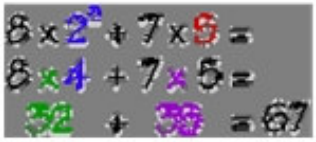
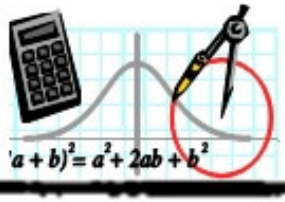
2007 Mississippi Mathematics Framework Revised

Strategies





Mississippi Department of Education
2007

2007 Mississippi Mathematics Framework Revised
Strategies

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SUGGESTED CURRICULUM GUIDE

The purpose of the "Curriculum Guide*"* is to assist school districts and teachers in the development of possible methods of organizing the competencies and objectives to be taught.

The curriculum guide is a set of teaching strategies designed to be only a starting point for innovative teaching. The suggested teaching strategies are optional, not mandatory. There may not be enough time to utilize every strategy in the curriculum guide. Most strategies in the curriculum guide are not fully developed and should be developed further by the school district and teachers.

KINDERGARTEN

Comp.	Obj.	Suggested Teaching Strategies
1	a	Practice rote counting forward to 10 and backward from 10 with motor activities. (For example: Students "grow" as they count forward and "shrink" as they count backward. Students clap as they count forward and snap as they count backward. Students take baby steps forward as they count forward and baby steps backward as they count backward.)
1	a	Read stories with counting forward and backward patterns such as *Ten in the Bed* by Penny Dale, *Five Little Monkeys* by Eileen Christelow, and *Mouse Count* by Ellen Stoll Walsh. Students predict the number that will be on the next page. Record and illustrate numbers as they appear in the book. Extension: Have students use manipulatives to model each number in the story.
1	a, b, c	Display a set of objects to 20 on the overhead. Students count the objects and write the number the set represents on a dry erase board.
1	a, b	Place 0 to 20 objects in a "Guessing Container." Students estimate how many objects are in the container. Count the objects to compare the estimation with the actual and discuss "reasonable estimates." Repeat with same sized container and different objects and different sized containers and same objects.
1	b	Use manipulatives such as bear counters, unifix cubes, buttons, etc., to build and count sets of 20.
1	b,c	Create number spinners or number cubes to 20. Have students spin the spinner, identify the number, and use manipulatives to represent the number.
1	e	Place ten students in a line and give instructions to particular students (For example: "If you are second in line, pat your head."). Demonstrate how to find that student using ordinal numbers. Also incorporate the vocabulary (next, last, before, after).
1	e	After reading a story such as *I Know an Old Lady Who Swallowed a Fly* by Mary Ann Hoberman to students, chart the sequence of the events using terms first, second, third, last, etc.
1	f	Model a story problem using Goldfish, Cheerios, or Fruit Loops. Model story events by adding or subtracting the appropriate number of objects.
1	f	Tell "People Problems," (such as "There Were Five Children Playing Ring-Around-the-Rosies. One child came to join them. How many children are playing?"; "There are four girls standing. The girl with pigtails sat down. How many girls are left standing?"; etc.). Students act out story and the teacher writes the corresponding addition or subtraction equation, discussing the meaning of the operations.

KINDERGARTEN

Comp.	Obj.	Suggested Teaching Strategies
1	f	Provide students with a two-column work mat and five unifix cubes of one color and five unifix cubes of another color to work guided addition problems. The teacher rolls a 0 to 5 number cube. The students build the first addend on the left side of the work mat with one color. The teacher records the first addend. The teacher rolls the number cube again. The students build the second addend on the right side of work mat with the other color. The teacher records the second addend. The students find the sum of the two addends. The teacher will record sum, completing the equation. Repeat.
1	f	Provide students with a work mat and ten unifix cubes of the same color to work guided subtraction problems. The teacher rolls a 5 to 10 number cube. The students build the minuend on the work mat. The teacher records the minuend. The teacher rolls a 0 to 4 number cube. The students take away the subtrahend, covering it with their hand. The teacher records the subtrahend. The students count what is not covered/taken away to find the difference. The teacher records the difference, completing the equation. Repeat.
1	g	After counting sets of objects, compare the sets using the terms too much, not enough, just right, more than, less than, and equal to.
2	a	Provide students with sorting trays and a variety of objects (pattern blocks, buttons, shells, etc.). Students sort by attribute and explain reasoning. Encourage students to sort in more than one way.
2	a	Read *Gray Rabbit's Odd One Out* by Alan Baker. Discuss how objects are sorted and why one object did not belong. Present a bag of objects (For example: A bag filled with a paintbrush, a crayon, a marker, a pencil, and a container of play dough). The students determine how the bag was sorted and which item does not belong (For example: The play dough does not belong). Repeat with other bags of objects.
2 5	a a	Read *Shoes* by Elizabeth Winthrop. Discuss the different kinds of shoes in the book. Have each student take off a shoe. Sort the shoes by attribute (For example: shoes with laces and shoes without laces). Use shoes to create a real graph. Discuss and analyze data, making comparisons. Repeat sorting by another attribute.
2 5	a a, b	Ask each student to bring a favorite fruit to school. Discuss and sort fruit. Create a real graph using the fruit. Discuss and compare data. Create a pictograph and discuss using terms "more," "less," and "same."
2	b	Lead students in a game of "Pattern Copy Cat." The teacher will play a simple pattern with rhythm sticks and have students echo. The teacher will clap a simple pattern and have students echo.
2	b	Create "People Patterns" using students. Discuss pattern and what would come next if the pattern was continued (for example: boy, boy, girl, boy, boy, girl, boy, boy, girl...).

KINDERGARTEN

Comp.	Obj.	Suggested Teaching Strategies
2	b	Provide pattern starter cards and a variety of manipulatives such as (cereal, unifix cubes, buttons, bottle tops, etc.). The students model, discuss, and extend a pattern.
3	a	Students trace a pattern of a shape using inside stencils. The students count and write the number of sides on the shape. Repeat with other shapes. Cut out shapes to make a mobile.
3	a	Model open and closed figures using a piece of yarn. (Open means ends of yarn do not touch. Closed means ends of yarn touch.)
3	b	Provide students with string. The students work together to create different two-dimensional shapes. Discuss how the shapes were created and their characteristics.
3	b	Have students explore the environment to find examples of squares, rectangles, circles, and triangles. Discuss the characteristics of each shape.
3	c	Play "Simon Says" using a theme related object such as a block. Students follow directions with positional words to manipulate object. (For example: "Put the block over your head."; "Put the block behind your back."; etc.)
4	a,b	Using adding machine tape, measure the height of all students. Arrange the lengths in order from shortest to tallest. Compare and discuss using the terms shorter/taller.
4	a,b	Allow students to compare the weight of classroom objects (For example: a pencil and a book). Compare and discuss using the terms lighter/heavier.
4	a,b	Investigate and compare the weights of objects (such as feather, block, box of crayons, pencil, glue, etc.) using a balance scale. Discuss heavier/lighter and more/less. Extension: Use ceramic tiles to weigh an object on a balance scale.
4	a	Explore measuring the length of objects using non-standard units of measurement (such as unifix cubes, popsicle sticks, tiles, etc.). Help students align non-standard units correctly to measure. Students will place units end to end, not overlapping units, and leaving no gaps.
4	b	At the sand table, explore and compare how much different containers hold using terms "more," "less," and "about the same."
4	b	Use a small scoop to fill assorted containers with rice. Compare the number of scoops using terms "more," "less," and "about the same."

KINDERGATEN

Comp.	Obj.	Suggested Teaching Strategies
4	c	Use a large Judy Clock to discuss how an analog clock is divided into minutes and hours and how the minute and hour hand work to tell time. Simulate clockwise motion. Provide students with a blank clock face with missing numbers. Provide students with number pieces. Students will fill in the numbers correctly. Have students identify the minute and hour hands.
5	a	Chart the weather each day of the week with calendar math. Use symbols to represent the weather of the day to create a pictograph. Discuss patterns and trends in weather.

FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a	Students practice rote counting on a daily basis. When counting forward, clap on every change in tens. Mastery of counting forward is a prerequisite to counting backward. With counting backward, count from 10 to 0. When students have mastered this, count from 20 to 0. Add a new decade until counting from 100 to 0 has been mastered.
1	a	Students use both a 0-99 chart and a 1-100 chart, pointing to the numbers as they count forward and backward. Students fill in a blank 10-by-10 grid (both 0-99 and 1-100.) The grid may be tailored such that tens are added upon mastery.
1	a,c	Call out a number from 0-99 or 1-100. Have students locate the number on the corresponding chart. Have students write the number on a dry erase board. Use vocabulary terms “more,” “less,” “greater than, “equal to,” “almost”, etc., to compare numbers on the grid.
1	a,b,c	Have boxes or bags with 1-100 of the same items in them. Items may include small manipulatives or small objects (such as buttons, bottle tops, old postage stamps, shells, etc.). Students will determine how many items are in a box/bag by counting by tens and ones. Use portion cups to place groups of tens. Students count portion cups by tens and the extras by ones. Students name and write number in standard and expanded form. For example: 6 portion cups (tens) and 3 extras (ones) equal the number 63. 6 tens + 3 ones = 63 60 + 3 = 63 After students have worked with three different boxes/bags, have the students compare the numbers and explain how they knew which was less, more, equal to, etc.
1	a,b,c	Prepare a large 0-99 or 1-100 chart and laminate it. Play “Guess My Number.” The teacher chooses a number. Students must ask yes and no questions to determine special number. Encourage questions that use before, after, between, greater than, less than, or knowledge of patterns on the chart. (For example: “Is your number greater than 50?”, “Does your number have a 3 in the tens place?”, “Is your number in the fifty family?”, etc.) Cross out numbers that can be eliminated by questions explaining why they can be crossed out. Continue until the special number is found.
1	b	Display a place value board that shows compartments for ones, tens, and hundreds. Use base ten blocks to model two-digit and three-digit numbers. Students pull a number out of a bag and build. Students count base ten blocks and discuss the number, attaching meaning to the digits. Students name and write number.

FIRST GRADE

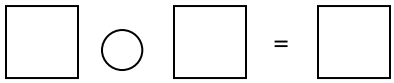
<table>
<tr><th>Comp.</th><th>Obj.</th><th>Suggested Teaching Strategies</th></tr>
<tr><td>1</td><td>b</td><td>Create student task bags by dividing index cards in half. On the top half, write two-digit numeral name and stamp with corresponding base ten block stamps. On the bottom half, write the numeral. Cut the index cards in half. Have the students empty their bag and match the numeral with its correct name and representation.

Extension: Divide index cards into thirds. On a third of the cards, write the numeral name and stamp with corresponding base ten block stamps. On the second third, write the numeral. On the last third, write the expanded notation form. Have students match.</td></tr>
<tr><td>1</td><td>b,d</td><td>Choose a certain number to work with. For example, provide students with 5 red unifix cubes and 5 blue unifix cubes. Students will combine the cubes to create sets that equal five. Encourage students to find and record all the different combinations and their equations.
<table>
<tr><th>Red</th><th>Blue</th><th>Total</th><th>Number Sentence</th></tr>
<tr><td>5</td><td>0</td><td>5</td><td>5 + 0 = 5</td></tr>
<tr><td>4</td><td>1</td><td>5</td><td>4 + 1 = 5</td></tr>
<tr><td>3</td><td>2</td><td>5</td><td>3 + 2 = 5</td></tr>
<tr><td>2</td><td>3</td><td>5</td><td>2 + 3 = 5</td></tr>
<tr><td>1</td><td>4</td><td>5</td><td>1 + 4 = 5</td></tr>
<tr><td>0</td><td>5</td><td>5</td><td>0 + 5 = 5</td></tr>
</table></td></tr>
<tr><td>1</td><td>c</td><td>Compare numbers using comparison terms. Students do “Math Exercises” by selecting an exercise such as knee bends, toe touches, jumping jacks, and counting by 1’s, 2’s, 5’s, and 10’s while performing the exercises.</td></tr>
<tr><td>1</td><td>c</td><td>Write numbers 0-100 on tag board cards. Give to students in sets of 3. Students sequence the numbers in order from least to greatest or from greatest to least. Ask before, after, and in between questions.</td></tr>
<tr><td>1</td><td>d</td><td>Provide spoons and cereal to play “Subtraction Munchies.” Students scoop a spoonful of cereal and count out total on workspace, recording minuend. Students determine how many to “eat” (take away), recording subtrahend. Students find difference and record, writing a complete subtraction equation. Repeat.</td></tr>
<tr><td>1</td><td>d</td><td>Provide students with unifix cubes. Each student should receive two trains of 9 in two different colors. Call out a 9 + __ fact, for example, 9 + 4. Students show with one 9 train and 4 extras. Students take one of the 4 extras and place it on 9 train to form a “fast ten.” Now, the students have 10 + 3, making the equation easier to solve because they know teen numbers are 10 + __. 10 + 3 = 13</td></tr>
</table>

FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	d	Provide students with dominos. Students choose a domino and write corresponding addition and subtraction number sentences. For example, a domino with 6 dots on the left and 0 dots on the right would have the following equations: 6 + 0 = 6 0 + 6 = 6 6 – 6 = 0 6 – 0 = 6 Include doubles to illustrate that doubles have only 1 addition and 1 subtraction fact. For example, a double 4 domino would have the following equations: 4 + 4 = 8 8 – 4 = 4
1	d	Create a chart that has been divided into 3 sections labeled “Less Than 10,” “Exactly 10,” and “More Than 10.” Provide partners with playing cards where face cards have been removed and aces have been turned into ones. Also provide partners with a chart. Students will draw 2 cards at a time, recording addition sentence under appropriate column. Repeat until all cards have been used. Students use strategies such as fast tens and doubles plus and minus 1 to help solve. Extension: Collect data from partnerships and tally how many times sums were less than ten, exactly ten, and more than ten. Discuss results and explain why results occurred the way they did. Predict if results would happen the same again. Repeat activity to see and discuss.
1	d	Create 2-digit addition task cards. (Make sure that you do not have to regroup when adding ones.) Students choose a task card. Students “build” the first addend with base ten blocks on a place value board. Then the students “build” the second addend with base ten blocks on the place value board. Have the students pull down the ones and find the sum. Then have them pull down the tens and find the sum to determine total. (This can be easily adapted for subtraction).
1	d	Provide students with examples of problems such as Jenny has 4 dolls. Together Jenny and Pam have 10 dolls. How many dolls does Pam have? or Mom baked 2 pans of cookies with 10 cookies on each pan. How many cookies did she bake in all? Have students draw examples of the problems and write the corresponding equations and bind for a class book. Have students present how they solved the problem.

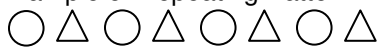
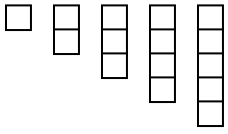
FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	d	Provide students with lima beans. Choose a particular number to work with to explore algebra with missing addends and subtrahends as you play "The Hand Game." For example, choose the number 10. Students will work with a partner. Partner 1 will be the "hand person." Partner 2 will be the "problem-solver." Partner 1 takes 10 lima beans and places some in left hand and some in right hand. For example Partner 1 puts 6 lima beans in left hand and 4 lima beans in right hand. Partner 1 opens left hand to reveal 6 lima beans, keeping right hand closed Partner 2 determines how many lima beans are in right hand using knowledge of the total number of lima beans provided. Repeat.
1	d	Provide a teacher-made folder game that looks like the following:  The rectangles will hold the number cards drawn. The circle will hold the appropriate operation sign (+ or □) depending upon how the students use the numbers. Provide a deck of cards numbered 0-10. Also provide a circle + card and a circle - card. Students work with a partner. Each player will draw a card. The students will use the two numbers drawn to make equations that will explore a missing addend, sum, minuend, subtrahend, or difference. For example: The cards drawn are 5 and 9. The students could do the following: $5 + \_\_\_ = 9$ $9 - 5 = \_\_\_$ $9 - \_\_\_ = 5$ $\_\_\_ + 5 = 9$
1 2	d c	Use commercial manipulatives (pattern blocks, unifix cubes, soft counters, etc.) or consumable manipulatives (Teddy Grams®, Cheerios, Goldfish, etc.) to create, model, and act out a variety of story problems involving addition, subtraction, missing addend, minuend, and subtrahend.
1	e	Take an egg carton and write a number in each space (0- 5 or 0-9). Place 3 small beans in the carton and close. Students shake carton and open to reveal where the three beans landed. Students write a number sentence with three addends and solve.
1	h	Provide students with magnifying glasses and real coins (1 each--penny, nickel, dime, and quarter.) Provide students with a recording sheet. Students work with a partner to find all the characteristics of each coin, recording words, drawings, and descriptions on recording sheet. Discuss in whole group and chart on class chart. Titles on the recording sheet should read: Penny, Nickel, Dime, and Quarter. They should then record all the characteristics of each coin. Discuss how the coins are alike and different.

FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	i,j	Demonstrate that counting pennies, nickels, and dimes is the same as counting by 1's, 5's, and 10's respectively and that 100 pennies equals $1.00, 20 nickels equals $1.00, and 10 dimes equals $1.00. Make a chart showing the value of one, two, three, and four quarters.
1	g,h,i,j	Play "Coin in My Pocket." The teacher places a coin in her pocket. The students ask yes and no coin characteristic questions to discover what coin is in the teacher's pocket. Students may not ask, "Do you have a quarter?" Students could ask, "Does your coin have rough edges?" "Does your coin have a building on the back?" "Does your coin have a torch and flame on the back?" Students use questions to eliminate coins. Play continues until the correct coin has been discovered. This game can be made more challenging by presenting the following situations: I have 20 cents in my pocket. Ask me interesting questions to discover what combination of coins I have. I have three silver coins in my pocket that are worth 25 cents. Ask me interesting questions to discover what coins are in my pocket.
1	i,j	Play "Spoonful of Money." Provide students with a bag of assorted real coins and different sized measuring spoons. (The larger the size of the spoon, the more challenging the activity becomes.) The students select a spoon and scoop a spoonful of money from the bag. The student sorts the coins from greatest to least value. The student records how many of each type of coin they have. The student counts to find total value (up to $1.00) and records. Repeat.
1	g,h,i,j	Play "Make the Price." Provide students with a choice of small items (toys, household items, etc.) that have been labeled with a price. Provide students with a bag of real coins and a recording sheet that has been divided into four sections. Students choose a toy and label price on recording sheet. Students create at least 3 different coin combinations that equal the price, recording by drawing combinations or by using money stamps (up to $1.00).
2	a	Model and extend patterns (with units such as AB, ABB, ABC, ABA, etc.) using large motor skills (such as stomp, clap, slap, snap, jump, etc.). A unit must be repeated at least two times to be a pattern. Explain patterns and show with real objects.
2	a,b,d	Add small beans, two at a time on the overhead. Count the beans and circle the correct number on 0-99 or 1-100 grid with each addition. Discuss the resulting pattern that every other number is circled, that you are counting on or adding 2 each time, which is the counting by 2's pattern. Repeat the activity with 5's and 10's.

FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
2	a	Play "What's My Rule?" Using a commercial 10-by-10 grid pocket chart, fill in with numbers 0-99 or 1-100. Using colored squares cut from transparencies, cover a pattern (such as: "All the numbers have a four in the ones place;" or "All the numbers are two-digit numbers that are made with the same digit;" or "All the numbers are even numbers;" etc.) Students discuss pattern and explain the rule followed.
2	a	Create 5 key cards each labeled with a different letter pattern. Create 5 task cards for each letter pattern, translating with stickers, stamps, number patterns, drawings, etc. (Each unit should be repeated at least three times on key cards and task cards.) Students get key cards and study letter patterns and their unit of pattern Students then sort task cards under appropriate letter pattern key card. As students sort like patterns into groups have them explain why they are the same.
2	a,b	Prepare a variety of pattern starter cards for unifix cubes and pattern blocks. For unifix cubes, color pattern on tag board. For pattern blocks, glue construction paper pattern blocks on tag board or use pattern block stamps and color. Repeat pattern unit at least three times for repeating patterns. For growing patterns, show progression of pattern at least three times. (Note: Growing patterns may show numbers in increasing or decreasing order or show buildings increasing or decreasing in size.) Example of Repeating Pattern:  Example of Growing Pattern:  Students choose pattern starter card. Students identify the unit of the given repeating pattern or the growing pattern rule. Students copy, extend and explain pattern.
2	a,b,d	Give each student a 0-99 or 1-100 chart and colored overhead discs. (Overhead discs are translucent and allow students to still see numbers.) Have students cover a variety of number patterns.
2	b	Have students build a unifix cube train one cube at a time, stopping between additions to discuss the pattern of adding one and writing corresponding equations. Have students build a unifix cube train of ten. Remove one cube at a time, stopping to discuss the pattern of subtracting one and writing corresponding equations. Repeat activity with different adding and subtracting rules such as plus/minus 2, plus/minus 3, etc.
2	b	Use cumulative growing patterns in children's literature to develop patterns of addition and subtraction. Use books such as *Fish Eyes* by Lois Ehlert, *One Cow Moo, Moo* by David Bennett, and *Ten in the Bed* by Penny Dale.

FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
2	b	Play "Show Me the Pattern." Give students a rule (such as: "The numbers all have a five in them;" or "I began with 6 and added 10 each time." Students use transparency squares to highlight pattern. Students explain how they know the numbers covered follow the pattern rule.
3	a	Review two-dimensional shapes by going on a "Shape Hunt." Have students record the real-world objects they find. Create charts for basic shapes and classify the real world objects on charts. Discuss characteristics of each shape and discuss how the shapes are alike and different. Extension: Prepare pieces of construction paper with a cut out shape glued to each. Give each student one paper. Ask students "What can you make with a shape." Have students refer back to charts. Students use pencil, crayons, and markers to create something from the shape. (For example: The student might create a Christmas tree from a triangle, a wagon from a rectangle, etc.)
3	a	Students will use pattern blocks and sort them according to attributes such as four sides and four angles, three sides and three angles, etc. Describe and compare triangle, square, trapezoid, rhombus, parallelogram, and hexagon.
3	a	Use attribute blocks to review characteristics of shapes.
3	b	Use three-dimensional shape models to discuss characteristics and how the three-dimensional shapes are alike and different (For example: sort by like faces.) Have students bring real objects from home that are three-dimensional. Sort into spheres, cubes, rectangular prisms, cylinders, cones, and pyramids. Discuss which three-dimensional shapes there are more of and discuss possible reasons why. Extension: Use three-dimensional shapes students brought in and three-dimensional shape models. In a large circle, place one three-dimensional shape for each student. Play "Musical Three-Dimensional Shapes." Turn music on. Students must walk clockwise around the circle until the music stops. When the music stops, each student stands by a three-dimensional shape. The teacher will call out a direction such as "Give a thumbs up if you are standing by a shape that has a circle face." Ask other questions like "Raise your hand if you have a shape with 4 triangle faces and 1 square face."
4	a	Read the story *How Big is A Foot*? by Rolf Myller. Discuss why the bed for the queen did not end up the right size. (The king measured with his "big" foot and the apprentice measured with his "little" foot.)

FIRST GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	a	Measure classroom objects with nonstandard units such as popsicle sticks and unifix cubes. Have students make estimates and check by measuring. Students record findings. Help students use nonstandard units to accurately measure, lining them up from end to end without overlapping or leaving gaps. Discuss why the measurements of the same object are different when using popsicle sticks versus unifix cubes. Note: Experiences and discussions like these with nonstandard units will help students understand the need for standard units and measuring units, helping students develop the awareness that different measuring tools will yield different numerical measurements.
4	b	Provide students with a balance scale and small objects (such as a box of crayons, a bottle of glue, a marker, a box of raisins, a pencil, an eraser, etc.) Have students predict which objects are lighter and heavier. Students will use a balance scale to compare objects. Students may order objects from lightest to heaviest or from heaviest to lightest.
4	c	Provide students with various size containers, a scoop, rice, and a recording sheet. Students will choose a container and estimate how many scoops of rice it will take to fill the container. Students will find the actual measurement and compare to estimate.
4	d	Use a large Judy Clock to model the direction and movement relationship of the clock hands, discussing seconds, minutes, and hours. Model telling time to the hour and half-hour. Relate counting how many minutes past an hour by counting by fives, discussing how the clock is divided into five-minute intervals from 0 to 60. Relate thirty-minutes past an hour to half-past. Show students a digital clock time and have the students place hands on small Judy Clocks to tell corresponding analog time.
5	a,b	Have students predict which color apple most students in the class will like best: red, yellow, or green. Have a "Taste test." Make a tally and/or bar graph to show which apple students like best. Extension: Have students predict if it is "likely" or "unlikely" for another class to like the same apple best. Have a neighboring class repeat activity and share results. Discuss in terms of "always," "maybe," "sometimes," "never," etc. Polling several classes (getting a larger sample) will enable students to see patterns and trends that will help them analyze data to make more reliable predictions.

SECOND GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a	Use vocabulary words to form addition and subtraction sentences. Select two words or students' names and count the number of letters in each word with the students. An addition and subtraction problem can be formed from these words. Example: Amy + Lorenzo 3 + 7 = 10 Create addition and subtraction problems to be shared and evaluated by classmates.
1	b	Demonstrate how to add and subtract numbers using vertical and horizontal format. Use grid paper to practice keeping numbers lined up. The teacher will write various addition problems containing two- and three-digit whole numbers on the board. (There should be a mixture of problems with and without regrouping.) The student will demonstrate and model the problems using base ten manipulatives. Practice using base ten blocks and base ten work mats.
1	c	Play "Concentration" with numbers in standard, word, and expanded forms.
1	c	The teacher will write a three-digit number on the board. The students will model the number using base ten blocks and a base ten mat. The students will record their findings on a recording sheet in expanded form. (ex. 300+ 20 + 9 = 329)
1	c	Use an Abacus constructed from a shoebox lid to show place value using four-digit numbers. Construct work mats and use unifix cubes or base ten blocks to demonstrate place value.
1	d	Use a number line to help with rounding.
1	e	Have groups of students roll number cubes to generate three-digit numbers. Write the numbers on dry erase boards with a middle space to fill in the appropriate symbol of equality or inequality. Have groups justify their choices.
1	f	Use real money or facsimiles to count coins. Have students arrange a variety of coins from highest to lowest value. Count coins from greatest to least value. Remind students to count by ones, fives, and tens when counting pennies, nickels, and dimes.
1	f	Given a money amount up to $1.00, have students use play money or money stamps to show the same amount in different ways. While working in pairs, have one student write an amount of money less than $1.00 on a card, and have the other student use coins or stamps to illustrate the amount shown on the card.

SECOND GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	f	Display a penny, nickel, dime, quarter, and half dollar. Students take turns naming the coins and their value. Introduce a dollar bill. Explain that $1.00 is the same as 100 cents. Write $1.00 on the chalkboard. Point out the dollar sign and the decimal point. Explain that the decimal point separates the dollars from cents. Give each student an envelope with different money amounts up to $5.00. Have the students count the money inside the envelope and determine who has the greater amount.
2	a	Show a beginning pattern, such as 12, 15, 18, __, __. Divide the class into small groups. Have the students discuss the pattern and take turns extending the pattern.
2	b	Model skip counting using a number line 0 to 20. Tape the number line to the floor. Demonstrate and explain how to count by 2's, 3's, 5's, and 10's. Circle the numbers as they are demonstrated. Practice using the number line and instruct students to "skip to 1's", "hop to 2's", "stretch to 3's", "jump to 5's" and "clap to 10's". Repeat this activity several times.
2	c	The teacher will create a set of word problems designed to identify missing addends, minuends and subtrahends. Example 1: Johnny and Alisha had ten cookies all together. Alisha had four cookies. How many cookies does Johnny have? Example 2: Pretend there were ten cookies in the cookie jar before you went to school. There were seven cookies in the jar when you got home from school. How many cookies did your mom eat while you were gone? The students will use work mats/story boards and manipulatives to discover the answers to the problems.
3	a	The teacher models and identifies shapes. Students should construct the same shapes on their geo-boards with rubber bands. Read The Greedy Triangle to discuss characteristics of shapes.
3	a	Provide each group of four to five students approximately 6 feet of yarn. Have them work together to form quadrilaterals (rhombus, square, trapezoid, parallelogram) hexagons, triangles, and circles. Ask, "How many corners and sides will the shape have?" "Will all sides be the same length?" Find similar shaped items in the classroom.
4	a	Put a list of measures on separate pieces of paper in two rows across a bulletin board: 1 inch 2 inches 4 inches 1 foot 2 feet 4 feet Show students how to measure objects to the nearest inch and to the nearest foot. When the measurement of an object matches one of the measurements on the bulletin board, have students write that object under the corresponding measure.

SECOND GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	a	Use appropriate units to estimate, measure, and compare lengths of various classroom objects, capacity using colored water or beans and a variety of containers and weights of classroom objects. (For example: apple in grams, chair in pounds)
4	a	As a whole group, use three empty boxes labeled “length”, “weight”, and “capacity”. Sort items such as piece of yarn, book, and can according to the appropriate measurement term. Complete a recording sheet and discuss why these choices were made.
4	a	Using a Fahrenheit thermometer, collect, chart, and compare temperature readings taken at different times during the year.
4	b	Display and discuss a schedule of classroom activities. Draw or use clock stamps to show the time for each activity. Write the time under the clocks, being sure to include a.m. or p.m. Discuss activities using the terms before, after, and until.
4	b	Display a demonstration clock and identify the hands. Discuss the meaning of the twelve numbers and the lines between them. Model with the students how to skip count by 5’s to show that there are 60-minutes in an hour. Read and write different times by having student pairs take turns writing a time on a dry erase board and showing the correct time on a demonstration clock.
5	a,b	Conduct a survey of students’ favorite day of the week. Organize and create a bar graph. Interpret and compare data using the terms “more”, “less”, “same”, “most” and “least.”
5	a,b	List the months of the year on a chart. Each student will indicate the month he/she was born by making a tally mark under the appropriate month. Create a pictograph using data from the birthday chart.

THIRD GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a,b	Given a four-digit number, write the number in word form. Count orally and write the five counting numbers before or after the given number.
1	d	Cut candy bars or pizza to demonstrate halves, thirds, fourths, fifths, sixths, and eighths or equivalent fractions. Compare the relationship between the fraction part and the whole.
1	f	Use base ten blocks to illustrate multiplication.
1	g	Provide students with graph paper. Have students cut the graph paper to represent various division problems. Ex: Put 6 grid blocks into groups of 2. The quotient is the number of groups.
2	a	Use colors, symbols, beads, or other objects to analyze and describe patterns.
2	a	Generate and extend number patterns. Analyze the patterns and explain the pattern by relating it to skip counting, number properties, or place value.
2	c	Use manipulatives such as M&M's® or linking cubes to demonstrate properties of basic operations. Ex: Commutative property of addition - 2 red cubes + 1 blue cube = 1 blue cube + 2 red cubes
3	a	Have pairs of students spin a spinner numbered three through ten. Have partners work together to glue toothpicks onto paper that represents a closed figure that has the number of sides shown on the spinner. Pairs of students can share and compare figures.
3	b	Have all students trace a cut-out triangle on a piece of paper so that they are all in the same position. Give students the following directions, one at a time. 1. Slide the triangle one time and trace. (translation) 2. Turn the triangle from a given point to the right and trace. (rotation) 3. Flip the triangle to the right two times and trace it each time. (reflection)
4	a	Use an overhead projector to display a 6 unit by 4 unit rectangle on centimeter graph paper. Demonstrate how to find the perimeter. To determine the perimeter, count the total number of length units around the four sides.
4	c	Perform an activity using dry and liquid measurements. Use various tools to weigh ingredients and compare amounts.

THIRD GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	c	Use Gallon Man or Big G for demonstration purposes. Gallon Man: Cut a large rectangle for **body** - **gallon**; cut four smaller rectangles for **arms** - **quarts**; cut eight even smaller rectangles for fingers and **toes** - **pints**; cut sixteen very small triangles for **fingernails**/**toenails** - **cups**. Paste together and draw head and face. Big G: Draw a big G. Inside the G, write four Q's; Inside each Q, write two P's; inside each P, write two C's.
5	a	Collect data based on students' interests (outside temperature, favorite books, movies, etc). Construct appropriate graphs - line, bar, and pictograph. Display findings and interpret data using student-generated questions.

FOURTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a,b	Use graph paper to assist students with adding and subtracting whole numbers and decimals.
1	c	Use colored chalk or colored overhead pens to differentiate the digits and subproducts. Ex: 321 x23 The 3 might be blue as would the product of 3 x 321 would be blue. The 2 might be red as would the product of 20 x 321. Have students justify their answers.
1	d	Have students turn their lined notebook paper horizontal to form columns in which to place the digits when dividing numbers. Have students justify their answers.
1	d	Use the mnemonic device "Does McDonalds Sell Cheese Burgers?" to help students remember the division algorithm: **D**ivide, **M**ultiply, **S**ubtract, **C**ompare, and **B**ring-down. Have students justify their answers.
1	e,f	Create fraction strips to aid in the addition of fractions with like and unlike denominators up to 12. The fraction strips may be "stacked" to show equivalent fractions when adding or subtracting with unlike denominators.
1	g	Using grid paper, have students construct fraction bars showing $^1/_2$ through $^{12}/_{12}$ using factors of 12. From this construction, the students will create a list of equivalent fractions, e.g., $^1/_2 = {}^2/_4 = {}^3/_6 = {}^6/_{12}$ and $^1/_3 = {}^2/_6 = {}^4/_{12}$, etc.
1	g	Using play money coins, the students can show fractional parts of a dollar and its equivalent decimal: 1 quarter = $^1/_4$ of a dollar = $^{25}/_{100}$ = .25 1 nickel = $^1/_{20}$ of a dollar = $^5/_{100}$ = .05 The students can create a table of coins to show fractional parts of a dollar and the equivalent decimal.
1	h	Have students look for large numbers and decimal numbers in a newspaper or magazine. Round the numbers to the greatest position. Have students justify answer verbally or in writing. Students should be aware that in decimal numbers, the digits to the *right* of the rounded position are dropped. For example, rounding 0.328 to the nearest hundredth = 0.33.

FOURTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	h	Have students estimate quotients using compatible numbers. Example: For 652 divided by 84, 652 is close to 640 and 84 is close to 80. 640 and 80 are compatible numbers. The estimated quotient is 8. Have students discuss how they determined their estimates. (The actual answer is 7.7)
1	h	Students can estimate products by rounding the factors to some multiple of 10. Multiply the counting digits and add the total number of zeros in both factors. Example: 3,456 x 57 would yield 3,000 x 60 or 3 x 6 =18 with 4 zeros = 180,000.
1	j	Write the digits 0 through 6 on 6 x 9 index cards. Write a comma on two index cards. Give one card to 9 students. Have them stand in a line across the front of the classroom. Call out instructions such as, "move the 6 to the hundreds place, the 4 to the hundred thousands place, the 1 to the millions place, etc. Have the rest of the class write the number in word, standard, and expanded form. The activity may be enhanced by writing a decimal point on an index card to create decimal numbers.
1	k	Fractions may be estimated by comparing them to 0, ½, or 1. For example: $^{3}/_{4} + {}^{4}/_{5}$ would round to 1 + 1 = 2.
1	l	Using hundred chart and markers, identify multiples of numbers by placing a dot of a designated color on each multiple. For example, multiples of 2, red dots are on 2, 4, 6, etc.
2	a	Explain that numbers can form patterns. Give examples such as multiples of numbers and families of numbers.
2	c	The students should experience input/output boxes. For example: The rule is 3x (That is, 3 multiplied by IN = OUT). Therefore if the IN is not given, the OUT can be divided by 3 to obtain the IN. IN | OUT 4 | 12 7 | 21 X | 45 12 | y
3	a	Have students use a geo-board or grid paper to make quadrilaterals. List like attributes.

FOURTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
3	a	Visit www.nctm.org/illumination. Students can create different shapes, identify shapes, and explore transformational results. The students can also explore three-dimensional solid figures.
3	a	Visit http://www.AAAmath.com for self-checking quizzes with two- and three-dimensional figures.
3	a	Have students draw, cut out, and identify various two-dimensional shapes. Glue shape to a card listing their attributes and create a mobile attaching each card with yarn and a clothes hanger.
3	a	Give each student or group of students a selection of pattern blocks. Have the students name the shape of the pattern block and identify angles on the shapes.
3	b	Students can use city maps, state maps, or other illustrations to identify points, lines, segments, and rays.
3	b	Use uncooked spaghetti to create acute, right, and obtuse angles.
4	b	Provide standard English measuring sets or household measuring containers, scales, water, and/or dry rice for measuring. Students will predict correct conversions and experiment to verify predictions and complete a table such as: _____ cups = ½ pint _____ pints = 1½ quarts _____ quarts = 1 gallon _____ pints = 1 gallon _____ fluid ounces = 1½ cups
5	a	Have students collect temperature data over a given time period and prepare a chart of the temperatures. Use the chart to create a bar graph.
5	a	Have the students design a bar graph about their favorite fast food restaurant.
5	a	Display a bag of M&M®s. Poll the students to determine their predictions as to the number of each color in the bag. Record their predictions and have the students graph the results on a pictograph. Have students count each color and record on a tally chart. Display and graph results. Have students compare estimate with actual.
5	a	In order for students to realize that the same data can appear differently in a graph, prepare bar graphs of the same data but with different scales. Ask the students to explain how the graphs are the same (same data). Ask how they are different (different scales). Generate a discussion as to what makes the data look different and how this may cause the viewer to misinterpret the data. Have the students generalize the discussion in writing.

FIFTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a,b	Give groups of students nine index cards with a single digit written on each. (Digits may be used more than once.) Arrange the cards to form the greatest and least value. Use symbols > or < to compare numbers. Have the students write both numbers in word and expanded form.
1	a,b	Give groups of students three index cards with a single digit written on each and one index card with a decimal point. Arrange the cards to make the greatest and least decimal numbers possible. Use symbols > or < to compare numbers. Have the students write the displayed numbers in all three forms.
1	a,e	Stretch a strong cord such as small diameter clothesline across the room. Prepare ten 5 x 9 index cards with whole numbers, fractions, and decimals written on them. Using paper clips or clothespins, place four or five cards on the line in correct order from least to greatest. Pass out the remaining cards to a group of students and have them pin or clip their card in the proper position on the line. The observing students should check the line and explain reasoning. As the school year progresses, mixed numbers can be added to the mix when using the number line.
1	c,d	Explain the divisibility rules by first stating that "divisibility" means able to be divided without having a remainder. Example: Divisible by 2 means that a number can be divided by 2 without having a remainder. **These rules are helpful when reducing fractions and finding prime numbers.** Display these rules and test a variety of numbers to 500.
1	c	Students should realize that multiples can be a result of "skipping counting". For example, when skip counting by 5s, (5, 10, 15, 20, 25, . . .) 15 is the 3rd multiple of 5 as 25 is the 5th multiple. Provide opportunities for students to find missing multiples, such as "What is the 7th multiple of 3? (21)
1	c,d	Provide a copy of a 100s chart to each student and prepare a "**Sieve of Eratosthenes**" to define the **prime** numbers between 1 and 100. Prime numbers have only 2 factors (1 and itself). A **composite** number has *more* than 2 factors. **To prepare the Sieve:** First, cross out 1 because it is neither prime nor composite. Circle 2, 3, 5, and 7. These are the prime numbers between 1 and 10. (**Note that 2 is the *only* even prime number**.) Using different colors, shade a portion of each square that contains multiples of 2, 3, 4, 5, 6, 7, 8, 9, 10. Circle all the numbers that are left. These circled numbers are the **prime** numbers between 1 and 100. Have the students write observations on what they discover. For example, all the multiples of 2 include the multiples of 4, 6, 8, and 10. All the multiples of 5 include the multiples of 10. Common multiples of 2 and 3 are also multiples of 6. The next step is to make the connection between this and the divisibility rules. Rule of 2 - The ones digit is 0, 2, 4, 6, 8 Rule of 3 - The sum of the digits is divisible by 3 Rule of 5 - The ones digit is 0 or 5 Rule of 6 - The number is divisible by 2 and 3 Rule of 10 - The ones digit is 0

FIFTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	c	**"Factors are Few, Multiples are Many"** To find **factors** and **common** factors of numbers, use a chart like the example below. Use divisibility rules to determine factors. Start with 1 since all numbers have 1 and itself as factors. Check to see if 2 is a factor and so on. Ex: The factors of 24 are: 1,2,3,4,6,8,12,24 The factor of 32 are: 1,2,4,8,16,32 Stress to students that there are only a certain number of factors for a given number - Factors are **FEW**. All factors of 24 and 32 are listed. Common factors between 24 and 32 are: 1,2,4, and 8. The **Greatest Common Factor (GCF)** is 8.
1	e	Use overhead and student sets of fractions strips to model commonly used fractions such as $^1/_8$, $^1/_6$, $^1/_4$, $^1/_3$, etc. Stack the fraction strips to show equivalent fractions.
1	e	Use fraction "pizzas" or circles to model equivalent fractions. Have students write their relationships, e.g., $^1/_2 = {}^2/_4 = {}^3/_6 = {}^4/_8 = {}^5/_{10} = {}^6/_{12}$.
1	f	Use fraction strips to demonstrate addition and subtraction of like and unlike fractions.
1	f	Use pattern blocks to show students how to add and subtract like and unlike fractions and mixed numbers. Use fraction calculators such as TI - Explorer to verify results. These calculators will also simplify fractions and mixed numbers.
1	f	Prepare index cards with decimal numbers. Have the students select two index cards. Using the calculator, find the product and record. Select a second card and find the product using the calculator. Continue until the rule for multiplying decimal numbers is discovered. The product will have the same number of decimal places as the two factors combined. Discuss products that end in zero as most calculators will simplify the product by dropping the zero.
1	f	Students will solve word problems that require division with a remainder. They will decide the necessity of either dropping the remainder, use it as part of the answer, or use to round the quotient up by 1.

FIFTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
2	a,b,d	Provide students with a blank input/output function table. Have them draw a rule card that will determine the output. The rule cards should be with addition, subtraction, multiplication, and division. Pass out cards with input values to include whole numbers, fractions, and decimals. Students will record the input values and compute the output by applying the rule. As a variation, cards can be prepared with some input values and some output values. This will require the student to compute the missing values using the inverse operation.
2	b	The teacher will prepare number sequence cards for half of the class. The other half will have cards prepared that show the rule that explains the sequence. An example of this would be 2, 4, 8, 16. The rule is double each number. Have students match the rule with the corresponding sequence card.
2	c	A rectangular array can be used to demonstrate the distributive property. Construct a rectangular array to represent 6 x 7; 6 down, 7 across. Separate this into two arrays of 6 down, 3 across and 4 across. 7 — # # # # # # # # # # # # # # 6 # 3 + 4 — # # # + # # # # # # # + # # # # 6 # # # + # # # # # # # + # # # # # # # + # # # # # # # + # # # # This shows that 6 x 7 = 6 · 3 + 6 · 4.
2	d	Use manipulatives to model balancing equations. For example, if there are 15 items on the right side of the equal sign and 8 on the left side of the equal sign, how many more are needed on the left to balance with the right side? Have students justify answer. Ex: 15 = 8 + n; therefore, 15 - 8 = n
3	c	Have students use pattern blocks to explore rotations reflections, and translations. Trace around their shapes on grid paper and perform one of the transformations and draw the shape again. Label each transformation as it is drawn. Repeat the process for each of the transformations.
3	c	Use geoboards and colored rubber bands to demonstrate transformations. The student will use one color band to represent the original figure and another color to represent the transformation specified by the teacher.

FIFTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
3	d	Have students use centimeter grid paper to draw congruent polygons . Draw examples of congruency using irregular shapes.
4	b,d	Measure the dimensions and weight of several objects and the capacity or volumes of various containers. Express each measurement using units of measure in both the metric and English system of measurement.
4	a,b,d	Place students in groups and have them consider objects such as width of the math textbook and the length of the classroom. Have students determine the best unit of measure to use in metric and in the English system. Have students measure the textbook to the nearest centimeter and one-eighth of an inch and the length of the classroom to the nearest meter and yard.
4	c	Display formulas: Area of rectangle = length x width (A = l x w) Area of triangle = $^1/_2$ base x height (A = $\frac{b \times h}{2}$) Place students into groups and have them use geoboards and bands to verify the formulas. Example: Describe a 2 x 4 rectangle with one color rubber band. Note that its area is a 2 x 4 or 8 sq. units. With another color band, divide the rectangle diagonally. Note that the rectangle is separated into two congruent triangles. If the two triangles are the same size, they must have the same area. If the area of the rectangle is 8, then the area of one triangle must be 4. The triangle's base is 2 units and the height is 4 units. A = ½ b x h so ½ (2 x 4) = 4.
4	c	Provide the students with centimeter grid paper. Have them create a figure with a perimeter of a given number of units.
4	c	Provide students with grid paper and problems with missing measures: Examples: 1. Length = 6 units Perimeter = 20 units 2. Width = 5 units Area = 25 square units Instruct the students to create the rectangles on the grid paper and find the area in #1 and the perimeter in #2.
4	c	Use trundle wheels displaying the measurements in metric and English units to measure the perimeter of the classroom, hall, etc. Students can derive a formula for the perimeter of a rectangular shape, i.e., P = 2l + 2w where l = length and w = width.

FIFTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	d	Place a thermometer that shows the temperature in Celsius and Fahrenheit outside the classroom in sight from a window. At a given time, have a student read the thermometer and record both the Celsius and Fahrenheit temperature. Have the students note the difference between Celsius and Fahrenheit. Explain that Celsius is a metric measurement and is based on a 100-degree difference between the freezing point and the boiling point (100°) of water. Fahrenheit is based on freezing at 32° and the boiling point at 212°. Display the conversion formulas and have students convert Celsius and Fahrenheit temperatures. $C = \frac{5(F - 32)}{9}$ $\qquad$ $F = (9/5c) + 32$
5	b	Measure and record heights of students in class. Organize and chart the information. Prepare box-and-whisker plots to determine gaps and clusters, if any, in the data.
5	b	Students will survey 50 students in their grade level to determine their favorite fast food restaurant. A tally chart will be used to record results of the survey. They will construct a frequency table for the information in the tally chart. Utilizing word processing and spreadsheet programs, students will present the data in at least two formats (line graphs, stem-and-leaf plots, histograms, and box-and-whisker plots). Additionally, students will compose a paragraph explaining the results of the data collection and display.

SIXTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a	Use index cards with rational numbers greater than or equal to zero. Students will draw two or more cards at random and compare numbers using =, < and >.
1	a	Students will record numbers as instructed on index cards. The teacher will call on groups of two to five students. Students will arrange themselves in the correct order and display their cards for the class to see.
1	c	Have students use a hundreds chart to find the LCM of numbers. For example, to find the LCM for 4, 6 and 8, use a red pen to cross out multiples of 4, a blue pen to cross out multiples of 6, and a green pen to cross out multiples of 8. Numbers crossed out with all three colors represent common multiples. The least of these numbers is the LCM.
1	d	Construct three decks of cards, two with numbers in either fraction or mixed number form, and the third consisting of operators (+, x). Have students pick a card from each pile and compute the final result in simplest form.
1	e	Given a problem to solve involving division with both whole number and decimal quotients and divisors, ask the student to explain the meaning of the quotient and remainder in context of the problem. Example: If 14 people are all going to the movies and each car can hold, at most, 4 people, how many cars are needed for everyone to get to the movies? 14 divided by 4 = 3 remainder 2. From this answer the student should see that the quotient of 3 indicates the number of full cars needed and that 2 people (remainder) are left. Thus, 4 cars are needed.
1	g	Using graph paper, have students shade in appropriate numbers of squares to represent different fractions, decimal amounts, and percentages of a given amount of squares. Have the students provide answers in all three forms.
1	g	Given a partially completed chart of fractions, decimals, and percents, students will complete the chart.
1	i	Using graph paper, have students shade in appropriate numbers of squares to represent different percentages of a given amount of squares.
1	k	Give a deck of cards to a pair of students. Let the black cards be positive and the red cards negative. Place eight cards face up on the desk. The objective of the game is to make zero using as many cards as possible. Example 1: A red 5 and a black 5 represent negative 5 and positive 5 that equal zero. Example 2: red 4, red 2, red 10, and black 10, black 6 equal zero.

SIXTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	k	Provide two colored counters to model addition and subtraction. Let red be negative and yellow be positive. Pull out any zero pairs. Zero pairs are one red and one yellow, since a positive one and a negative one equal zero. Whatever is left is the answer. Example: $3 + \bar{5}$ Y Y Y R R R R R There are three Y/R pairs which are equivalent to zero. Two reds are left; therefore, the answer is -2. Have students relate the actions to the algorithm. Example: $3 - (\bar{4})$ There are no negatives (R) to subtract so zero pairs (Y/R) must be added. Y Y Y YR YR YR YR When the four negatives are removed, seven positives (Y) remain. $3 - (\bar{4})$ is the same as $3 + 4 = 7$
2	a	Use manipulatives such as Algebra Tiles™ to model the process of solving equations.
2	b	The teacher writes down a rule such as $2x + 5$ and covers it up. Have students give the teacher a number to apply to the rule. The teacher gives an answer. Have students guess the rule.
2	d	Divide the class into two teams. On an overhead, write problems that can be solved easier by using properties. For example: $(25 \times 6 \times 4) = (25 \times 4) \times 6$. One person from each team races to get the correct answer. Have students explain the use of properties with each problem.
3	b	Using straws and paper clips have students construct various three-dimensional shapes. Cut out paper to form faces and attach to the vertices and edges.
4	b	Given dimensions of a wall, students will calculate the area to determine the amount of paint needed to cover the wall. Given the dimensions of a picture, students will determine the size of the frame needed to go around the painting.
4	b	Have students build as many rectangles as possible using square tiles that have the same perimeter. Students should be able to discover that rectangles with the same perimeter could produce different areas.

SIXTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	b	Use grid paper to demonstrate the different ways that a number can be modeled as a rectangle. Make a table from the different lengths and widths that produce the given number. Discuss that different factors will produce the same product. Example: 4 | 1x4, 2x2, 4x1 6 | 1x6, 2x3, 3x2, 6x1 8 | 1x8, 2x4, 4x2, 8x1
4	c,g	Have students use string and ruler or measuring tape to measure the circumference and diameter of several circular objects. Place the round object on a sheet of paper and trace it. Cut out the circle, and fold it to get increased accuracy of the diameter. Using a calculator, divide the circumference by the diameter. Discuss results from all of the objects to discover the meaning of *pi*. (All of the student's findings of *pi* could be examined using mean, median, and mode.)
4	e	Using boxes, have students predict the volume of the box, then measure the dimensions of the box to calculate the volume. Have the students perform the same task with the classroom using various units of measurement.
4	f	Have students determine appropriate units of measurement for various items such as length of a paper clip, the distance to their home, etc.
4	f	Have students estimate using appropriate units of length, mass, and of various objects. After estimation, have students measure with an appropriate instrument to check the estimation.
4	f	Using appropriate instruments, measure various objects in and around the school to the nearest sixteenth of an inch and the nearest millimeter.
4	f	Identify appropriate units of measurement and tools for measuring items such as water in a glass, mass of a book, or weight of a penny.
4 5	f a	Use student heights to construct a frequency table. From a frequency table have the students construct histograms or bar graphs.
5	a	Use a bag of candy such as M&Ms® or Skittles® and separate the candy by color to construct a frequency table and bar graph.
5	b	Provide students with a data set to compute mean, median, and mode. Add another data point or change one of the values for students to re-compute the mean, median, and mode. Discuss the effect the additional value or changed value has on the measures of central tendency.
5	b	Have students develop a set of data for a predetermined mean, median, or mode.

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	a	Present students with an order of operations problem which has been worked showing all steps. Have students determine if the answer is correct and explain why it is or isn't correct. If there is an error, identify the error and correct it.
1	b	Using recipes, double, triple and quadruple the ingredients. Calculate ingredients needed to serve the class.
1 4	c a	The following may help students remember the metric chart "**K**ing **H**ector **D**ied **M**onday; **D**on't **C**all **M**e," or "**K**ing **H**enry **D**ied **M**onday **D**rinking **C**hocolate **M**ilk". Liters or grams can be used as base units.
1 4	a,c a	Provide the student with a chart of equivalent measures. Show students how to use cancellation to find answers. **Example:** Convert 5 gal. to quarts. $5\text{gal} \bullet \frac{4\text{qt}}{1\text{gal}} = 5 \times 4\text{qt} = 20\text{qt}$ Explain to students that whatever unit they begin with must be the unit in the denominator of the second fraction and the numerator is its equivalent measure. Multiply numerators. If a number is greater than 1 in the denominator, divide by that number. Use in real-world situations. Use unlike measures within a problem; i.e., a problem is in inches and solution must be in feet.
1 4	c a	Convert by solving a proportion. 5 gal = ____qt. $\frac{5\text{ gal}}{n\text{ qt}} = \frac{1\text{ gal}}{4\text{ qt}}$
1	c	Have students use base ten blocks and/or cm grid paper to model percent of increase. For example, students put a hundred squares on their desks and identify this as 1 whole. Ask the students what fraction is one (1) square. ($^1/_{100}$) Then ask what percent is this (1%). Have the students put a 1-square next to the hundred squares. By doing this, the hundred square is increased by 1%. Have students add a ten-strip to increase the hundred-square by 10%. Ask what fraction is 1 ten-strip. (10/100) and ask what percent is this. (10%). Inform students that adding a ten-strip increase the hundred-square by 10%. Have students use the blocks to increase the hundred-square by various percents. Have students count the squares subtracted from the hundred grid to determine percent of decrease.

SEVENTH GRADE

<table>
<tr><th>Comp.</th><th>Obj.</th><th>Suggested Teaching Strategies</th></tr>
<tr><td>1</td><td>c</td><td>Place students in groups of 3 or 4. Give each group a set of index cards with numbers written on them (fractions, decimals, mixed numbers, and percents). Typically, use numbers between 0 and 2 and include halves, thirds, fourths, fifths, sixths, tenths, etc. Some of the cards may be equivalents. Be sure the cards have been well mixed. Students are to sort the cards in order. Hang a clothesline in the room and allow each group to clip their cards to the clothesline. If there are cards with equivalent numbers, clip them underneath each other, making sure all cards can be seen.</td></tr>
<tr><td>1
5</td><td>c
d</td><td>Use only the face cards from a deck of cards. Lay the cards face-up in random order. If three cards are chosen at random, what is the probability of various series of events if the cards are returned after each draw and if the cards are not returned after each draw, i.e., P (Queen, Jack, or King)? Write each probability as a decimal, ratio, and percent.</td></tr>
<tr><td>1</td><td>c</td><td>Play the “Concentration Game”. Students work with a partner. Each group is given a stack of 24 cards. Eight of the cards will have a ratio written on them, eight will have the decimal form, and the remaining eight will have the percent form, i.e., ¾, 0.75, 75%. Shuffle the cards and place face down in rows of four. Play “Concentration” with three cards to match a ratio with its decimal and percent. The student with the most matches at the end of the game is the winner.</td></tr>
<tr><td>1</td><td>c,h</td><td>Compare the number of boys and girls in various classrooms and convert boy/girl ratios to percent. Use proportions to predict the number of boys or girls in the school. Use school records to confirm. Discuss the differences and why they occur (sampling.)</td></tr>
<tr><td>1</td><td>d</td><td>Use cm squares or graph paper, illustrate various squares. Discuss the sides and note representation of square root. These squares represent “perfect squares.” Tell how many pieces it takes to make the squares. Note the square of one side is equal to the area. Since the sides of a square are the same, the root is expressed as the measure of one of the sides. Thoroughly discuss the inverse relationship between square roots and squared numbers.
Ex. $3 \times 3 = 9$; $3^2 = 9$; $\sqrt{9} = 3$</td></tr>
<tr><td>1</td><td>d</td><td>Provide the students with a set of numbers. Have the students predict which numbers are perfect squares. Have the students use the calculator to check their answers. Example:
<table><tr><td>Number</td><td>Prediction</td><td>Calculator Check</td></tr><tr><td>1</td><td>Yes</td><td>$\sqrt{1}$ = yes</td></tr><tr><td>10</td><td>No</td><td>$\sqrt{10}$ = 3.2 no</td></tr><tr><td>18</td><td>Yes</td><td>$\sqrt{18}$ = 4.2 no</td></tr></table></td></tr>
</table>

