* to *standard form* (e.g., 2^4 = 2^4=16) and recognize that $10^0 = 1$. b. Read and write *numerals* from thousandths to one billion. c. Write a whole number to 999,999 in *expanded form* using *exponents* (e.g., 876,539 = 8 x 10^5 + 7 x 10^4 + 6 x 10^3 + 5 x 10^2 + 3 x 10^1 + 9 x 10^0). d. Express numbers in *scientific notation* using positive powers of ten. e. Classify whole numbers to 100 as *prime*, *composite*, or neither. f. Determine the *prime factorization* for a whole number up to 50.

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

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Objective 3: **Model and illustrate meanings of the operations of addition and subtraction and describe how they relate.** a. Demonstrate the joining and separating of sets of objects to solve problems. b. Describe the joining or separating of sets with informal language when using models. c. Record pictorially the results from the joining or separating of sets.	**Objective 3:** **Model and illustrate meanings of the operations of addition and subtraction and describe how they relate.** a. Demonstrate the joining and separating of sets with twelve or fewer objects and record the results with pictures or symbols. b. Model two meanings of subtraction: separating of sets ("take away") and comparison of sets ("how many more/fewer") using objects, pictorial representations, and symbols. c. Use correct vocabulary and symbols to describe addition (i.e., add, "and," plus, +, sum), subtraction (i.e., subtract, minus, -, take away, how many more/fewer), and equals (i.e., =, same as). d. Use zero in addition and subtraction sentences.	**Objective 3:** **Model and illustrate meanings of the operations of addition and subtraction and describe how they relate.** a. Demonstrate the joining and separating of sets with eighteen or fewer objects and record the results with pictures or symbols. b. Model three meanings of subtraction: separating of sets ("take away"), comparison of sets ("how many more/fewer"), and missing addends using objects, pictorial representations, and symbols. c. Separate a given set of objects into two, three, five, or ten groups of equal size. d. Model addition and subtraction of two-digit whole numbers in a variety of ways. e. Select an addition or subtraction sentence to solve a problem involving joining or separating of sets with eighteen or fewer objects. f. Recognize that addition number sentences have related subtraction sentences (e.g., 8-5=3, 3+5=8).	**Objective 3:** **Model and illustrate meanings of the operations of addition, subtraction, multiplication, and division and describe how they relate.** a. Model addition and subtraction of two- and three-digit *whole numbers* in a variety of ways. b. Model multiplication of a one-digit *factor* by a one-digit factor using various methods (e.g., repeated addition, rectangular *arrays*, manipulatives, pictures) and connect the representation to an *algorithm*. c. Model division as sharing equally and as repeated subtraction using various methods (e.g., rectangular arrays, manipulatives, number lines, pictorial representations). d. Demonstrate, using objects, that multiplication and division are inverse operations (e.g., 3x4=12; thus, 12÷4=3 and 12÷3=4). e. Select and write an addition, subtraction, or multiplication sentence to solve a problem related to the students' environment, and write a story problem that relates to a given equation. f. Demonstrate the effects of place value when multiplying whole numbers by 10.	**Objective 3:** **Model and illustrate meanings of the four operations and describe how they relate.** a. Use models to represent multiplication of a one- or two-digit *factor* by a two-digit factor (up to 30) using a variety of methods (e.g., rectangular *arrays*, manipulatives, pictures) and connect the representation to an *algorithm*. b. Recognize that division by zero is not possible (e.g., 6÷0 is undefined). c. Select and write a multiplication or division sentence to solve a problem related to the students' environment and write a story problem that relates to a given equation. d. Represent division of a two-digit *dividend* by a one-digit *divisor*, including whole number remainders, using various methods (e.g., rectangular arrays, manipulatives, pictures) and connect the representation to an algorithm. e. Demonstrate that multiplication and division are inverse operations (e.g., 3x4=12; thus, 12÷4=3 and 12÷3=4). f. Describe the effect of place value when multiplying whole numbers by 10 and 100.	**Objective 3:** **Model and illustrate meanings of operations and describe how they relate.** a. Identify the *dividend*, *divisor*, and *quotient* regardless of the division symbol used. b. Determine whether a whole number is divisible by 2, 3, 5, 9, and/or 10, using the *rules of divisibility*. c. Represent remainders as *whole numbers*, decimals, or fractions and describe the meaning of remainders as they apply to problems from the students' environment (e.g., If there are 53 people, how many vans are needed if each van holds 8 people?). d. Model addition, subtraction, and multiplication of fractions and decimals in a variety of ways (e.g., using objects and a number line). e Select or write the number sentences that can be used to solve a two-step problem. f. Model different strategies for whole number multiplication (e.g., partial product, lattice) and division (e.g., partial quotient). g. Describe the effect on place value when multiplying and dividing whole numbers and decimals by 10, 100, and 1,000.	**Objective 3:** **Model and illustrate meanings of operations and describe how they relate.** a. Represent division of a multi-digit *dividend* by two-digit *divisors*, including decimals, using models, pictures, and symbols. b. Model addition, subtraction, multiplication, and division of fractions and decimals in a variety of ways (e.g., objects, a number line). c. Apply *rules of divisibility*. d. Select or write a number sentence that can be used to solve a multi-step problem and write a word problem when given a two-step expression or equation.

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

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	Objective 5: **Solve whole number problems using addition and subtraction in horizontal and vertical notation.** a. Compute addition and subtraction facts to twelve. b. Add three whole numbers with sums to twelve.	**Objective 5:** **Solve whole number problems using addition and subtraction in vertical and horizontal notation.** a. Use a variety of methods and tools to facilitate computation (e.g., estimation, mental math strategies, paper and pencil, calculator). b. Compute accurately with basic number combinations for addition and subtraction facts to eighteen. c. Add three *whole numbers* with *sums* to eighteen. d. Find the sum of two-digit whole numbers and describe the process used.	**Objective 5:** **Solve whole number problems using addition, subtraction, multiplication, and division in vertical and horizontal notation.** a. Use a variety of methods and tools to facilitate computation (e.g., estimation, mental math strategies, paper and pencil, calculator). b. Find the sum of any two *addends* with three or fewer digits, including monetary amounts, and describe the process used. c. Find the *difference* of two-digit *whole numbers* and describe the process used. d. Find the *product* for multiplication facts through ten times ten and describe the process used.	**Objective 5:** **Solve whole number problems using addition, subtraction, multiplication, and division in vertical and horizontal notation.** a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator. b. Find the sum and difference of four-digit numbers, including monetary amounts, and describe the process used. c. Multiply two- and three-digit *factors* by a one-digit factor and describe the process used. d. Divide a two-digit *whole number dividend* by a one-digit *divisor*, with a *remainder* of zero and describe the process used.	**Objective 5:** **Solve problems using the four operations with whole numbers, decimals, and fractions.** a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator. b. Use estimation strategies to determine whether results obtained using a calculator are reasonable. c. Multiply up to a three-digit *whole number* by a one- or two-digit whole number. d. Divide up to a three-digit whole number *dividend* by a one-digit *divisor*. e. Add and subtract decimals with digits to the hundredths place (e.g., 35.42+7.2; 75.2–13.45). f. Add, subtract, and multiply fractions. g. Simplify *expressions*, without *exponents*, using the *order of operations*.	**Objective 5:** **Solve problems using the four operations with whole numbers, decimals, and fractions.** a. Determine when it is appropriate to use estimation, mental math strategies, paper and pencil, or a calculator. b. Use estimation strategies to determine whether results obtained using a calculator are reasonable. c. Multiply up to a three-digit *factor* by a one- or two-digit factor including decimals. d. Divide up to a three-digit *dividend* by a one- or two-digit *divisor* including decimals. e. Add and subtract decimals to the thousandths place (e.g., 34.567+3.45; 65.3-5.987). f. Add, subtract, multiply, and divide fractions and mixed numbers. g. Solve problems using ratios and proportions. h. Simplify *expressions*, with *exponents*, using the *order of operations*.

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					Objective 6: **Model and illustrate integers.** a. Identify, read, and locate *integers* on a number line. b. Describe situations where integers are used in the students' environment.	**Objective 6:** **Model, illustrate, and perform the operations of addition and subtraction of integers.** a. Recognize that the sum of an *integer* and its opposite is zero. b. Model addition and subtraction of integers using manipulatives and a number line. c. Add and subtract integers.
Standard II: **Students will identify and use patterns to represent mathematical situations.**	**Standard II:** **Students will identify and use patterns and relations to represent mathematical situations.**	**Standard II:** **Students will identify and use patterns and relations to represent mathematical situations.**	**Standard II:** **Students will use patterns and relations to represent mathematical situations.**	**Standard II:** **Students will use patterns and relations to represent mathematical situations.**	**Standard II:** **Students will use patterns and relations to represent and analyze mathematical situations using algebraic symbols.**	**Standard II:** **Students will use patterns, relations, and functions to represent and analyze mathematical situations using algebraic symbols.**
Objective 1: **Identify and sort objects according to common attributes.** a. Sort objects into groups by color, shape, size, number, or other *attributes*. b. Identify which attribute was used to sort objects into a group. c. Find multiple ways to sort and classify a group of objects.	**Objective 1:** **Recognize and represent patterns with one or two attributes.** a. Sort and classify objects by one or two *attributes*. b. Identify, create, and label simple patterns using manipulatives, pictures, and symbolic notation (e.g., ABAB. . ., □ ○ △ □ ○ △ . . .). c. Identify patterns in the environment. d. Identify horizontal and vertical patterns on hundreds charts. e. Use patterns to establish skip counting by twos to 20 and by fives and tens to 100. f. Count backward from 10 to 0 and identify the pattern.	**Objective 1:** **Recognize and represent patterns having multiple attributes.** a. Sort, classify, and label objects by three or more *attributes*. b. Identify and label repeating and *growing patterns* using objects, pictures, and symbolic notation (e.g., ABAABBAAABBB...). c. Identify repeating and growing patterns in the environment. d. Construct models and skip count by twos, threes, fives, and tens and relate to repeated addition.	**Objective 1:** **Recognize and create patterns with given attributes.** a. Create and extend *repeating* and *growing* patterns using objects, numbers, and tables. b. Record results of patterns created using manipulatives, pictures, and numeric representations and describe how they are extended.	**Objective 1:** **Recognize, describe, and use patterns and identify the attributes.** a. Represent and analyze repeating and growing patterns using objects, pictures, numbers, and tables. b. Recognize and extend multiples and other number patterns using a variety of methods.	**Objective 1:** **Recognize, analyze, and use patterns and describe their attributes.** a. Analyze and make predictions about patterns involving *whole numbers*, decimals, and fractions using a variety of tools including organized lists, tables, objects, and variables. b. Extend patterns and describe a rule for predicting the next element.	**Objective 1:** **Recognize, analyze, and use multiple representations of patterns and functions and describe their attributes.** a. Analyze patterns on graphs and tables and write a generalization to predict how the patterns will continue. b. Create tables and graphs to represent given patterns and algebraic *expressions*. c. Draw a graph from a table of values or to represent an equation. d. Write an algebraic expression from a graph or a table of values.

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Objective 2: **Identify and use patterns to describe numbers or objects.** a. Use patterns to count orally from 1 to 20 and backward from 10 to 0. b. Identify simple patterns in the environment. c. Predict what comes next in an established pattern and justify thinking. d. Duplicate, extend, and create simple patterns using objects and pictorial representations.	**Objective 2:** **Recognize and represent relations using mathematical symbols.** a. Recognize that "=" indicates a relationship in which the quantities on each side of an equation are equal. b. Recognize that symbols such as □, △, or ◇ in an addition or subtraction equation represent a missing value that will make the statement true (e.g., □ + 3 = 6, 5 +7 = △, 4 = 5 – ◇). c. Demonstrate that changing the order of *addends* does not change the *sum* (e.g., 3+2=5 and 2+3=5).	**Objective 2:** **Recognize and represent relations using mathematical symbols.** a. Recognize that "≠" indicates a relationship in which the quantities on each side are not of equal value. b. Recognize that symbols such as □, △, or ◇ in an addition or subtraction equation represent a value that will make the statement true (e.g., □ +3=6, 5+7=△, 7=9-◇). c. Demonstrate that changing the order of *addends* does not change the *sum* (e.g., 3+2+7=12, 7+3+2=12) and that changing the grouping of three or more addends does not change the sum (e.g., (2+3)+7=12, 2+(3+7)=12).	**Objective 2:** **Recognize and represent mathematical situations using patterns and symbols.** a. Recognize that symbols such as □, △, or ◇ in an addition, subtraction, or multiplication equation, represent a value that will make the statement true (e.g., 5+7=△, □-3=6, ◇=2x4). b. Solve equations involving equivalent expressions (e.g., 6+4 = □+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. Demonstrate that grouping three or more *addends* does not change the *sum* (e.g., 3+(2+7)=12, (7+3)+2=12) and changing the order of *factors* does not change the *product* (e.g., 3x7=21, 7x3=21). e. Use a variety of manipulatives to model the *identity property of addition* (e.g., 3+0=3), the *identity property of multiplication* (e.g., 7x1=7), and the *zero property of multiplication* (e.g., 6x0=0).	**Objective 2:** **Recognize, represent, and solve mathematical situations using patterns and symbols.** a. Solve equations involving equivalent expressions (e.g., 6x2= □x3 or 6x□=9+9). b. Use the <, >, = symbols to compare two expressions involving addition, subtraction, multiplication, and division (e.g., 5x4◇9÷3). c. Recognize that a given variable maintains the same value throughout an equation or expression (e.g., □+□=8; □=4). d. Demonstrate that changing the order of *factors* does not change the *product* (e.g., 2x3=6, 3x2=6) and that the grouping of three or more factors does not change the product (e.g., (2x3)x1=6; 2x(3x1)=6). e. Demonstrate the distribution of multiplication over addition using a rectangular *array* (e.g., 8x14=8 rows of 10 plus 8 rows of 4).	**Objective 2:** **Represent, solve, and analyze mathematical situations using algebraic symbols.** a. Recognize a variety of symbols for multiplication and division including x, •, and * as symbols for multiplication and ÷, ⌐, and a fraction bar (/ or -) as division symbols. b. Recognize that a variable (◇, n, x) represents an unknown quantity. c. Solve one-step equations involving *whole numbers* and a single variable (e.g., n÷7=3). d. Recognize that the answer to a multiplication problem involving a factor of zero is equal to zero (e.g., 0x45=0). e. Use expressions or one-step equations to represent real-world situations. f. Use the *associative*, *commutative*, and *distributive properties* to compute with whole numbers.	**Objective 2:** **Represent, solve, and analyze mathematical situations using algebraic symbols.** a. Recognize that a number in front of a variable indicates multiplication (e.g., 3y means 3 times the quantity y). b. Solve two-step equations involving *whole numbers* and a single variable (e.g., 3x+4=19). c. Recognize that "≈" indicates a relationship in which the quantities on each side are approximately of equal value (e.g., π ≈3.14). d. Recognize that an *exponent* can be represented in the following ways: 4^3 or 4^3. e. Evaluate *expressions* and formulas, substituting given values for the variables (e.g., 2x+4; x=2; therefore, 2(2)+4=8). f. Recognize that if the *product* is zero, then one or more *factors* equal zero (i.e., if ab=0 then either a=0 or b=0 or a and b=0).

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Standard III: **Students will identify and create simple geometric shapes and describe spatial relationships.**	**Standard III:** **Students will describe, identify, and create and simple geometric shapes and describe spatial relationships.**	**Standard III:** **Students will describe, identify, and create geometric shapes and describe spatial relationships.**	**Standard III:** **Students will use spatial reasoning to describe, identify, and create geometric shapes.**	**Standard III:** **Students will use spatial reasoning to recognize, describe, and identify geometric shapes.**	**Standard III:** **Students will use spatial reasoning to recognize, describe, and identify geometric shapes and principles.**	**Standard III:** **Students will use spatial and logical reasoning to recognize, describe, and identify geometric shapes and principles.**
Objective 1: **Identify and create simple geometric shapes.** a. Identify circles, triangles, rectangles, and squares. b. Combine shapes to create *two-dimensional* objects. c. Draw circles, triangles, rectangles, and squares. d. Recognize circles, triangles, rectangles, and squares in the students' environment.	**Objective 1:** **Describe, identify, and create simple geometric shapes.** a. Identify, name, draw, create, and sort circles, triangles, rectangles, and squares. b. Identify circles, triangles, rectangles, and squares in the students' environment. c. Recognize that combining simple geometric shapes can create more complex geometric shapes.	**Objective 1:** **Describe, identify, and create geometric shapes.** a. Identify, name, draw, sort, and compare circles, triangles, and *parallelograms*. b. Identify and name spheres, cones, and cylinders. c. Find and identify familiar geometric shapes in the students' environment. d. Determine whether a circle, triangle, square, or rectangle has a *line of symmetry*.	**Objective 1:** **Describe, identify, and create geometric shapes.** a. Identify and draw *points*, *lines*, *line segments*, and *endpoints*. b. Identify and draw *lines of symmetry* on triangles, squares, circles, and rectangles. c. Determine whether an angle is *right*, *obtuse*, or *acute* by comparing the angle to the corner of a rectangle. d. Classify polygons (e.g., *quadrilaterals*, pentagons, hexagons, octagons) by the number of sides and corners. e. Identify, make, and describe cubes (e.g., a cube has 6 square *faces*, 8 *vertices*, and 12 *edges*).	**Objective 1:** **Describe, identify, and analyze characteristics and properties of geometric shapes.** a. Identify and draw *parallel lines* and *intersecting lines*. b. Identify and draw lines of symmetry on a variety of *polygons*. c. Identify and describe *quadrilaterals* (i.e., rectangles, squares, *rhombuses*, *trapezoids*, kites). d. Identify *right*, *obtuse*, and *acute* angles. e. Compare two polygons to determine whether they are *congruent* or *similar*. f. Identify and describe *cylinders* and *rectangular prisms*.	**Objective 1:** **Describe, identify, and analyze characteristics and properties of geometric shapes.** a. Identify and draw *perpendicular* lines. b. Draw, label, and describe rays and describe an angle as two rays sharing a common endpoint. c. Label an angle as acute, *obtuse*, *right*, or *straight*. d. Identify and describe *equilateral*, *isosceles*, *scalene*, *right*, *acute*, and *obtuse* triangles. e. Identify the *vertex* of an angle or the *vertices* of a polygon. f. Compare *corresponding angles* of two triangles and determine whether the triangles are *similar*. g. Identify and describe *pyramids* and *prisms*.	**Objective 1:** **Identify and analyze characteristics and properties of geometric shapes.** a. Identify the *midpoint* of a *line segment*. b. Identify concave and *convex polygons*. c. Identify the center, *radius*, *diameter*, and *circumference* of a circle. d. Identify the number of *faces*, *edges*, and *vertices* of *pyramids* and *prisms*.

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

Kindergarten	1st Grade	2nd Grade	3rd Grade	4th Grade	5th Grade	6th Grade
Standard IV: **Students will understand and use simple measurement tools and techniques.**	**Standard IV:** **Students will understand and use simple measurement tools and techniques.**	**Standard IV:** **Students will understand and use measurement tools and techniques.**	**Standard IV:** **Students will understand and use measurement tools and techniques.**	**Standard IV:** **Students will understand and use measurement tools and techniques.**	**Standard IV:** **Students will understand and apply measurement tools and techniques.**	**Standard IV:** **Students will understand and apply measurement tools and techniques.**
Objective 1: **Identify measurable attributes of objects and units of measurement.** a. Identify clocks and calendars as tools that measure time. b. Identify a day, week, and month on a calendar. c. Identify pennies, nickels, dimes, and quarters as units of money.	**Objective 1:** **Identify measurable attributes of objects and units of measurement.** a. Identify the appropriate tools for measuring length, weight, capacity, temperature, and time. b. Identify the values of a penny, nickel, dime, and quarter. c. Estimate the length of an object by comparing to a nonstandard unit (e.g., How many new pencils wide is your desk?).	**Objective 1:** **Identify measurable attributes of objects and units of measurement.** a. Sequence a series of events of a day in order by time (e.g., breakfast at 7:00, school begins at 9:00). b. Identify the name and value of a penny, nickel, dime, quarter, and dollar. c. Estimate length, *capacity*, and weight using customary units.	**Objective 1:** **Identify and describe measurable attributes of objects and units of measurement.** a. Recognize the two systems of measurement: *metric* and *customary*. b. Describe the relationship between metric units of length (i.e., centimeter, meter). c. Describe the relationship among customary units of length (i.e., inch, foot, yard) and the relationship between customary units of *capacity* (i.e., cup, quart). d. Estimate length, capacity, and weight using metric and customary units.	**Objective 1:** **Identify and describe measurable attributes of objects and units of measurement.** a. Describe the relationship among *metric* units of length (i.e., millimeter, centimeter, meter), between metric units of capacity (i.e., milliliter, liter), and between metric units of weight (i.e., gram, kilogram). b. Identify a mile as a measure of distance and its relationship to other *customary* units of length. c. Describe the relationship among customary units of *capacity* (i.e., cup, pint, quart, gallon). d. Estimate length, capacity, and weight using metric and customary units.	**Objective 1:** **Identify and describe measurable attributes of objects and units of measurement.** a. Describe the relationship among *metric* units of length (i.e., millimeter, centimeter, meter, kilometer). b. Describe the relationship among *customary* units of weight (i.e., ounce, pound). c. Identify the correct units of measurement for *volume*, *area*, and *perimeter* in both metric and customary systems. d. Estimate length, volume, weight, and area using metric and customary units. e. Convert units of measurement within the metric system and convert units of measurement within the customary system.	**Objective 1:** **Identify and describe measurable attributes of objects and units of measurement.** a. Compare a meter to a yard, a liter to a quart, and a kilometer to a mile. b. Identify *pi* as the ratio of the *circumference* to *diameter* of a circle. c. Explain how the size of the unit used in measuring affects the precision. d. Estimate length, volume, weight, and area using *metric* and customary units.

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

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

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

Mathematics Glossary

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

coordinate grid	A *two-dimensional* system in which the *coordinates* of a point are its distances from two intersecting, usually *perpendicular*, straight lines called axes.
coordinates	An ordered pair of numbers that identify a point on a coordinate plane or grid.
corresponding angles	Angles in the same position from one line to another.
cube (solid figure)	A regular solid with six congruent square faces.
customary system	A system of measurement used in the U.S. The system includes units for measuring length, capacity, and weight.
cylinder	A three-dimensional figure with two circular bases that are *parallel* and *congruent*.
diameter	A *chord* that goes through the center of a circle.
difference	The amount that remains after one quantity is subtracted from another.
Distributive Property	When one of the *factors* of a *product* is a *sum*, multiplying each *addend* before adding does not change the *product*. For example: 6x(2+3)=(6x2)+(6x3)
dividend	A number that is divided by another number.
divisor	The number by which another number is divided.
e.g.	This abbreviation means "for example." When used in the Core, *e.g.* is not limited to the examples given.
edge	The *line segment* where two *faces* of a solid figure meet.
elapsed time	The amount of time that passes between two times.
endpoint	A point at either end of a *line segment*, arc, or a point at one end of a *ray*.
equilateral triangle	A triangle with all sides the same length.
expanded form	A way to write numbers that shows the place value of each digit. 263 = 200 + 60 + 3 or 263 is 2 hundreds, 60 tens, and 3 ones.
exponent	The number that tells how many equal *factors* there are.

expression	A variable or combination of variables, numbers, and operation symbols that represents a mathematical relationship. 6, 2 + 3, x, x + 4, and x + 2y are all *expressions*.
face	A plane figure that serves as one side of a solid figure. The *faces* of a *cube* are squares.
factors	The *whole numbers* that are multiplied to get a *product*. In 6x3=18, 6 and 3 are factors of 18.
flip	A transformation creating a mirror image of a figure on the opposite side of a line. A *flip* is also called a *reflection*.
greatest common factor	The greatest number that is a *factor* of every number in a set of numbers. 3 is the *greatest common factor* of 9 and 15.
growing pattern	A pattern that grows or increases.
horizontal line	A line that is *parallel* to the horizon. A *horizontal line* is straight across.
i.e.	This abbreviation means "that is to say." When used in the Core, *i.e.* is limited to the specific examples given.
Identity Property of Addition	If you add zero to a number, the *sum* is the same as that number. For example, 8+0=8.
Identity Property of Multiplication	If you multiply a number by one, the *product* is the same as that number. For example, 18x1=18.
integers	*Whole numbers* and their opposites.
intersect	To meet or cross.
isosceles triangle	A triangle that has exactly two *congruent* sides.
least common multiple	The least common multiple of a set of two or more numbers. For example, the *least common multiple* of 3 and 5 is 15.
line	A set of connected points continuing without end in both directions.
line of symmetry	A line that divides a figure into two *congruent* halves that are mirror images of each other.
line plot	A graph showing frequency of data on a number line.