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	f	Research distances from each planet to the sun. Write each distance in standard form and in scientific notation.
1	g	Set up a class store with produce, meat, and canned good sections. Have students bring pictures of items that are found in these sections. The students will cut out the pictures and glue them to construction paper. Provide prices by each item, such as, bananas cost 4/$1.00, apples cost 3/$0.89, etc. Set up the items in centers. Have the students rotate from one item to the next to determine the unit rate. Determine the cost of sets such as 5 apples, etc. Have the students work with a partner to compare and discuss.
1	g	Have the students bring in grocery ads from newspapers. Have the students figure and compare unit prices on given items at two different stores to find the best buy.
1	g	Have students look at sale advertisements. Select one item and write the specific size, brand, and other characteristics. From several stores find the original price of the same item. Compare prices to see if the sale item is actually a good buy. Calculate the discount, sale price, sales tax, and percent decrease for the item.
1	g	Have students get a sales advertisement from a department store. Pretend each student has $100 to spend. Have the students make a purchase and determine the total cost including 7% sales tax without overspending.
1	g	Have the students look through the newspaper car sales. The students should select a car and use the formula for simple interest to determine the total cost with the given rate of interest and time period.
1	g	Have students research interest rates at local banks for savings accounts. Use the simple interest formula to calculate the amount of interest for various deposits based on interest rates over set periods of time.
1	g	Teach students how to solve proportions using factor of change or unit rate. Factor of change: $\frac{20 \text{ min.}}{4 \text{ mi.}} = \frac{n}{12 \text{ mi.}}$ Multiply by 3 $\frac{20 \times 3 = 60 \text{ min.}}{4 \times 3 = 12}$ Unit Rate: $\frac{20 \text{ min.}}{4 \text{ mi.}} = \frac{n}{12 \text{ mi.}}$ It takes 20 minutes to go 4 miles. $20 \div 4 = 5$, so it takes 5 minutes to go 1 mile. $12 \text{ miles} \times \frac{5 \text{ min.}}{1 \text{ mi.}} = 60 \text{ minutes}$

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
1	g	Investigate the connections between test grades (percents), total problems, and number correct. Example 1: Use proportions to determine how many problems would have to be correct on a 25 problem test to make a grade of A, B, C, D, F. Example 2: Determine how many items were on the test if the student made a grade of 80 and got 12 correct.
1	g	Have students create a scale drawing of the classroom. Show the proportions used for the measures. Have students create scale drawings of their bedrooms.
1	g	Have the students set up a proportion using real world situations. Example: "Sheila wants to buy a CD player that costs $240. She earns $25 in 5 hours for babysitting. How many hours will Sheila have to work in order to buy the CD player? $\frac{5\ (\ hrs\ )}{25\ (\ earnings)} = \frac{n\ (hrs)}{240\ (\ earnings\ )}$
1 3	g c	Give students two different sizes of the same shape. Have students identify the corresponding sides and corresponding angles. Use ratios to prove similarity.
1 3	g c	Make sets of cards showing congruent figures and similar figures. Indicate side measures on all figures. Pass cards out to students and have them find the matching congruent card and/or similar card. Students must be able to justify the match.
2	a	Have the students study the pattern below: 999 x 2 = 1998 999 x 3 = 2997 999 x 4 = 3996 999 x 5 = 4995 Have the students explain the patterns they see. Have the students extend the pattern to find 999 x 9. An extension to this activity would be for the students to use the pattern to find 9,999 x 7 and 99,999 x 8.
2	a	The teacher will think of a rule. One student at a time will call out a number. The teacher applies the rule to the number and tells the class the solution. Repeat the process until someone determines the rule the teacher is applying.
2	a	Describe and extend patterns in sequences. ❑ Use pattern blocks to create a tessellation. ❑ Use pencil and paper to illustrate patterns. ❑ Observe sets of numbers or geometric shapes that are in a sequence. Determine numbers or shapes that will continue the sequence by determining a rule to explain the pattern. ❑ Explore patterns in the Fibonacci sequence.

SEVENTH GRADE

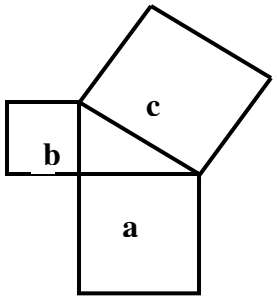
Comp.	Obj.	Suggested Teaching Strategies
2	c	Create cards using algebraic expressions and verbal phrases. Have the students match the expression to the corresponding phrase. Example: Clue — Answer A number (x) increased by five — x + 5 Twice a number (n) — 2n Six minutes less than Bob's time (t) — t – 6 3 years younger than Seth (s) — s - 3
2	c	Give the students a number. Have the students perform the instructed operations on that number. Example: Start with 12 — 12 Twice that number — 12 x 2 = 24 Less 8 — 24 - 8 = 16 Divide by 4 — 16 ÷ 4 = 4 Increase by 2 — 4 + 2 = 6 Square that number — $6^2 = 36$
2	c	Read a sentence such as 2 times what number is 10. Have students write the algebraic equation. A correct response will be 2x = 10. Repeat this activity several times using sentences involving all four basic operations.
2	c	Provide students with checking account scenarios such as "I have money in my checking account. I wrote a check for $43.00. I had $25.00 left in my account. How much did I have in my account before I wrote the check?" Write an equation such as x - 43 = 25 to solve.
2	c	Relate equations to sports. Give students an equation and have them tell a sports situation that could represent the equation. Example: 14 + p = 30. John scored 14 points in the basketball game on Tuesday. By the end of the second game on Friday, his two-game total was 30 points. How many points did John score in the second game? Solution: Tuesday's game + Friday's game = total points or 14 + p = 30.
2	c	Choose several occupations and write problem-solving situations for each occupation on index cards. Divide the class into groups according to the occupations chosen and distribute the cards for that occupation to the appropriate group. Each group will write and explain equations that describe the real world situation. Group presentations can be made demonstrating how various occupations use equations. Example: Carpenters One sheet of 4x8 plywood will cover 32 sq. ft. How many sheets will be needed to cover 640 sq. ft.? 32 p = 640

SEVENTH GRADE

<table>
<tr><th>Comp.</th><th>Obj.</th><th>Suggested Teaching Strategies</th></tr>
<tr><td>2</td><td>d</td><td>Have the student create a function table for the following example.

The average American family wastes approximately 30,000 gallons of water a year. F is the number of families and W is the amount of water wasted in a year.
Down the Drain
<table>
<tr><td>F</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>10</td><td>100</td></tr>
<tr><td>W</td><td>30,000</td><td>60,000</td><td>90,000</td><td>120,000</td><td>---</td><td>---</td><td>---</td></tr>
</table>
The students will find the pattern and write a rule. Before using the rule to extend the pattern, have the students check the rule with the values that they already know.</td></tr>
<tr><td>3</td><td>b</td><td>Give students three-dimensional drawings of various space figures. Ask students to draw the corresponding net for each figure on grid paper and cut out their net to check for correctness.</td></tr>
<tr><td>3</td><td>b</td><td>Working with both three-dimensional shapes and two- dimensional drawings (nets), select strategies such as: make a table, use a formula, draw a diagram, or guess and check to complete the table below.
N - The number of sides in the base
F - The number of faces
V - The number of vertices
E - The number of edges
Identify the relationship among the number of faces, vertices and edges. Look for equivalent expressions or equations.
<table>
<tr><th>Figures</th><th>N</th><th>F</th><th>V</th><th>E</th></tr>
<tr><td>Triangular Prism</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Rectangular Prism</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Pentagonal Prism</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>3
4</td><td>c
c,d</td><td>Visit NCTM’s Illuminations website:
http://illuminations.nctm.org/index.asp and use the following lessons:
- “Linking Length, Perimeter, Area, and Volume” - “Patterns and Function”</td></tr>
<tr><td>3</td><td>c,e</td><td>Have students go outside and measure their height, the length of their shadow, and the length of the shadow of the flagpole. Using their understanding of similar figures, ask students to determine the height of the flagpole.</td></tr>
<tr><td>3</td><td>d</td><td>Research the art of M. C. Escher. Model rotations, reflections, and translations using graph paper. Draw tessellations.</td></tr>
<tr><td>3</td><td>d</td><td>Using a coordinate grid, name coordinates and create patterns or figures (e.g., butterfly, umbrella, sailboat) by plotting points. Perform transformations on these patterns. Name and label coordinates of the transformed image.</td></tr>
</table>

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
3	d	Plot the following points on grid paper and translate (slide) the point and name the new coordinates. Use colored pencils to mark new points. Example: point A: (-2, 4) Slide 4 units right to point A_1: (2, 4) point B:(4, 0) Slide 3 units down to point B_1:(4, -3)
3	e	Using a geoboard, construct a right triangle that has legs of 3 units and 4 units long. Form two squares using the length of each leg as the side of each square. Also form a square using the hypotenuse as one side. The area of square "a" plus the area of square "b" = the area of square "c". Show students the relationship of the lengths squared to the hypotenuse squared. 
3	e	Use grid paper to draw and justify the Pythagorean theorem $a^2 + b^2 = c^2$. Give the measures of two legs and find the hypotenuse and/or give a leg and the hypotenuse and find the missing leg.
3	e	Give students three side measures of a triangle. Students cut strips of paper to the given 3 lengths and attempt to assemble them into a right triangle. Hold up figures and see if anyone constructed a right triangle. Have students prove if the triangle could be a right triangle using the Pythagorean theorem.
3	e	Challenge students to find the Pythagorean triples (measures of right triangles using whole numbers). Note to teachers: If students find a set of triples, they can multiply each side by the same constant to find another set of triples (similar figures). Example: 3, 4, 5 is a Pythagorean triple. Multiply all sides by two and 6, 8, 10 is also a triple.
3	f	Using index cards, draw angles with their measures marked. Have students select index cards which are complements and/or supplements. Put angles together to prove.
3	f	Working in pairs, one student draws a pair of complementary or supplementary angles with one of the angle measures indicated. The partner must identify the pair as complements or supplements and state the missing measure.
4	a,b	Visit NCTM's Illuminations website: **http://illuminations.nctm.org/index.asp** and use the lesson "Measuring Up: Concepts in Measurement."

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	a	Draw a very large capital G on the chalkboard/ overhead. Explain to the students that the G stands for one gallon. Within the G write four capital letter Q's This stands for 4 Quarts. Inside each of the 4 Q's, write two capital letter P's. This stands for 2 pints in 1 quart. Within each of the P's write two capital letter C's. This stands for 2 cups in 1 pint. Within each of the C's place 8 dots. These dots represent fluid ounces. There are 8 fluid ounces in 1 cup. Apply to real-world problems.
4 5	a b,c	Have students measure their height in cm. Make a frequency table. Find the mean, median, mode, and range of their heights. Ask students what would happen to the mean, median, mode, and range if a very tall person or very short person were included in the group.
4 5	a c	Have students measure their height and arm span to the nearest centimeter. Construct into two frequency tables. Have groups of students construct stem-and-leaf plots from both sets of data.
4	a	Students will estimate the length of one of their shoes in inches, centimeters, and millimeters. Measure to check for accuracy.
4	a	Given objects found in any classroom (e.g., books, paper clips, desktops), estimate and measure to find the dimensions of these objects.
4	b	Provide several circular items. Have students measure and record the circumference and the diameter of each item. Have students use the formula for circumference of a circle with the measured diameter. Discuss differences between measured and calculated circumference.
4	b	Using grid paper, draw a circle with a diameter of 4 cm. Cut the circle into eight equal wedges. Color half of the wedges and fit the wedges together to form a shape that looks like a parallelogram. Use the formula for area of a parallelogram to justify the formula for area of a circle.
4	b	Have students work with a partner. Each group will be given a page from the local newspaper and a centimeter ruler. Students will estimate the total area of the newspaper page, excluding margins, and determine the area of each section. The sections may consist of local news, national news, advertisements, entertainment, sports, photographs, weather, obituaries, etc. Have students express the area of the article to the area of the page as a fraction, decimal and percent. The class records all findings. The total area of each of the sections is calculated and compared to the area of the entire newspaper page.
4	c	Have students calculate the volume of boxes, i.e., tissue box, cereal box, snack food box.

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
4	c	Present students with the idea of working in the marketing department of a candy company. The task is to design the best box to hold fudge. The fudge needs to be shipped in quantities of one dozen. Each piece of fudge is 2 square inches. The fudge can be stacked. Design at least two boxes to hold the fudge. Which box requires the least material?
4	c	Collect several different sizes of gift boxes. Have students measure the boxes and determine the minimum amount (surface area) of wrapping paper needed to wrap each box.
5	a,c	Have the students estimate how many hours per day they spend doing various activities. Collect data and create a circle graph.
5	a,c	Provide the class with several examples of bar graphs, circle graphs, and histograms. Working in pairs or small groups, have the students select a graph. The students will write a variety of questions that can be answered from the data given in their graph including questions on the key, the intervals used, the type of graph used and what the graph represents. Groups exchange graphs with questions. Have each group answer the questions.
5	a	Visit NCTM's Illuminations website: http://illuminations.nctm.org/index.asp and use the following lessons: -"Accessing and Investigating Data using the World Wide Web"; - "Application: Using Graphs and Patterns in Everyday Life"; - "Exploring Histograms"; - "Mathematics as Communication: Graphing Information Collected Over Time"; -"State Names: Investigating Real World Data"; - "Uses of Numbers".
5	b	Give students the following test scores: 85, 80, 93, 85, 80, 88, 65, 50, 93, 90, and 57. Have students place the test scores in order from least to greatest and find the mean, mode, median and range. Ask what would happen to the mean, median, mode, and range if someone made a zero. What would happen if someone made 110?
5	c	List the grades made on a particular test in random order. Students will place in a frequency table and construct stem-and-leaf and/or bar graph.
5	c	Construct a frequency table to find the favorite football team of the class. Divide the class into 3 groups. Assign each group a different type of graph to construct from the data (circle, bar, stem and leaf plot, etc). Have the groups present their graphs to the class. Conduct a class discussion to help recognize the benefits of the different representations of the same data.

SEVENTH GRADE

Comp.	Obj.	Suggested Teaching Strategies
5	c,d	Have the student roll two number cubes and find their sum. Record results in a frequency table. Use results to determine experimental probability of getting two sums of 2 through 12. Express probability as a decimal, ratio, and percent.
5	c	Use the Internet to track the progress of a given stock for the past year. Predict patterns or trends for the next month.
5	d	Visit NCTM's Illuminations website: http://illuminations.nctm.org/index.asp and use the lesson "Simulating Probability Situations Using Box Models" and "Sticks and Stones: Investigating Probability with a Native American Game."
5	d	Discuss why a town of 20,000 households with one phone each must have multiple prefixes in addition to the 4 digit phone numbers. Example: 10 x 10 x 10 x 10 = 10,000 possible numbers < 20,000 households Extension: Why did Mississippi have to split the state into three area codes? Show how prefixes could determine 400,000 different phone numbers.
5	d	Have the students roll a number cube to find the probability of rolling an even number, odd number, prime number, composite number, and a given number.
5	d	Present students with a menu from a sandwich shop. Have students consider the number of different lunches that could be ordered from the menu if a lunch consists of a beverage, a sandwich, and a salad. Have students make guesses at the number of different lunches. Ask each student to describe different lunch options until all options are listed. Show them how a tree diagram can be used to create the same list and how the Fundamental Counting Principle can be used to obtain the total number of possibilities.
5	d	Present the scenario: Ned has a 1-6 number cube and three cards: a jack, a queen, and a king. Ask the students to use an organized list or tree diagram to name every possible outcome and use the Fundamental Counting Principle to confirm the total possible if he rolls the number cube and selects one card at the same time.

PRE-ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
1	a	Use yarn to create a Venn diagram of real numbers (natural, whole, integer, rational, and irrational). Choose an index card with a number on it and place it in the correct place.
1 5	a a	Using a weather map, compare temperatures around the country. Discuss differences. Find mean and median of weekly temperatures.
1	b	Use maps, bus/plane schedules and fares, hotel rates, etc., to plan a vacation. Estimate total expenses.
1	d	Divide the class into two groups to play tic-tac-toe. A student from each group goes to the board to work an order of operations problem. The first correct answer wins and marks the tic-tac-toe board. Continue until one group wins.
1 2	d b	Divide class into groups of two. Ask each student to write a step-by-step solution to simplify or evaluate an algebraic expression. Have each student exchange work with partner. Partners study the work to determine if it is correct. If incorrect, label the errors and discuss.
1	e	Distribute problems involving multiplying and dividing like bases or powers of ten. Work in groups to discuss and determine a rule for solving the problems.
1	f	Use articles to find examples of very large and very small numbers. Using the examples, write the numbers in scientific notation. Select two of these numbers to multiply and divide indicating the answer in scientific notation and standard form. Discuss the advantage of writing and using numbers in scientific notation.
1	g	Play "Jeopardy" with powers, squares, square roots and cube roots. From an overhead transparency, select a category and point value (equations for 200). Allow calculators.
2	a	Have pairs of students write an algebraic expression. Put these into a hat. Each pair draws out one algebraic expression and writes a real-life situation, which corresponds to the algebraic expression they drew.
2	a,b,c	Play Algebraic Jeopardy. From an overhead transparency, choose a category and point value (e.g., expressions for 400). Categories include expressions, word phrases/sentences, properties, equations, inequalities, or algebraic phrases/sentences. Points range from 10 to 50 based on level of difficulty. Answers must be in the form of a question. The team with the most points when the board is completed or when time runs out wins.

PRE-ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
2	b	Have pairs of students write an algebraic expression. Put these into a hat. Each pair draws out one algebraic expression and writes a real-life situation, which corresponds to the algebraic expression they drew.
2	c,d,e	Play Algebraic Jeopardy. From an overhead transparency, choose a category and point value (e.g., expressions for 400). Categories include expressions, word phrases/ sentences, properties, equations, inequalities, or algebraic phrases/sentences. Points range from 10 to 50 based on level of difficulty. Answers must be in the form of a question. The team with the most points when the board is completed or when time runs out wins.
2	c,e,g	Divide the class into two teams. On an overhead, write problems that can be solved by using properties. For example: (25 x 6 x 4) = (25 x 4) x 6. One person from each team races to get the correct answer. (Explain the use of properties with each problem.) The team with the most number of correct answers wins.
2	f	Prepare a set of index cards containing equations and/or inequalities. The set should contain pairs that have the same solution. Distribute one card to each student. Have students solve and graph their equation/inequality on a number line. Identify the classmate with the same solution.
2	f	Write a linear equation on the overhead. Give each row of the class different x or y values to use in solving the equation. Let one row choose their own values. When all have finished, have each row plot their points on a wall coordinate grid. Discuss the reasons that all points fall on the same line. If any points are not on the line, look for mistakes in calculations. Determine the line's slope and y-intercept.
2	f	Give each student a pipe cleaner. Call out a type of slope (positive, negative, undefined, or zero) and ask students to hold the pipe cleaner up in a way which represents that slope.
2	g	Divide the class into groups of two. Ask each student to draw a line with a given slope and y-intercept and compare his or her line with partner's line and discuss findings.
2	h	Divide the class into groups of two. Given a coordinate plane, ask each student to draw a line on the front and write its slope and y-intercept on the back. Exchange papers. Each partner will determine the line's slope and y-intercept. Flip the paper to compare/discuss answer. Give each student an individual dry erase board with a pre-marked coordinate grid or graph paper. Call out a y-intercept and slope and ask students to graph the corresponding line on his/her board/paper and hold it up for teacher observation. Use algebra tiles™ to develop the rules of exponents and apply the rules to adding, subtracting, multiplying, and dividing monomials and polynomials.