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

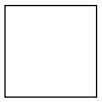
pi	The ratio of the *circumference* of any circle to its *diameter*, approximately equal to 3.14.
pictograph	A graph that uses pictures to show data.
plane	A flat surface that extends infinitely in all directions.
point	An exact location in space represented by a dot.
polygon	A closed plane figure made by *line segments*.
prime factorization	A way to show a number as the *product* of *prime factors*. The *prime factorization* of 12 is 2x2x3.
prime number	A *whole number* greater than 0 that has exactly two different *factors*, 1 and itself. 5 is a *prime number* because its only *factors* are 1 and 5.
prism	A three-dimensional figure that has two *congruent* and *parallel* faces that are *polygons*. The rest of the faces are *parallelograms*.
product	The answer to a multiplication problem. For example, 6x3=18, 18 is the *product* of 6x3.
pyramid	A polyhedron whose base is a *polygon* and whose other *faces* are triangles that share a common *vertex*.
quadrants	The four sections of a *coordinate grid* that are separated by the axes.
Quadrilateral	A four-sided *polygon*.
quotient	The answer to a division problem.
radius	The segment, or the length of the segment, from the center of a circle to any point on the circle.
Range	The difference between the greatest number and the least number in a set of numbers.
rational number	A number that can be expressed as a ratio of two non-zero *integers*.
ray	A part of a line that has one *endpoint* and goes on forever in one direction.
rectangular prism	A *prism* with six rectangular faces.
reflection	A transformation creating a mirror image of a figure on the opposite side of a line. A *reflection* is also called a *flip*.

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

trapezoid	A *quadrilateral* with one pair of *parallel* sides and one pair of sides that are not parallel.
turn	The transformation that occurs when a figure is turned a certain angle and direction around a point. A *turn* is also called a *rotation*.
two-dimensional	A figure that has length and width, but not height. Having *area*, but not *volume*. The image on a movie screen is two-dimensional.
vertex	The point at which two *line segments*, *lines*, or *rays* meet to form an angle.
vertical line	A line that has right angles to the horizon. A *vertical line* is straight up and down.
vertices	Plural of *vertex*.
volume	The number of cubic units it takes to fill a figure.
whole number	Any of the numbers 0, 1, 2, 3, 4, 5, and so on.
Zero Property of Multiplication	The *product* of any number and zero is zero. For example, 8x0=0.

Mathematics 5
Reference Sheet

Square



s

Area = s^2
Perimeter = 4s

Rectangle

w

l

Area = *lw*
Perimeter = 2*l* + 2*w*

Definitions

MEAN: In a collection of data, the sum of all the data divided by the number of data.

MODE: The number or numbers that occur most often in a collection of data.

RANGE: The difference between the greatest and the least numbers in a collection of data.

REFLECTION OR FLIP: A mirror image of a figure across its line of symmetry.

TRANSLATION OR SLIDE: A change in position of a figure.All points in the figure move in the same direction for the same distance.

ROTATION OR TURN: Turning a figure clockwise or counter-clockwise about a point.

Customary Conversions

8 ounces = 1 cup
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
3 teaspoons = 1 tablespoon
16 tablespoons = 1 cup
16 ounces = 1 pint
8 pints = 1 gallon
16 ounces = 1 pound
5280 feet = 1 mile

Metric Conversions

kilo	hecto	deka	meter liter gram	deci	centi	milli
1000	100	10	1.0	0.1	0.01	0.001
K	H	D	M	D	C	M

Facilitated Activities

Writing in Mathematics– Three Strategies

Background Information

Writing can be used in mathematics as a reflection, as a way to explain the thought process in problem solving, and as a way to communicate understanding about mathematical concepts. When students write about the their mathematical understanding, they have to think deeply and sort out what they know and understand. Writing is a way to organize and cement what has been learned.

"Opportunities to explain, conjecture, and defend one's ideas orally and in writing can stimulate deeper understandings of concepts and principles…" NCTM standards

Research Basis

Burns, Marilyn. (1995). *Writing in Math Class*. Math Solutions Publications. ISBN 0-941355-13-6

"Writing encourages students to examine their ideas and reflect on what they have learned. It helps them deepen and extend their understanding. When students write about mathematics, they are actively involved in thinking and learning about mathematics" (p.13).

Countryman, Joan. (1992). *Writing to Learn Mathematics*. Portsmouth, NH: Heinemann.

"Knowing mathematics is doing mathematics. We need to create situations where students can be active, creative, and responsive to the physical world. I believe that to learn mathematics, students must construct it for themselves. They can only do that by exploring, justifying, representing, discussing, using, describing, investigating, predicting, in short by being active in the world. Writing is an ideal activity for such processes" (p. 2).

Instructional Procedures

Mathematical Reflections

1. Mathematical reflections may be used at the beginning of the year, the beginning or end of a unit of instruction. Reflections can be helpful for assessing attitudes as well as understanding.

2. For a beginning of the year prompt use a general prompt such as the following:

   "My Mathematical Autobiography" which may include general topics such as "How I learn math," What I know about math, what I like about math" "What is hard for me in math."

3. For a beginning of unit of end of unit prompt use specific prompts such as he following;

   "What I know about…" or What I learned about…"

Writing about Problem Solving

1. As students solve problems, have them write about how they thought about solving the problem.
2. May be used for assessing understanding.

Writing about Explaining Mathematical Concepts

1. Have students write about concepts such as fractions, equivalent fractions, and how fractions and decimals are related
2. May be used for assessing understanding.

Writing Formats

1. Use a variety of formats and situations for writing.
2. Journals may be used to keep an ongoing record of activities within mathematics class (see following page).

Resources

Books

Burns, Marilyn. *Writing in Math Class*. (1995). Math Solutions Publication. ISBN 0-941355-13-6.

Countryman, Joan. (1992). *Writing to Learn Mathematics*. Portsmouth, NH: Heinemann. ISBN 0-435-08329-5

Ways to Use Writing in Math

Mathematical Reflections

- Math autobiography
- Reflections
  - Beginning of a unit
  - End of a unit

Writing about Solving Math Problems

- Writing to present answers and explain their reasoning
  - Problems of the week
  - Explanations and solutions in students' own words

Writing to Explain Mathematical Ideas and Concepts

- Writing about specific math concepts
- Writing at the beginning and then again at the end of the unit

Letters to the Teacher

- Explanations and conjectures
- Defend ideas or convince

Other Uses for Writing

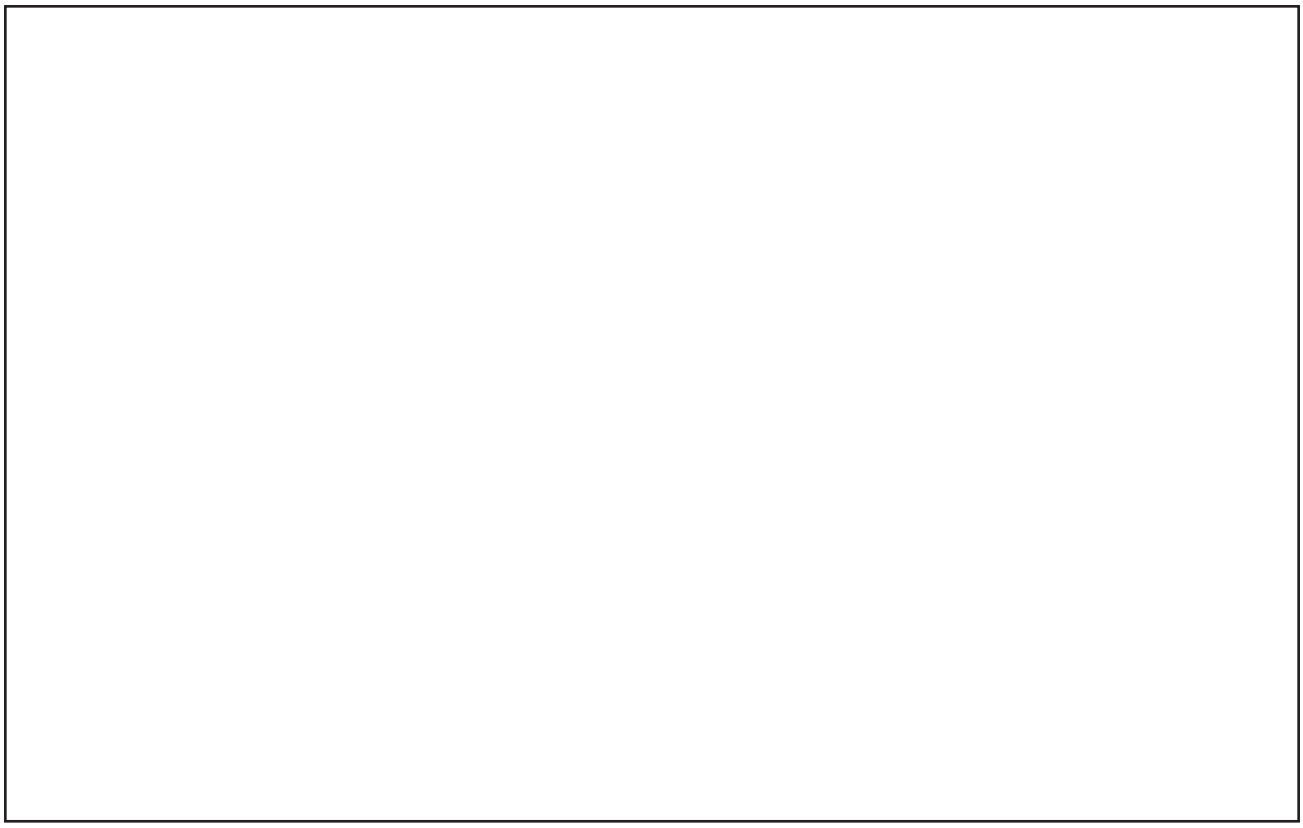
- Assess student understanding
- Communicate with parents

Math Journals

- Ideas for Prompts
  - Write about what you did
  - Write about what you learned
  - Write about what you're not sure about or wondering about
- Daily Journal Entry
  - Day of the year
  - Write as a fraction (out of 100), decimal, percent
  - Write in word form, expanded form with exponents
  - List factors, prime factors, first five multiples
  - List Lease Common Multiple (of day and 100)
  - Greatest Common Factor (of day and 100)

Name _____

Journal Page



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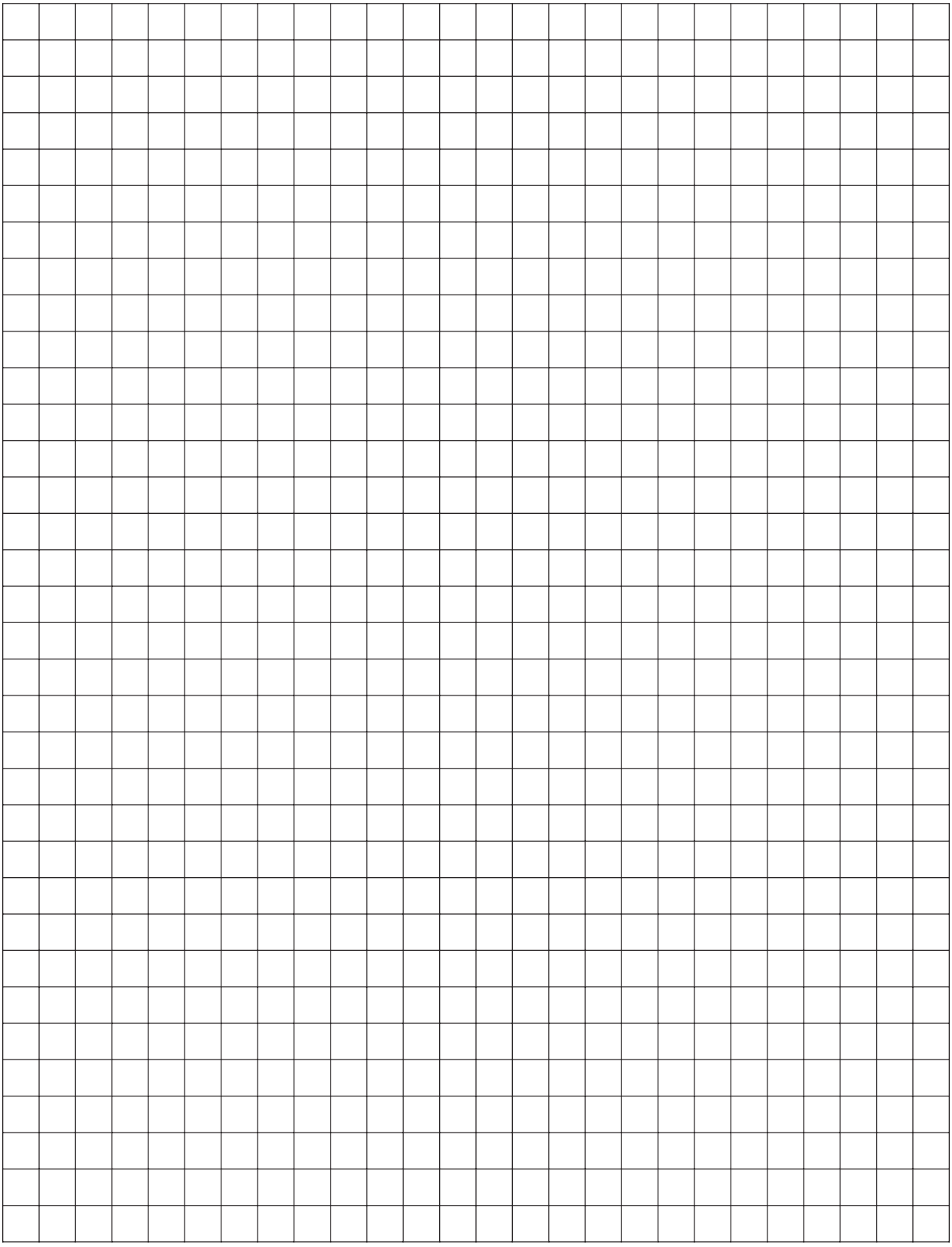
Grid



Problem Solving Strategies

Background Information

When faced with mathematical problems or situations, students should be able to find solutions using a variety of problem solving methods and procedures called strategies. Strategies are general in nature and can be used alone or with each other to solve all kinds of problems across the mathematics curriculum. In essence, strategies are tools that give students the freedom, creativity and confidence to make sense of mathematical problems.

Problem solving strategies are taught as part of the ongoing mathematics curriculum rather than in isolation.

Research Basis

Burns, Marilyn. *About Teaching Mathematics*. 2000. Math Solutions Publications.

"Students benefit from learning about problem-solving procedures that are useful for analyzing and solving problems."

Wilson, James W., Maria L Fernandez, and Nelda Hadaway. "Mathematical Problem Solving." Department of Mathematics Education. University of Georgia http://mathforum.org/library/ed_topics/methods_solving/

"Problem solving has a special importance in the study of mathematics. A primary goal of mathematics teaching and learning is to develop the ability to solve a wide variety of complex mathematics problems."

Instructional Procedures

1. Provide students with different types of problems that lend themselves to a variety of problems solving strategies.
2. As students work to solve problems either individually, with partners, or in small groups, ask them to explain how they thought about the problem and how they went about solving it.
3. Look for students who use a particular problem-solving strategy that you want to teach or reinforce. Have students share their thinking process and the problem solving strategy they used.
4. If there is a problem-solving strategy that you feel would be helpful to your students for solving a particular problem you will want to directly teach that strategy if students do not think of it on their own.

5. Make charts of different problem solving strategies to post in classroom
6. Encourage students to share problem-solving strategies throughout the year as you teach different math content areas.

Resources

Book

Burns. Marilyn. *About Teaching Mathematics: A K-8 Resource*. 2000. Math Solutions Publications. ISBN 0-941355-25-X

Types of Problem Solving Strategies

- From *About Teaching Mathematics,* by Marilyn Burns; ISBN 094135525X

- Look for a Pattern
- Construct a Table
- Make an Organized List
- Act It Out
- Draw a Picture
- Use Objects
- Guess and Check
- Work Backward
- Write an Equation
- Solve a Simpler Problem
- Make a Model

Learning Styles

Background Information

For every effective lesson presented, teachers must address all four learning styles—visual, auditory, tactile, and kinesthetic.

In our classrooms, the breakdown of our students are visual 32%, auditory 18%, tactile 25%, and kinesthetic 25%. The majority of teachers address auditory, then visual, then tactile, and lastly kinesthetic. Let me point out, the vast majority of dropouts, detention, and suspended students are tactile and kinesthetic learners. Teachers must address these modalities in every lesson plan.

Research Basis

Beninghof, A.M. (2005) Educational Consultant and Trainer, Highlands Ranch, Colorado

"Teachers must address each of the four learning styles in order to present effective lessons."

Andrini, B. (1998). Cooperative Learning and Mathematics. San Clemente, CA: Kagan Cooperative Learning

Teachers versed in a variety of structures use them as building blocks to create powerful lessons in which each structure provides a powerful learning experience.

Instructional Procedures

1. Introduce the four modalities—visual, auditory, tactile, and kinesthetic.
2. Discuss why all modalities must be addressed in every lesson.
3. Have teachers turn to the *Student Learning Styles* worksheet. Have teachers quickly check which behaviors they have.
4. Chart the results on the board. (Most teachers are visual.)
5. Have all teachers turn to the *Learning Style Lesson Plan*. Since teachers are in groups of four, use the Number Head procedure. Have participants refer to the lesson on measurement and fill in: 1's visual, 2's auditory, 3's tactile, and 4's kinesthetic. (Allow one or two minutes only!)
6. Have the group share their ideas. Even numbers go first, then odd numbers. Allow approximately 30 seconds per team member.

Materials

- ❏ *Student Learning Styles* worksheet
- ❏ *Learning Style Lesson Plan*

7. Roll a dice or spin a spinner and have that team report their lesson plan.
8. Conclude with a review of the lesson.

Resources

Book

SenseAble Strategies, by Anne M. Beninghof (available from www.ideasforeducators.com); ISBN 1-57035-160-0, Item W32328

Name _____

Student Learning Styles

Check behaviors frequently observed.

Visual

- ☐ Takes notes regularly.
- ☐ Draws or doodles.
- ☐ Wants to look at the pictures.
- ☐ Needs eye contact to listen well.
- ☐ Chooses reading.
- ☐ Closely examines objects and pictures.
- ☐ Notices and comments on the visual aspects of things.

Auditory

- ☐ Chooses to listen to tapes.
- ☐ Follows verbal directions while appearing not to listen.
- ☐ Prefers music or singing.
- ☐ Likes and participates in oral discussions.
- ☐ Reads aloud to self.
- ☐ Sounds out words.
- ☐ Talks to self.

Tactile

- ☐ Touches object.
- ☐ Fiddles with objects in/on desk.
- ☐ Carries small objects around.
- ☐ Chooses to work with manipulatives.
- ☐ Grabs items.
- ☐ Plays with pencils, pens, eraser, etc.

Kinesthetic

- ☐ Walks around the room.
- ☐ Stands while working at desk.
- ☐ Jumps out of seat.
- ☐ Uses expressive body language.
- ☐ Enjoys physical activities.
- ☐ Volunteers to demonstrate or run errands.
- ☐ Volunteers to act and play roles.

Learning Styles Lesson Plan

Lesson Objective: _____

Visual	**Auditory**
Tactile	**Kinesthetic**

Estimation Centers

Background Information

Students are often asked to select the correct units for making a measurement or to convert from one unit of measurement to another before they have a sound understanding of what those units really look like and how they relate to each other. Because of this lack of real-world experience with the units of measurement, many students struggle or work only from rote memorization of steps and formulas.

One way to help students develop a workable understanding of measurement units is to have them make daily estimations using familiar objects and locations. Making estimations can also promote the use of problem solving skills as students look for methods that will help them become more accurate with their estimations. A daily estimation center requires little time, but can pay big dividends as students make connections between math lessons and the real world.

The procedures below have been successfully used in the classroom. You may need to adapt them to fit your classroom and teaching style. Be creative and have fun. Rewards offered for participation and accuracy help create excitement and keep students motivated. You can decide whether or not to make participation mandatory, however most students are motivated to participate by rewards and the competition. Even if a student doesn't participate by making an estimate, they will benefit as the class discusses what units were appropriate, what estimation strategies worked the best, and what the actual measurement was. After a few weeks, the estimation center will become a part of your daily routine and provide students with real life practice throughout the year.

Research Basis

Davis, R. B. (1984). Learning mathematics: The cognitive science approach to mathematics education. Norwood, NJ:Ablex

It is important that students adapt or "shape" new skills as they are learning them. During this "shaping phase," learners attend to their conceptual understanding. Without a conceptual understanding students are apt to use procedures in shallow and ineffective ways.

Healy, J.M. (1990). Endangered minds: Why our children don't think. New York: Simon & Schuster.

Teachers in the United States tend to prematurely engage students in heavy practice and rush them through multiple examples before they are ready. Japanese educators attend to the needs of the shaping process by slowly working through only a few examples at a time.

Instructional Procedures

Materials

- ❑ Various measurement tools (e.g., tape measures, meter sticks, scales and weights, measuring cups, etc.)
- ❑ Items to be measured (e.g., text books, bottles, the classroom, students, etc.)
- ❑ Place to write or post the daily estimation.
- ❑ *Daily Estimation Record Sheet*

1. Select the units you would like to begin with. You may want to start with the units your students are most familiar with, such as feet, inches, and yards. Prepare a sign for the first estimation, such as "Estimate the distance in feet from the door to the teacher's desk."
2. Explain to the class they will be practicing their measurement skills daily by making estimations.
3. Distribute the *Daily Estimation Record Sheet* and post the sign with the first estimation task.
4. Have a brief discussion of how long a foot is. Leave out a ruler, but tell students they cannot use the ruler to measure the distance; they can only use it as a benchmark to make their estimate.

   Note: Do not spend a lot of time modeling and discussing how they should make their estimations. The idea is to get students to come up with their own methods and test them out.
5. Discuss with the class when they will have time to make their estimations.

   Note: Good times to have students complete their estimations might be when they have finished work, before school, or after school. You could also provide a few minutes during a daily self-start period when students have a number of tasks that they work on.
6. Tell the students they may use any strategies they like (except actual measurement) to make their estimation. They should record their estimation on their *Daily Estimation Record Sheet*. Students should use the same record page all week and turn it in on Friday.
7. The following day, select a time when you will have a few minutes to discuss their estimations. Have students share their estimations with the class. This can be done in a number of ways, such as having everyone come to the board and write their estimations. Teams could be given a small whiteboard on which

each team member writes their estimation, or students could just share their estimation with their team members.

8. Measure the distance and determine who had the closest estimate. Ask students with the closest estimate to share what strategies they used. Call on other students to share their methods.

   Note: Allowing students to share their methods will encourage students to try out other methods to see if they work, or modify their own in an effort to improve their estimates.

9. Reward students for participation and accuracy. Display and explain the estimation task for the next day.

Notes

- When working with a new unit, students' estimations may be way off, but as they continue working with that unit they should show improvement. When students become proficient using a unit, you may want to introduce a new unit by having them make conversions, such as to estimate the distance of the length of the hall in feet, then convert your estimate to yards by dividing the number of feet by 3. Or students could be asked to convert their estimate to inches by multiplying by 12.
- Don't mix the metric system with standard measurement. Try doing a week of measuring distance in standard measurement and then do the same distances the next week using metric units.
- When doing weight, start with grams and estimate the weight of small items such as pencils, combs, etc., moving to larger items like text books, rocks, etc., then heavier things, like desks, the teacher, or a student. When estimating heavier items, have students record their estimates in grams and kilograms. When working with standard measurement, start with ounces and then pounds, and follow the same procedures that were used with metric units. Always besure to set out a benchmark weight for students to use when making weight estimations.
- To estimate volume, use product containers, such as pop bottles and milk jugs, blacking out the label part that shows the volume. Again, set out a benchmark for each unit you want students to use.

Name _____

Estimation Centers

1. Go to each of the estimation centers in the room and make an estimate.
2. Record your estimates on this record page.
3. You may use any method you would like, but may not make actual measurements.
4. If you don't have time to complete your estimations now, finish them during break or other free times during the day.
5. Take your *Daily Estimation Record Sheet* to today's afternoon session.

Weight Center

Item _____

Estimate _____ g

_____ kg

Distance/Length Center

Item _____

Estimate _____ cm

_____ m

Volume/Capacity Center

Item _____

Estimate _____ ml

_____ L

Name _____

Daily Estimation Record Sheet

Day	Item	Estimate	Actual Measurement
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			

Name _____

Daily Estimation Record Sheet

Day	Item	Estimate	Actual Measurement
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			

Algebra Tables

Background Information

We must give students opportunity to think and solve problems. Computations are extremely important, but we must help students use their math knowledge to solve real life problems with efficiently and accurately.

This activity gives the student practice on extending patterns and finding the rule. It gives them an opportunity to make a table and see its usefulness. This activity can be used to assess the algebra knowledge of students and see if they transfer their in and out tables to useful application.

Research Basis

Burns, M. (2000). *About Teaching Mathematics*. Sausalito, CA: Math Solution Publications.

Marilyn Burns states, "Research studies examined why children's ability to solve word problems falls far below their ability to compute, they found certain common myths to be untrue. Although children can perform the computations adequately, they do not understand the arithmetic process in way that enables them to make those connections to the word problems."

The National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA

Effective teaching involves observing students, listening carefully to their ideas and explanations, having mathematical goals, and using the information to make instructional decisions. Teachers who employ such practices motivate students to engage in mathematical thinking and reasoning, and provide learning opportunities that challenge students at all levels of understanding.

Instructional Procedures

Best Prices 1

1. Display on overhead and/or give students a copy of *Best Prices 1*.

   Questions to ask:

   - How many pencils can you buy at Pal-Mart for 50¢?
   - Can you tell which store has the best price by comparing prices? Explain.

Materials

- ❑ *Best Prices 1*
- ❑ *Best Prices 2*

- Can you tell which store has the best price by comparing the amount of pencils?
- Could you use an in and out table to help solve these questions?

2. Give the students time to problem solve, reason, share strategies, brainstorm, justify, and draw conclusions.
3. Move around the room, observing the strategies students use, asking questions, and watching their discoveries.
4. Ask what students are noticing. Have students come up to the board or overhead to explain their results.

Answers

1. Pal-Mart 5¢ per pencil Q-mart 6¢ per pencil
2. Pal-Mart $2.50 Q-Mart $3.00

Best Prices 2

1. Present *Best Prices 2*, not as much scaffolding will be required. Students should already have some strategies in mind.

Answers

1. Crazy Crayons for $7.20
2. Cool Crayons for $17.28

Resources

Book

Groundworks (Algebra Puzzles and Problems Grade 5), by Carole Greenes and Carol Findell; ISBN 0-7622-0556-3

Name _____

Best Prices 1

Pal-Mart	Q-Mart
Pencils 10 for 50¢	Pencils 5 for 30¢

1. Which store has the best price for pencils, Pal-Mart or Q-Mart?

   _____

   Explain why. _____

   _____

2. If you needed 50 pencils, which store has the best price? Show your work and explain your answer.

   _____

   _____

Name _____

Best Prices 2

Crazy Crayons	Cool Crayons
12 for $2.40	16 for $2.88

1. If Sally needs 36 crayons, which package(s) would give her the best price?

   _____

   Explain and show your work._____

   _____

2. If Sally needs 96 crayons, which package(s) would give her the best price?

   _____

   Explain and show your work._____

   _____

Homework Practices

Background Information

School only occupies about 13 percent of the waking hours in the first 18 years of a life! Therefore, homework needs to become a part of students' lives.

Research shows that homework has a relatively small effect on student achievement at grades 4-6. Harris Cooper (1989) reports "even though he found little effect for homework for students at the elementary level in his 1989 report, he still recommended homework for elementary students:

"First, I recommend that elementary students be given homework even though it should not be expected to improve test scores. Instead, homework for young children should help them develop good study habits, foster positive attitudes toward school, and communicate to students the idea that learning takes work at home as well as at school." (Cooper,1989. p.90).

Cooper went on to state that students from second grade on should be given some homework. The amount of time students in upper elementary grades should spend on homework varies from study to study. The average amount is approximately 40 minutes per day.

Parent involvement in homework should be kept to a minimum. Parents should be informed of the student's homework, but not help them. Studies show negative effects when parents are asked to help their child with homework. Parents need to take the role of facilitator, but they are not there to "do" the problems for their child.

Homework must be explained and understood. Teachers must be very specific with the homework assignment. Not all homework is for the same purpose. Homework can serve two purposes. First, it can be for practice of a specific skill. However, the skill to be practiced must be quite familiar to them. Students unfamiliar with a skill might practice it wrong, which is ineffective. The second purpose of homework is to prepare students for a new topic or to find more information on something they have just learned.

Assigned homework must be commented on. Research has shown the effect of homework depends on teacher feedback. Homework that has been graded increases tests scores, however, homework that is graded and commented on increases even more.

Instructional Procedures

1. Have participants brainstorm in their journals four good practices of homework (one minute). Ask the tables to share their best ideas, writing only one per table on a sentence strip. When finished, have them tape them to the board (3minutes).
2. Introduce the book in which this research has been found. *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement*, chapter five pages 60-64.
3. Pass out sections of the chapter to each table. Each table is to read and report on sentence strip(s). Assign 1's to read aloud to group; 2's to take notes as read; 3's to summerize on sentence strip; 4's to give oral report to class; and (optional) 5's to place sentence strip on board.
4. Review and synthesize what was read and discovered.

Resources

Book

Marzano, R., Pickering, D., & Pollock, J., (2001). *Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement*. ASCD, Alexandria, VA.

Article

Cooper, H., (1989). Synthesis of Research on Homework. *Educational Leadership*. *47*(3). 85-92.

Math Standard I-4 Activities

Flexible Fractions

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

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

Intended Learning Outcomes:
2. Become mathematical problem solvers.
3. Reason mathematically.
4. Communicate mathematically.

Content Connections:
Math V; Science V

Math Standard I

Objective 4

Connections

Background Information

Fractional numbers can be demonstrated with three types of models: the area model, length model, and set model. Creating physical models generates a concrete representation, and in turn, establishes a long-lasting nonlinguistic image of this knowledge in the student's mind. In this activity, students use a variety of different methods to record their fractional set. Students should learn to equate the numerator of a fraction with the "count"—number of items in the whole set—and the denominator with the "size"—as in how big is this portion. In other words, a fraction is the count/size. So a fraction such as four-fifths means we have four of something and each one of the pieces or sections is sized at one-fifth of the unit whole. Throughout this activity, student pairs record and summarize their information on a structured activity sheet. This graphic organizer allows students to manipulate new ideas and see how these ideas are related to concepts they already know. The brain has a natural capacity to organize, and the graphic organizer allows us to teach to that ability.

Research Basis

Barton, M., Heidema, C., (2002) *Teaching Reading in Mathematics*. Aurora, CO. McREL

This supplement to *Teaching Reading in the Content Areas* explains the terminology of "reading mathematics" and the skills needed to comprehend the words, symbols and text structures associated with mathematics. The manual also presents suggestions and strategies to help students become more proficient in mathematics literacy.

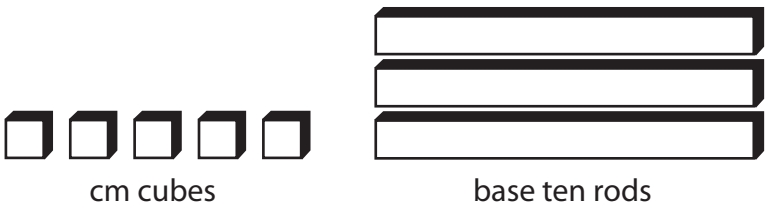
Marzano, R., Pickering, D., Pollock, J., (2001) *Classroom Instruction that Works*, Alexandria, VA. ASCD.

This K-12 guide provides extensive research evidence, statistical data, and case studies that support nine critical teaching strategies, one of which is nonlinguistic representations. The chapter on nonlinguistic representations stresses the use of a variety of activities and elaboration on acquired knowledge.

Assessment Suggestions

- Provide students with a collection of related items that includes at least one variable (color, length, etc.). Items could include cm cubes and base ten rods, tangram pieces, several different crayons in two or three colors, etc. Have students sort the items, write statements about the similarities and differences using fractions in their statements, and represent the group with fractions and a set illustration.

  Sample answer: There are 5 cm cubes and 3 base ten rods, so 3/8 of the set are base ten rods and 5/8 of the set are cm cubes



- Show students an area model that is divided into three sections. Two of the parts are colored, one is not. Have students write an explanation on how to find the fraction that describes the shaded part of the area model. Explain that you don't want to know the fraction, but *how they would decide* what the fraction is.

  Sample answer: First you count how many total parts there are. That is the denominator. Then count how many parts are different (shaded). That is the numerator. Write the fraction by putting the numerator on top and the denominator on the bottom.

- Using the school population, have the students write three to five questions that could be used to highlight certain portions of the population. They could survey and find which students fit their highlighted category, and represent that information in fractional form and illustrated form.

  Sample question: How many fifth graders are left handed?

Invitation to Learn

Provide a variety of materials for groups to sort into three groups—region, set, and line models (e.g., ruler, length of yarn, piece of material, sheet of paper, strip of paper, geoboard, base ten rods, golf tees, erasers, 2-colored chips, centimeter cubes, etc.).

Instructional Procedures

1. Demonstrate how each pair will draw the specified number of beans from the cup and record the selections on the *Activity Record Sheet* by coloring in their beans. Then color the graph to show the number and color of each bean in the group.
2. Distribute the cups, *Activity Record Sheets*, and colored pencils to each group.
3. Advise the students that in the last round, they will be using all 12 jelly beans (so don't eat any).
4. The students can either return the beans to the cup after each round, or simply draw the necessary number of new beans to complete the next round.

   Example: When moving on to round four, the students could draw just one bean and add it to the beans used in round three to equal 5 total beans, or they could return all the beans to the cup and draw out 5 new beans to record.
5. After the beans have been colored and the circle graph has been constructed, the students should summarize the data by writing the fractional portion each color represented of the entire group of beans (the unit whole).

   Example: If they drew 2 white and 1 yellow in round two, the group would write 2/3 to represent the white beans and 1/3 to represent the yellow bean, with 3 being the unit whole.
6. In round six, the students need to group their beans by color and then color them on the strip. The strip will work as a template to construct the circle graph. After they have completed the coloring, they can cut it out and curl one end around the circumference of the circle. Use this as a guide to mark the sectors on the circle graph.

Materials

- ❏ Region, set, and line model manipulatives
- ❏ Jelly beans (12 beans per pair; use no more than 3 or 4 colors of beans per cup)
- ❏ Small paper cup for each pair
- ❏ *Activity Record Sheet*
- ❏ Colored pencils
- ❏ Journals

Materials

- ❑ Art paper
- ❑ Jelly beans
- ❑ Cup

7. Students should compare and generalize the data in their math journals.
   a. Discuss why 1 red bean in round one equals 1/2, but after drawing 1 red bean in round three, its value drops down to equal only 1/4.
   b. What was the relationship between the colors most often drawn to the color mix in their cup?

Part 2

1. Partner A puts a selected number of beans in the cup, without letting partner B know how many beans are in the cup.
2. Partner A then draws a few of the beans out and gives them to partner B along with a clue and a challenge. Partner A gives the clue of telling partner B what fraction of the beans are now out on the desk.
3. Partner B is then challenged to calculate how many total beans are in the cup.
4. Partner B must prove their answer is correct by illustrating the whole set, showing the fractional part of the set which was drawn out of the cup.
5. Partners change roles and continue.

Curriculum Extensions/Adaptations/Integration

- Small groups draw quick stick figure drawings of their whole group, calling attention to specific attributes that some members share. Attributes should be observable, or verifiable by conversation, such as wearing watches or owning a dog.
- As a group, write four observational sentences about the group, using fractions to express the findings.

  Example: 3/4 of the students in our group are wearing shoes with shoelaces.
- Discuss how the complementary, or shadow, fraction (1/4 of the students are not wearing shoes with shoelaces) relates to the unit whole.
- Create equations by listing a portion of the students with an observable trait that is equal to 1/2 of the students with that trait. How many total students share that attribute?

  Example: These three students have braces, that is 1/2 of our group that has braces. How many total students have braces?

Continue by changing the fractional part (1/4 of our group, 1/6 of our group, etc.).

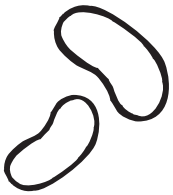
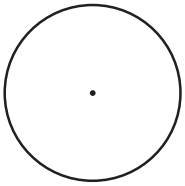
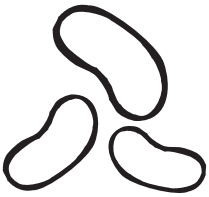
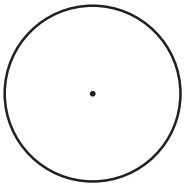
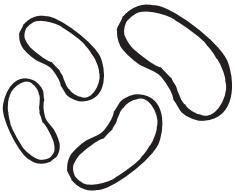
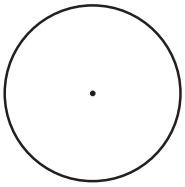
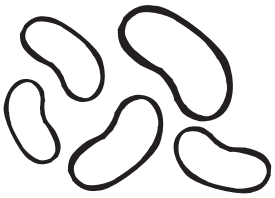
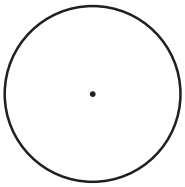
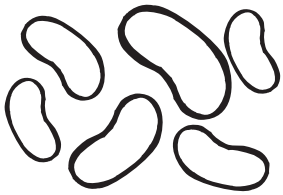
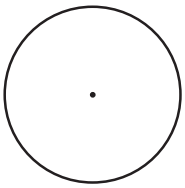
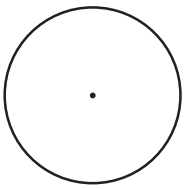
Family Connections

- Students can discuss inherited traits with family members and then recreate a group picture using exaggerated attributes as outlined in the extension. Be sensitive to students who may not be living with birth families and instead suggest that they find other common attributes (3/4 of our family members made their bed this morning).
- Using items found in the home, draw fractional parts of sets used to prepare the family meal and write a sentence describing the fractional part and a question/answer about the unit whole.

  Example: A student would draw three forks and a sentence such as "This is 1/3 of the forks used to set the table for dinner. How many forks did we use all together?" (9)

Name _____

Activity Record Sheet

	Draw It	Example	Summarize Using Fractions
Round 1		Show 	1/2 = one red 1/2 = one yellow
Round 2		Show 	
Round 3		Show 	
Round 4		Show 	
Round 5		Show 	
Round 6		Show 	Use fractions to describe the jelly beans by color. Compare the data and make generalizations.

Sort jelly beans by color and record on this paper strip. Cut and curl around the circle. Use as a guide to mark the circle and make a circle graph.

A Picture's Worth

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

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

Intended Learning Outcomes:
1. Demonstrate a positive learning attitude toward mathematics.
4. Communicate mathematically.
6. Represent mathematical situations.

Content Connections:
Math II, III; Music

Math Standard I

Objective 4

Connections

Background Information

One of the foundational steps in working with fractions is to understand the concept of the unit whole. If the unit whole is divided into four equal sized pieces, then each piece is 1/4 of the unit whole. A common misunderstanding that can occur is that the fractional piece always remains the same, when in fact, there is a direct relationship and if the unit whole changes, the fractional piece changes as well. In order for students to gain a working knowledge of this abstract concept, they must first begin with concrete lessons, and bridge to the abstract with pictorial representations. This is especially true for English Language Learners. For some students, it is helpful to think of fractions as equal portions, or fair share/fair trade. After students gain a mastery of the concept of the unit whole and its component parts, they will then be ready to tackle addition and subtraction operations with fractions.

Components of the unit whole objective include an understanding of equivalency as well as an understanding of key vocabulary terms, including mixed number, improper fraction, and proper fraction. Just like a foreign language, for students to master the language of mathematics, they must be given numerous opportunities to practice using it in context. Students need to develop an appreciation of the need for precise definitions and for the communicative power of conventional mathematical terms by first communicating in their own words. Allowing students to grapple with their ideas and develop their own informal means of expressing the information can be an effective way to foster engagement and ownership. In this light, all students are MLL (math language learners) and should be combined together in pairs or small groups to analyze, record, and demonstrate the concepts of fractions. As they work together, they will be forced to use the mathematical language.

Research Basis

National Council of Teachers of Mathematics. (2000) *Principles and standards for school mathematics*. Reston, VA.

A comprehensive volume that establishes the guiding standards and principles that should be included in all mathematics programs. It describes particular features of a high quality mathematics curriculum, as well as sets forth a forward thinking vision of what instruction could become.

Texas Education Agency. (2000) *The Texas Successful Schools Study: Quality Education for Limited English Proficient Students*. ERIC Document Reproduction Service No. ED479 179

A study by the Texas Education Agency examined the variables contributing to the academic success of economically disadvantaged and language minority students. Data was collected from seven high-achieving elementary schools with high poverty rates and high percentages of Limited English Proficient (LEP) students.

Assessment Suggestions

- With the students using the pattern blocks and teacher using the overhead pattern blocks, ask the students to respond by drawing the answer to questions similar to the following:
  - If 1 red trapezoid equals 1 unit, then the yellow hexagon equals _____
  - If the red trapezoid equals 1 unit, then the blue parallelogram equals _____
  - If the green triangle equals 1/2 of the unit whole, then draw the unit whole _____
  - If the green triangle is 1/2 of the unit whole, then draw 2 1/2 units _____
  - If the blue parallelogram equals 2, then draw 1 unit _____
  - If the yellow hexagon equals 3 units, then the blue parallelogram equals _____
  - If the red trapezoid equals 1/2, then draw 1 unit _____

- Students could also be assessed by responding in writing to:
  - Explain how you know that 1 unit whole = 6/6.
  - Write an equation showing a fraction that is equivalent to 1 1/2.
  - Draw three pictures showing an improper fraction.
  - Explain why pattern block pieces have different values in different equations.
- Create a design and ask the students to find the value of the total if the unit whole equals 1 red trapezoid. Or find the value if the unit whole equals 1 green triangle.

Invitation to Learn

Provide each small group a copy of the yin yang symbol. This example has 1/2 of the circle in black and 1/2 of the circle in white. Ask each student to take a 3" x 5" card and have them select a colored pencil. They are to color exactly 1/2 of their card, but the challenge is to do it in an interesting and creative way. At the conclusion of the activity, display all the cards and draw attention to the many different ways the objective was demonstrated.

Materials

For each group:

- ❑ Yin Yang symbol

For each student:

- ❑ 3" x 5" index card
- ❑ Colored pencils

Instructional Procedures

1. Have each pair of students select one larger pattern block piece (yellow or red) and several smaller pieces that are all the same color and that will cover the larger pattern block piece.
2. Continue selecting and covering pieces until a number of relationships between pieces is discovered.
3. Using the markers and large chart paper, have each pair record these relationships and write the fraction that corresponds with it. It is suggested that you demonstrate with the first relationship using the overhead pattern blocks and provide a model for the students to follow.

   Example: How many green equilateral triangles are in one yellow hexagon?

   The students can then go on and discover how many triangles are in the red trapezoid, how many blue parallelograms are in the yellow hexagon, etc. You may even have a student discover that

Materials

- ❑ Overhead pattern blocks

For each pair:

- ❑ Tub of several pattern blocks
- ❑ 5" x 8" index card

For each student:

- ❑ Colored pencils/markers
- ❑ Construction paper pattern block pieces or pattern block stickers
- ❑ Large chart paper/ student journals

they can put two green equilateral triangles in a blue. As new relationships are found, stress the equivalency by noting and writing comments such as "3 blue parallelograms are in 1 yellow hexagon, so 3 parallelograms equal 1 yellow hexagon. 3/3 =1."

4. Have students express the mathematical relationships in their journals using colored pencils.
5. Assign the yellow hexagon the value of 1. This makes it the "unit whole." Express the value of the other pieces in fractional form, in relation to the yellow hexagon (unit whole).

   Example: If the yellow hexagon is the unit whole, then 1 red trapezoid equals 1/2."

   Go over the pieces several times until the students are very familiar with the value of each piece when yellow is the unit whole. Make sure you include the phrase, "if 1 yellow hexagon equals the unit whole, then…" After the students have mastered the relationships, pick up one purple right triangle and ask them the value. They will probably say 1/12, but let them know that they must add the relationship to the unit whole. In other words, the correct answer is "if the unit whole equals 1 yellow hexagon, then the purple right triangle equals 1/12." Otherwise, they should have responded, "What is the unit whole?"
6. Once the students are comfortable with pieces and their relationship to the unit whole being the yellow hexagon, select a new piece as the unit whole and express the revised values of the remaining pieces.

   Example: If the red trapezoid equals the unit whole, what is the value of the green equilateral triangle? (1/3)

If the red trapezoid is the unit whole, what is the value of the yellow hexagon? (2)

7. Again using the yellow hexagon as the unit whole, select several pieces of the same color and determine the fractional value.

   Example: 5 red trapezoids = 5/2. But we can combine them together to equal 2 1/2. This shows that 5/2 = 2 1/2.

   Use explicit instruction to introduce the math vocabulary terms

   - Equivalent Fractions (5/2 = 2 1/2)
   - Improper Fraction (5/2)
   - Mixed number (2 1/2)

   Have students work with their tables to find other relationships between pattern block pieces that are greater than 1. Show both the improper and the mixed number. Once they have found their

own relationships, have them find pieces that match your specifics, such as "How can you demonstrate 2 and 1/3 using just one kind of fraction piece?" Or, "What piece would you need to use to equal 2 1/2 and uses 10 of the same color?"

8. Distribute a 5" x 8" index card to each pair. Have them create a design using the construction paper pattern blocks or pattern block stickers that equals a specific total, with the yellow hexagon representing the unit whole.

   Example: "If this yellow hexagon equals the unit whole, I would like you to select pieces that would total 3 1/2 and lay them on your paper. Write the value of each piece in relation to the unit whole, then write the corresponding mathematical equation, which should equal 3 1/2. Demonstrate that if you took 1 yellow hexagon, it would equal 1. If you took 3 red trapezoids, that would equal 1/2 + 1/2 + 1/2 or 1 1/2, and if you had 6 green equilateral triangles, it would equal 1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 = 6/6 or 1. So our equation would be 1 + 1/2 + 1/2 + 1/2 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 + 1/6 = 3 1/2."

Curriculum Extensions/Adaptations/Integration

- To add a challenge for accelerated learners, you might require that they use an odd number of pieces, or at least three different colors, or at least seven pieces. Have them write a math sentence on their card that proves their total.
- For students who struggle with this activity, you could adapt it by having them select all their pieces of the same color. For example the red trapezoid. They would then find out that the relationship to the hexagon equals 1/2. They could place three yellow hexagons on their desk, cover them with six red trapezoid pieces, and then add one more. They could then count the seven trapezoid pieces and express them as the improper fraction 7/2 = 3 1/2.
- Have early finishers use the pattern block pieces to solve algebraic equations such as, "If 1 yellow hexagon + 1 blue parallelogram equals the unit whole, then what is the value of a green equilateral triangle?" Or, "If 1 yellow hexagon + 1 green equilateral triangle equal 1, then what is the value of the red trapezoid?"

  For an even more challenging activity: "If 1 green equilateral triangle and 1 red trapezoid = 2/3, then what equals 1?" Or, "If

Materials

For each student:

- ❑ Construction paper pattern block pieces or pattern block stickers
- ❑ Black construction paper 3 1/2" x 5"
- ❑ Glue sticks

1 yellow hexagon – 1 blue parallelogram equals 1 1/3, then what equals 2/3?"

Art Integration

1. Distribute a 3" x 5" piece of black construction paper to each student.
2. Have four students work together on one card to create a design using the pattern block pieces.

   (For better coverage, use combinations of red, brown, purple, and yellow...or blue, green, purple, and yellow.)
3. Once the initial pattern piece has been designed, replicate it on each of the other three black papers and then join them together to form a large design, similar to a quilt block.
4. Calculate the total of the large quilt block if the yellow hexagon equals the unit whole.

Music Integration

Have a variety of different types of sheet music available. Look specifically for different time signatures.

1. Duplicate a piece of sheet music for each student. With a quarter note representing the unit whole, what is the value of each measure?
2. Compare your findings with a variety of different selections. What generalizations can be observed?
3. Discover a variety of different ways that whole, half, quarter and eighth notes can be rearranged to equal the four beats in a measure.

Resources

Web site

Many parts of this lesson could also be adapted for use with technology by assessing online pattern block math manipulatives such as those found at: http://matti.usu.edu (on the home page, access the pattern blocks by typing in "pattern blocks" in the search window and then clicking on any of the options listed).

Family Connections

- Find items at home that are equivalent.

  Example: 2 juice glasses equals 1 water glass; 2 sessions of piano practicing equals 1 T.V. news program.

Math Standard I-2 Activities

Coin Conversions

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

Objective 2:
Identify relationships among whole numbers, fractions, decimals, and percents.

Intended Learning Outcomes:
1. Demonstrate a positive learning attitude toward mathematics.
2. Become mathematical problem solvers.
3. Reason mathematically.
4. Communicate mathematically.
5. Make mathematical connections.

Content Connections

Math Standard I

Objective 2

Connections

Background Information

This activity uses money as a way to introduce the relationship between fractions, decimals, and percents. Most students have a good understanding of money by fifth grade, even if their reading, language, and/or math skills are not at grade level. This lesson works well with photocopies of coins, but if you have access to plastic coins the lesson would be even more lifelike. Students should already have an understanding of fractions as a way to represent parts of a whole, and of how to simplify fractions. They should also be familiar with the concept of decimals and how to read them.

This lesson uses math journals, assuming that each student has been using one throughout the year. A math journal is a great way for students to record their thoughts about math lessons, new discoveries, example problems, and math definitions. Any type of notebook works well. If you do not use math journals, students can write the results on a piece of paper.

Research Basis

Irwin, K.C. (2001). Using Everyday Knowledge of Decimals to Enhance Understanding. *Journal for Research in Mathematics Education, 32*(4), 399-420.

"Half the pairs worked on problems presented in familiar contexts and half worked on problems presented without context." This article presents results of an investigation that showed students who were presented decimal problems in a familiar context succeeded more often than students who were given no context.

Verschaffel, L. & De Corte, E. (1997). Teaching Realistic Mathematics Modeling in the Elementary School: A Teaching Experiment With Fifth Graders. *Journal for Research in Mathematics Education, 28*(5), 577–601.

"Recent research has convincingly documented elementary school childrens' tendency to neglect real-world knowledge and realistic considerations during mathematical modeling …" This article suggests that using real-world modeling can help students have a better disposition toward mathematical concepts.

Assessment Suggestions

- Keep mental notes during the initial lesson. Which students are not willingly participating in discussion? Which students seem reluctant to write in their journals? Which students were already familiar with the percent symbol? Record these notes immediately following the lesson.
- Journals can be collected and reviewed periodically. They should not be tied to a grade, as they are meant to be a means for students to practice and explore. However, a journal is a great assessment tool in which a teacher can observe a student's understanding of mathematical concepts.
- *Coin Conversions* is an assessment of a student's ability to independently convert common money-related decimals to fractions and percents.
- *Price Problem* is an assessment of a student's ability to apply what s/he learned about equivalent representations, along with problem-solving skills, to obtain a reasonable solution.