PRE-ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
3	a	Use masking tape on the floor to create parallel lines cut by a transversal. Number the interior and exterior angles 1 to 8. Play "Twister™" by placing hands and feet on indicated pairs of angles.
3	b	Ask students to draw a pair of parallel lines and cut them with a transversal. Number the angles 1 to 8 and use a protractor to measure them. Each student presents findings to the class. After each presentation, students analyze results to search for similarities (patterns) that work on each drawing. Continue presentations until students can reliably calculate the 7 missing angle measures when given one angle measure.
3	c	Create a table to determine the relationship between the number of angles, sides, diagonals, total triangles, and the total degrees in polygons. Then given an n-sided regular polygon, students use their found patterns to determine the number of degrees in each of its angles.
3	c	Have students sketch right triangles on grid paper. Use the Pythagorean Theorem to find the measure of the hypotenuse. Verify the measure with a ruler or by counting the squares on the grid paper.
3	c,d	Students go outside and measure their height, the length of their shadow and the length of the shadow of the flagpole. Using their understanding of similar figures, ask students to determine the height of the flagpole. Using the flagpole's calculated height and measured shadow length, apply the Pythagorean Theorem to determine the distance from the top of the flagpole to the end of its shadow.
3	e	Use Tinkertoys™, Connects™, Legos™ or other building manipulatives to create a three-dimensional figure from a two-dimensional drawing. Describe how the figure looks from the top, bottom, left, right, front and back.
3	e	Give students a two-dimensional net drawing of a three- dimensional object. Ask them to draw how the figure looks from the top, bottom, front, back, left and right. Give students the three-dimensional object and have them compare their drawings to how it actually looks from those six perspectives.
4	a,b,c	Design decks of various shapes to be added to a patio. Use basic formulas to find perimeter, area, and amount of materials needed for the job. Select appropriate units of measurement.
4	a,c	Measure length and width of the classroom in feet. Calculate the number of square yards needed to cover the room with carpet. Given the conversion factor, estimate the number of square meters needed.
4	a,c	Students will design a can to hold soup. They must determine the surface area of their can (the metal), the lateral area of their can (the label), and the volume of their can (the soup).
4	c	Determine measurements of given objects found in any classroom (e.g., books, paper clips, trash can).

PRE-ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
5	c	Take students outside to record the colors of cars that go by. Using this data, ask students to predict the color of the next ten cars.
5	c	Use marbles, coins, number cubes and spinners to calculate basic probability of simple, compound, independent and dependent events.
5	c	Given a packet of clothes (such as pants and shirts in different colors), arrange clothes and determine possible number of outfits.
5	c	Imagine a certain group of students eating at a restaurant. Use an organized list, a tree diagram, or the Fundamental Counting Principle to determine the number of different meals available or the different ways the group can be seated.

TRANSITION TO ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
1	a	Show relationships using visual organizers (Venn Diagrams) among the subset(s) of the set of real numbers.
1	a	Distribute cards containing a rational or irrational number. Have students arrange cards in order on a number line and justify placement.
1	b	Have teams comprised of four students form numerical expressions to represent the numbers 1 to 26. Teams will use grouping symbols, the digits 1,2,3, and 5 only once, and the basic operations to create each expression.
1	b	Create foursomes such as: $3(x + 4) = 3x + 12$ $3x + 2x = x(3 + 2)$ Distributive property $5x + 3 = 3 + 5x$ Which one does not belong?
1	c	Use the graphing calculator in scientific model to discover rules for multiplying and dividing numbers in scientific notation.
2	a	Working in pairs, one student runs a specified distance while another uses a stopwatch to measure time. Use the formula $d = rt$ to determine rate.
2	a,c	Given a solved equation with mistakes, verify and explain why the process is incorrect.
2	b	Using algebra tiles™ to show differences among "x+ x" and "x • x", "x + y", "x • y", "(+ 1) + x" and "(y + 1) • x" Given a rectangle of specific length and width, extend length and width by a variable and calculate new perimeter and area in terms of the variable.
2	c	Use manipulatives (e.g., algebra tiles or blocks) to model processes used to solve equations. Check solutions using the graphing calculator or substitution.
2	h	Using a graphing calculator, enter $y = x$, $y = 2x$, $y = \frac{1}{2}x$, and $y = \frac{1}{4}x$ one at a time. Explore what happens with the steepness of each line.

TRANSITION TO ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
3	a	Plot two points on a coordinate plane. Use the Pythagorean Theorem to find distance. Show how the distance formula is derived from the Pythagorean Theorem.
3	b	Given two similar triangles, use highlighters to color code corresponding parts; set up ratios and proportions to find unknown measures.
4	a	Using a coffee can, calculate volume of the can. Calculate circumference and area of one of the bases.
5	a	In groups, assign each a topic from which to design and conduct a survey. Compile, graph, and interpret results and present to class.

ALGEBRA I

Comp.	Obj.	Suggested Teaching Strategies
1	a	Have students play expression Concentration by preparing card with expressions and their simplifications on another card. Students must match the original expression with its correct simplification.
2	a	Ask students to solve the following problem: A spike is hammered into a train rail. You are standing at the other end of the rail. You hear the sound of the hammer strike both through the air and through the rail itself. These sounds arrive at your point six seconds apart. You know that sound travels through air at 1100 feet per second and through steel at 16,500 feet per second. How far away is that spike? (http://www.purplemath.com/modules/distance2.htm) Discuss what type of information would be helpful ($d = rt$). Students may solve the problem in multiple ways, including using a linear equation.
2	a	Reinforce solving multi-step inequalities by placing the steps for solving inequalities on sentence strips. Cut apart each step and place in an envelope. Make enough inequality envelopes so that small groups of students or student pairs must solve at least four of them and order them on chart paper. Have each group report out or do student presentations of their solutions.
2	b	Prepare Absolute Value Inequality Cards that contain the inequality, the graphed solution, and the solution set. As a whole class activity or in small student groups, have the students play concentration with them matching the inequality, the graph and its solution set in set notation.
2	c	Give students a relation presented in several forms: a table of values, a set of ordered pairs, and a graph and ask them to identify whether the relation is a function. As an extension, if the relation is not a function, have them tell you how to modify the relation or the domain/range to make it a function, if possible.
2	d	Using equations involving rational numbers, such as $y = 0.05x$ to represent the value of x nickels, explore how changes in x affect y. Identify domain as nickels and range as value. Use a T-table to graph the relation and verify with graphing calculator.
2	e	Give real-world examples of linear functions such as car rental costs vs. mileage; error ranges in polling numbers; and postage rates at various years.
2	e	Demonstrate how to write linear equations when given a table of values, the slope and an ordered pair, the x and y intercepts, or when given a graph.
2	f	Demonstrate the three methods for solving systems of equations e.g. substitution, elimination, and graphing so that students understand when to utilize the methods.

ALGEBRA I

Comp.	Obj.	Suggested Teaching Strategies
2	f	Joan King is marketing director for the BurgerRama restaurant chain. BurgerRama has decided to have a cartoon-character doll made to sell at a premium price at participating BurgerRama locations. The company can choose from several different versions of the doll that sell at different prices. King's problem is to decide which selling price will best suit the needs of BurgerRama's customers and store managers. King has data from previous similar promotions to help her make a decision. Selling Price of Each Doll — Number Supplied Week/Store — Number Requested Week /Store $1.00 — 35 — 530 $2.00 — 130 — 400 $4.00 — 320 — 140
2	g	Use algebra tiles™ to demonstrate adding, subtracting, and multiplying polynomial expressions. When multiplying expressions, utilize the Box Method.
2	h	Utilize algebra tiles™ to factor polynomials.
2	h	Have students to expand the terms of a polynomial into prime factors in order to help determine the GCF.
2	i,j	Utilize the graphing calculator to help students connect the factors with the *x* intercepts. Use the quadratic formula to solve quadratic equations. Be sure to link the terms solutions, *x* intercepts, and factors.
2	j	Use the discriminant to help students determine when a quadratic equation will have rational number solution(s).
2	j	Have students graph two equations ($3x^2 - 2y^2 + 3y = 7$ and $10y^2 - 4y = 8$), identify the *x* and *y* intercepts, and determine if the solutions are rational or irrational solutions.
2	k	Using a graphing calculator, have students graph a parent equation, such as $y = x^2$. Change the coefficient of the *x*-term and have students generalize the effect on the parabola. Similarly, start with the parent equation, graph several more parabolas with a different constant. Have students generalize the effect on the parabola. This activity can be changed so that the parent graph begins with an absolute value equation: $y = \lvert x \rvert$.
2	l	Give students clues about an inequality graph and have them find the inequality. For example, The boundary of the graph has a slope of 2 and passes through (2, 3). The points on the boundary line are not solutions of the inequality. The point (5, 0) is a solution of the inequality.

ALGEBRA I

Comp.	Obj.	Suggested Teaching Strategies
3	a	Relate systems of equations to intersecting, parallel, and perpendicular lines by having students to re-write the equations in slope-intercept form and analyze the slope of the lines.
3	a	Using a graphing calculator, graph a parent line, such as $y = x$, and change the coefficient of the x-term to determine the effect on a graph. Continue by changing the constant term. Make generalizations about the effect of the values on the graph.
3	b	Relate income to the number of hours worked in equations such as: $y = 5.25x$ and $y = 15.85x$
3	b	Have students design an experiment to model a dripping faucet and determine the amount of water that would drip and be wasted. Using the data they gather in a table, graph and write an equation for a line of best fit. Use their derived equation to make predictions about the amount of water that would be wasted from one leak over a long period of time.
4	a	Mark off distances such as 100 ft, 60 ft, and 30 ft. Let students use a stopwatch to calculate the time it takes to walk the given distances. Use the data to calculate the students' walking speed. Then the student will use calculated rate at different distances to see how close the calculated rate is to the actual walked rate.
4	a	Have students to measure the dimensions of the classroom and use the dimensions to calculate the perimeter and the area of the classroom. Can be a "warm-up" for the following project: Have students to design a floor plan for their dream house. They must calculate the total square footage of the house. Have the students find the perimeter to estimate the lumber needed, etc. Can also calculate surface area of halls and ceilings, then calculate amounts and costs of sheetrock, painting, ceiling tiles, etc.
4	b	Give pairs of students several sets of coordinates that will form different plane figures (parallelograms, triangles, etc.). Instruct students to utilize the distance formula, the Pythagorean Theorem, and the slope formula to determine the type of plane figure involved. They must justify their answer algebraically, graphically, and geometrically.
4	c	Use Algebra Tiles™ to solve problems involving perimeter and area.
5	a,b	Have students collect data such as height, shoe size, arm span, forearm length, foot length, etc. for 10-25 people. Relate this to linear equations by having them take two of the gathered data such as height and shoe size, and graph it in a scatter-plot. They can use spaghetti to approximate the line of best fit. Then, use the linear regression feature of the graphing calculator to have them find the slope and y intercept of the line. Have them to write the equations in slope-intercept form, point-slope form, and standard form.

GEOMETRY

Comp.	Obj.	Suggested Teaching Strategies
1	a	Given two similar polygons, use highlighters to color code corresponding parts. Set up ratios and proportions to find unknown measures.
1	b,c	Use calculators to verify results and justify estimates
2	a	Provide students with the following equations: $y = 2x$ $y = 2x - 1$ $y = -\frac{1}{2}x$ $y = -\frac{1}{2}x + 1$ Have students graph these equations on a graphing calculator and draw conclusions about their relationships. Investigate the relationships among slopes of these lines.
2	b	Form a square with string. Measure a side and calculate perimeter and area. Cut the string in half and repeat procedure. Record results and determine the relationship between change in perimeter and resulting area.
3	a	Given situations that require logical thinking, classify as inductive or deductive reasoning.
3	b	Create jumbled proofs. On index cards, write statements and reasons to a two column proof (one per card). Shuffle, distribute, then have students put in logical order.
3	c	Construct a moveable model of parallel lines cut by a transversal from three strips of tag board fastened together with brads. Measure the various angles and show the relationship among the angles.
3	d	Fold different types of triangles to demonstrate medians, altitudes, and bisectors. (Patty paper would work well for this.)
3	d	Use a compass and straight-edge to create constructions including angles, segments, angle bisectors, segment bisectors, perpendicular bisectors, altitudes, and other geometric figures.
3	f	Investigate several designs by M.C. Escher and other tessellation sites and use them to create original tessellations.
3	f	Given three straws of different lengths, explore the question: “Is it always possible to form a triangle?” Given labeled sets of triangles, match to the appropriate congruence postulate or theorem.
3	h	Relate the intersection of a cone and a plane to the various conic sections.

GEOMETRY

Comp.	Obj.	Suggested Teaching Strategies
3	h	Use the Pythagorean Theorem to calculate the norm (magnitude) of a vector. Using a protractor and ruler, construct vectors given the magnitude and direction. Research different notations for vectors using the internet or the library. Compare and contrast the different notations.
4	a	Create a display illustrating parts of a circle, their definitions and properties. Construct a circle of any radius. Use a straight-edge to draw various angles formed by segments. Use a protractor to measure and draw conclusions about formulas used to find these unknown measures and enhance with appropriate technology.
4	b	Draw a polygon. Connect a vertex to the non-adjacent vertices and form triangles. Discover the polygon interior angle theorem by counting the triangles and finding the sum of the angles.
4	b	Students will construct a clinometer using a protractor and a plum line. They will then calculate the height of a flagpole or basketball goal using right triangle trigonometry.
4	c	Have students measure the dimensions of the classroom and calculate the length of the diagonal from an upper corner. Then measure the distance and compare with the calculation.
4	c	Measure and calculate the volume of cans of various sizes in metric units. Test calculations by filling with water (1cc = 1ml). Design and construct models of geometric solids and create a table illustrating the relationships among faces, edges, and vertices of the solids.
5	a	Determine how many handshakes there would be between five people if everyone had to shake hands with each person exactly once. Explain or sketch how the answer was determined. Use a dart board and geometric probability to determine the probability of a dart landing in a specific area.

ALGEBRA II

Comp.	Obj.	Suggested Teaching Strategies
1	a	In groups, students will write on index cards one number in each set and subset of the complex number system including complex, real, pure imaginary, rational, irrational, integer, whole, and natural. Shuffle the cards and create a tree diagram for display.
1	b	Use the Box Method to demonstrate how to multiply radical expressions.
1	b	Prepare cards with radical expressions on them. Pairs of students are to pull two cards and perform operations such as +, -, x with the two cards. Have each student pair to present their solutions to the class. Have students to find the perimeter and area of polygons using radical terms as dimensions.
1	b	Prepare cards with complex number expressions on them. Pair students and instruct them to pull two expressions and perform all four operations on the expressions. Have the pairs to chart the problems and present to the class.
1	c	Simplify powers *i* through at least three cycles. Let student pairs explain and discuss the pattern. Let students simplify powers of *i* and construct a power of *i* to given specifications (Ex. Find a power of *i* that is equal to -*i* with an exponent between 240 and 250. There may be more than one answer.).
1	d	Give students the values for matrices A, B, and C. In pairs, let students perform the following operations: AB and BA, and A(BC) and (AB)C. Utilize these matrices to teach/reinforce that all real number properties do not apply to matrix operations. Verify with technology using the matrix operation of the graphics calculator.
1	d	Draw a rectangle in the coordinate plane with one vertex at the origin. Label the vertices of the rectangle. Set up a 2 x 2 matrix using the two points adjacent to the origin with the x-values in the top row and the y-values in the bottom row. Find the determinant of the matrix using the following formula: $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - bc$ Find the area of the rectangle and compare to the determinant. Try with a parallelogram (let one side of the parallelogram be on the x-axis).
1	d	Use the graphing calculator to find the inverse of a 2 x 2 matrix and verify using the following formula: $A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

ALGEBRA II

Comp.	Obj.	Suggested Teaching Strategies
2	a	Prepare cardstock sets of compound inequalities with their solutions presented in three forms: interval notation, graphs, and set notation. Play Concentration where students must match the inequality with its solution set, interval, and graph, and justify their selections.
2	a	One approach to solving absolute valve inequalities is to emphasize the definition of absolute value as the "distance from zero". Ex. $\lvert 2x + 3 \rvert < 4$ is translated to '2x + 3 is less than 4 units from zero'. Less than 4 units from zero must be between -4 and 4 which translates to $-4 < 2x + 3 < 4$. Likewise, $\lvert 2x + 3 \rvert > 4$ is translated to '2x + 3 is more than 4 units from zero'. More than 4 units from zero must be less than -4 or greater than 4 which translates to $2x + 3 < -4$ or $2x + 3 > 4$. Compare the graphic interpretation of the solution to the interval notation.
2	b	Use the graphing calculator to examine the graphic solutions to a variety of problems. Graph both sides of the equation as separate functions and examine the points of intersection. When graphing absolute value equations, graph both sides of the equation and also graph the inequality using the TEST menu.
2	e	Use a Semantic Feature Analysis chart that contains various quadratic equations where the students must classify the number of roots and whether the roots are complex, real, rational, irrational, etc.
2	f	Introduce alternative methods such as Tic-Tac-Toe for factoring polynomials.
2	f	Utilize the graphing calculator to demonstrate why some polynomials are prime and to verify algebraic methods such as the use of the quadratic formula.
2	g	Solve radical equations on sentence strips. Cut the strips apart, mix them up, and place them in envelopes. In small groups, have students to order the steps.
2	h	Prepare a set of 10 rational expressions to include all four basic operations. Set up a relay system with groups of four students with one student working one step of the process and passing it on to the next student. When completed, the group leader brings the completed problem to the teacher for verification. If the answer is incorrect, the group must collaborate and figure out the error without teacher direction.

ALGEBRA II

Comp.	Obj.	Suggested Teaching Strategies
2	i	Compare solving equations with rational expressions to solving proportions. For example, use the proportion $\frac{7}{4} = \frac{x}{2}$ and compare the steps to solving rational equations such as $\frac{x-3}{x+1} = \frac{x-2}{x-1}$. Have the students to utilize the same steps to solve for x in the rational equation. Point out to students that more complex rational equations such as $\frac{6}{x-1} - \frac{3}{x+1} = \frac{3}{x}$ involve simplification of the left hand side of the equation prior to utilizing the cross multiplication exemplified in solving proportions.
2	j	To find the composition of two functions *R(x)* and *G(x*), where *R(x)* is written in red and *G(x)* is written green colored markers in the board, ask the students to find *R(G(x))* and *G(R(x))* coded in the appropriate colors.
3	a	Use the graphing calculator to verify if two functions are inverses by inputting *f(g(x))* in *y* = to see if you obtain *y=x*. If not, the two functions are not inverses.
3	c	Given the transformation of parent graphs, match the graphs of functions with the word descriptions of the functions.
3	d	Using the Cartesian coordinate plane, plot 2 complex numbers, add them and plot the sum. Then draw three vectors for the origin to each complex number and complete a parallelogram. The sum is the diagnosed of the parallelogram.
3	e	Given a list of quadratic equations, determine the type of conic section. Write each equation in standard form and identify specific characteristics. Graph each conic section with and without graphing calculator.
4	b	Write statements involving inequalities and absolute values that model finding the gas tank capacity, average city miles per gallon, and highway miles per gallon of a car.
5	a	Make cards with 3 non-collinear points on them so that each pair or trio of students has at least three different cards. Use the STAT menu of the graphing calculator to perform the quadratic regression analysis for the three points.
5	a	Make cards with 3 collinear points so that each pair or trio of students has at least three different cards. Use the STAT menu of the graphing calculator to perform the linear regression analysis for the three points.