Invitation to Learn

Distribute a *Coin Combinations* worksheet and one set of coin manipulatives to each student. (Students may also work in small groups.) Ask students to find as many combinations of coins as they can to make 50¢ using pennies, nickels, dimes, and/or quarters. Students use the manipulatives and record each combination on the sheet.

Instructional Procedures

1. Say the following to students:
   - "Using your manipulatives, show me the way to make 50¢ using only two coins."
   - "What two coins did you use?"

- "Record in your journal the way this amount of money would look on a price tag in a store."
- "Good. Money is usually written using decimals. On which side of the decimal would you find the whole dollar amount? On which side of the decimal would you find the coin amount? Today we will be working with digits to the right of the decimal, or the money that is not enough to make a whole dollar."
- "I see everyone has two quarters out. How many quarters would it take to make a whole dollar? (4) And how many quarters are we using right now? (2) Can anyone tell me what fraction of a dollar we're using? Record that fraction right next to your previous answer in your journal. What is that fraction in simplest form?"
- Write the percent symbol (%) on the board and say, "Raise your hand if you've seen this symbol before. If you know the name of it, please write that name in your journal. (pause) If you wrote "percent," you are correct. If you didn't, please write this word now. Look at the word and underline a hidden four-letter word that starts with "c." What is that word? Wow, we've just been working with cents! How many cents does it take to make one whole dollar? One way to write the percent of a number is to write how many cents you have. Then we write this percent symbol (%) after the number. Please try to write as a percent the amount of money you have with your two quarters.
- "You've just written 50¢ as a decimal, fraction, and percent. Did the amount of money we used change? Can anyone make a mathematical statement about your decimal, fraction, and percent? (They are all equal.) Write that statement in your journals. We can represent parts of a whole as a decimal, fraction, percent, or all three!"

2. Repeat the steps above asking students to make certain amounts using a different coin each time (e.g., 25¢ cents using quarters = .25, 1/4, and 25%. 10¢ using dimes = .10, 1/10, and 10%, etc.).
3. Try having students make the same amount using different coins and discussing why the decimal and percent look the same, but the fraction looks different until you simplify (e.g., 80¢ using pennies = .80, 80/100, and 80%, while the same amount using dimes = .80, 8/10, and 80%).

Materials

For each student:

- ❏ *Coin Combinations* worksheet
- ❏ Two-sided copy of *Coin Conversions/Price Problem* worksheet
- ❏ One set of coin manipulatives (plastic coins or paper copies of 100 pennies, 20 nickels, 10 dimes, and 4 quarters).

4. When students are comfortable with this concept, allow them to try the *Coin Conversions* and *Price Problem* worksheets. Most students should be able to work independently, allowing you time to work with those who may still be struggling.

Curriculum Extensions/Adaptations/Integration

- For students who have difficulty with the *Price Problem* worksheet, you can have students act it out for the class. Students can make signs advertising each sale, and use their play money to actually make purchases. This may help all students understand that the same amount was spent at each store.
- Allow students who were able to solve the challenge question on *Coin Conversions* to present their reasoning to small groups of students who were unable to find the solution.
- This type of activity could be used with other money systems, connecting with the fifth grade social studies curriculum. Specifically, the money system used in colonial times, representing farthings, pounds, etc. as fractions, decimals, and percents.

Family Connections

- Gather spare change from around the house. Have family members sit around the coins. One person selects some coins. (It is easiest to select only one type of coins, but can be done using a variety.) Have a race to see which family member can write the selected amount as a decimal, fraction, and percent first.
- Go shopping with your family. Watch for signs that advertise sales. Does the sign show the discount in decimal, fraction, or percent form? What would the discount be in the other two forms?

Name _____

Coin Combinations

Use coin manipulatives to find as many ways as you can to make 50¢.

	# of Pennies Used	# of Nickles Used	# of Dimes Used	# of Quarters Used
Combination #1				
Combination #2				
Combination #3				
Combination #4				
Combination #5				
Combination #6				
Combination #7				
Combination #8				
Combination #9				
Combination #10				

Name _____

Coin Combinations

Use coin manipulatives to find as many ways as you can to make 50¢.

	# of Pennies Used	# of Nickles Used	# of Dimes Used	# of Quarters Used
Combination #1				
Combination #2				
Combination #3				
Combination #4				
Combination #5				
Combination #6				
Combination #7				
Combination #8				
Combination #9				
Combination #10				

Name _____

Coin Conversions

Represent the following amounts of money as a decimal, fraction, and percent. The first one has been done for you. Use coin manipulatives if needed.

	Decimal	Fraction Before Simplifying	Fraction in Simplest Form	Percent
10¢ (with dimes)	.10	1/10	1/10	10%
75¢ (with quarters)				
75¢ (with pennies)				
25¢ (with quarters)				
50¢ (with dimes)				
90¢ (with dimes)				
60¢ (with pennies)				

Challenge: Look at the fractions in the "Fractions Before Simplifying" column. Examine the denominators. Can you explain why only certain denominators were used? Why weren't there any 3's, 4's, 6's, used as denominators?

Name _____

Price Problem

Jackie, Alex, and Jason are all in the same fifth grade class. Almost everyone in their class has a fancy pen with feathers on the cap, and they want one too! That evening, they each convince their parents to take them to a store to buy a fancy pen with their allowance money. Each student went to a different store, but each store had these pens on sale. Each store sold the pens at a regular price of $1.00. Below are the advertisements for the sale each store was having.

The next day at school, Jackie, Alex, and Jason each showed up with two new fancy pens. Each was very proud of the deal they got, and they actually got into an argument over who saved the most money. Using the signs below, find out how much money each student spent on the two pens. Who should win the argument? Why?

The sign Jackie saw:	The sign Alex saw:	The sign Jason saw:
Fancy Pens! Buy one for $1.00 & Get $0.25 off the Second One!	**Fancy Pens! Buy one pen at regular price, and we'll take 25% off the Second Pen!**	**Fancy Pens! Buy the first pen for $1.00 & we'll take 1/4 of the price off the second pen!**

Sports Math

Math Standard I

Objective 2

Connections

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

Objective 2:
Identify relationships among whole numbers, fractions, decimals, and percents.

Intended Learning Outcomes:
1. Demonstrate a positive learning attitude toward mathematics.
2. Become mathematical problem solvers.
3. Reason mathematically.
5. Make mathematical connections.

Content Connections:

Background Information

This activity should be used after Coin Conversions (pp. 4-3 to 4-9), or after an introduction to the concept that parts of a whole can be represented as decimals, fractions, and percents. This lesson uses real basketballs and hoops, but can easily be adapted for use inside the classroom using small balls and garbage cans. Make sure when you are doing the paper/garbage can demo, that the can is close enough to you that you can "rig" the number of shots made. This example should be very simple so that all students are successful, and don't get scared right away with more difficult problems.

Research Basis

Irwin, K.C. (2001). Using Everyday Knowledge of Decimals to Enhance Understanding. *Journal for Research in Mathematics Education, 32*(4), 399-420.

"Half the pairs worked on problems presented in familiar contexts and half worked on problems presented without context." This article presents results of an investigation that showed students who were presented decimal problems in a familiar context succeeded more often than students who were given no context.

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"Recent research has convincingly documented elementary school childrens' tendency to neglect real-world knowledge and realistic considerations during mathematical modeling …" This article suggests that using real-world modeling can help students have a better disposition toward mathematical concepts.

Assessment Suggestions

- Take notes during the basketball activity. Which students appear confident in their ability to record their shots as fractions? Are students displaying a positive attitude toward the assignment?
- The *Sports Math* worksheet should be completed with accuracy. The questions at the end assess a student's understanding of not just how to convert, but the concept of how percentages work.

Invitation to Learn

Have students brainstorm names of sports and athletes they enjoy playing or watching. Share their results in small groups. Hopefully, all students will be able to list at least one. After the discussion, tell them they will be learning how math is used in sports.

Instructional Procedures

1. Say the following to students:
   - "How many of you consider yourself a true sports fan?"
   - "Does anyone keep track of a favorite athlete's stats?"
   - "The word "stats" is short for statistics, which are used in sports to keep track, mathematically, of how well athletes are playing."
   - "Today we are all going to be athletes and we are going to record some stats for ourselves and our classmates. Before we can do that, we need to learn some skills we'll need to keep accurate stats."
   - "Let's start with something easy. I am going to toss some paper into the garbage can. I need one volunteer to crumple up these ten sheets of paper, and another volunteer to tally on the board all the shots I make." Make 5 out of the 10 shots, with students counting aloud and someone tallying on the board.
   - "How many total shots did I take?"
   - "How many were successful shots?"
   - "Please represent my shots as a fraction in your math journal."
   - "Good, 5/10 is correct. Did anyone write this fraction in simplest form?"

Materials

For each group:

- ❑ Basketball and hoop
- ❑ Set of number cards
- ❑ 10 pieces of scrap paper
- ❑ Garbage can

For each student:

- ❑ *Sports Math* worksheet

   - "Who can think of a way to represent my number of shots as a decimal?"
   - "And as a percent?"

2. Discuss, and make sure all students know the correct answers. "That was pretty simple. It seems we're all pretty familiar with the fact that 1/2 = .50 = 50%. But sometimes athletes' stats get a little more complicated and can't be so easily computed mentally."
   - "I'm going to show you how to take any fraction, no matter how difficult it looks, and represent it as a decimal and a percent."
3. Demonstrate how to convert a fraction to a decimal, reminding students that the fraction bar is really just a division symbol. If they remember that, the fraction tells them what to do. Review the division process, and how a decimal must be placed if the divisor is larger than the dividend. Point out that the answer can be rounded, or can be represented with a repeat bar. In baseball, batting averages are always represented as decimals rounded to the nearest thousandths place.
4. Write on the board some common decimals/percent equivalencies such as .25 = 25%, and .50 = 50%. Ask students if they see a pattern, or if they can explain the difference. They should reply with such answers as, "One has a decimal and one has a percent sign," or, "The decimal disappears when it becomes a percent." Remind students that all whole numbers could have a decimal after them, but we don't usually write it if there are no digits after the decimal. So actually, 25% could be written as 25.0%.
5. Say to the class:
   - "When we change from a decimal to a percent, we actually multiply the decimal by a number, and that gives us our percent. What kind of number do you think we could multiply by and keep the digits the same, but scoot the decimal over two places to the right?" Let the kids explore, then explain the reason we multiply by one hundred is because a percent is a portion of one hundred. Do several exercises together as a class.
6. Give directions for the basketball activity. Each group will receive one set of number cards, a *Sports Math* worksheet for each student, and one basketball. Each student selects a card—the number on the card tells them how many shots they get to try. Each student must tally the shots of every other student in his/her

group. The scores must be represented as fractions, decimals, and percents. When everyone has made their shots (outside or in the gym), they return to class to complete their calculations and the rest of the problems. After students have had a chance to complete the worksheet, discuss the results as a class. Let students explain whether or not they think the total number of shots attempted matters to an athlete. Did the student who got four tries have as good of a chance as the student who got six tries?

Curriculum Extensions/Adaptations/Integration

- During physical education, assign different students to keep stats for players in the games. This can be done with almost any sport. Rotate the students so they all get a chance to keep stats.
- This is a great opportunity to discuss appropriate calculator usage. After students have had lots of practice converting manually, allow them to compute stats with a calculator. This will act as a fun extension for quick learners, and as a helpful tool for struggling learners.

Resources

Web sites

When your class has access to computers, have them visit the following site. It allows them to compute batting averages online, as well as many other sports-math connections.
http://oncampus.richmond.edu/academics/education/projects/webunits/math/sport.html

Students can get access to batting averages of professional players at www.mlb.com, click on "stats" (with parent permission).

Family Connections

- Encourage students to have a family basketball game, with the student keeping stats for each player. Afterward, the student can present a homemade trophy to the player with the best percentage of shots.
- If someone in a student's family collects baseball cards, the student can compare batting averages of each player, and convert them to percents.

Number Cards

You get to attempt 6 shots.	You get to attempt 5 shots	You get to attempt 10 shots
You get to attempt 20 shots	You get to attempt 8 shots	You get to attempt 12 shots

Name _____

Sports Math

For each teammate, including yourself, record the number of shots attempted and the number of shots made. Represent each stat as a fraction, decimal, and percent.

Teammate's Name	Number of Tries	Number of Shots Made	Fraction	Decimal	Percent

1. Which teammate had the highest percentage of shots made?

2. Which teammate had the lowest percentage of shots made?

3. Do you think the number of tries has a big effect on the percentage? Explain your answer.

Math Standard IV-1 Activities

How Much is a Million?

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

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

Intended Learning Outcomes:
4. Communicate mathematically.
5. Make mathematical connections.
6. Represent mathematical situations.

Content Connections:
Language Arts II, VIII; Math I, V

Math Standard IV

Objective 1

Connections

Background Information

This activity allows students to explore the relationship among customary and/or metric units of measurement. There is a strong reading and writing component to the activity. Students will measure ordinary, readily available materials. They will then have to use their knowledge of conversion to answer any or all of the following questions in book form: How much? How many? or How far? Students should be encouraged to use examples of length, volume, weight, and area using both customary and metric units. The project should provide a valuable tool for determining the students' understanding of measurable attributes as well as conversions to appropriate units of measure.

Research Basis

Taylor, P.M., Simms, K., Kim, O. & Reys, R.E. (2001) Do your students measure up metrically? *Teaching Children Mathematics*. 7(5). 282-287.

Various attempts have been made to adopt the metric system in the United States. Thomas Jefferson was the first to introduce the concept. Today the U.S. is one of only three countries not using the metric system. The Third International Mathematics and Science Study (TIMSS) showed that students in the U.S. are behind in their understanding and use of the metric system. Teachers are encouraged to use metrics in their curriculum to develop a broader sense of measurement.

Principles and Standards for School Mathematics. (2000). Reston, VA: The National Council of Teachers of Mathematics.

In learning measurement, students should be actively involved, drawing on familiar and accessible contexts. The first step is to understand measurable attributes of objects and the units of measurement—both customary and metric. Connection(s) must be made to real-world applications. Students should investigate a wide variety of applications.

Assessment Suggestions

- Observe students while they are working in groups and individually. Did they work well in cooperative groups? Were the materials used properly and accurately? Could the students present and discuss their opinions and feelings.
- Students complete the *How Much is a Million?* worksheet based on their observations and turn it in. Students must journal their procedures, questions, and results. The students will create and turn in a finished *Millions Book*.

Materials

- ❑ *How Much is a Million?*
- ❑ *If You Made a Million*
- ❑ Ruler with customary and metric measures
- ❑ Measuring cups: customary and metric
- ❑ Scale(s): customary and metric
- ❑ Paper
- ❑ Pencils
- ❑ Roll of pennies
- ❑ Dollar bill for each cooperative group
- ❑ Miscellaneous materials, e.g., paper clips, gum eraser, unsharpened pencil, straight pin, etc.
- ❑ Colored construction paper
- ❑ 8 1/2" x 11" white paper (4 sheets per student)
- ❑ Scissors
- ❑ Glue stick
- ❑ CRT Conversion Chart (Core Curriculum, p. 1-39)
- ❑ *If I had a Million?* worksheet

Invitation to Learn

Materials should be distributed and ready for use. Have students brainstorm different tools of measurement and list them on the board—both customary and metric. Read *How Much is a Million?* Ask the students to journal their thoughts on "how much a million is."

Instructional Procedures

1. In cooperative groups, have students measure the length of a dollar bill. Ask, "How far would a million bills reach?" Students should use customary and metric units of measure to calculate the answer.
2. Repeat the above procedure using other items (e.g., pennies, pencils, paper clips, etc.). Ask the same question "How far would a million ___ reach?" Students should have at least six different items that they measured, calculated, and recorded their findings on the *How Much is a Million?* worksheet.
3. Students write about the activity in their journals.
4. Make a *Millions Book*. (Teacher models this procedure as the students work.)

a. Using one sheet of white paper, have the students find the mid-point of the two opposite long sides. (This is done by folding the paper in half.)

b. Tell students to make a mark on the fold one inch down from the top and one inch up from the bottom.

c. Using their scissors, the students make a 1/8 inch cut into the fold at the marks. They will be removing the center part of the page between the two marks, leaving the one inch sections intact to keep the paper together.

d. Using the other three pieces of paper, students fold at the mid-point of the long sides (best if all three are folded together at same time).

e. Students make a mark on one of the sheets, along the fold one inch down and one inch up (as done in step b).

f. Tell the students to cut on the fold from the top down (making sure all three pieces are together) to the mark (may go a little beyond it).

g. Cut on the fold from the bottom up to mark (may go a little beyond it).

h. Open the pages and roll the three pieces of paper lengthwise, inserting in the cutout section of first piece of paper. Once the cuts in the three pieces line up with the fold of the first piece of paper, move the cuts to slip over the parts of the first paper that were not cut on the fold. This will keep the papers from separating, forming a booklet.

i. Once the above is completed, tell the students to fold the colored construction paper in half at the mid-point of the two long sides.

j. Apply glue to one side of the outermost piece of the four white sheets joined together.

k. Insert the four pieces into the construction paper, matching fold-to-fold.

l. Once the sheet is glued on one side, apply glue to remaining back page of the white paper. Close the booklet, letting the back page adhere to the construction paper.

5. With the book created, students brainstorm, using their journals, different measurements of a million they could write about and illustrate on each of the 12 pages (exclude the pages glued to the front and back covers). They should be thinking about using the measurements and calculations completed in steps 1-3.

6. Students complete their *Millions Book* by writing and illustrating at least six of the items measured earlier. There should be two pages for each item measured—one page for customary and one page for metric. Each page should include the words: "If I had a million …, I would …" or "how far would a million … reach?"

Curriculum Extensions/Adaptations/Integration

- Read *If You Made a Million*. Have the students use the *If I Had A Million?* worksheet to create and replace the last two pages in the *Millions Book*. This worksheet may also be used to create a separate book.
- Use volume measuring tools to measure and include volume in the books, replacing some of the linear measurement pages (e.g., If I have a million cups, or liters, or gallons, etc.). This could be extended to weight also.

Resources

Books

How Much is a Million?, by David M. Schwartz; ISBN 0-590-43614-7

If You Made a Million, by David M. Schwartz; ISBN 0590-43608-2

The Magic of a Million, by David M. Schwartz & David J. Whitin; ISBN 0-590-70133-9

Web sites

http://www.eduref.org/Virtual/Lessons/Mathematics/Measurement/MEA0204.html

Rowlett, Russ. *The Metric System in the United States*. University of North Carolina at Chapel Hill. http://www.unc.edu/~rowlett/units/usmetric.html

Family Connections

- Students take home a copy of the *If I Had A Million?* worksheet and discuss with family and/or friends.
- Create a measurement booklet to explore and record ideas and items families have measured.

Name _____

How Much is a Million?

Measure at least six items using customary and metric measurements. Record your measurements. Multiply each by 1,000,000 and place your answers in the appropriate box.

	Customary	Metric	A Million? (customary)	A Million? (metric)
Pencil				
Paper				
Paper Clip				
Penny (lay flat)				
Penny Roll				
Dollar Bill				
Ruler				
Other:				
Other:				

Which would reach the farthest? Explain.

Pick two items and explain what you could do with 1,000,000 of each.

*Use the above data table to help you create your *Millions Book*.

If I had a Million?

(Cover) If I had a Million? A book by:

(On individual pages, write and draw your responses to the following wishes.)

I wish I had 1,000,000…

I wouldn't want 1,000,000…

I can make 1,000,000…

I could eat 1,000,000…

I could never eat 1,000,000…

Having 1,000,000… would be great!

Having 1,000,000… could be a problem.

If I had $1,000,000 I would…

Here is what $1,000,000 looks like to me.

(On the next pages write and draw about the things you might have one million of.)

If I had a million... I would…

Chances

Books

Friends

Lives

Pieces of clothing

Dogs

Fishing poles

Cars

Video games

Wishes

Jelly beans

Brains

Trees

(Last Page) If I had million… I would… (You choose something.)

Measuring Me

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

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

Intended Learning Outcomes:
2. Become mathematical problem solvers.
3. Reason mathematically.
4. Communicate mathematically.

Content Connections:
Language Arts II, VIII; Social Studies IV, VIII

Math Standard IV

Objective 1

Connections

Background Information

This activity is a good cross-curricular investigation of Objectives 1 & 2 of Standard IV of the 5th grade mathematics Core Curriculum. It relies on two pieces of literature, *Millions to Measure* and *Measuring Penny*. Students will learn the importance of accurate measurement both in customary and metric units. They will gain an understanding of the relationship between units of measurement in the metric system. Students will be able to compare and contrast customary measure and metric.

Research Basis

Van Zoest, L. & Enyart, A. (1998). Discourse, of course: encouraging genuine mathematical conversations, *Mathematics Teaching in the Middle Schools,4(3)*, 151-157.

Students should be encouraged to defend, question, and clarify their mathematical ideas. Discussion is one of the most important components to students gaining mathematical understanding. If they can express themselves orally, then journaling becomes easier. Teachers should listen carefully to the students' ideas. The teacher's role is to facilitate discussion, providing information, clarification, and modeling if needed. Students are to investigate, form conjectures, and determine mathematical evidence to be used in their discussions and journaling.

NCTM. (2000). Principles and Standards for school mathematics. (Online at http://standards.nctm.org/).

In learning measurement, students should be actively involved, drawing on familiar and accessible contexts, e.g., body parts. The first step is to understand measurable attributes of objects and the units of measurement—both customary and metric. Measurement is the bridge from number sense to geometry. Connection(s) must be made to real-world applications. Students should investigate a wide variety of applications.

Assessment Suggestions

- Observe students while they are working in groups and individually. Did they work well in cooperative groups? Were the materials used properly and accurately? Could the students present and discuss their opinions and feelings?
- Evaluate the completed *Measuring Me* worksheets.
- In cooperative groups, students will find the measurements to create the average student representing their group. This also reinforces the concept of mean.
- Did the student adequately journal this activity with procedure, observations, and conclusions described and illustrated?

Invitation to Learn

Have each student measure his/her foot and report their measurement on board. Read *Millions to Measure*. Journal the following question, "Should the U.S. join the rest of the world and measure only in the metric system?" Discuss the journal responses.

Instructional Procedures

1. Read *Measuring Penny*.
2. Discuss how this story compares with *Millions to Measure*.
3. In cooperative groups, each student will measure (in both units of measure) and record their body parts listed on their *Measuring Me* worksheet.
4. In groups, students take their measurements (to the nearest 1/2 inch or inch) and average each body part to obtain the average measurement representing the students in their groups. Remind the class that the mean is an average obtained by adding the set of data for the same body part and dividing by the number of units in that set.
5. As a class, create a chart or graph representing the comparison of all the groups in the classroom.
6. Using the *Measuring Me 2* worksheet, students follow the directions and complete the assignment. (This may take a few days.) The teacher should stress accurate measuring and creativity. Students can choose to present their work in a variety of formats. Discuss/brainstorm the different formats that could be used for "publishing" this assignment.

Materials

- ❑ *Millions to Measure*
- ❑ *Measuring Penny*
- ❑ Ruler with customary and metric measures
- ❑ Measuring cups: customary and metric
- ❑ Scales(s): customary and metric
- ❑ Tape measure
- ❑ Paper
- ❑ Pencils
- ❑ *Measuring Me* worksheet
- ❑ *Measuring Me 2* worksheet

7. Discuss the Extension activities. Optional: Model with class an example. Use brainstorming and consensus to chose activity.

Curriculum Extensions/Adaptations/Integration

- Students create their own unit of measure using a body part. Explain their reasoning and give three examples of its use.
- Each student could create a book (see *How Much is a Million?*, step 4, pp. 5-4 to 5-5), in the same pattern as *Measuring Penny*, titled *Measuring Me*.
- Students create their own menu for a simple dinner and measure appropriate portions using the measuring cups, spoons, and a scale. Provide guidelines on size of portions or the size of the entire meal.

Resources

Books

Millions to Measure, by David M. Schwartz; ISBN 0-688-12916-1

Measuring Penny, by Loreen Leedy; ISBN 0-8050-6572-5

The Write Math: Writing in the Math Classroom, by Cathy Marks Krpan; ISBN 0-7690-2505-6

Investigations in Number, Data, and Space: Measurement Benchmarks—Estimating and Measuring, by Catherine Anderson; ISBN 1-57232-801-0

Web sites

Your Body Ruler—A User's Manual. 29 February 2005. http://vendian.org/mncharity/dir3body ruler

The Metric System in the United States, by Russ Rowlett; University of North Carolina at Chapel Hill. http://www.unc.edu/~rowlett/units/usmetric.html

Family Connections

- Students and their families can use *Measuring Penny* as a model for measuring one of their pets and comparing to other animals found around the home and/or neighborhoods. Use the *Measuring Me 2* worksheet as an outline for this home activity.

Name _____

Measuring Me

Measure different parts of your body using customary and metric units of measure. Choose an appropriate unit of measure. Record your measurements on this page.

My Measurements		
	Cutsomary	**Metric**
Head (circumference)		
Across Shoulders		
Arm (shoulder to wrist)		
Hand (wrist to end of longest finger)		
Waist		
Inseam		
Foot		

My Group (Customary)					
	Me	**2**	**3**	**4**	**Mean**
Head					
Shoulder					
Arm					
Hand					
Waist					
Inseam					
Foot					

My Group (Metric)					
	Me	**2**	**3**	**4**	**Mean**
Head					
Shoulder					
Arm					
Hand					
Waist					
Inseam					
Foot					

Reflect upon your investigation. Use the back of this page to explain how these measurements could be used in a real-world situation.

Name _____

Measuring Me 2

Using Mr. Jayson's model from the book, *Measuring Me*, complete the assignment as outlined below.

1. Choose something to measure.

2. Measure it in as many ways as you can (e.g., height, width, length, weight, volume, temperature, time, etc.).

3. Record your results.

4. Include at least one comparison:
   Example: "It is taller than…" or "heavier than…" etc.

Remember, a measurement always has two parts:

1. A number
2. A unit

Example: "I am 6 feet tall."

Which units can you use?

Examples:

Standard Units: inches, feet, yards, centimeters, meters, teaspoons, cups, gallons, pounds, minutes, etc.

Nonstandard Units: paper clips, bricks, frogs, marbles, pencils, toes, etc.

Be Creative!

Math Standard IV-2 Activities

Playground Measurement

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

Objective 2:
Determine measurements using appropriate tools and formulas.

Intended Learning Outcomes:
2. Become mathematical problem solvers.
3. Reason mathematically.
5. Make mathematical connections.
6. Represent mathematical situations.

Content Connections:
Language Arts IV, VI, VIII; Math I, III, IV-1

Math Standard IV

Objective 2

Connections

Background Information

Prior to this lesson, students should have been introduced to metric measurements of length, in particular decimeters and meters. The purpose of the lesson is to help students measure more accurately to the nearest centimeter and apply that knowledge to measuring perimeter.

This lesson usually takes three to four days to complete and assess.

The format of this activity can also be used to teach customary measurements.

Research Basis

Gerik, I. and Kavspvec. M. (1999). Differences in cognitive processing Observed with EEG. *Educational Technology Research and Development, 47*,(3).5-14

The activities incorporate the use of nonlinguistic representations. Examples of nonlinguistic representations found in the lesson plan are using manipulatives and constructing making physical models. "The more we (teachers) use both systems of representations—linguistic and nonlinguistic—he better we are able to think and recall knowledge. It has even been shown that explicitly engaging students in the creation of nonlinguistic representations stimulates and increases activity in the brain."

Sweet, D. (1993) Performance assessment. Consumer Research. Retrieved January 12, 2005, from www.ed.gov/pubs/OR/Consumer/Abs.Doc

The assessment activity was developed to use the benefits of performance assessment. Research suggests that performance assessment provides impetus for improving instruction and increases student understanding of what they need to know and be able to do. "Performance assessment requires students to structure and apply information, and thereby helps to engage students in active learning."

Dance, R. and Moore A. (1997). A characterization of aspects of the culture of a successful mathematics classroom in an inner city school. College Park: University of Maryland.

Research conducted by Rosalie Dance and Ann Moore characterizing aspects of the culture of a successful mathematics classroom provided evidence that classroom activities offering "a sense of community," and "atmosphere of challenge" had a positive affect on student's responses to the study of mathematics. The activities in this lesson plan were designed with the intent of maximizing the benefits of working together as a learning community (group learning and activities) to solve challenging problems.

Assessment Suggestions

Materials

- ❑ Spool of string or lace
- ❑ Posterboard cut in squares, rectangles, and nonstandard shapes

- Evaluating the student's completed *Playground Measurement* worksheet provides the teacher with information on student understanding.
- Students measure various shapes made from posterboard and calculate the perimeter. Using this information, they cut the appropriate length of lace or string to "frame" the object. If the lace frames the perimeter without overlapping or falling short, the perimeter was calculated correctly.
- Invite a parent or member of the community whose career relates with measurement to make a presentation to the class. Before the presentation, students create a list of measurement related questions for the presenters.
- Each student chooses two objects in the classroom to measure length, width, and perimeter. Write a riddle for each object using the measurement information. Students exchange and solve riddles.

Invitation to Learn

Materials

- ❑ 12-15 magazines

Give one magazine to each pair of students. Ask them to look for structures, objects, or events where accurate measurement is crucial (e.g., bridges, stadiums, homes, etc.). Have students share their pictures with the class and why they think accurate measurement is critical to their example. Emphasize units of length, but if students include measurements relating to time or capacity, do not discourage them from sharing.

Instructional Procedures

1. To help students gain a concrete concept of the length of 1 centimeter, provide each pair with a *Centimeter Grid Paper*. Students measure the length of the tops of their desks using a square centimeter. After the students have measured the length, ask them what problems they faced using a square centimeter as a measuring tool. Give them a metric ruler and tape measure. Allow them to choose which measuring tool they would like to use to measure the width of their desks. Report measurements in centimeters. Use measurement to find the perimeters of their desks.
2. As a class, find a rectangular or square object in the classroom to measure. Before measuring, have students estimate the length, width, and perimeter of the object. Ask students how the methods of finding perimeters of rectangles and squares could be applied to finding the perimeter of other objects. Practice using classroom objects.
3. Provide each pair with a ruler/measuring tape. Instruct them to find an object of their choice in the classroom to measure. Allow them time to experiment with each of the measuring tools to determine which method is the most efficient. Ask the groups to share measurement information about the objects they measured. Discuss which groups used rulers, which groups chose to use measuring tape, and why.
4. Ask the students if they could record their measurement without changing its value to other units of metric measurement, such as decimeters or meters. Have the students convert their measurement to another unit. If needed, review the conversion process.
5. Ask students how they recorded their measurements. Follow by reviewing proper notation (if necessary).
6. Ask for an example of something in the room that appears to be longer than the measuring tape.

   Model an estimation "think aloud"—"I think the structure will be at least _____cm in length because I know a _____ measures _____cm."

   Model how to use the measuring tape on that item, emphasizing the accurate marking of the end of the tape using the wax pencil—and how to continue measuring to that point. Model how the measurement should be recorded.

Materials

For each pair:

- ❑ *Centimeter Grid Paper*
- ❑ Ruler
- ❑ Metric measuring tape
- ❑ White wax pencil
- ❑ *Playground Measurement* worksheet

For each group:

- ❑ 20-8" bendable straws
- ❑ 6 pipe cleaners
- ❑ Oil-based modeling clay
- ❑ Plastic bottle caps—not to exceed 1 1/2 inch in diameter
- ❑ Scissors
- ❑ String
- ❑ *Construction Guidelines* handout
- ❑ *Construction Log* worksheet

7. Give each pair a measuring tape and *Playground Measurement* worksheet.

   Note: Before going to the playground, place students in pairs. Use orange cones to designate the physical boundaries for the activity. Designate an area for early finishers to sit and wait while others finish, or challenge early finishers to measure other structures.

8. Make sure the students understand how to record the measurements to the nearest centimeter.
9. Have the students estimate the measurement of each playground object before measuring it.
10. Students record their estimates and actual measurements on the *Playground Measurement* worksheet.
11. Share findings with the class and if major discrepancies in data collection arise, have the students collaborate to find a solution.

Constructing a Playground Model

This continuation activity is intended to be completed the following day.

1. Each group of three students will receive a playground structure construction assignment. Refer to the *Construction Guidelines* handout. Students use pipe cleaners, straws, scissors, clay, plastic caps, paper, and string to complete the assignment.
2. As a class, discuss which structure(s) should be the largest and smallest. Determine the exact height for those items. This gives groups a starting point for determining the size of their structures. To accommodate students who are struggling, assign them structures whose measurements have been predetermined for them.
3. One student from each group should be in charge of collaborating with other groups to help determine the design and size of their group's structure. For example, the group in charge of constructing the monkey bars needs to collaborate with the group constructing the slides to ensure the slides are not as tall as the monkey bars. The student in charge of inter-group collaborating must visit all of the other groups before construction begins.

   a. After each group has completed the construction of their model, prepare a space in the room to set up the playground. A large table or empty floor space works well. Each group presents their model and briefly describes measuring decisions they made. Place each structure to create a complete model playground area.

b. As a class, design a fence or boundary line to surround the playground (perimeter).

c. Students complete their *Construction Log* worksheets and place in their math journals.

Curriculum Extensions/Adaptations/Integration

- Students who need an extra challenge can research engineering failures in relation to measurement, for example the Johnstown Dam (1889) and Charles De Galle Airport (2004).
- Use construction or grid paper to make a "bird's eye" scale model of all of the rectangular, square, and linear objects in the classroom. Measure the actual objects before building a 1:200 scale model of the room, including the rectangular, square, and linear objects in the classroom. Be sure to include the perimeter of the classroom. Artistic additions and detail may be included to give the model a more authentic feel. This incorporates the concept of area.

  1 cm on paper = 200 cm in actual size

  $$\frac{\text{actual size}}{200} = \text{scale size on paper}$$

- As a reinforcement activity, students use a trundle wheel to measure the shortest route to the lunch room, library, playground, etc.
- Play *Centimeter Centipede* to provide extra support with the concept and measurement of centimeters and decimeters.

  Objective: Using estimation, get as close to the edge of a piece of 12" x 18" paper as possible without going over.

  Game Instructions

  1. In pairs, students take turns rolling a die. The number that is rolled determines the number of centimeter squares the student will place in a line on the paper, creating a "centipede."
  2. As students near the edge of the paper, they choose whether to stop or keep rolling. Once they decide to stop, they may not roll again. However, if they roll too high of a number, causing their centipede to run off the paper, they lose.
  3. Have the students give the length of their completed centipede in centimeters.

Materials

For each pair:

- ❑ Die
- ❑ 12" x 18" construction paper
- ❑ *Centimeter Grid Paper*

Resources

Book

Measurement Mania, by Lynette Long; ISBN 0-471-36980-2

Web sites

www.pbs.org/teachersource

www.mathforum.org

Family Connections

- Using a piece of string, measure the smiles of those you live with. Measure the length of the string using a ruler or measuring tape to see which of your family members has the largest smile.
- Play *Guess The Object In The Room* by measuring an object in one of the rooms in your house. Take turns leaving the room, as one or two people choose an object in the room to measure. Have the rest of your family return to the room and give them the measurements of the item. They must then guess the items based on the measurements provided.
- Choose two or more houseplants. Over a period of two months, measure and graph the differences in their growth.

Name _____

Playground Measurement

1. Find something on the playground you think will measure about 3m or 300cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

2. Find something on the playground you think will measure about 10m or 1,000cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

3. Find something on the playground you think will measure about 1m or 100cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

4. Find something on the playground you think will measure about 5m or 500cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

5. Find something on the playground you think will measure about 1dm or 10cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

6. Find a face of a rectangular object or a rectangular plane object to measure. Be sure to measure the length and width.
   Object:_____
   Length: ___ Height: ___ Perimeter: _____

7. Choose an object to measure. Be sure to estimate before you measure.
   Object:_____
   Estimated Measurement:_____ Actual Measurement:_____

8. Choose an object that is not rectangular or square. Find its perimeter.
   How will you go about finding the perimeter?
   Perimeter: _____

Construction Guidelines

Slide: must include a ladder with evenly places rungs, or evenly placed stairs

Basketball Hoop with a 1/2 Court: must include court lines
Record the perimeter on your *Construction Log*

Hanging Rings: rings must be evenly spaced

Monkey Bars: monkey bars must be evenly spaced

Bridge: must be free standing
Record the perimeter on your *Construction Log*

Set of three "tricky bars": height of each set of bars must be different

Goal Post and Field: each goal post must be an equal distance from the middle line
Record the perimeter on your *Construction Log*

Four Square and Ball Wall: all four squares must be equal in size
Record the perimeter on your *Construction Log*

Swing Set: individual swings must be evenly spaced

Activity Platform: must include a rectangular base
Record the perimeter on your *Construction Log*

Note: You can assign the same structure to more than one group.

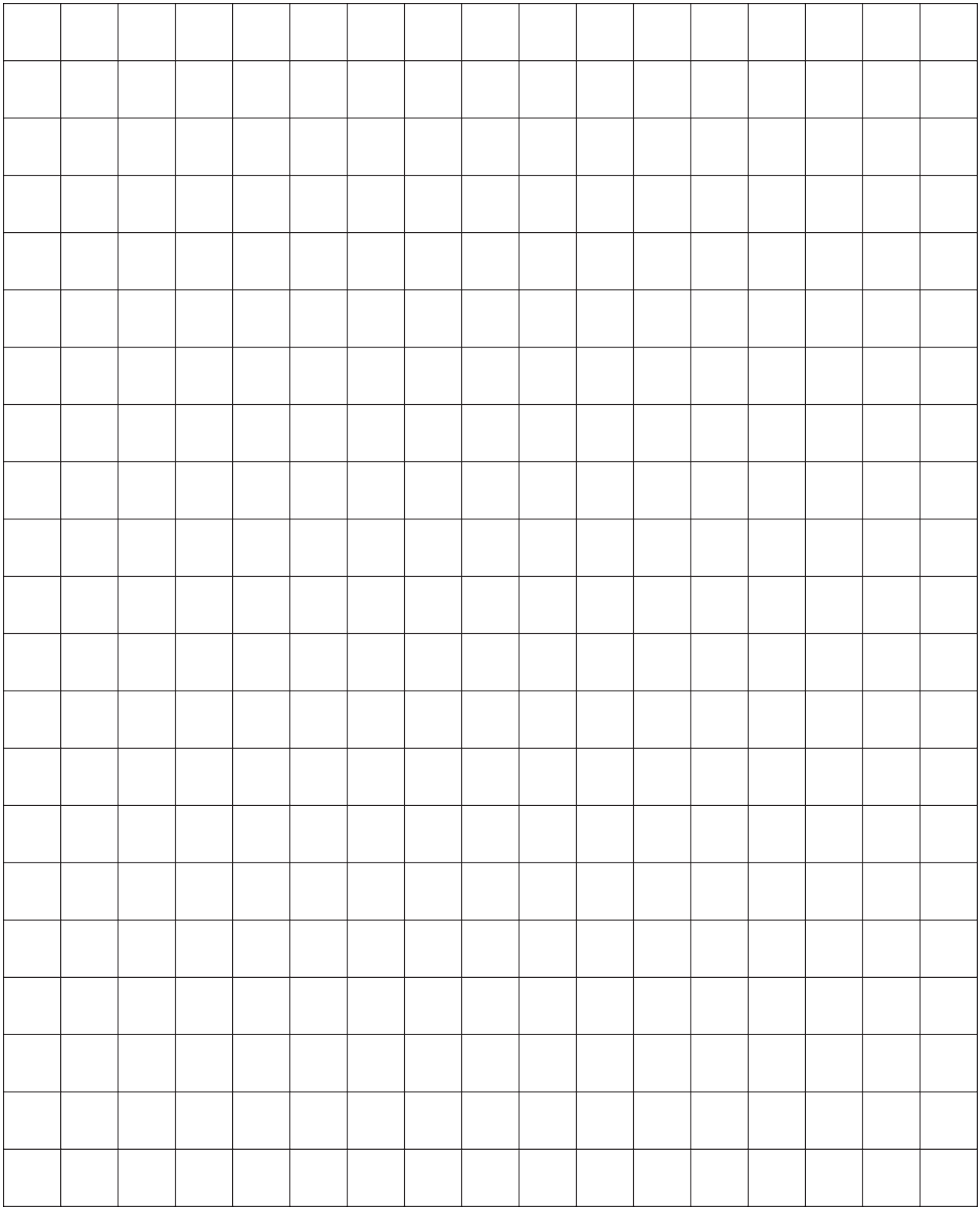
Name _____

Construction Log

Structure Name			
Measurement of Individual Parts			
Name of Part	**Length**	**Width**	**Height**
Spacing between parts (if applicable)			
Perimeter of structure (if applicable)			
Measurement challenges encountered during construction			
How did you use problem solving to overcome challenges?			
Names of group members			

Name _____

Centimeter Grid Paper



Artistic Angles

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

Objective 2:
Determine measurements using appropriate tools and formulas.

Intended Learning Outcomes:
1. Demonstrate a positive learning attitude toward mathematics.
2. Become mathematical problem solvers.

Content Connections:
Visual Arts II-1, IV-1; Math III-1, IV-1; Science II-I

Math Standard IV

Objective 2

Connections

Background Information

Prior to this activity, students should have an understanding of right angle, acute angle, obtuse angle, and vertex.

The size of an angle depends on the opening between the two sides of the angle. Angles are measured in units referred to as degrees and labeled with the ˚ symbol.

The size of an angle can be described in relation to a complete circle (360˚), 1/2 of a circle (180˚), or 1/4 of a circle (90˚).

It is important to teach students how to extend rays of an angle when using a protractor. This not only helps them measure but, helps in the construction of angles. It is also important to make sure students understand how to use the interior and exterior numbers on a protractor.

When selecting art prints, try to select a wide variety. See *Art Print Suggestions* for ideas.

Twizzler Pull Aparts or Wikki Stix can be used in place of paper and pencil when constructing angles.

This lesson usually takes about three days to teach and assess.

Research Basis

Hartshorn, R. & Boren, S. (1990). Experiential learning of mathematics; using manipulatives. Eric Digest #ED321967

This lesson includes the angle wheel because it serves as a concrete representation of angles. Research suggests that incorporating the use of manipulatives in mathematic instruction is "useful in the transition from concrete to abstract taught in steps, semi-concrete to semi-abstract." In this lesson, the angle wheel serves as the concrete and is introduced before moving on to the abstract—measuring of angles on paper.

Gresham, G., Sloan T., and Vinson B. (1997). Reducing mathematics anxiety in fourth grade at risk students. Retrieved January 2, 2005, from Athens Stage College, School of Education Web site: http://www.Athens.edu/vinsobm/research_4.html.

Research also suggests that the use of mathematical manipulatives reduces the level of math anxiety in high risk students.

Lou, Y., Abrami, P.C., Spence, J.C., Paulsen C., Chambers B., & d'Apollonio,S. (1996). Within-class grouping: a meta analysis. *Review of Educational Research, 66*(4), 423-458.

The activities in this lesson plan were designed to be completed in pairs or groups of three. Research on cooperative learning and group work indicates that "small teams of three to four members" are more effective than larger groups. This lesson was created with the intention of maximizing the benefits of cooperative learning.

Assessment Suggestions

- Have each student choose three to five of the angle measurements they measured and recorded from the art prints. Using the measurements, students construct the angles and include them in their own piece of hand drawn abstract art. Students could also create a piece that uses angles to create the illusion of depth or perspective (refer to M.C. Escher print *Ascending and Descending*). The use of protractors must be incorporated in their art.
- Use protractors to complete the *Angle Assessment* worksheet.

Invitation to Learn

Have each student spread out his/her fingers and look at his/her hand. Use the following questions to promote discussion and thinking about angles, "Do you think people with larger hands have larger angles between their fingers?" Take student predictions and explain that at the end of the lesson we will use our class as a sampling to answer the question, "Can you use your fingers to make a 90˚ angle?" (thumb and index)

Instructional Procedures

Developing "angle sense"

Use foam or fraction circles to help students visualize angle size in relation to a 360˚ circle. Start with a whole circle, 1/2s, 1/4s, and 1/8s. Add along the way (e.g., 1/4 = 90˚ so it will take four 1/4 pieces to equal the 360˚ whole).

1. Give each student an angle wheel to help further develop "angle sense." Before moving on, make sure they understand that angles are measured in degrees.
2. Allow students to experiment with their wheels, asking them to look for patterns. For example, the larger the angle the greater the measurement in degrees.
3. Place students in pairs. Partners take turns displaying an angle while the other partner estimates the measurement of the angle.

Measuring Angles

1. Display sets of angles on the chalkboard and ask, "Would the angle wheel be an effective measurement tool to measure these angles?"
2. Introduce the protractor using the chalkboard protractor. Be sure to model several examples of measuring angles with a protractor before handing out individual protractors to each student. Explain interior and exterior numbers on the protractor. Show students how to extend rays when necessary for easier measuring. Does extending the rays of the angle change the measurement of the angle? Practice measuring angles in isolation before moving on to measuring angles in the prints. (Math books include such angles and work well for practicing.)
3. Place students in pairs or groups of three. Using 10-15 different art prints, each pair/group measures an angle from each piece of art. Record the measurement of an angle from each print, including a description of the object it belongs to, in math journals. Allow each group three to five minutes with each print before passing the print to another group.
    - Numbering each print with a Post-it® note helps make sure each group has a chance to work with all of the prints. It also helps the students organize and record information about the prints in their journals.
    - Use transparency sheets to protect the prints. Sometimes ray extension will be necessary for easier measuring of angles.

Materials

- ❑ Chalkboard protractor
- ❑ 10-15 different art prints

For each group:

- ❑ Transparency sheets
- ❑ Wax pencil

For each student:

- ❑ Protractor
- ❑ *Angle Wheel* handouts
- ❑ Protractor transparency
- ❑ Metal brad
- ❑ *Angle Assessment* worksheet

The students may only write on the transparencies with wax pencils.

4. Instruct students to select their choice of prints to answer the following questions in their math journals. They must choose a different print to answer each question.
   - How does the artist use angles to create the overall feel in the piece of art?
   - How does the artist use angles to create depth and/or perspective?
   - Which styles/types of art use sharper, more definite angles?
   - Choose your favorite print. Did the artist use a variety of angles?
   - How did the use of angles affect the feel the piece?

Constructing Angles

1. Using the information on how to measure an existing angle, ask students how they could use a protractor to create their own angles. Model angle construction using the chalkboard protractor. For guided practice, have a few students suggest angles for the class to construct. The *Angle Assessment* worksheet may also be used for guided practice.
2. Students use what they have learned by spreading their fingers apart and measuring the angles between them. This works best when done in pairs. Instruct students to use their protractors, pencil, and paper to neatly measure and construct the angles between two of their fingers. Record and compare data to answer the question posed at the beginning of the lesson.

Curriculum Extensions/Adaptations/Integration

- The following extension possibilities work well for students who need extra support:
  - Use a clock manipulative as an example of angles to help with recognizing different angles in their surroundings.
  - Start with a straight line (180˚) and progressively create a new angle every 10˚. This helps students see the correlation between angle size and the protractor.

- The following extension possibilities work well for students who need extra challenges:
  - Design a perfect circle using a protractor.
  - Use a protractor to design runs for a ski resort. How will the angles of the more difficult runs compare to the beginner runs?
  - Use a protractor to design ramps for a skate park. How does the degree of difficulty relate to the measurement of the angle?
  - Research the relationship between landslides, glaciers, erosion, and slope angles.

Resources

Web sites

www.pbs.org/teachersource/mathline

Wikki Stix www.unitednow.com pkg of 48

Wikki Stix www.kaplanco.com pkg of 300

www.art.com *Ascending and Descending*, by M.C. Escher

Family Connections

- Give students a protractor transparency to take home and demonstrate their new skills to their families.
- Send family members on an angle scavenger hunt. For example, find something in the house that has an angle measurement between 120˚ and 140˚.

Art Print Suggestions

Braque: *Still Life*

Brueghel, Pieter: *The Numbering at Bethlehem*

Cezanne, Paul: *House at Aixen Provence* and *The House of Pere Locroix*

Chagall, Marc: *I and the Village*

Daumer, Honore: *Notre Dame De Paris*

Davis, Stuart: *Combination Concrete*

Escher, M.C.: *Ascending and Descending* (this print has such a variety of angles that can be easily measured using a protractor) and *Waterfall*

Hurd Clement: *Goodnight Moon* (If a print is not available, the children's book can be used in place of the print.)

Kandinksy, Wassily: *Circles in a Circle*

Klee, Paul: *Castle and Sun*

Picasso, Pablo: *The Three Musicians, Violin and Guitar,* and *Paysage Mediterranean*

Rivera, Diego: *Flower Festival: Feast of Santa Anita, 1931*

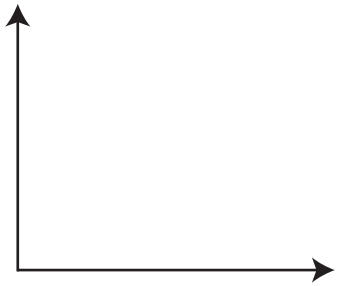
VanAllsburg, Chris: *Jumanji* and *The Mysteries of Harris Burdick* (children's books)

Wyeth, Andrew: *Bradford House*

Name _____

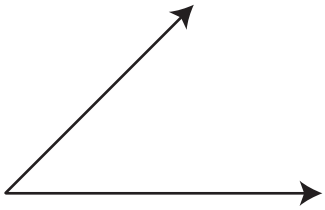
Angle Assessment

Estimate the measurement of each of the angles. Use a protractor to check your estimates.