ALGEBRA II

Comp.	Obj.	Suggested Teaching Strategies
5	b,d	Give students 5 cubes of different colors. Have them make as many combinations of 2 colors as possible. (10) Have students draw two blank cards to symbolize the cubes to be chosen. Ask them how many choices for the 1st cube (5) and for the 2nd cube (4). Write in the blank: 5 x 4 = 20. Point out to students that a red/blue combination is the same as a blue/red combination (since with combinations order is not important) so we divided by 2 to obtain 10.

ADVANCED ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
1	c	Place students in small groups. Have each student write the rules on how to find determinates using expansion by minors. Once you are sure their rules are correct, give them 4x4 matrices on index cards and tell each member of the group to complete a step in the group rules. Have them use different colored highlighters/pens to identify their step, and then have them review each other's work to ensure correctness. Follow up with having them write a summary of the rules and their group's experiences working on their project. Use graphing calculators to find determinants of matrices, allow students to work in groups. Have each student write the process of how the graphing calculator was utilized.
2	a,b	Place functions that do/do not have inverses on index cards or small strips of paper. Ask students to work in small groups to determine which functions do/do not have inverses. Then, have the group prepare a report on their findings.
2	c	Give example involving baseball player's batting average. In small groups, have the students work problems involving batting averages and coin tossing using the Binomial Theorem and Pascal's Triangle. (Have them determine the probability of getting at least 3 hits in next 5 times at bat.)
2	d	On index cards, describe conics (parabola, circle, ellipse, hyperbola). Have students to write the equation about each.
2	e	Create, construct, and solve a linear programming problem with at least four equations.
2	e	Give students systems of linear equations to solve, encourage/require use of graphing calculators to confirm answers. Then give students systems of linear-quadratic equations and quadratic-quadratic equations and inequalities to solve by use of a graphing calculator. Have the students write the steps used in the calculator to solve the systems of equations.
3	a,b	Given a list of quadratic equations, have students determine the type of conic section and justify their reasons. Given several graphs, have students determine the type of conic section and justify their reasons. Write each equation in standard form and identify specific characteristics of each equation/graph.
3	b	Graph parent conic sections and identify their equations and predict translations, verify using a calculator.
3	b	Give students conic sections by equations and ask them to sketch the graph on graph paper. Verify using a graphing calculator.

ADVANCED ALGEBRA

Comp.	Obj.	Suggested Teaching Strategies
4	a	Have students work in small groups and assist each other in using the graphing calculators to determine quadratic and cubic regression equations for given data. Require the students to discuss their decisions and justify their answers.
4	a	Using a graphing calculator, use curve fitting to find the equation of the curve of best fit containing three or more non-linear points. Make predictions using the equation and the graph.
4	a	Students will plot their shoe size and wrist measurement on a large graph. After drawing the line of best fit, predict a professional athlete's wrist size based on a given shoe size.

TRIGONOMETRY

Comp.	Obj.	Suggested Teaching Strategies
1	b	Use a transparency for a polar graph and place a rectangular graph with common units on top of it to illustrate.
1	d	Show complex numbers in the form $a + bi$ and remind students that the cosine function relates to x and the sine function relates to y. Therefore $a + bi = r(\cos\theta + i\sin\theta)$ where $r = \sqrt{a^2 + b^2}$, $\cos\theta = {}^{a}/_{b}$ and $\sin\theta = {}^{b}/_{r}$.
1	b	Review laws of exponents to relate products and quotients in trigonometric forms. For example in $(2x^3)(3x^4)$ we multiply numbers and add the exponents. In $3(\cos 30° + i\sin 30°) \bullet 2(\cos 60° + i\sin 60°)$ we multiply radii and add angles. (Of course we simplify the product to rectangular form if necessary.)
1	c	Have students expand and simplify $(3 + 2i)^6$ algebraically. Then to emphasize the value of De Moivre's Theorem, change the problem to polar form and simplify using De Moivre's Theorem.
3	a	Using graphing calculators have students pick several angles in the domain of given functions. Substitute each angle into given identities to show that the identities are true.
3	d	Use technology to verify answers. For example in the equation $\cos 2x + 3\cos x = -2$, Let $y_1 = \cos 2x + 3\cos x$ and $y_2 = -2$. Graph and use the calculate intersect feature to compare the "paper and pencil" solution to the graphic solution. Use degrees instead of radians on the interval [0°, 360°).
4	a	Using a protractor and a paper plate, show the multiples of 30°, 45°, 60°, and the quadrantals for all key angles in the circles. Label in degrees and radians.
4	b	Review the 30°- 60°- 90° and the 45°- 45° - 90° special right triangles. Define the 6 trigonometric functions for each special triangle.
4	c,d	Use graphing calculators to show the basic graphs, their inverses, and to illustrate transformation.
4	e	Have students go throughout the building or outside and illustrate non-right triangles. Then use Law of Sines and Law of Cosines to solve for unknown parts. Afterward have them measure all parts to verify.

TRIGONOMETRY

Comp.	Obj.	Suggested Teaching Strategies
4	f	Have students research and give examples of things that can be modeled with polar coordinates. (like satellites). Illustrate the path using polar graph paper.
5	a	Bring 2 or 3 pies of different radii. Use the arc length formula to find the crust length and the area of a sector formula for several pieces of pie of different sizes. (Estimate the central angle in radians.) Eat the pie.

PRE-CALCULUS

Comp.	Obj.	Suggested Teaching Strategies
1	a,b	On the first day of January, Bob ate one candy bar. Each day thereafter, he ate one more candy bar than the previous day. Determine the number of candy bars he ate during the month of January.
1	a	Count the spirals (left and right) on a pinecone, pineapple, or artichoke. Illustrate that the number of spirals are numbers in the Fibonacci Sequence. Write the first ten terms of the sequence, and have the students write recursive formulas for each term.
1	b	Tear a square piece of paper with an area of one, in half. Tear it in half again. Predict the area of one of the resulting rectangles after six tears.
1	c	Divide the class into groups and provide each group with a ball. As the ball is thrown or dropped, use technology (Computer Based Learning) to record the path of the ball.
2	b	Using a graphing calculator, determine asymptotes of a function and write a paragraph explaining the results. Discuss how the vertical and horizontal asymptotes are determined.
2	b	Using a graphing calculator, graph a rational function like $f(x) = (2x^2 + x - 1)/(x^2 - 1)$. Label the vertical asymptote and the hole. Analyze the function algebraically by factoring the numerator and denominator. Identify the vertical asymptote and hole, and compare the results to those on the graphing calculator.
2	c	Using a graphing calculator, determine domain and range of a piece-wise function. Discuss how to determine domain and range of a piece-wise function, and how to use tables, graphs, etc of the graphing calculator to do so.
2	d	Using a graphing calculator, determine end behavior for several different polynomial functions. Give students different polynomial functions and ask them to describe the end behavior of that function and the equation of the function.
2	d	Using the graphing calculator, determine the end behavior of a function and write a paragraph explaining the results. Discuss how the degree of the function affected the end behaviors. Create a spreadsheet of values to determine the end behavior of a graph.

PRE-CALCULUS

Comp.	Obj.	Suggested Teaching Strategies
2	e	Discuss what composite functions are and write a paragraph describing your conclusions. Using a graphing calculator, graph composite functions and their inverses. Describe in your paragraph any similarities/dissimilarities you may see.
2	e	Fold graph paper about the line $y = x$. Draw the graph of any function. Trace the graph on the other side of the fold to reveal the inverse.
2	e	Using the composition $h(x) = f(g(x))$ where $h(x) = \sqrt{x^2 - 4}$, decompose $h(x)$ into the two components $f(x)$ and $g(x)$. Have students find more than one correct answer.
2	e	Write the partial fraction decomposition of the rational expression $1 / (a^2 - x^2)$. Check your results algebraically. Then assign a value to the constant a, and check the result graphically.
2	f	In small groups, create, explain, and verify specific examples for each of the properties of exponents.
2	f	Compare the relationships of a logarithmic function and the inverse of an exponential function. Write an equation in one form, exchange papers, and write the inverse form.
2	f	Solve growth and decay problems involving half-life using logarithms.
2	f	The population of Jackson, MS (in thousands) is given by the exponential formula $P = 220e^{kt}$, where $t = 0$ is the year 2000. In 1980 the population was 169,500. Find the value of k, and use the results to predict the population in 2020.
2	g	In small groups, discuss what the rational root theorem is and when to use it. Write a paragraph about the group discussion. Give each group a polynomial function and ask them to use the rational roots theorem, and each member of the group must perform a step in this process. They may report their findings to the class in a variety of ways.
2	g	Use the table features of a graphing calculator to determine which of the possible roots are zeros of the polynomial $f(x) = x^5 + x^3 + 2x^2 - 12x + 8$ or other given polynomials. Set the table feature on "ASK" mode and enter each of the possible roots to find the zeros.
2	h	In small groups, write a paragraph containing the rules of synthetic division and the Factor Theorem. Using these rules, give each group polynomial functions and require them to use both synthetic division and the Factor Theorem to solve for zeros of the polynomial functions. Also have the students compare the synthetic division to long division, and compare the two methods.

PRE-CALCULUS

Comp.	Obj.	Suggested Teaching Strategies
2	h	Create and graph an equation of a polynomial function. Write a paragraph explaining the zeros of a function and how to determine where they are located on the graph.
2	i	In small groups, create, solve, and graph rational and polynomial inequalities. Extend to graphing systems of inequalities by shading solutions with colored pencils. Given a function, find the maximum and minimum of the shaded region.
2	i	Given a quadratic inequality, find and verify the values of *x* and express the solution in inequality notation, interval notation, and graphically.
2	j	In small groups, factor using rational and negative exponents, and then factor with non-standard difference of squares. Write a paragraph explaining each process.
2	j	In small groups, give students index cards that contain an integral with rational functions. Decompose the fraction into partial fractions. Write each step omitting parts of that particular step, and leave the final answer blank. Ask each group to fill in the missing pieces of information. Give the groups several of these, with different pieces missing for each integral. Each student should write a paragraph explaining how the group answered each step.
3	c	Using a graphing calculator, graph exponential, logarithmic, rational, and piece-wise functions and then sketch on graph paper. Discuss what characteristics of the graph in your calculator you used to begin sketching on paper. Would you use those same characteristics if you had not seen the graph in the calculator?
4	a,b,c	Give students data from application problems. Use the graphing calculator STAT PLOT feature to fit the data to exponential, logarithmic, and cubic regressions.

DISCRETE MATHEMATICS

Comp.	Obj.	Suggested Teaching Strategies
2	d	Provide students with sample arguments, and have the students decide if these arguments are valid using the rules of logic.
2	e,f	Have students use a recursive definition of multiplication such as f (1) = 3, and f(n) = 3 + f(n-1), to see that multiplication can be defined as repeated addition. Use a similar idea to see that powers can be defined as repeated multiplications and in turn repeated additions.
2	h	Use different identifying properties to create sets of students found in the class, such as color of clothing, wearing earrings, wearing glasses, etc. from these sets have students determine the elements of unions, intersections, differences, and complements of sets.
3	a,c	Use a circuit board to build simple circuit from a Boolean expression and note the output.
3	b,c	Provide the students with a simple circuit on a circuit board and have the students write down a Boolean algebra statement for the circuit.
3	e	Provide students with examples of platonic solids, and the students count the number of edges and vertices. From several examples have the students write a general statement about the number of edges and vertices: Euler's Formula.

CALCULUS

Comp.	Obj.	Suggested Teaching Strategies
2	a,b	Divide the class into groups. Each group will investigate the function: $f(x) = \frac{x^3-1}{x-1}$ Group assignments: 1) Have one group create a table of 10 to 20 function values for [12], 2) Create table values for [0,1]. 3) Graph function using a decimal (friendly) calculator window. List five (5) observations about what happens to *y* values as *x* gets closer to 1. 4) Predict what graph will look like and list at least five characteristics. 5) Algebraically explore the function: "Can it be factored?"
2	b,c	Compare the graphs of several rational functions to table values for behavior at points near where the denominator is undefined.
2	c	Distribute examples of graphed functions. For each example: a. Use the graph to identify intervals where the function is continuous. b. Discuss and identify the values of the function where failure occurs for each of the three tests of continuity.
2	c	Explore Layman's version of continuity: A function is continuous if you can draw it without ever lifting your pencil.
4	c	Compare a list of indeterminate forms and discuss why they are indeterminant.
4	c	Use $\lim_{x \to \infty} (1+ \frac{1}{x})^x$ to show/explore why 1^∞ is an indeterminate form.
5	a	Using an overhead-graphing calculator to create overheads of different functions, create two bugs (from hole punched dots) to travel along the overhead functions. Get students to predict what will happen as both bugs walk along the curve toward each other and a string connects the two bugs—one bug stays still and the other approaches the first bug.
5	b,c	After basic differentiation rules have been introduced, provide memory tools. For example, PI **(P**ower then do the **I**nside), and PTA (**P**ower, **T**rig, **A**ngle).
5	c	Given the graph of a function draw the tangent line at a variety of points on the function. Estimate the slope and analyze in terms of rate of change.
5	c	Determine the tangents to the curve $49^2 x\ y^2 + = 36$ at the ends of each axis. Describe the relationship between the two sets of tangents.

CALCULUS

Comp.	Obj.	Suggested Teaching Strategies
5 7	d b	Give students a function like $f(x) = x^5 + 3x^4 - 4x^3 - 12x^2$ a) Where are the zeros for f'(x)? b) Identify intervals where graph is increasing/decreasing. c) Have students compute derivative and graph the derivative. Where is f(x) above the x-axis; Below the x-axis? d) State x coordinates of max/min points for f(x).
5	d	Make a set of match-cards to include f(x), f', (x), f"f'(x), f"(x) for each group of students. (Extend: Critical number cards) Have groups match all the parts, then present one complete solution to the class.
6	a	Use the Fundamental Theorem of Calculus to explain the difference between definite and indefinite integrals.
6	b	Create a graph that would model the average value formula.

STATISTICS

Comp.	Obj.	Suggested Teaching Strategies
1	g	Research the Buffon Needle Problem and perform the classic experiment by dropping pipe cleaners on a tiled floor. Use data to compare with actual formulas involving *n.*
1	c	Investigate how a state, like Mississippi, determines the sequence patterns of numbers and letters for license plates or how the phone company decides to issue new area codes.
1	d	Use the school lunch menu and construct a tree diagram to determine the number of possible meals.
1	e	Discuss whether the following example is a mutually exclusive event: *Given a standard deck of 52 cards, find the probability of drawing a card that is a red card or a face card. Validate by randomly pulling the red card and the face cards and count the total number. Then change the situation to drawing two cards from the deck that are red cards or face cards and illustrate differences with cards and explain use of combination formula for this example.*
1	e	Discuss the differences between independent and dependent events. Present the class with a bag of marbles consisting of 5 red, 6 blue, and 4 green marbles. Ask students to determine the probability of drawing out a blue, a red, and another blue marble in that order without replacement. Divide the class into groups and discuss whether "with replacement" or "without replacement" has the greatest probability of success. The large group will then discuss results of the experiment and will explain their conclusions.
1	f	Design a target with five sections so that the probability of hitting only one particular section is 25%.
1	g	Using dice and decks of cards, work in small groups to create a theoretical/experimental probability simulation for one of the other groups to carry out.

STATISTICS

Comp.	Obj.	Suggested Teaching Strategies
1	g	Suppose a presidential election has just taken place. A large sample of voters was interviewed on whether or not they switched part affiliations. The following contains the probability data resulting from this survey. Democrat Republican 0.8 0.2 0.6 0.4 Given that a voter is a Democrat at this election, what is the probability that party affiliation will be switched in the election after the next two transitions? According to statistics, at the time the survey was taken, 60% of the voters were Democrat and 40% were Republicans. Based on the survey results, what percent of the population will be Democrats in the election after two transitions?
1	i	Repeatedly toss four coins and record the number of heads obtained on each trial. Find the mean number of heads in 5, 10, 25, 50, and 100 trials of the experiment. For each number of trials, find the probability distribution for the number of heads obtained. (The mean of the random variable is 2.) The mean number of heads observed when four coins is tossed many times approaches the population mean of the probability distribution.
2	b	The teacher writes down all scores on the last major test. Each student will standardize his/her score. Students will discuss measures of central tendency for the test scores.
2	c	Design an experiment to compare the means of two samples. Write hypotheses, collect and analyze data, draw appropriate conclusions, and communicate the results.
3	a,b,c	Analyze monthly income/expenses using current market values, which are independently and realistically determined. Use the following categories of expenses: ● Taxes: federal income tax, state income tax, FICA ● Housing: mortgage or rent, insurance, taxes ● Groceries ● Utilities: water, electric, gas, phone, sanitation fee, cable ● Automobile: payment, insurance, tag, gas ● Entertainment ● Savings ● Charitable contributions ● Insurance: medical, life ● Clothing Collect and organize data, then choose the graph type that represents the data and construct this graph. Analyze results to see if future adjustment should be made in expense patterns.

STATISTICS

Comp.	Obj.	Suggested Teaching Strategies
3	a	Gather nutritional data about favorite cereals. Decide on best means to organize information; frequency, stem-leaf plots, and /or histograms.
3	b,c	Provide each group with a different data set. Each group decides on best type of graph to display data. Groups share graphs and justification to the class.
4	a,b,c, d	Gather information on closing prices of selected stocks for a one-year period. In small groups and using different companies: ● Examine differences percentile growth from month to month ● Interpret and analyze data using the necessary formulas. ● Communicate results in written and oral form to the class. ● After discussion, make conclusions about which stock would be the best investment based upon one year's growth.
5	a	Design a method of obtaining a simple random sample to determine the typical number of hours studied each week night by students in grades in 11 and 12 at your school.
5	a	Design a method for obtaining a stratified sample to determine who among three hypothetical candidates will be elected Homecoming Queen at your school.
5	a	Divide the class into groups of three. Each group will design an experiment, keeping in mind the concepts of confounding variables, control groups, placebo effects, blinding, randomization, and replication.
4	b	Explore to find the possible differences between the largest and smallest of five integers whose mean is 5, and whose mode is 8.
5	b,c	Consult a scientific journal. Find an example of an observational study, a survey, and an experiment. Critique each study to determine if it is a well-designed and well-conducted study. Identify any sources of bias.