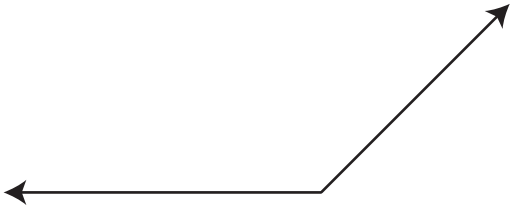
Estimated measurement:___

Actual measurement:___



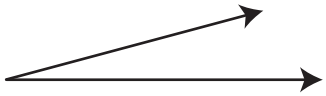
Estimated measurement:___

Actual measurement:___



Estimated measurement:___

Actual measurement:____



Estimated measurement:___

Actual measurement:____

Look at the clock to answer the following questions:

1. Name a time of day when the hands on the clock form a 180˚ angle.

2. Name a time of day when the hands on the clock form a 90˚ angle.

Use your protractor to create the following angles:

a. 45˚ angle

b. 80˚ angle

c. 165˚ angle

d. 170˚ angle

e. 110˚ angle

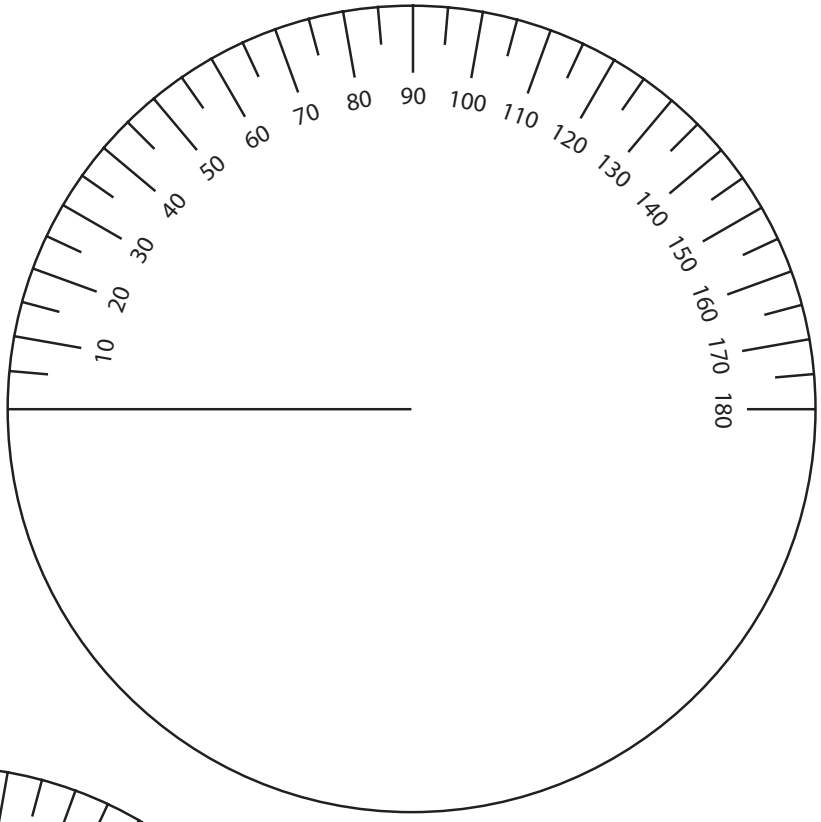
f. 20˚ angle

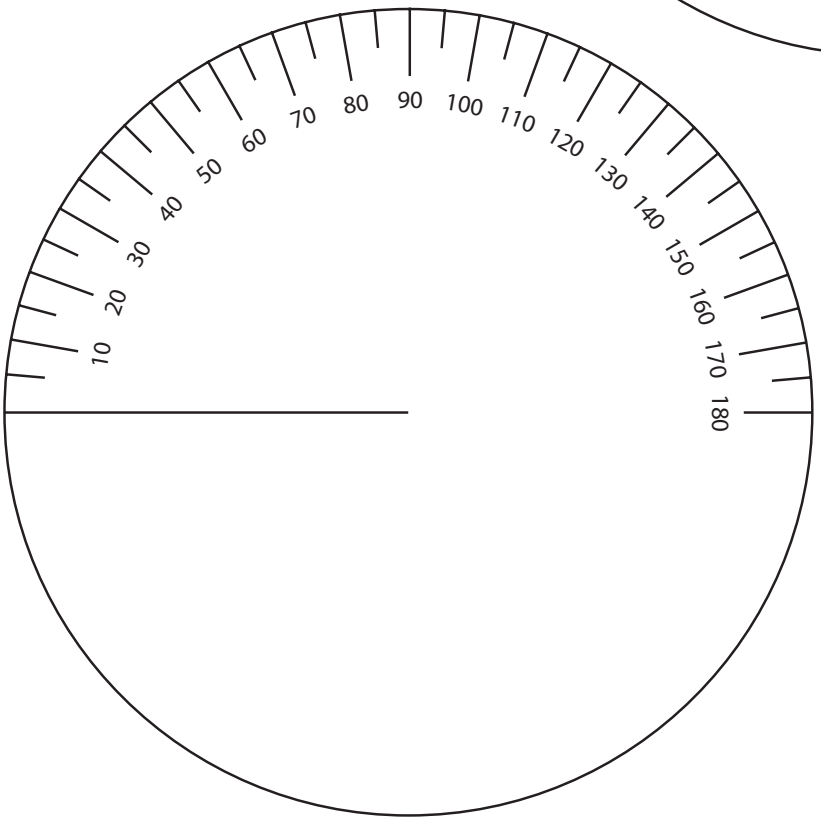
Construct an angle of your choice and measure it.

Angle measurement:____

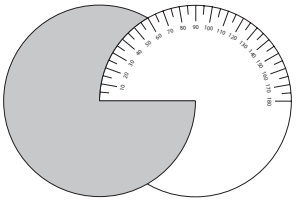
Angle Wheel Pattern Part A

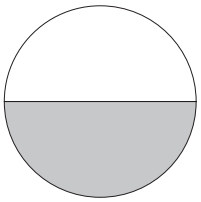
Copy on white cardstock.





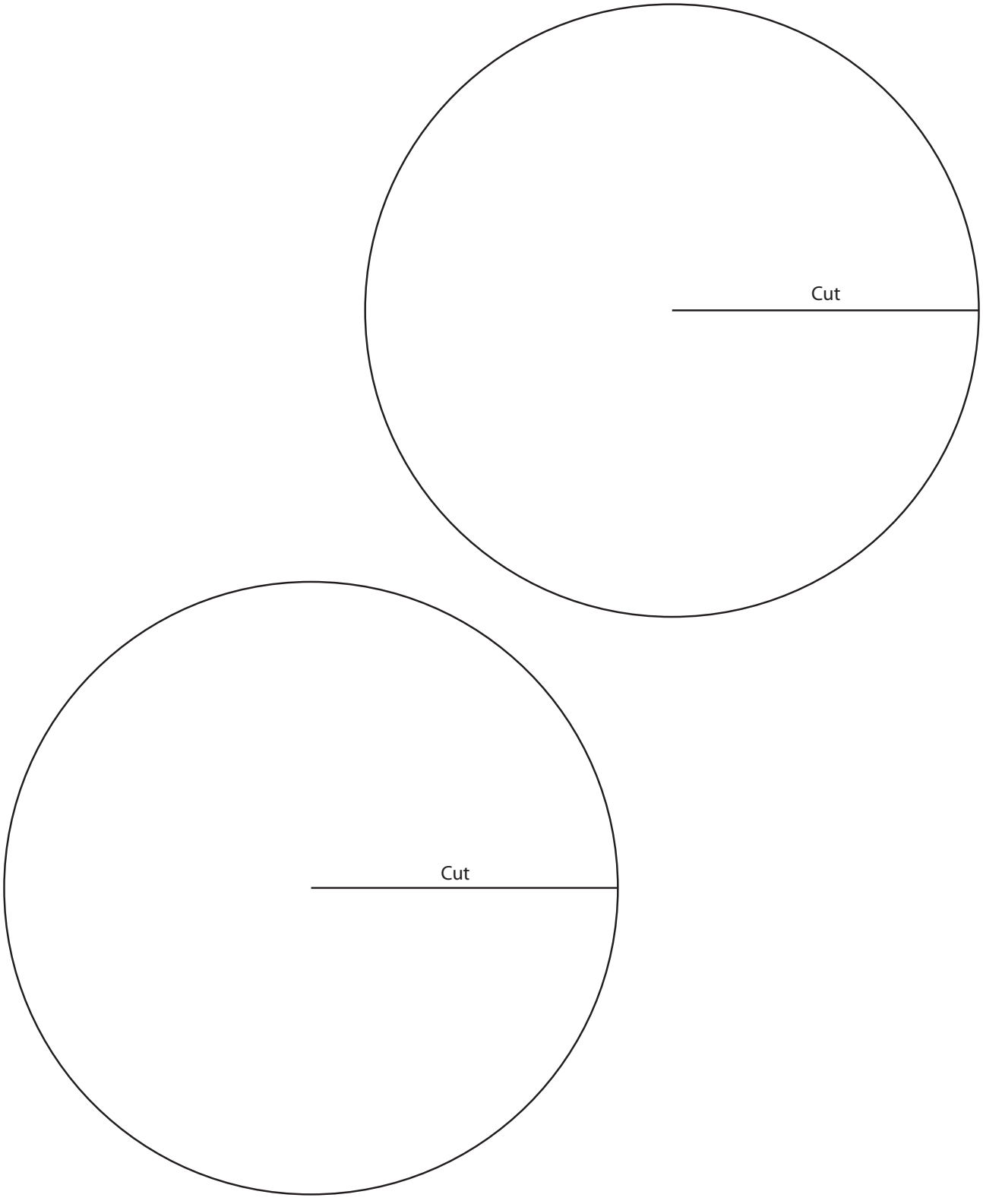
Rotate the circles around the center.
Use a brad to fasten the circles together.





Angle Wheel Pattern Part B

Copy on colored cardstock.



Math Standard II-1 Activities

Eye Spy a Pattern

Standard II:
Students will use patterns and relations to represent and analyze mathematical situations using algebraic symbols.

Objective 1:
Recognize, analyze, and use patterns and describe their attributes.

Intended Learning Outcomes:
2. Become mathematical problem solvers.
3. Reason mathematically.

Content Connections:
Language Arts VII-1 & 2; Art I-1

Math Standard II

Objective 1

Connections

Background Information

Students look for understandable ways to make sense out of what they are learning. If they are directed and encouraged into seeing and understanding how things work together, then they are seeing and understanding patterns. Helping students understand and communicate the connection and relationship in patterns enables them to understand strategies for problem solving in a variety of ways.

It is beneficial for students to play games, learn, and work together. This practice encourages the lowest to the highest achieving students to engage in active and social learning. Many cooperative learning research studies have proven that when students work together they practice and experience a variety of social skills.

Give students some background information by explaining to them that Blaise Pascal was a French mathematician, philosopher, and scientist who studied number patterns and lived from 1623 to 1662. Leonardo Fibonacci was an Italian mathematician who studied number patterns and lived from 1180 to 1250.

Research Basis

Kagan, S. (1994). *Cooperative learning*. Resources for Teachers, Inc. ISBN 1-879097-10-9.

Cooperative learning promotes higher achievement than competitive and individualistic learning structures across all age levels, subject areas, and almost all tasks. Studies have demonstrated that when students are allowed to work together, they experience an increase in a variety of social skills. Students become more able to solve problems that demand cooperation for a solution, are better able to take the role of the other, and are generally more cooperative on a variety of measures, such as willingness to help and reward others.

Assessment Suggestions

- Students write a summary and draw examples of their definition of patterns in their math journals.
- Go on a walking field trip around the school. Have students spy patterns they see and describe how they repeat, grow, or continue.

Materials

❑ 1/2 inch graph paper

- As a class, assign each letter of the alphabet a different solid color or colored pattern. Then, hand each student a piece of graph paper. Have the students write each letter of their first name very lightly across the first row of graph squares (one letter per graph square). Repeat this seven times, moving to the next row each time. Cut out the square that is created with the letters. Color each letter the assigned color or pattern. Have the students describe patterns they see. Display the students' work around the room.

  Example: If possible, have the students create their *Patterned Name Square* using a keyboarding program.

Patterned Name Square

C	A	R	L	A
C	A	R	L	A
C	A	R	L	A
C	A	R	L	A
C	A	R	L	A
C	A	R	L	A
C	A	R	L	A

Variation: Delete or add one column and one row, see what pattern is created. Discuss the changes and new patterns that are seen. Have the students explain in detail how the pattern will repeat and grow and how many graph squares will be needed to create their name two or more times.

Example:

C	A	R	L
A	C	A	R
L	A	C	A
R	L	A	C
A	R	L	A
C	A	R	L

Invitation to Learn

Choose one or both of the following activities to get the students thinking about patterns and how to describe them.

Spy A Pattern

1. Tell the students that you 'Spy a Pattern' in the classroom (choose a pattern visible for all students to see, e.g., repeating tiles on the ceiling, bricks on the wall, a group of shelves, etc.).
2. Students are the detectives and they are to guess what you have chosen for the pattern by asking questions. When one or more students have guessed the pattern, have them tell the class what it is and explain how they guessed it.

Growing Patterns

1. Have the students sing a song with a growing pattern such as "BINGO," "I Knew an Old Lady Who Swallowed a Fly," "There's a Hole in the Bottom of the Sea," or "The Green Grass Grew All Around."
2. Ask the students to listen for patterns as they are singing (e.g., the rhythm or beat of the song, letters or words increasing or decreasing, lyrics repeat, etc.).
3. After the song is over, have the students explain the patterns they heard and write these on the board.

Instructional Procedures

Eye Spy a Pattern

Materials

For each pair:

- ❑ *Eye Spy a Pattern* worksheet.

1. Give an *Eye Spy a Pattern* worksheet to each pair.
2. Each pair studies a pattern in the first column, then, discuss the possible solution(s) to the corresponding question in the second column. Solve and talk about one pattern at a time.
3. Give the students time to figure out each solution. If needed, give clues as to what the solution(s) may be. Guide students to look for patterns by adding, subtracting, looking at the numbers diagonally, top to bottom, right to left, etc.
4. When time is up, choose groups to come to the front of the classroom and explain the solution(s) to an assigned pattern.
5. Ask questions like, "What is the rule for the next pattern? Is there more than one pattern? What patterns do we see in the world around us?"

Hundreds Board Patterns

Materials

For each student:

- ❑ *Hundreds Board* handout
- ❑ Colored pencils

1. Hand each student a *Hundreds Board* worksheet.
2. Have students follow the directions below. After each direction is given, have the students describe the pattern.
   - Underline all multiples of 2 with red.
   - Circle all multiples of 3 with blue.
   - Draw a purple box around each multiple of 6.
   - Cross out all multiples of 9 with orange.
   - Draw a yellow triangle around each multiple of 5.

   True/False
   - Multiples of 2 are found in alternating columns.

- All multiples of 3 are also multiples of 2.
- Multiples of 6 are multiples of both 2 and 3.
- Multiples of 9 are also multiples of 3.
- The sum of the digits for all multiples of 9 (except 99) is 9.
- The multiples of 6 are also multiples of 9.
- 90 is a multiple of 2, 3, 5, 6, and 9.
- All multiples of 5 end in 5 or 0.

3. Discuss the correlation between multiplication and patterns. Explain how multiplication is repeated addition, while division is repeated subtraction.

Patterns and Patterns Galore

Divide students into teams of two to four. Give each team a *Hundreds Board* handout and a set of number tiles. Explain how to play a game called *Patterns and Patterns Galore*.

Materials

For each group:

- ❑ *Hundreds Board* handout
- ❑ Set of number tiles

1. Place the number tiles face down on the table next to the *Hundreds Board* handout.
2. Each player draws 10 number tiles and places them face up in front of them on the table.
3. Player 1 places any number pattern or sequence of numbers on the *Hundreds Board* using any of his/her 10 number tiles. A pattern or sequence may be horizontal, vertical, or diagonal. A pattern or sequence may be any length, but may go in one direction only. Player one does not draw additional tiles at this time.
4. Player 2 adds any number pattern or sequence of numbers to what is already on the board. If a player cannot add on or start a new number pattern or sequence, s/he draws 2 tiles from the pile and play moves on to the next player.
5. Players continue taking turns adding number tiles to existing number patterns and sequences, starting new ones when needed, or drawing two tiles from the pile.
6. The first player to place all of his/her tiles on the board wins.
7. Have each team show and discuss the various patterns created. Ask students if they see any patterns that continue with a rule (e.g., 10, 20, 30, 40, the rule is n x 10).

Curriculum Extensions/Adaptations/Integration

- Read picture books on counting to the students (e.g., *Math for All Seasons* and *Ten Little Rabbits*). Have students describe patterns they hear and see in the illustrations.

Resources

Books

Math for All Seasons, by Greg Tang; ISBN 0-439-44440-3

Ten Little Rabbits, by Virginia Grossman; ISBN 0-87701-552-X

A Problem Solving Approach to Mathematics for Elementary School Teachers, by Rick Billstein; ISBN 0-201-52565-8

Hundred Number Board Activities Grades 4-5, by Cindy Barden; ISBN 0-7424-2780-3

Math Grades 4-6, The Best of The Mailbox Magazine; ISBN 1-56234-157-X

Math on Call, by Great Source; ISBN 0-669-45770-1

Web sites

http//illuminations.nctm.org/print_lesson.aspx?id=144

http//illuminations.nctm.org/print_lesson.aspx?id-304

Family Connections

- Have students do the *Patterned Names* activity at home with family, using a family member's name. Compare and contrast differences and what is alike between all name patterns created.
- Conduct a Family Math Night at school. Invite students and family members to come in the evening to experience the fun of the math activities used in the lesson.

Answers for Eye Spy a Pattern worksheet:

1. N; Reading left to right and top to bottom, the letters are the first letters in the number words 1-9.
2. 1 9 36 84 126 126 84 36 9 1. Answers will vary. Yes.
3. 12345 X 9 + 6 = 111111. Yes, it will work until you add 10.
4. 89, 144, 233. Answers will vary.
5. D, A (Beginning in the top left corner, the pattern consists of A, AB, ABC, ABCD; B, BC, BCD, BCDA; etc.)

Name _____

Eye Spy a Pattern

Pattern	Solution
<table><tr><td>O</td><td>T</td><td>T</td></tr><tr><td>F</td><td>F</td><td>S</td></tr><tr><td>S</td><td>E</td><td>?</td></tr></table>	1. What letter belongs in the box with the question mark?
Pascal's Triangle 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1 1 5 10 10 5 1 1 6 15 20 15 6 1 1 7 21 35 35 21 7 1 1 8 28 56 70 56 28 8 1	2. Can you predict the next row of numbers? Is there a patern in the sums of the numbers in the rows? Do any numbers repeat?
1 x 9 + 2 = 11 12 x 9 + 3 = 111 123 x 9 + 4 = 1111 1234 x 9 + 5 = 11111	3. What is the sequence in row 5? Does the pattern continue to grow for row 6?
Fibonacci Sequence 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, . . .	4. What are the next three numbers in the sequence? How do you know?
A A B A B C A B C D B B C B C D B C _ _	5. What letters (A, B, C, D) belong in the two empty spaces?

Hundreds Board

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

Eye Spy a Rule

Standard II:
Students will use patterns and relations to represent and analyze mathematical situations using algebraic symbols.

Objective 1:
Recognize, analyze, and use patterns and describe their attributes.

Intended Learning Outcomes:
2. Become mathematical problem solvers.
3. Reason mathematically.
4. Communicate mathematically.

Content Connections:
Language Arts VII-1 & 2; Art I-1

Math Standard II

Objective 1

Connections

Background Information

When students develop an understanding of patterns, they begin to create and discover a reasoning of how patterns grow, repeat, continue, or are solved. This is when students need added encouragement to promote discovery of 'rules for the pattern.' When a student understands how to represent the 'rule for the pattern,' s/he begins to develop a sense that the rule can be applied several times, and in many different ways. This gives the student prior knowledge so s/he becomes a flexible problem solver and realizes that there is a solution.

Research Basis

Kagan, S. (1994). *Cooperative Learning*. Resources for Teachers, Inc. ISBN 1-879097-10-9.

A student who is off task and misbehaving is usually a student wanting attention. In a cooperative learning atmosphere, each student is repeatedly included in a group of students working as a team to achieve the goal of being a successful individual.

Assessment Suggestions

- Have students write a summary of what they learned in their math journals. Draw patterns and write what the rule is as an example.
- Have students play concentration with the *Match The Rule Game Cards*.

Materials

- ❑ *Match The Rule Game Cards*

Invitation to Learn

Choose one or both of the following activities to get students to think about patterns and how to describe them.

What's the Rule?

Explain how to play a game called *What's the Rule?*

1. Two students who have something in common are chosen to come to the front of the classroom. For example, what they have in common, or the 'rule,' may be that both students have blue tennis shoes on.
2. The rest of the class or audience needs to think about what the rule may be. A student from the class or audience is called on, who in turns calls on another student from the audience who they think follows the rule.
3. If the student called on does not fit the rule, then s/he must stand off to the side of the classroom. If s/he follows the rule, then s/he joins the two at the front of the classroom.
4. Have the class continue taking turns naming other students in the audience who they think follow the rule until all students who follow the rule have been named.

   Some examples of rules to use: all boys or all girls, wearing something in their hair, wearing short or long-sleeved shirts, wearing shorts or long pants, wearing a watch, has short or long hair, wearing glasses, etc.

Ordinary Mary's Extraordinary Deed

Read *Ordinary Mary's Extraordinary Deed*. As you read the book, begin to write on the board the rule for how many people are exchanging good deeds. An example of this is:

1 person	=	5 deeds
5 people	=	25 deeds
25 people	=	125 deeds

What is the Rule? (If n = number of people, then n x 5, or 5n, = the number of deeds.)

Question: How many deeds will be exchanged with 50 people? (1,250)

When finished, determine how many good deed exchanges would take place in the classroom if each student exchanged five deeds.

Instructional Procedures

1. Give at least 30 toothpicks to each student. Have students make a square using the toothpicks, telling how many toothpicks they used. Students add another square at the lower right corner. How many toothpicks were used? Continue this until four squares are made. Record the information given on the board.

   Example: 1 square = 4 toothpicks
   2 squares = 8 toothpicks
   3 squares = 12 toothpicks
   4 squares = 16 toothpicks

   Ask students if they see a pattern in the numbers written on the board. Ask for explanations. The pattern they are seeing can be described with a rule. The rule is square x 4 = toothpick or n x 4 = y (use a variety of symbols to represent this rule).
2. Have students make triangles. Add one triangle at a time to the lower left vertex of the previous triangle. Continue until they come up with the rule.
3. Give each student several square, triangle, rhombus, hexagon, and trapezoid pattern blocks. Have them complete the first section of the *Growing Patterns* worksheet. Model how to complete the worksheet using one of the shapes and going across the row.
4. Have students complete the second section by making a pattern using three to five pattern blocks (e.g., square, hexagon, square, hexagon). Call on select students to tell what their pattern is.
5. Discuss student answers. Have them tell how they decided on the rule for their pattern.
6. Hand out the *What's The Rule? I* worksheet to each pair of students. Have each pair solve what numbers come next in the pattern and state the rule. Students may use pattern blocks to help them visualize the growing pattern. (Answers: Steamship n + 2, Pattern Path 2x + 2, Drawbridge n - 1, Suns n x 6, Fish & Fins n x 2, and Building Flowers n x 4.)
7. For an extra challenge, give each student a *What's The Rule? II* worksheet. Have them add, subtract, and multiply to find the missing numbers. Read *Quack and Count*. As the book is read, show students that numbers can be added or subtracted from each other to find a pattern.

Materials

For the class:

- ❏ *Quack and Count*

For each pair:

- ❏ *What's the Rule? I* worksheet

For each student:

- ❏ 30+ toothpicks, sticks, or Base Ten rods
- ❏ 2 *Pattern Blocks* worksheets
- ❏ *Growing Patterns* worksheet
- ❏ *What's The Rule? II* worksheet
- ❏ *What's The Rule? III* worksheet

8. Give each student a *What's The Rule? III* worksheet. Have them create their own patterns and rules on their worksheet. Exchange with classmates to solve when finished.

Curriculum Extensions/Adaptations/Integration

- Create an art project where the pattern in the design grows as it repeats.
- Make quilt blocks using pattern blocks and display them in the classroom.
- Design a tiled floor. Use a 2" x 2" square as the main pattern piece. Have students determine how many pattern pieces are needed for a certain size of floor.

Resources

Books

Quack and Count, by Kieth Baker; ISBN 0-15-292858-8

Family Math in the Middle School Years, by Virginia Thompson and Karen Mayfield-Ingram; ISBN 0-912511-29-X

Hundred Number Board Activities Grades 4-5, by Cindy Barden; ISBN 0-7424-2780-3

Navigating through Algebra in Grades 3-5, by Gilbert J. Cuevas and Karol Yeatts; ISBN 0-87353-500-6

Ordinary Mary's Extraordinary Deed, by Emily Pearson; ISBN 0-87905-978-8

Web sites

Spare Moment Activities, www.TeachNow.com

http//illuminations.nctm.org/print_lesson.aspx?id-305

Family Connections

- Have students take home extra *What's The Rule? II* and *What's The Rule? III* worksheets and complete them with a family member.
- Conduct a Family Math Night at school. Invite students and family members to come in the evening to experience the fun of the math activities used in the lesson.

Name _____

Growing Patterns

Count and record the sides of each individual pattern block for the first column. Continue adding pattern pieces, then count the number of sides and record the amount for each column. Pattern blocks with sides touching count as one.