SURVEY OF MATHEMATICAL TOPICS

Comp.	Obj.	Suggested Teaching Strategies
1	a	Create a budget for a family of four with a given yearly income.
1	b	Use simulated checks, checks register, and reconciliation forms to maintain a checking account and to reconcile the checkbook with the bank statement.
1	c	Obtain copies of 1040EZ and 1040A forms and instruction booklets from the IRS or local library. In groups, discuss the forms and provide sample information for students to complete both forms
1	d	Create a poster with the following headings for six used cars cut out from newspaper advertisements: • Sticker price • Down payment (use 10%) • Loan amount • Monthly payments (use current interest rate and three years for loan) • Total payments • Total amount including down payment Use a calculator and the monthly payment formula to complete the poster. Justify which car would be the best buy after verifying the condition of the car by visiting the dealership offering the car.
1	e	Investigate the following for each of ten local apartments for rent" • Square footage • Monthly rent • Number of bathrooms • Number of bedrooms Using a graphing calculator, calculate linear regression and find the line of best fit to compare any two apartments. Use this information to make predictions.
1	f	Visit local banks to gather information on savings accounts. Prepare a poster, which compares the data.
1	g	Invite an actuary or local insurance agent to speak to the class concerning life and health insurance policies.
1	h	Find gross pay based on commission sales and hourly rate. Use federal and/or state tax tables and FICA percentage rate to calculate deductions and net pay.
1	i	Collect several credit card applications. Compare terms, finance charges, APR, etc. Determine which application is the most advantageous to the consumer.
1	j,k	Plan a trip to a far away city within the 48 contiguous United States. Decide on destination and length of trip. Call a travel agent (or use the Internet) to compare various modes of transportation for cost and time constraints. Prepare a budget of anticipated expenses.

SURVEY OF MATHEMATICAL TOPICS

Comp.	Obj.	Suggested Teaching Strategies
1	j,k	Obtain state maps for each student. Given two locations on the map, discuss the best route to travel from one location to another. Calculate the costs of driving a car to this destination. Discuss the pros and cons of driving versus other modes of transportation.
1	l	Contact the Mississippi Economic Council (MEC) for information on participating in the state Stock Market Game.
2	a	Use a calculator and the appropriate formula to compute monthly payments when buying a car or house.
2	a	Suppose the ancestors deposited $1 in a savings account 200 years ago. Using simple interest of 3%, calculate the value of that account today. Repeat using compound interest. Discuss the results. (Extend: Vary the amount of originally deposited and/or the interest rate.)
2	a	Use the Rule of 72 to estimate how long it would take to become a millionaire with an initial deposit of $1000 with an interest rate of 10%. Repeat varying interest rates and initial deposit.
2	b	Use the method of linear programming to maximize or minimize certain factors in a business situation.
2 1	c m	Find the break-even point given cost and revenue equations. Analyze the regions between the two curves when graphed.
2	c	Research different types and financial amounts of fringe benefits offered by local employers. Using this data, compute additional costs associated with employment.
3	a	Create an amortization schedule to illustrate the concept of installment loans.
3	a	Investigate car-buying options involving rebates versus the offer of an extremely low interest rate. Discuss the advantages/disadvantages of each option for the dealer, loan institution, and buyer.
3	b	Use the Rule of 78 to estimate the savings when a loan of $1000 for 12 months at 7% is paid off after four months.

INTRODUCTION TO ENGINEERING

Comp.	Obj.	Suggested Teaching Strategies
1	a	Have students convert simple and complex units in English, metric, and SI. Examples: 93,500 inches to km, 3 weeks to milliseconds, 2560 feet^2 to hectares, \$8.08 per yard^3 to cents per liter, specific weight of steel 490 lb/feet^3 to SI units.
1	b	After discussing different techniques for proper conversion of base 2 (binary) and base 10 (decimal) systems, have students solve these types of problems for practice. Students may verify their answers by working the problems employing alternative techniques.
1	c	Interpret a surveyor's legal description of a piece of property written in terms of "meets and bounds" and create an accurate plot. Provide students with an actual legal description available from courthouse records. After understanding surveyors' symbols, have them read and interpret the description and plot the land description. The plot should be drawn to scale and should close at the point of beginning.
1	d	Solve for output values in a Truth Table of various configurations of Logic Gates as part of an overview of Digital Systems. Have students solve problems involving True/ False or binary input of 1's and 0's in logic gate analyses.
1	e	This assignment should come after the section on unit conversion in order to utilize standardized methods of conversion. Have students solve a fictitious murder mystery in which physical properties for four poisons are given including molecular weight and density. Using these given properties, students should calculate molarity in order to prepare calibration curve graphs of Molarity vs. Area.
1	e,f	Working in groups, have students reinforce a two-story balsa wood structure in a cost-effective manner to better withstand a simulated earthquake. Perform calculations to determine maximum force allowed. Apply Euler's Column Equation to determine maximum force that can be applied to a slender column without buckling.
1	f	Using ALICE software, have students program a virtual world storyboard using proper sequencing programming techniques (do while, do together, if then, etc.). www.alice.org
2	a	With the basic formula for mass and energy balance, Accumulation = Inflow – Outflow, have students write equations to calculate the amount of rainfall in a reservoir (inflow) knowing daily municipal water demands (outflow) and water level rise (accumulation) over the past month. Students can also solve for human body weight loss or gain (accumulation) based on caloric food intake (inflow) and caloric exercise activities (outflow) over a month's time. One kg of human body fat contains about 33.1 MJ of metabolizable energy.

INTRODUCTION TO ENGINEERING

Comp.	Obj.	Suggested Teaching Strategies
2	b	Have students write equations and solve for unknowns in given circuit schematics. Ohm's Law (V = iR) and Kirchhoff's Voltage and Current Laws can be employed to help students write their own equations. A lab practical could be added to this topic to allow students to actually measure voltage and current with a multimeter, creating a circuit with batteries, resistors (or light bulbs), wire, alligator clips, breadboard, or other frame.
2	c	Create graph of a "Line of Best Fit" from given lab data of a linear pattern. Determine the degree of linearity (R^2 value), slope of the line, and equation of the line. Solve for unknown values from established line graphs by hand calculations and Excel spreadsheet calculations. Continuing on the murder mystery project first described in 1 (e), calibration data including volume percent and area of GC peaks will be provided to the students for creating calibration curves (lines of best fit) and associated equations for each of the poisons. Students should calculate the degree of linearity (R^2 value) of each calibration curve to assess the reliability of the data. It is recommended that students learn how to complete this task using an Excel spreadsheet and by hand. Fictitious GC results of blood sample analysis for several victims are provided for students to compare to poison calibration curves for solving the mystery.
2	d	Use mathematical functions to solve for BTU requirements and associated utility costs. Use a variety of heat sources (natural gas, propane, electricity, coal, solar, etc.) to accomplish various processes such as boiling a gallon of room temp water or taking a hot shower with given flow rates and temperature differences, or other applications. Using a standard heat transfer formula, $q/A = U(\Delta T)$, determine the utility costs of a home considering heat loss through windows. Consider an electric home heating system and a natural gas home heating system. Compare costs based on local utility rates and a need to maintain 70º F inside the house while the outside of the house is 30° F. Compare BTU requirements and associated utility costs based on 5 windows, 10 windows, 15 windows, 20 windows, etc. Create graphs to evaluate the data.
3	a	Solve surveyors' problems of incomplete field data using geometric calculations. Convert DMS to DD without calculator aid. Determine volume of asphalt to be placed on a highway given specific road grade, lane width, and survey data. Compare asphalt calculations given 15 percent slope vs. 15° slope road grade. Calculate the quantities of removed soil, volume of contained water, and formed concrete needed to construct a swimming pool, sidewalk system, and retaining walls on a sloped hillside.

INTRODUCTION TO ENGINEERING

Comp.	Obj.	Suggested Teaching Strategies
3	b	Sketch and calculate a crane's dynamic moment upon lifting a weight from a body of water using Force and Moment equations. Interpret the causes of this crane's overturning due to lifting excessive weight in terms of geometric and spatial positions. Write equations based on $\Sigma F_y = 0$ and $\Sigma M = 0$. Solve for maximum load the crane can lift before overturning. Based on a provided "Series of Unfortunate Events" photo series, have students offer intuitive interpretation of the cause of the overturning crane and suggestions for preventing the failure.
3	c	Have students calculate seepage under a hypothetical dam by applying Darcy's Law and evaluating a given geological flownet diagram. This assignment could be modified to evaluate seepage under an actual dam, mass balance of rainfall in a reservoir, or dam failure data from the Johnstown Flood of 1889.
3	d	Discuss the 5 basic types of internal stresses with which members of a structure respond to forces or loads applied (tension, compression, shear, torsion, and bending).
4	a	Design and construct an original automated coffee-maker system to accomplish the goal of producing 0.5 liters of coffee at 140º F within 10 minutes. Working in groups of 3, with proper supervision, have students creatively design and build a working coffee-making system in accordance with given criteria. Coffee-maker systems should be tested in a proper chemistry lab with all required safety precautions. Design must be approved by instructor prior to construction.
4	b	Design a crystal radio that will receive AM radio stations and construct the radio on a breadboard. Calculations will be performed to obtain the correct length of wire for an inductor that will be used in the tuning section of the radio. A hand-wound inductor will then be fabricated using the calculations. Working in groups of 3, have students design and build a working circuit board crystal AM radio using hand-wound inductor coil of calculated length capable of producing proper amount of induction to be able to tune in stations after dark. Provide formulas for calculating induction for a hollow-core cylinder. Provide kit with proper size resistor, variable capacitor, diode, magnet wire, breadboard, and alligator clips. Test radios with ground wire and antenna. Have students present accurate inductor calculations to determine number of coils needed, as-built schematic of radio circuit, and listening log of at least one AM radio station.

INTRODUCTION TO ENGINEERING

Comp.	Obj.	Suggested Teaching Strategies
4	c	Design and construct a mousetrap-powered throwing device utilizing optimal angles, arm rotation and elevation, capable of projecting a ball through the air to hit a target 20 feet away. Students will also learn to calibrate their designs to be able to make adjustments to hit a target at variable distances. Working in groups of 3, have students design and construct a mousetrap-powered throwing device capable of projecting a plastic ball through the air to hit a target 20 feet away. Designs may be made of any materials approved by the instructor. Supervision of the construction should be provided as necessary. Designs should also be constructed so that adjustments can be made to hit a target at variable distances. Before the test date, students should create a calibration table to be able to properly adjust their device in spring tension, angle of release, sweeping arm angle, or other feature to be able to hit variable target distances consistently and accurately. The student groups' design must be drawn to scale and/or with dimensions, and approved by instructor prior to construction.
5	a	Have students evaluate an environmental groundwater fictitious contamination problem from given data using Darcy's Law and a set of assumptions. Students should calculate the amount of time for contamination to migrate from one location to another and present the solution to this problem in an Excel spreadsheet and set of graphs with a range of values for each variable including velocity of groundwater flow, Δh of well water levels, distance between wells, conductivity of the soil, and soil porosity.

LITERATURE CONNECTIONS

The *Literature Connections* is designed to serve as a guide and first-stop source for making cross-curriculum connections. The titles are not extensive and other books should be used in the classroom.

Kindergarten through Second Grade

Adams, Pam	THERE WERE TEN IN THE BED. Child's Play International, 1979. Every time the little one says, "Roll over," a child falls out of bed. The reader manipulates a dial which moves a figure at each turn.
Allen, Pamela	MR. ARCHIMEDES BATH. New York: Lothrop, Lee, and Shepard Books, 1980. A good introduction to volume and water displacement of objects.
Anno, Mitsumasa	ANNO'S MAGIC SEEDS. Philmel Books, 1995. A golden seed grows by one's, two's, and so on. The arithmetic puzzles presented help develop numeration and problem-solving skills.
Anno, Mitsumasa	ANNO'S MYSTERIOUS MULTIPLYING JAR. Putham and Masaichiro Publishing, 1983. This story introduces factorials in a tale about a porcelain jar with a sea inside.
Axelrod, Amy	PIGS WILL BE PIGS. Arladin Paperbacks, 1997. A counting book about a family of pigs. This story contains a menu with prices, money problems, and a bonus problem.
Barret, J.	CLOUDY WITH A CHANCE OF MEATBALLS. MacMillian Publishing, 1978. A story about a town where it rains soup and juice, snows mashed potatoes, and blows storms of hamburgers.
Berenstain, Jean	THE BERENTAIN BEARS' TROUBLE WITH MONEY. Random and Stan House, 1983. To earn coins for the Astro Bear video game, Brother and Sister Bear find ways to work for money. How they find the middle ground Bears with money - between being spendthrifts and little misers makes for a funny, realistic story.
Brisson, Pat	BENNY'S PENNIES. Yearling Books, 1995. This story introduces money and counting by exploring what Benny can buy with five pennies.

Burns, Marilyn	THE GREEDY TRIANGLE. Scholastic Trade,1995. This story introduces the many different ways shapes appear in the world. A dissatisfied triangle transforms into different shapes, trying to find the best one.
Carle, Eric	THE VERY HUNGRY CATERPILLAR. New York: Philomel Books,1987. A hungry caterpillar is born on Sunday and on Monday begins to eat his way through fruit and stair-step fashion up to ten pieces on Saturday.
Carle, Eric	1, 2, 3 TO THE ZOO. Penguin Putnam Books for Young Readers, 1998. This story offers youngsters an introduction to numbers and number sets while learning about different animals.
Carter, David A.	STICKER BUGS NUMBERS. New York: Simon and Schuster, 1996. This book contains a set of stickers for numbers 1 to 10.
Cassidy, John	THE TIME BOOK. Palo Alto, California: Klutz Press, 1991. This book introduces estimates with time along with time intervals.
Clement, Rod	COUNTING ON FRANK. Gareth Steven Children's Books, 1991. A dog named Frank and his young owner explore estimation of measurements and numbers.
Crews, Donald	TEN BLACK DOTS. Mulberry Books, 1995. This book uses rhymes and everyday objects to demonstrate counting up to ten black dots.
Edens, Cooper	THE WONDERFUL COUNTING CLOCK. New York: Simon and Schuster Books for Young Readers. A counting book that presents the numbers 1 to12.
Esbensen, Barbara Juster	ECHOES FOR THE EYES: POEMS TO CELEBRATE PATTERNS IN NATURE. Pennsylvania: Harper Collins Publishers, 1996. This book contains poems and paintings that create images of repeating patterns in nature.
Feelings, Muriel	MOJA MEANS ONE: A SWAHILI COUNTING BOOK. New York: Dial Books for Young Readers, 1971. This book reinforces counting skills by counting objects, one through ten. Swahili names for the numbers are presented as well.

Freeman, Don	CORDUROY. Viking Penguin, 1968. Corduroy is a bear that once lived in the toy department of a big store. Day after day, he waited with all the other animals and dolls for somebody to come along and take him home.
Friedman, Aileen	THE KING'S COMMISSIONERS. Scholastic Press, 1994. This story introduces the concept of people counting by grouping.
Friedman, Aileen	A CLOAK FOR THE DREAMER. Scholastic Press, 1995. This story is about three sons' father, who is a tailor. Each son is asked to sew a cloak to keep out the wind and rain. Each son uses different shapes to make their cloak.
Gerstein, Mordicai	THE SUN'S DAY. New York: Harper & Row Publishers, 1989. This story presents the progression of a day from sunrise to sunset.
Giganti, Paul Jr.	HOW MANY SNAILS? Harper Trophy, 1994. This story is about a child who takes a walk to different places and wonders about the amount and variety of things seen on the way.
Giganti, Paul Jr.	EACH ORANGE HAD EIGHT SLICES: A COUNTING BOOK. Greenwillow, 1992. This story uses familiar objects to introduce familiar math concepts.
Hamm, Diane Johnston	HOW MANY FEET IN THE BED?. Simon & Schuster, 1994. A counting book that has a family of five tumbling in and out of bed while adding and subtracting feet.
Harshman, Marc	ONLY ONE. Dutton Books, 1993. This book uses a county fair to introduce the concepts of parts of a whole.
Haskins, Jim	COUNT YOUR WAY THROUGH CHINA. Minneapolis, Minnesota: Carolrhoda Books, 1987. This story shows how to write and pronounce the numbers one through ten in Chinese. Each number leads to the exploration of Chinese history and culture.
Hindley, Judy	TEN BRIGHT EYES. Peachtree Publishers, 1998. This story is about a mother bird searching for breakfast for her young. Introduces patterns, shapes, and numbers.

Hong, Lily Toy	TWO OF EVERYTHING. Whitman and Company, 1993. A Chinese folktale that helps develop number sense and numeration concepts.
Hughes, Shirley	LUCY AND TOM'S 1, 2, 3. Marking, Ontario: Viking Kestrel, 1987. This book introduces a variety of ways that mathematics is used on an everyday basis. One-to-one correspondence, addition, division, even and odd numbers, and measurement are some of the concepts covered.
Hutchins, Pat	1 HUNTER. Harper Trophy, 1986. 1 Hunter walks through the jungle. He does not see 2 elephants or 3 giraffes, but they see him.
Keats, Ezra Jack	OVER IN THE MEADOW: A COUNTING-OUT RHYTHM. Penguin Putnam, 1999. This story introduces animals and their young using the numbers one through ten.
Leedy, Loreen	FRACTION ACTION. Holiday House, 1996. This story explores fractions by using examples they find in the world around them.
Lewis, Paul Owen	P. BEAR'S NEW YEAR'S PARTY. Tricycle Press, 1999. This book features a large analog clock for exploring time.
Linn, Charles	ESTIMATION. New York: Thomas Y. Crowell Publishers, 1972. This book consists of activities and experiments to help improve skills in estimating countable quantities, volumes, and lengths.
Lionni, Leo	INCH BY INCH. Harper Trophy, 1995. An inchworm demonstrates how he can be used as a measurement tool.
Long, Lynette	DOMINO ADDITION. Massachusetts; Charlesbridge Publishing, 1996. This book has pictures of dominoes to show basic sums for the numbers 0 to 12.
Maccarone, Grace	MONSTER MATH. Scholastic, Inc., 1995. This story follows the activities of twelve monsters that diminish one by one. Includes a section of counting activities.
McGrath, Barbara	THE M&M'S BRAND COUNTING BOOK. Charlesbridge Publishing, 1994. This book uses M&M's to introduce counting, additions, subtraction, sets, colors, and shapes.

McMillan, Bruce — EATING FRACTIONS. New York: Scholastic, 1991. This book introduces wholes, halves, thirds, and fourths through food examples. Recipes are included at the end to extend the discussion to measurement.

Merriam, Eve — 12 WAYS TO GET 11. Aladdin Paperbacks, 1996. This book provides strategies for counting and numeration with collections of objects.

Morozumi, Atsuko — ONE GORILLA. Farrar Strauss & Firoux, 1990. This book is about a gorilla that counts hidden creatures in the jungle.

Murphy, Stuart — SUPER SAND CASTLE SATURDAY. HarperCollins, 1998. This book introduces the concept of nonstandard measurement as three friends compete in a sand castle contest.

Myllar, Rolf — HOW BIG IS A FOOT? New York: Dell Publishing, 1991. This is a tale about nonstandard measures and how they were used to make a bed for a queen.

Neasi, Barbara — A MINUTE IS A MINUTE. Chicago: Children's Press, 1988. This book explores the meaning of a minute from a child's perspective.