Number of Shapes used	1	2	3	4	5	6	What's the Rule?
Triangle							
Hexagon							
Square							
Rhombus							
Trapezoid							

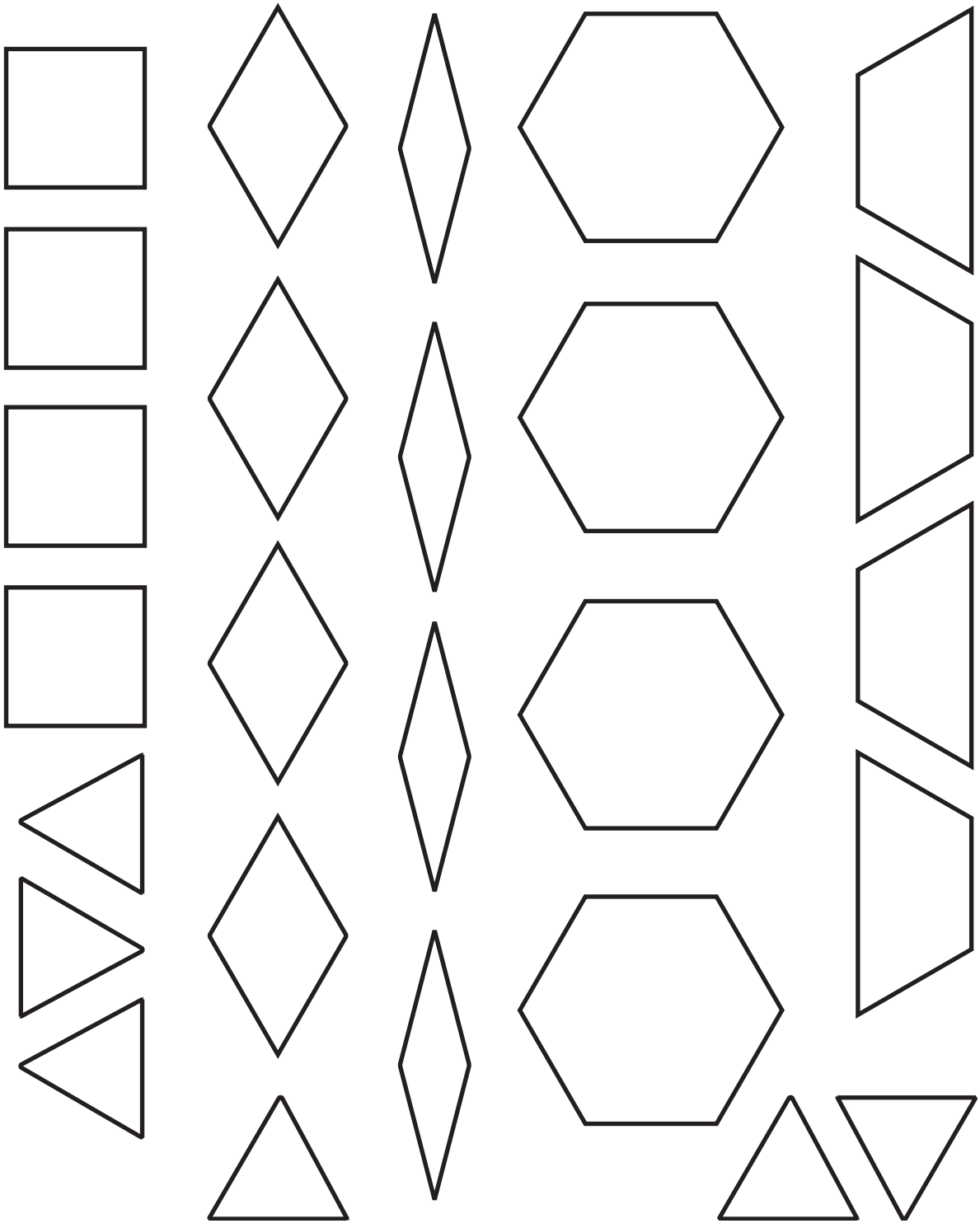
Create a pattern using three to five pattern blocks. Repeat this pattern two more times, then answer the questions.

1. How many sides are there in the original pattern?_____
2. How many sides are there when two patterns are side by side? _____
3. How many sides are there when the pattern is repeated three times? _____
4. What is the rule?_____
5. Use the rule to find how many sides there will be when the pattern repeats nine times. Circle your answer.

Draw your original pattern:

Patterns for Pattern Blocks

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

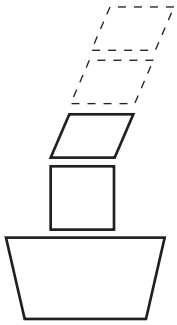


Name _____

What's the Rule? I

Steamship

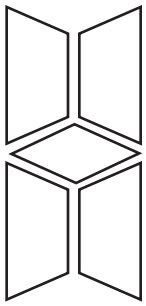
Puffs of Smoke	Number of Blocks
1	3
2	4
3	5
4	
10	



What's the RULE?

Pattern Path

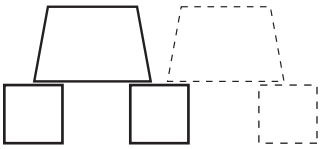
Red Bricks	Blue Bricks
1	4
2	6
3	8
6	
10	



What's the RULE?

Drawbridge

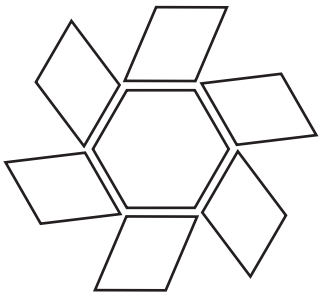
Posts	Bridge
2	1
3	2
4	3
5	
8	



What's the RULE?

Suns

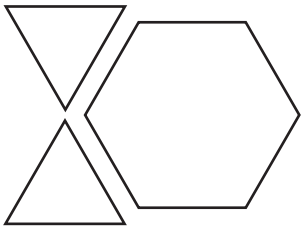
Sun	Rays
1	6
2	12
3	18
5	
11	



What's the RULE?

Fish & Fins

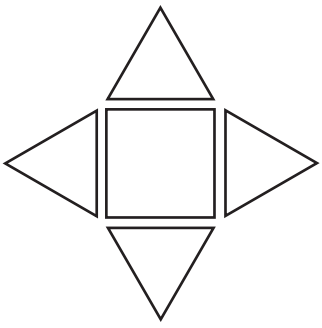
Fish	Fins
1	2
2	4
3	6
6	
12	



What's the RULE?

Building Flowers

Flowers	Petals
1	4
2	8
3	12
4	
10	



What's the RULE?

Name _____

What's the Rule? II

Fill in the missing numbers.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
a	8	11	9					12	18	14	16
b	5	7	8	10	12	25	15				
c	3	4	1	6	5	10					
d	2	3		4			11		6	0	16

	A	B	C	D	E	F	G	H	I	J	K
s	8	14	14	20	2				0	8	10
t	4	7	7				11	25			
u	6	8	10	20	9		17				
v	2	1	3	10		4					
w	8	9			17	20		25	30	20	55

Name _____

What's the Rule? III

Create your own, pass to a friend.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
a											
b											
c											
d											

	A	B	C	D	E	F	G	H	I	J	K
s											
t											
u											
v											
w											

Match the Rule Game Cards

9 and 3 15 and 5 24 and 8	n divided by 3	9 and 4 11 and 6 18 and 13	n – 5
1 and 10 3 and 30 7 and 70	n x 10	4 and 20 5 and 25 7 and 35	n x 5
0 and 0 8 and 1 24 and 3	n divided by 8	72 and 8 36 and 4 9 and 1	n divided by 9
2 and 7 3 and 8 4 and 9	n + 5	3 and 21 7 and 49 9 and 63	n x 7
5 and 12 15 and 22 25 and 32	n + 7	12 and 2 36 and 6 54 and 9	n divided by 6

1 and 4 2 and 8 3 and 12	n x 4	4 and 14 7 and 17 9 and 19	n + 10
6 and 4 9 and 7 15 and 13	n – 2	20 and 2 50 and 5 80 and 8	n divided by 10
10 and 5 8 and 4 6 and 3	n divided by 2	1 and 35 3 and 37 10 and 44	n + 34
7 and 1 10 and 4 15 and 9	n – 6	12 and 15 20 and 23 36 and 39	n + 3
9 and 2 11 and 4 16 and 9	n – 7	5 and 30 7 and 42 8 and 48	n x 6

Math Standard V-1 Activities

What Does Average Look Like?

Standard V:
Students will collect, analyze, and draw conclusions from data and apply basic concepts of probability.

Objective 1:
Formulate and answer questions using statistical methods to compare data.

Intended Learning Outcomes:
2. Become mathematical problem solvers.
4. Communicate mathematically.
5. Make mathematical connections.
6. Represent mathematical situations.

Content Connections:
Language Arts VI-1, VII-2, VIII-6; Science ILO 1, 4

Math Standard V

Objective 1

Connections

Background Information

Many students can calculate the range, median, mode, and mean of a set of numbers. But if asked what that looks like, students have difficulty expressing these concepts. This lesson will help students understand the concepts of range, median, mode, and mean through the use of graphs drawn from models. Students will use manipulatives to represent data that they have collected within groups. By using models, students can compare the differences between mode, median, and mean. Students should understand that the mean, median, and mode are just different ways of calculating what the "middle" is in a set of data. The range will be represented visually as students arrange their models from smallest to greatest. As students show a representation of the mean, the teacher can lead a discussion on the meaning of what the remainder represents. Depending on the students' background knowledge, the teacher can either have the students disregard the remainder or model how the remainder can be represented in fraction or decimal form.

Research Basis

Lappan, G., Fey, J., Fitzgerald, W. Friel, S. & Phillips, E. (1996). *Data about us*. Connected Mathematics Project, Palo Alto, CA.

"The mode, median, and mean are kinds of averages that are a part of representations and statistics used to analyze data." Students need to understand each of these measures and how they are applied and calculated. This article examines two ways in which the concept of "mean" can be demonstrated.

Hitch, C. & Armstrong, G. (1994). Daily activities for data analysis. *Arithmetic Teacher. 41*(1) 242-245.

"Children develop mathematical concepts by seeing them in a variety of settings." For students to understand statistics and graphs, they need exposure to the process of collecting, organizing, and describing data. This article describes useful activities that help students understand and display data.

Assessment Suggestions

- Students will be able to show understanding of the terms mean, mode, median, and range by:
  - Using their cubes to model the data they have collected in their groups.
  - Drawing their models in their journals using markers or colored pencils. They should have four illustrations—one for each vocabulary word/concept.
  - Having a written explanation next to each illustration explaining how they calculated the data.
- Median is not a concept that needs to be assessed in the 5th grade; however, it relates directly to understanding mean, mode, and range in a set of data.

Invitation to Learn

Display a set of objects such as various sizes of crayons on the overhead. Ask the students if they can tell what the average length is in the set of crayons. "Who can draw a picture on the board of what an average looks like?" "When do we use averages?"

Instructional Procedures

1. Tell students that they are going to learn four key math words today (range, median, mode, and mean) and that they will draw pictures about these words.
2. Hold up the *Vocabulary Matching Cards*. Read the words and their definitions to students. Explain that these terms will be used during the day's activities.
3. Discuss how graphs and charts represent data that was collected to answer a question (purpose). Explain that you need a question to answer before you can begin to collect data.

4. As a class, come up with a simple question for students to answer with a number that is between 0-10.

   Possible questions:

   – How many TV's are in your home?
   – How many pairs of shoes do you have?
   – How many times have you been to Disney Land?
   – How many hours a day do you read?

5. Display the question on the board.
6. Put the students into groups of three, five, or seven. This will make it easier to calculate the median.
7. Pass out 10 like-colored cubes per student and assign each student in the group a different color. Pass out 1 flat square to each student to use as a "0" if needed.
8. Tell students that they can use the cubes to make a tower that shows their answer to the class question. Have students in each group compare their answer (tower) with the others in their group. Have each group line up their towers in order from least to greatest.
9. Teach the concept of range. Tell the students that the highest tower is the maximum number in their set of data and that the shortest tower is the minimum number in their set of data. To find the range, they need to subtract the minimum from the maximum. Have each group calculate the range for their set of data. Refer back to the vocabulary definitions used at the beginning of the lesson. Have each student draw a picture of their group's towers (this should look like a bar graph) in their math journals. Have them write the equation that represents the range and an explanation of how they calculated it.
10. Ask students how many in their group have the same size tower. Explain that if they do, this is he mode. (Refer back to the vocabulary cards.) Have students draw a picture of the mode on their journals and give an explanation of how they calculated it. (The teacher should explain that groups could have more than one mode.)
11. Have the students line their towers up from least to greatest again. Explain that the middle tower represents the median. Have students draw and explain this in their journals. (This part of the activity is optional because this is not an assessed concept in the 5th grade.)

Materials

- ❏ Chart paper
- ❏ Markers/colored pencils
- ❏ Connecting colored cubes
- ❏ Flat squares of paper the same size as the cubes (This will be used to represent "0")
- ❏ Math journals (lined paper)
- ❏ *Vocabulary Matching Cards*

12. To teach the mean, ask students if all of them have the same size tower. Ask them how they would find the "average height" of their towers. (Many will be able to explain how to calculate it using paper pencil or a calculator.) Demonstrate how to show the average height of their towers by moving blocks until all the towers are the same height. Have them set the leftover blocks aside until you are ready to discuss remainders. (Give them time to manipulate their blocks.)
13. Explain that the remainder would have to be divided up evenly among the towers to make them truly even. This requires splitting wholes into parts. Have students estimate how much of each remaining block would need to be added to each tower to make them even. Demonstrate on the board using either decimals or fractions what that looks like.
14. Explain that an average is a way to "even" things out, and that all the towers should be the same size in their groups. Have students draw and explain this in their journals as before.
15. Have each group come up with their own questions to use to calculate the range, mean, mode, and median. Let them draw charts representing their data in their journals and share their results with the class.

Curriculum Extensions/Adaptations/Integration

- Students who have a difficult time writing may dictate their explanations to the teacher or another person and have them record it in student's journal next to the illustrations.
- Using the scientific method, have students create experiments where the data can be graphed using bar graphs, and the mean, median, range, and mode can be calculated.

Resources

Book

Navigating through Data Analysis and Probability in Grades 3-5, by Peggy A. House; ISBN 0-87353-521-9

Web sites

http://math.rice.edu/~lanius/Lessons/

http://score.kings.k12.ca.us/lessons.html

http://nces.ed.gov/nceskids/graphing/

Family Connections

- Have the students measure each member in their family and record the results. Use the information in a daily activity where students calculate the mean, mode, median, and range for the heights. Ask the students if they can tell by the data the age of the family members as it applies to range.

Vocabulary Matching Cards

Range	The difference between the greatest and the least number in a set of numbers.
Median	The middle number in a set of numbers arranged in order from least to greatest.
Mode	The number that appears most frequently in a set of numbers. There may be one, more than one, or no mode.
Mean	A number found by dividing the sum of two or more numbers by the number of addends. The mean is often referred to as the average.

The Human Line Plot

Standard V:
Students will collect, analyze, and draw conclusions from data and apply basic concepts of probability.

Objective 1:
Formulate and answer questions using statistical methods to compare data.

Intended Learning Outcomes:
2. Become mathematical problem solvers.
4. Communicate mathematically.
5. Make mathematical connections.
6. Represent mathematical situations.

Content Connections:
Language Arts I-1, VI-1, VII-2, VIII-6; Science ILO 1 & 4

Math Standard V

Objective 1

Connections

Background Information

Many students encounter the line plot in their textbooks but do not understand what it means or how it can be used to show data. Line plots deal with amounts and not categories. The X's on a line plot do not all have the same value.

Research Basis

Lappan, G., Fey, J., Fitzgerald, W. Friel, S. & Phillips, E. (1996). *Data about us*. Connected Mathematics Project, Palo Alto, CA.

"The mode, median, and mean are kinds of averages that are a part of representations and statistics used to analyze data. Students need to understand each of these measures and how they are applied and calculated. This article examines two ways in which the concept of "mean" can be demonstrated.

Hitch, C. & Armstrong, G. (1994). Daily activities for data analysis. *Arithmetic Teacher. 41*(1) 242-245.

"Children develop mathematical concepts by seeing them in a variety of settings." For students to understand statistics and graphs, they need exposure to the process of collecting, organizing, and describing data. This article describes useful activities that help students understand and display data.

Assessment Suggestions

- Assess each student's math journal to see that the frequency charts and line plots have been drawn correctly. Each student is

also responsible for including the data that their group compiled to share with the class. Students should be able to do this with 100% accuracy.

Invitation to Learn

Conduct an informal survey of how many times each student has had stitches. After collecting the data, ask students to predict the most, least, and average amount of stitches the students have had. Draw a frequency table and line plot on the board to represent the data.

Instructional Procedures

Materials

- ❑ 6' x 8' line plot numbered 0-8
- ❑ Markers/colored pencils
- ❑ Math journals

1. Set a paper line plot on the floor in front of the class.
2. Have the class generate a question (purpose) that can be demonstrated on the line plot, such as "How many pets do you have?"
3. Survey 15 students in the class for their answers. Have all the students record the data on a frequency chart in their journals.
4. Have the 15 students come up and stand next to the line plot by the number that represents their answer.
5. Have the rest of the students to look at the human line plot. Ask the following questions to the students who are not on the line plot:
   - How many students have 0 pets? 1 pet? 2 pets…8 or more pets?
   - What amount of pets is most frequent?
   - What is the range of this data?
   - How could we change the range? (Increase the highest amount of pets that you could have.)
   - What is the mode of this data?
   - What is the median of this data?
6. Continue by showing the class that you can start at each end of the plot and remove people one by one until you find the middle person standing. The number that person represents is the median.
7. Excuse the 15 students to sit down. Have the class come up with another question or purpose, such as "How many books a month do you read?"

8. Survey the rest of the class and have all the students record this information on a frequency chart in their math journals. Have the students that were surveyed come and stand next to the line plot by the number that represents their answer. Ask the class these questions:
   - How many students have read 0 books? 1 book? 2 books? 8 or more books?
   - How many books are most frequently read in a month?
   - What is the range of the data?
   - How could we change the range?
   - What is the mode of the data?
   - What is the median of the data?
9. Emphasize that each person by a different number represents a different value, and that in this case not all persons are equal. (If you have done the activity What Does Average Look Like, explain that the blocks in each tower had an equal value. Compare the people on the line plot who equal different values.)
10. Find the median of this data by showing the class that you can start at each end of the plot and remove people one by one until you find the middle person standing.
11. Excuse the students to return to their desks. Show the class a regular line plot with x's. Explain that each x represents a person that was on the human line plot. Compare this to the human line plot that they just created. Have the students draw a matching line plot for each frequency chart in their math journals.
12. Students work in groups to come up with their own survey, matching frequency chart, and line plot. They must also find the mode, median, and range for this data. Have them record the graphs in their math journals. Give each group time to present their data and charts to the class.

Curriculum Extensions/Adaptations/Integration

- Students who have a difficult time writing may dictate their explanations to the teacher or another person and have them record it in student's journal next to the illustrations.
- Use the human line plot activity to help students plot data they have been working with in science such as heredity.

- Students survey other classes and count the number of students in each class that can roll their tongue (heredity trait). After compiling all the data, create a frequency chart and matching line plot.

Resources

Book

Navigating through Data Analysis and Probability in Grades 3-5, by Peggy A. House; ISBN 0-87353-521-9

Web sites

http://math.rice.edu/~lanius/Lessons/

http://score.kings.k12.ca.us/lessons.html

http://nces.ed.gov/nceskids/graphing/

Family Connections

- This is an opportunity for students to do a different kind of "Chore Chart." Have students collect data on how many hours they spend a day/week doing chores at home. Compile the data for the entire class on a frequency chart and then represent the data on a huge human line plot. Have the class calculate the mean, median, mode, and range for the data.
- Students count the number of light switches that are in their house. During class, compile the information on a frequency chart and matching line plot.

Name _____

How Many Pets Do You Own?

Amount	Tally
0	
1	
2	
3	
4	
5	
6	
7	
8	

Name _____

How Many Books Do You Read A Month?

Amount	Tally
0	
1	
2	
3	
4	
5	
6	
7	
8	

Appendix

Name _____

Student Learning Styles

Check behaviors frequently observed.

Visual

- ☐ Takes notes regularly.
- ☐ Draws or doodles.
- ☐ Wants to look at the pictures.
- ☐ Needs eye contact to listen well.
- ☐ Chooses reading.
- ☐ Closely examines objects and pictures.
- ☐ Notices and comments on the visual aspects of things.

Auditory

- ☐ Chooses to listen to tapes.
- ☐ Follows verbal directions while appearing not to listen.
- ☐ Prefers music or singing.
- ☐ Likes and participates in oral discussions.
- ☐ Reads aloud to self.
- ☐ Sounds out words.
- ☐ Talks to self.

Tactile

- ☐ Touches object.
- ☐ Fiddles with objects in/on desk.
- ☐ Carries small objects around.
- ☐ Chooses to work with manipulatives.
- ☐ Grabs items.
- ☐ Plays with pencils, pens, eraser, etc.

Kinesthetic

- ☐ Walks around the room.
- ☐ Stands while working at desk.
- ☐ Jumps out of seat.
- ☐ Uses expressive body language.
- ☐ Enjoys physical activities.
- ☐ Volunteers to demonstrate or run errands.
- ☐ Volunteers to act and play roles.

Learning Styles Lesson Plan

Lesson Objective: _____

Visual	**Auditory**
Tactile	**Kinesthetic**

Name _____

Estimation Centers

1. Go to each of the estimation centers in the room and make an estimate.
2. Record your estimates on this record page.
3. You may use any method you would like, but may not make actual measurements.
4. If you don't have time to complete your estimations now, finish them during break or other free times during the day.
5. Take your *Daily Estimation Record Sheet* to today's afternoon session.

Weight Center

Item _____

Estimate _____g

_____kg

Distance/Length Center

Item _____

Estimate _____cm

_____m

Volume/Capacity Center

Item _____

Estimate _____ml

_____L

Name _____

Best Prices 1

Pal-Mart	Q-Mart
Pencils 10 for 50¢	Pencils 5 for 30¢

1. Which store has the best price for pencils, Pal-Mart or Q-Mart?

   _____

   Explain why. _____

   _____

2. If you needed 50 pencils, which store has the best price? Show your work and explain your answer.

   _____

   _____

Name _____

Best Prices 2

Crazy Crayons	Cool Crayons
12 for $2.40	16 for $2.88

1. If Sally needs 36 crayons, which package(s) would give her the best price?

   _____

   Explain and show your work._____

   _____

2. If Sally needs 96 crayons, which package(s) would give her the best price?

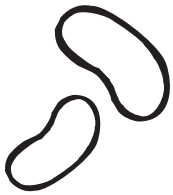
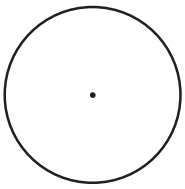
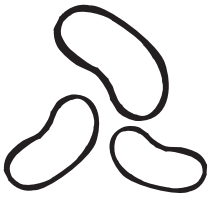
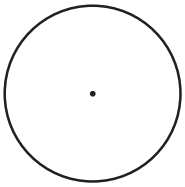
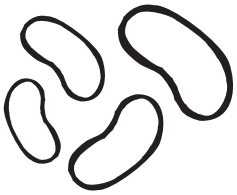
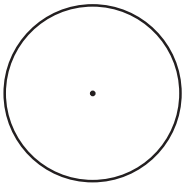
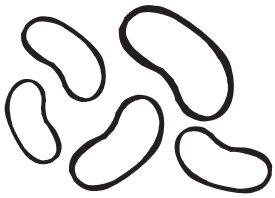
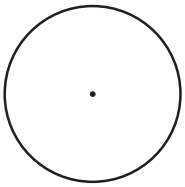
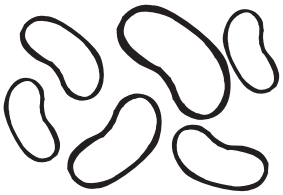
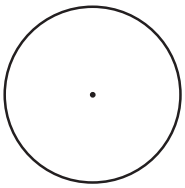
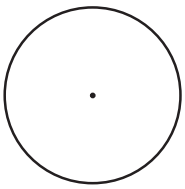
   _____

   Explain and show your work._____

   _____

Name _____

Activity Record Sheet

	Draw It	Example	Summarize Using Fractions
Round 1		Show 	1/2 = one red 1/2 = one yellow
Round 2		Show 	
Round 3		Show 	
Round 4		Show 	
Round 5		Show 	
Round 6		Show 	Use fractions to describe the jelly beans by color. Compare the data and make generalizations.

Sort jelly beans by color and record on this paper strip. Cut and curl around the circle. Use as a guide to mark the circle and make a circle graph.

Name _____

Coin Combinations

Use coin manipulatives to find as many ways as you can to make 50¢.

	# of Pennies Used	# of Nickles Used	# of Dimes Used	# of Quarters Used
Combination #1				
Combination #2				
Combination #3				
Combination #4				
Combination #5				
Combination #6				
Combination #7				
Combination #8				
Combination #9				
Combination #10				

Name _____

Coin Combinations

Use coin manipulatives to find as many ways as you can to make 50¢.

	# of Pennies Used	# of Nickles Used	# of Dimes Used	# of Quarters Used
Combination #1				
Combination #2				
Combination #3				
Combination #4				
Combination #5				
Combination #6				
Combination #7				
Combination #8				
Combination #9				
Combination #10				

Name _____

Coin Conversions

Represent the following amounts of money as a decimal, fraction, and percent. The first one has been done for you. Use coin manipulatives if needed.

	Decimal	Fraction Before Simplifying	Fraction in Simplest Form	Percent
10¢ (with dimes)	.10	1/10	1/10	10%
75¢ (with quarters)				
75¢ (with pennies)				
25¢ (with quarters)				
50¢ (with dimes)				
90¢ (with dimes)				
60¢ (with pennies)				

Challenge: Look at the fractions in the "Fractions Before Simplifying" column. Examine the denominators. Can you explain why only certain denominators were used? Why weren't there any 3's, 4's, 6's, used as denominators?

Name _____

Price Problem

Jackie, Alex, and Jason are all in the same fifth grade class. Almost everyone in their class has a fancy pen with feathers on the cap, and they want one too! That evening, they each convince their parents to take them to a store to buy a fancy pen with their allowance money. Each student went to a different store, but each store had these pens on sale. Each store sold the pens at a regular price of $1.00. Below are the advertisements for the sale each store was having.

The next day at school, Jackie, Alex, and Jason each showed up with two new fancy pens. Each was very proud of the deal they got, and they actually got into an argument over who saved the most money. Using the signs below, find out how much money each student spent on the two pens. Who should win the argument? Why?

The sign Jackie saw:	The sign Alex saw:	The sign Jason saw:
Fancy Pens! Buy one for $1.00 & Get $0.25 off the Second One!	**Fancy Pens! Buy one pen at regular price, and we'll take 25% off the Second Pen!**	**Fancy Pens! Buy the first pen for $1.00 & we'll take 1/4 of the price off the second pen!**

Name _____

Sports Math

For each teammate, including yourself, record the number of shots attempted and the number of shots made. Represent each stat as a fraction, decimal, and percent.

Teammate's Name	Number of Tries	Number of Shots Made	Fraction	Decimal	Percent

1. Which teammate had the highest percentage of shots made?

2. Which teammate had the lowest percentage of shots made?

3. Do you think the number of tries has a big effect on the percentage? Explain your answer.

Name _____

How Much is a Million?

Measure at least six items using customary and metric measurements. Record your measurements. Multiply each by 1,000,000 and place your answers in the appropriate box.

	Customary	Metric	A Million? (customary)	A Million? (metric)
Pencil				
Paper				
Paper Clip				
Penny (lay flat)				
Penny Roll				
Dollar Bill				
Ruler				
Other:				
Other:				

Which would reach the farthest? Explain.

Pick two items and explain what you could do with 1,000,000 of each.

*Use the above data table to help you create your *Millions Book*.

Name _____

Measuring Me

Measure different parts of your body using customary and metric units of measure. Choose an appropriate unit of measure. Record your measurements on this page.

My Measurements		
	Cutsomary	**Metric**
Head (circumference)		
Across Shoulders		
Arm (shoulder to wrist)		
Hand (wrist to end of longest finger)		
Waist		
Inseam		
Foot		

My Group (Customary)					
	Me	**2**	**3**	**4**	**Mean**
Head					
Shoulder					
Arm					
Hand					
Waist					
Inseam					
Foot					

My Group (Metric)					
	Me	**2**	**3**	**4**	**Mean**
Head					
Shoulder					
Arm					
Hand					
Waist					
Inseam					
Foot					

Reflect upon your investigation. Use the back of this page to explain how these measurements could be used in a real-world situation.

Name _____

Playground Measurement

1. Find something on the playground you think will measure about 3m or 300cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

2. Find something on the playground you think will measure about 10m or 1,000cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

3. Find something on the playground you think will measure about 1m or 100cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

4. Find something on the playground you think will measure about 5m or 500cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

5. Find something on the playground you think will measure about 1dm or 10cm.
   Object:_____
   Actual Measurement:_____ Difference + ___ or – ___

6. Find a face of a rectangular object or a rectangular plane object to measure. Be sure to measure the length and width.
   Object:_____
   Length: ___ Height: ___ Perimeter: _____

7. Choose an object to measure. Be sure to estimate before you measure.
   Object:_____
   Estimated Measurement:_____ Actual Measurement:_____

8. Choose an object that is not rectangular or square. Find its perimeter.
   How will you go about finding the perimeter?
   Perimeter: _____

Art Print Suggestions

Braque: *Still Life*

Brueghel, Pieter: *The Numbering at Bethlehem*

Cezanne, Paul: *House at Aixen Provence* and *The House of Pere Locroix*

Chagall, Marc: *I and the Village*

Daumer, Honore: *Notre Dame De Paris*

Davis, Stuart: *Combination Concrete*

Escher, M.C.: *Ascending and Descending* (this print has such a variety of angles that can be easily measured using a protractor) and *Waterfall*

Hurd Clement: *Goodnight Moon* (If a print is not available, the children's book can be used in place of the print.)

Kandinksy, Wassily: *Circles in a Circle*

Klee, Paul: *Castle and Sun*

Picasso, Pablo: *The Three Musicians, Violin and Guitar,* and *Paysage Mediterranean*

Rivera, Diego: *Flower Festival: Feast of Santa Anita, 1931*

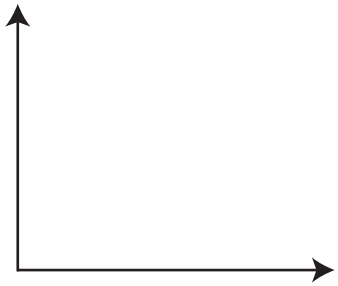
VanAllsburg, Chris: *Jumanji* and *The Mysteries of Harris Burdick* (children's books)

Wyeth, Andrew: *Bradford House*

Name _____

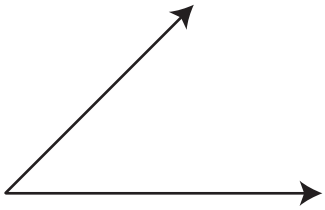
Angle Assessment

Estimate the measurement of each of the angles. Use a protractor to check your estimates.



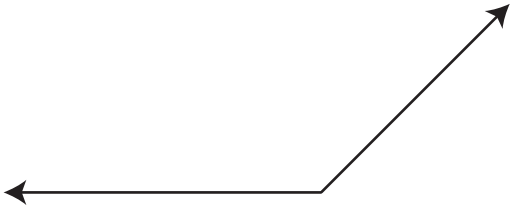
Estimated measurement:___

Actual measurement:___



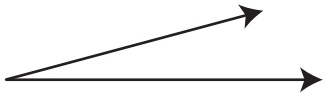
Estimated measurement:___

Actual measurement:___



Estimated measurement:___

Actual measurement:____



Estimated measurement:___

Actual measurement:____

Look at the clock to answer the following questions:

1. Name a time of day when the hands on the clock form a 180˚ angle.

2. Name a time of day when the hands on the clock form a 90˚ angle.

Use your protractor to create the following angles:

a. 45˚ angle

b. 80˚ angle

c. 165˚ angle

d. 170˚ angle

e. 110˚ angle

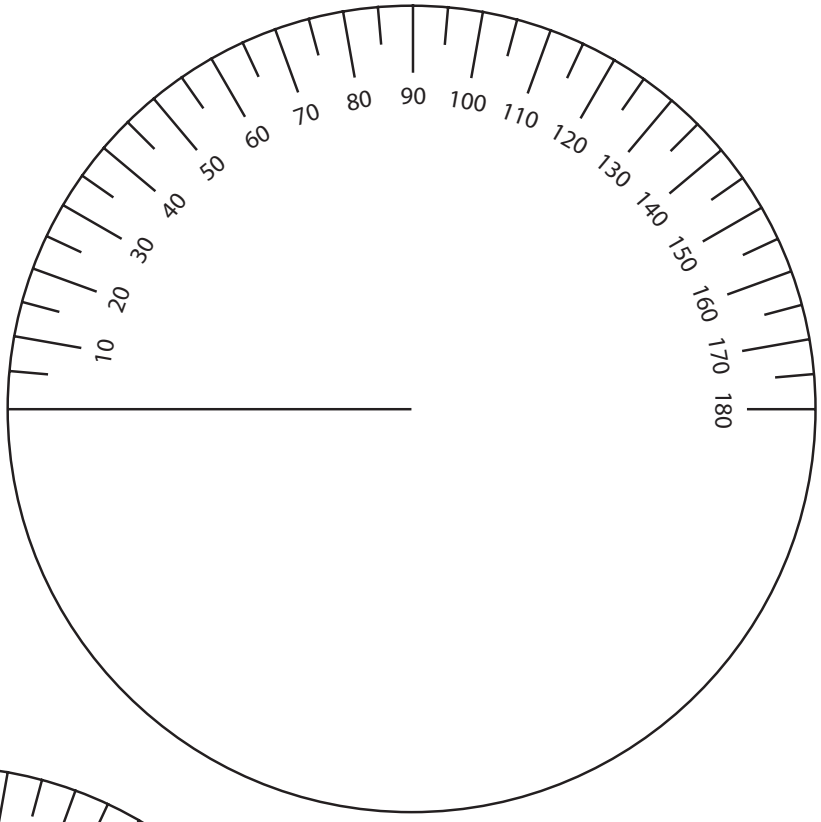
f. 20˚ angle

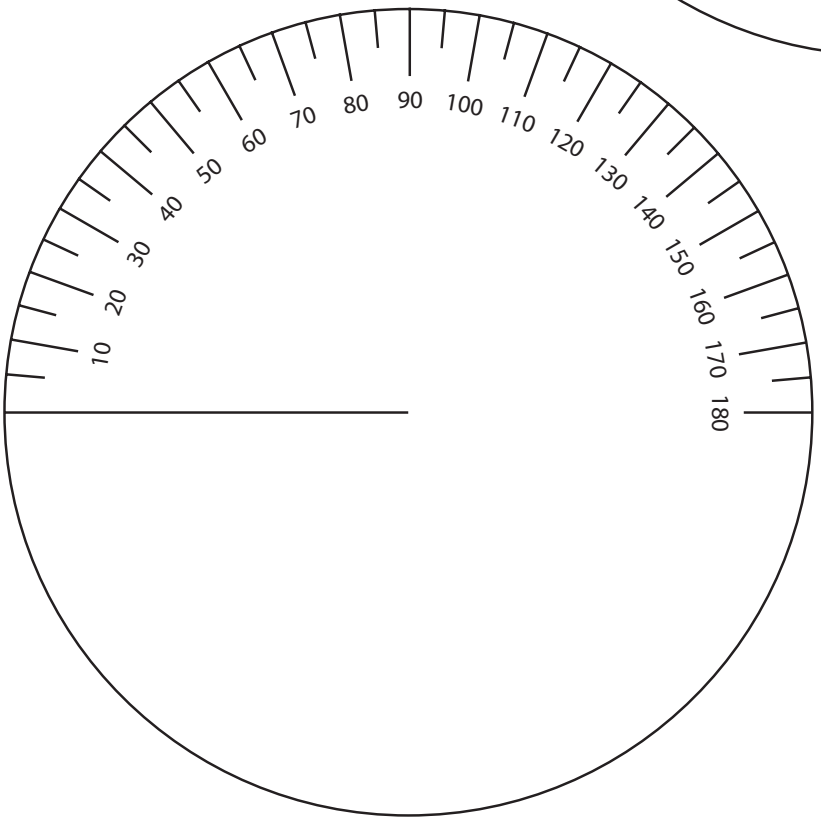
Construct an angle of your choice and measure it.

Angle measurement:____

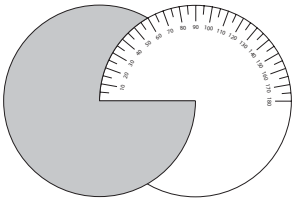
Angle Wheel Pattern Part A

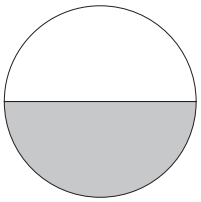
Copy on white cardstock.





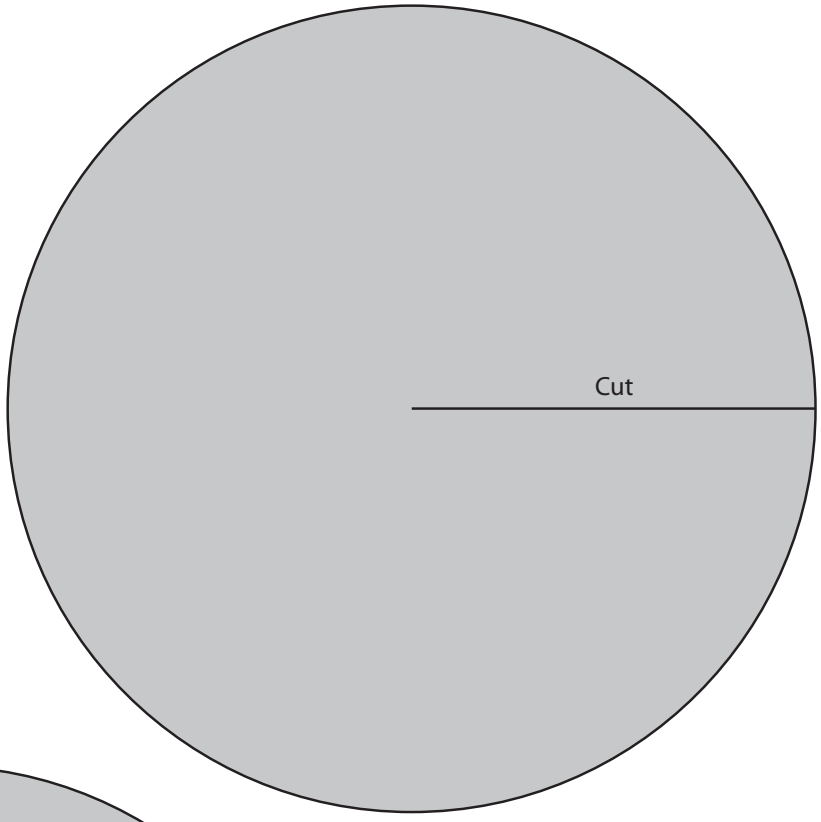
Rotate the circles around the center.
Use a brad to fasten the circles together.

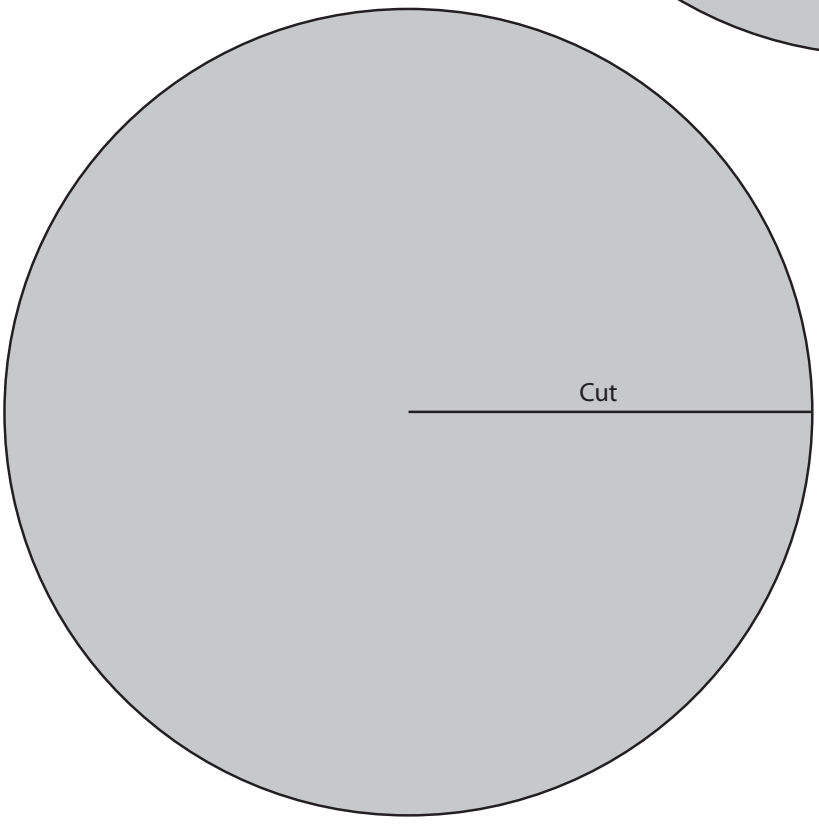




Angle Wheel Pattern Part B

Copy on colored cardstock.





Name _____

Centimeter Grid Paper

Name _____

Eye Spy a Pattern

Pattern	Solution
<table><tr><td>O</td><td>T</td><td>T</td></tr><tr><td>F</td><td>F</td><td>S</td></tr><tr><td>S</td><td>E</td><td>?</td></tr></table>	1. What letter belongs in the box with the question mark?
Pascal's Triangle 1 1 1 1 2 1 1 3 3 1 1 4 6 4 1 1 5 10 10 5 1 1 6 15 20 15 6 1 1 7 21 35 35 21 7 1 1 8 28 56 70 56 28 8 1	2. Can you predict the next row of numbers? Is there a patern in the sums of the numbers in the rows? Do any numbers repeat?
$1 \times 9 + 2 = 11$ $12 \times 9 + 3 = 111$ $123 \times 9 + 4 = 1111$ $1234 \times 9 + 5 = 11111$	3. What is the sequence in row 5? Does the pattern continue to grow for row 6?
Fibonacci Sequence 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, . . .	4. What are the next three numbers in the sequence? How do you know?
A A B A B C A B C D B B C B C D B C _ _	5. What letters (A, B, C, D) belong in the two empty spaces?

Hundreds Board

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

Name _____

Growing Patterns

Count and record the sides of each individual pattern block for the first column. Continue adding pattern pieces, then count the number of sides and record the amount for each column. Pattern blocks with sides touching count as one.

Number of Shapes used	1	2	3	4	5	6	What's the Rule?
Triangle							
Hexagon							
Square							
Rhombus							
Trapezoid							

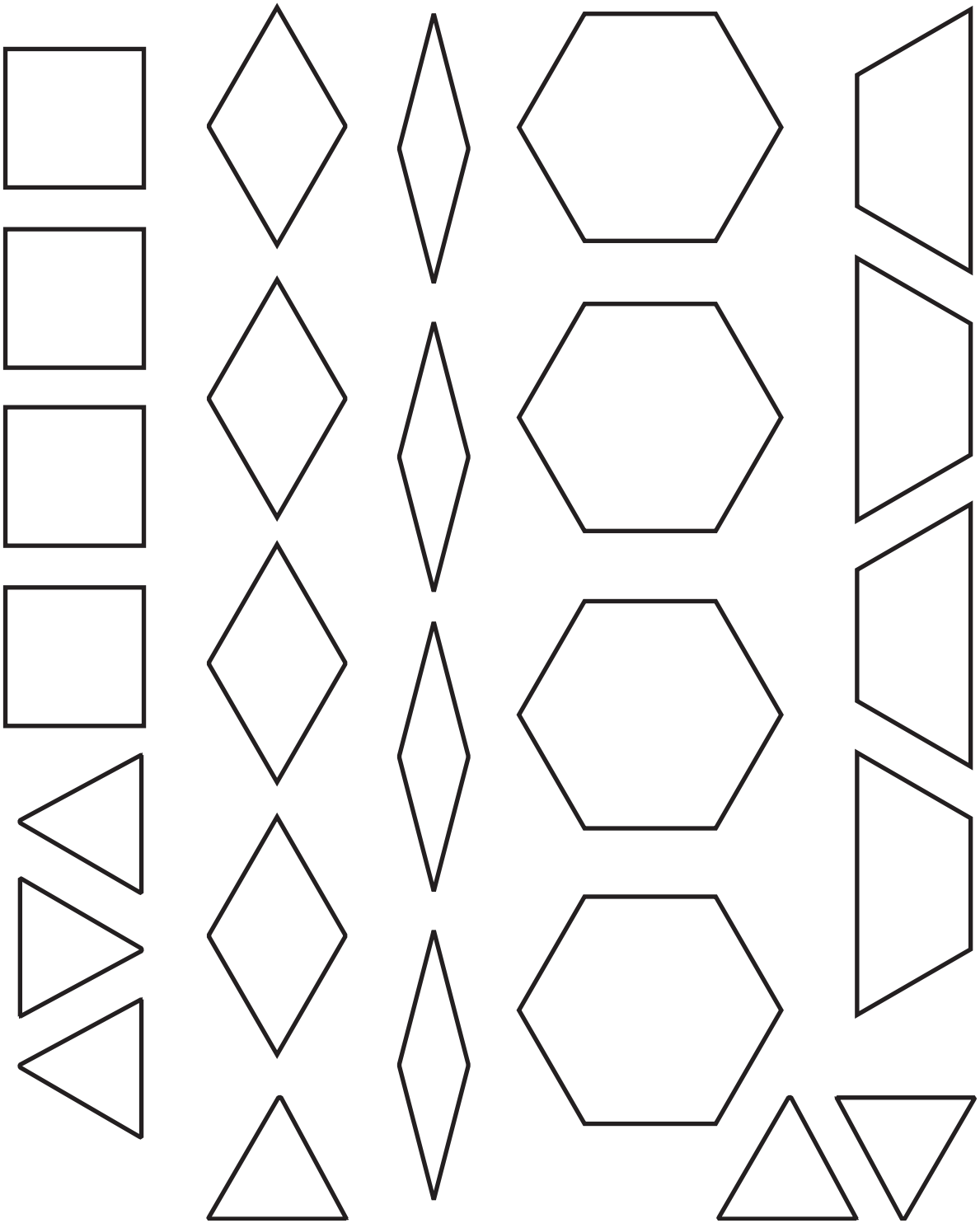
Create a pattern using three to five pattern blocks. Repeat this pattern two more times, then answer the questions.

1. How many sides are there in the original pattern?_____
2. How many sides are there when two patterns are side by side? _____
3. How many sides are there when the pattern is repeated three times? _____
4. What is the rule?_____
5. Use the rule to find how many sides there will be when the pattern repeats nine times. Circle your answer.

Draw your original pattern:

Patterns for Pattern Blocks

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

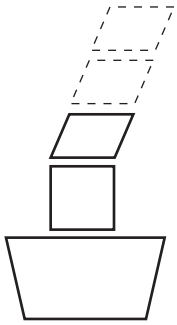


Name _____

What's the Rule? I

Steamship

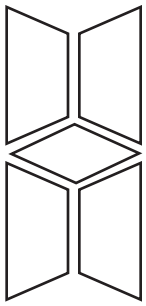
Puffs of Smoke	Number of Blocks
1	3
2	4
3	5
4	
10	



What's the RULE?

Pattern Path

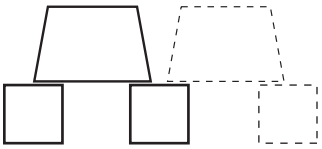
Red Bricks	Blue Bricks
1	4
2	6
3	8
6	
10	



What's the RULE?

Drawbridge

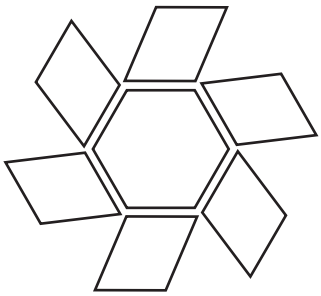
Posts	Bridge
2	1
3	2
4	3
5	
8	



What's the RULE?

Suns

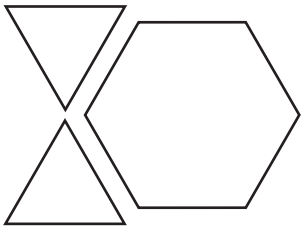
Sun	Rays
1	6
2	12
3	18
5	
11	



What's the RULE?

Fish & Fins

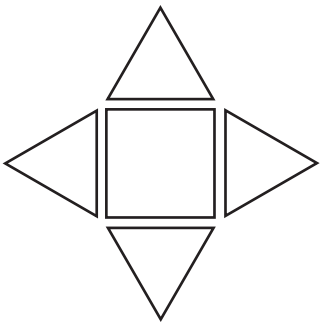
Fish	Fins
1	2
2	4
3	6
6	
12	



What's the RULE?

Building Flowers

Flowers	Petals
1	4
2	8
3	12
4	
10	



What's the RULE?

Name _____

What's the Rule? II

Fill in the missing numbers.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
a	8	11	9					12	18	14	16
b	5	7	8	10	12	25	15				
c	3	4	1	6	5	10					
d	2	3		4			11		6	0	16

	A	B	C	D	E	F	G	H	I	J	K
s	8	14	14	20	2				0	8	10
t	4	7	7				11	25			
u	6	8	10	20	9		17				
v	2	1	3	10		4					
w	8	9			17	20		25	30	20	55

Name _____

What's the Rule? III

Create your own, pass to a friend.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
a											
b											
c											
d											

	A	B	C	D	E	F	G	H	I	J	K
s											
t											
u											
v											
w											

Match the Rule Game Cards

9 and 3 15 and 5 24 and 8	n divided by 3	9 and 4 11 and 6 18 and 13	n – 5
1 and 10 3 and 30 7 and 70	n x 10	4 and 20 5 and 25 7 and 35	n x 5
0 and 0 8 and 1 24 and 3	n divided by 8	72 and 8 36 and 4 9 and 1	n divided by 9
2 and 7 3 and 8 4 and 9	n + 5	3 and 21 7 and 49 9 and 63	n x 7
5 and 12 15 and 22 25 and 32	n + 7	12 and 2 36 and 6 54 and 9	n divided by 6

1 and 4 2 and 8 3 and 12	n x 4	4 and 14 7 and 17 9 and 19	n + 10
6 and 4 9 and 7 15 and 13	n – 2	20 and 2 50 and 5 80 and 8	n divided by 10
10 and 5 8 and 4 6 and 3	n divided by 2	1 and 35 3 and 37 10 and 44	n + 34
7 and 1 10 and 4 15 and 9	n – 6	12 and 15 20 and 23 36 and 39	n + 3
9 and 2 11 and 4 16 and 9	n – 7	5 and 30 7 and 42 8 and 48	n x 6