Paul, Anne Whitford — EIGHT HANDS ROUND. Harper Collins Juvenile Books, 1991. This story tells the history behind the art of quilting and introduces patterns and symmetry.

Pinczes, Elinor — REMAINDER OF ONE. Houghton Mifflin, 2002. This story applies numerical division to a practical problem in a fun and exciting way.

Pluckrose, Henry — WEIGHT. New York: Franklin Watts, 1988. The need to know is presented text along with applications of the metric system.

Reid, Margarette — THE BUTTON BOX. Puffin, 1995. This book introduces counting concepts with a grandmother's box of buttons.

Resier, Lynn — BEACH FEET. New York; Greenwillow Books, 1996. The beach displays human feet which squish, splash, or rest, as well as animal feet which may number five, six or even nine and which have many uses.

Richardson, John	TEN BEARS IN A BED. Sadie Fields Productions, Inc., 1992. Nine bears fall out of bed one by one when the littlest bear says "roll over."
Rocklin, Joanne	HELLO, MATH READER: HOW MUCH IS THAT GUINEA PIG IN THE WINDOW? New York: Scholastic, 1995. This book introduces money concepts.
Rogers, Paul	THE SHAPES GAME. Holth, 1989. This book introduces geometric shapes with riddles and illustrations.
Russo, Marisabina	ONLY SIX MORE DAYS LEFT. New York: Greenwillow Book, 1988. This story helps generate discussion of countdowns to certain events.
Schwerin, Doris	THE TOMORROW BOOK. New York: Pantheon Books, 1984. This book contributes to a discussion of what tomorrow means.
Scieszka, Jon and Lane Smith	MATH CURSE. Penguin Group, 1995. An amusing look at numbers in everyday life.
Sendack, Maurice	CHICKEN SOUP WITH RICE: A BOOK OF MONTHS. New York: Scholastic, 1986. This story takes the reader through the months of the year by portraying activities for each month.
Shapp, Martha and Charles Shapp	LET'S FIND OUT ABOUT WHAT'S LIGHT AND WHAT'S HEAVY. New York: Franklin Watts, 1975. Two suggested experiments explore the comparative lightness and heaviness of different objects.
Spurr, Elizabeth	THE BIGGEST BIRTHDAY CAKE IN THE WORLD. Harcourt Brace Jovanovich, 1991. The richest fattest man in the world falls into his birthday cake - the biggest in the world.
Srivastava, Jane Jonas	SPACES, SHAPES, AND SIZES. New York: Thomas Y. Crowell Publishers, 1980. The experiments of five mischievous animals help students investigate the concept of volume.
Srivastava, Jane Jonas	WEIGHING AND BALANCING. New York: Thomas Y. Crowell Publishers, 1970. This book provides directions for making a simple balance along with investigations to use this balance with nonstandard and standard units of measurement.

Tucker, Sian	1-2-3 COUNT WITH ME. New York: Simon and Schuster, 1996. This counting book involves lifting a flap on each page to count the objects hidden beneath.
Viorst, Judith	ALEXANDER WHO USED TO BE RICH LAST SUNDAY. New York: Atheneum Publishers, 1979. Alexander receives $1.00 from his grandparents. Through the course of a week, Alexander's money disappears through a series of events. It is left to the reader to determine whether he has lost all of his money by accounting for all his expenses.
Wahl, John & Stacy	I CAN COUNT THE PETALS OF A FLOWER. NCTM, 1985. This is a counting book.
Ward, Cindy	COOKIE'S WEEK. New York: G. P. Putnam's Sons, 1988. This book promotes discussion of the sequential days of the week.
Weiss, Malcolm E.	SOLOMON GRUNDY, BORN ON ONE DAY: A FINITE ARITHMETIC PUZZLE. New York: Thomas Y. Crowell Publishers, 1977. This story is about Solomon Grundy and asks if he was really buried a week after his birth and explores the cyclic nature of the days of the week. Patterns, arithmetic, and time can be discussed within the context of this book.
Williams, Vera	A CHAIR FOR MY MOTHER. Greenville, 1984. This book is about a family who saves dimes in a jar to buy a chair after losing everything in a fire, introduces counting and money.
Williams, Vera	CHERRIES AND CHERRY PITS. Mulberry Books, 1991. This book provides story problems related to a bag of ripe red cherries.
Wise, William	TEN SLY PIRANHAS: A COUNTING STORY IN REVERSE (A TALE OF WICKEDNESS—AND WORSE). Dial Books for Young Readers, 1993. This story is about piranhas that eat from ten fish down to one.
Zimelman, Nathan	HOW THE SECOND GRADE GOT $8,205.50 TO VISIT THE STATUE OF LIBERTY. Albert Whitman and Company, 1992. A story about a group of children trying to raise money to go on a trip.

Third through Fifth Grade

Adams, Barbara Johnson	THE GO-AROUND DOLLAR. Simon and Schuster, 1992. This picture book is about the travels of a single dollar.
Adams, Pam	TEN BEDS TALL. Child's Play, International Ltd., 1988. A washable book that has an attached set of beads and a series of stories and exercises that help students learn about measurement.
Anno, Mitsumas	ANNO'S SUNDIAL. New York: Philomel Books, 1987. These three-dimensional pop-ups illustrate how the motions of the sun and the Earth led people to discover ways to tell the time of the day.
Anno, Mitsumasa and Masaichiro	ANNO'S MYSTERIOUS MULTIPLYING JAR. Putnam Publishing Group, 1983. This book introduces factorials in a story about a porcelain jar with a sea inside.
Burns, Marilyn	SPAGHETTI AND MEATBALLS FOR ALL. Scholastic Trade, 1997. This book introduces concepts of area and perimeter as a family tries to make room for everyone who attends a family reunion.
Burns, Marilyn	THE GREEDY TRIANGLE. Scholastic Trade, 1995. This book introduces the many ways shapes appear in the world.
Burns, Marilyn and Joanne Rocklin	ONE HUNGRY CAT. Sagebrush Education Resources, 1997. Tom the cat tries to evenly divide the snacks he has baked for himself and two friends. Includes division activities.
Clement, Rod	COUNTING ON FRANK. Gareth Sterens, 1991. This book is about a boy who uses fact, figures, and a wild imagination to make counting fun.
Dahl, Ronald	ESIO TROT. Puffin, 1992. This book is about Mr. Hoppy, who devises a plan to win Mrs. Silver's heart that leads to thinking about measurement and division.
Ernst, Lisa Campbell Mulbery Books,	SAM JOHNSON AND THE BLUE RIBBON QUILT. 1992 This story is about quilt-making to introduce patterns and symmetry.
Falwell, Cathryn	FEAST FOR 10. Clarion Books, 1993. This book shows what it takes to make a meal for ten people.

Friedman, Aileen	THE KING'S COMMISSIONERS. Scholastic Trade, 1995. This book introduces the concept of counting by grouping.
Friedman, Aileen	A CLOAK FOR THE DREAMER. Scholastic Trade, 1995. This story is about three sons father, who is a tailor. Each son is asked to sew a cloak to keep out the wind and rain. Each son uses different shapes to make their cloak.
Hutchings, Pat	THE DOORBELL RANG. Mulberry Books, 1989. This is about each time the doorbell rings, someone else shows up to share some cookies.
Leedy, Loreen	MEASURING PENNY. Henry Holt & Company, 2000. This book uses mathematics by Lisa measuring her dog, Penny, in several different ways.
Matthews, Louise	BUNCHES AND BUNCHES OF BUNNIES. Dodd, Mead, 1978. This book teaches the multiplication facts one through twelve using rhymes.
Pittman, Helena Glare	A GRAIN OF RICE. Skylark, 1996. This story is about a farmer teaching an emperor a math lesson. As a reward, the farmer asks for a single grain of rice, doubled every day for 100 days.
Schwartz, David M.	HOW MUCH IS A MILLION? Mulberry Books, 1993. This book gives meaning to one million, one billion, and one trillion.
Schwartz, David M.	IF YOU MADE A MILLION. Lothrop, Lee, and Shepand, 1989. This book explores ways to earn and spend a penny, a nickel, and a million dollars.
Tompert, Ann	GRANDFATHER TANG'S STORY: A TALE TOLD WITH TANGRAMS. Demco Media, 1997. A grandfather tells a story to his granddaughter with arranged tangrams to show the shape of each animal in the tale.
Viorst, Judith	ALEXANDER WHO USED TO BE RICH LAST SUNDAY. New York Atheneum Publishers 1978. This book is about Alexander who receives $1.00 from his grandparents. Through the course of a week, Alexander's money disappears through a series of events. It is left to the reader to determine whether he has lost all his money by accounting for all his expenses.

Sixth through Eighth Grade

Anno, Masaichiro and Mitsumasa	ANNO'S MYSTERIOUS MULTIPLYING JAR. Penguin Putnam, 1999. This story demonstrates the concept of factorials in mathematics.
Apfel, Necia H.	CALENDARS. New York: Franklin Watts, 1985. A book about calendars that integrates social studies, science, and measurement.
Ardley, Neil	MAKING METRIC MEASUREMENTS. New York: Franklin Watts, 1983. Hands-on activities from the Action Science series.
Berg, Olvie S.	I'VE GOT YOUR NUMBER, JOHN. New York: Holt, Rhinehart, and Winston, 1965. This book explores how numbers are used in license plates and area codes. It also explores the binary number system and how it is used in the electronic phone system.
Branley, Franklyn M.	THINK METRIC. New York; Thomas Y. Crowell Publishers, 1972. Explores the origins of measurement units and comparisons between the English and metric systems.
Briers, Audrey	MONEY. New York: Franklin Watts, 1987. Traces the development of currency from bartering to credit cards.
Brindze, Ruth	STORY OF OUR CALENDAR. New York: Vangaurd Press, 1949. A history of the calendar.
Burns, Marilyn	THE I HATE MATHEMATICS BOOK. Boston: Little, Brown and Company, 1975. A book that shows how much fun math can be.
Burns, Marilyn	MATH FOR SMARTY PANTS. Boston: Little, Brown and Company, 1982. A collection of problems and facts to help captivate middle school students.
Burns, Marilyn	THIS BOOK IS ABOUT TIME. Boston: Little, Brown and Company, 1978. This book contains information and activities about time.
Butrick, Lyn McClure	LOGIC FOR SPACE AGE KIDS. Athens, Ohio: University Classics, 1984. Zeno, from the planet Zircon, ponders problems involving logical deduction.

Cantwell, Lois	MONEY AND BANKING. New York: Franklin Watts, 1984. An account of money as it developed to the Middle Ages and the Renaissance. This book also discusses the development of coins and paper money in the United States.
Cushman, Jean	DO YOU WANNA BET? YOUR CHANCE TO FIND OUT ABOUT PROBABILITY. New York: Clarion Books, 1991. Two boys become involved in everyday situations that involve probability.
Dilson, Jesse	THE ABACUS: A POCKET COMPUTER. New York: St. Martin's Press, 1968. Explores numeration and operations through the Chinese abacus.
Fehr, Howard	NUMBER PATTERNS MAKE SENSE: A WISE OWL BOOK. New York: Holt, Rhinehart, and Winston, 1965. Explores number patterns through creative problem-solving.
Fisher, Leonard E.	CALENDAR ART: THIRTEEN DAYS, WEEKS, MONTHS, YEARS FROM AROUND THE WORLD. New York: Four Winds Press, 1987. This book presents various ways cultures throughout history respond to the need for accurate recording of time.
Fisher, Leonard E.	NUMBER ART: 1-2-3s FROM AROUND THE WORLD. New York: Four Winds Press, 1982. The history and development of thirteen number systems are presented.
Hayes, Cyril and Dympna	NUMBER MYSTERIES. Milwaukee, Wisconsin: Penworthy Publishing, 1987. Readers use strategies such as number lines, diagrams, models, graphs, tables, and patterns to solve challenging problems.
Holland, Penny	LOOKING AT COMPUTER PROGRAMMING. New York; Franklin Watts, 1984. This book focuses on using logical thinking to understand how computer programs work.
James, Elizabeth and Carol Barkin	MANAGING YOUR MONEY. Chicago: Children's Press, 1977. This book explores what money is, why we have it, how you earn it, how checking and savings accounts work, what credit cards are, and how to manage money.

Juster, Norton	THE PHANTOM TOLLBOOTH. Random House, 1971. This book brings to life infinity, distance measurement, and averaging while Milo journeys to an unknown land.
Kirst, Werner	TIME. Woodstock, New York: Beekman Publishers, 1977. Short articles related to time measurement.
Kyte, Kathy S.	THE KIDS COMPLETE GUIDE TO MONEY. New York: Alfred A. Knopf, 1984. Demonstrates how kids can manage money and make intelligent decisions about money.
Laithwaite, Eric	SIZE: THE MEASURE OF THINGS. New York: Franklin Watts, 1988. This book presents size in terms of relationships such as scaling, size and time, length and frequency, biggest and smallest, size in numbers, etc.
Laithwaite, Eric	SHAPE: THE PURPOSE OF FORMS. Franklin Watts, 1986. This book is part of a series that connect science with real-world applications.
Lamm, Joyce	LET'S TALK ABOUT THE METRIC SYSTEM. Middle Village, New York: Jonathan David Publishers, 1974. This book discusses the need for measurement, the historical development of measurement, and the confusion of different systems.
Leighton, Ralph and Carl Feynman	HOW TO COUNT SHEEP WITHOUT FALLING ASLEEP. New Jersey: Prentice Hall, 1976. A fictitious account of the development of our number system.
Luce, Marnie	ONE IS UNIQUE. Minneapolis, Minnesota: Lerner Publications, 1969. This book discusses concepts such as cardinality, multiplicative identity, reciprocal, division of fractions, set notation, and infinity.
Luce, Marnie	ZERO IS SOMETHING. Minneapolis, Minnesota: Lerner Publishers, 1969. This book discusses the historical development of our current numeration system.
Parker, Pat and Teresa Kennedy	LOGO FUN. New York: Scholastic, 1985. This book uses computer usage concepts along with problem-solving and geometric concepts.
Petty, Kate	NUMBERS. New York: Gloucester Press, 1985. This book presents increasing complex computer programs and computer games.

Phillips, Louis	263 BRAIN BUSTERS: JUST HOW SMART ARE YOU, ANYWAY? New York: Penguin Books, 1985. A collection of brainteasers.
Pluckrose, Henry	TIME. New York: Franklin Watts, 1988. This book explores units of time measurement along with the importance of timekeeping.
Ritchie, Alan	ERIN MCEWAN YOUR DAYS ARE NUMBERED. Random House, 1991. In danger of flunking sixth grade because of math, Erin takes a job in a deli where she is told to help with the bookkeeping.
Sarasas, Claude	ABC'S OF ORIGAMI. Rutland, Vermont: Charles E. Tuttle Company, 1964. Origami patterns of 26 objects are illustrated with sequenced diagrams.
Saunders, Kenneth	HEXAGRAMS. Stradbroke, England: Tarquin, 1983. A collection of puzzles that can be solved by using a hexagon cut into eight pieces.
Sharp, Richard and Seymour Metzner	THE SNEAKY SQUARE AND 113 OTHER MATH ACTIVITIES FOR KIDS. TAB Books, 1990. A book of problems and puzzles.
Sleater, William	THE BOY WHO REVERSED HIMSELF. Penguin Putnam, 1998. This story takes the mathematical complexity and uncertainty of the fourth dimension and translates it into an entertaining novel.
Stwertka, Eve and Albert	MAKE IT GRAPHIC! DRAWING GRAPHS FOR SCIENCE AND SOCIAL STUDIES PROJECTS. New York: Julian Messener, 1985. This book covers the production, use, and value of many types of graphs.
Simon, Seymour and Steven D. Schindler	EINSTEIN ANDERSON. Avon Books, 1998. Einstein Anderson is a whiz at science and he investigates the mysteries of science.
Tahan, Malba	THE MAN WHO COUNTED: A COLLECTION OF MATHEMATICAL ADVENTURES. Norton, W.W. & Company, 1992. The adventures of Beremiz Samir takes the reader on a journey where mathematical powers are used to settle disputes, give advice, overcome enemies, and win fame and fortune.

(Unknown Author) MILLIONS OF PEOPLE. New York: Holt, Rhinehart, and Winston, 1971. Graphs present population data gathered about people from the classroom, the United States, and the world.

Van Note, Peter TANGRAMS: PICTURE-MAKING PUZZLE GAME. Rutland, Vermont: Charles E. Tuttle Company, 1966. A collection of tangram puzzles.

Zaslavsky, Claudia TIC-TAC-TOE. New York: Thomas Y. Crowell Publishers, 1982. A book of strategy games.

Ninth Grade through Twelfth

Belton, John and Joella Cramblitt DOMINO GAMES. Milwaukee, Wisconsin: Raintree Publications, 1976. Domino games that require strategies as well as chance to win.

Diggins, Julia E. STRING, STRAIGHTEDGE, AND SHADOW: THE STORY OF GEOMETRY. New York: Viking Press, 1965. This book explores geometry in nature along with a history of some famous geometers and how geometry was used in ancient times.

Flannery, Sarah and David Flannery IN CODE: A MATHEMATICAL JOURNEY. Algonquin Books, 2002. This story tells how the girl next door moved from the simple math puzzles that were the staple of dinnertime conversation to number theory and her creative algorithm breakthroughs.

Haney, Jan P. CALCULATORS. Milwaukee, Wisconsin: Raintree Publications, 1985. This book contains a history of calculating machines and illustrations of the parts of a calculator. Also, includes calculator games and activities.

Paraquin, Charles H. WORLD'S BEST OPTICAL ILLUSIONS. New York: Sterling Publishing Company, 1987. This book of illusions, with a question posed about each illusion reinforces spatial perception.

Sakade, Florence ORIGAMI, JAPANESE PAPER FOLDING. Rutland, Vermont: Charles E. Tuttle Company, 1957. A background on origami.

Singh, Simon — CODE BOOK: HOW TO MAKE IT, BREAK IT, HACK IT, OR CRACK IT. Bantam Doubleday, 2002. This book covers actual instances of code-breaking from its role in the plan to execute Mary, Queen of Scots, to the Navajo code talkers in World War II.

Singh, Simon — FERMAT'S ENIGMA: THE EPIC QUEST TO SOLVE THE WORLD'S GREATEST MATHEMATICAL PROBLEM. Knopf Publishing, 1998. This book brings to life a riveting story of a mathematical problem that sprang from the study of the Pythagorean theorem.

Technology Resource Guide

The Technology Resource Guide is designed as a companion to the *2007 Mathematics Framework Revised* to provide the mathematics teacher options to include technology in their instructional practices in order to enhance particular strategies. It gives examples of suggested software programs and online resources that maybe helpful.

The mathematics teacher should use this guide to find extra information about technology that can enhance student achievement in mathematics. Due to rapid changes in technology, the resources included here are as current as possible. (March 2007)

Online Resources

Search Tools

Yahoo	http://www.yahoo.com
Excite	http://www.excite.com
Altavista	http://www.altavista.com
Lycos	http://www.lycos.com
Hotsheet	http://www.hotsheet.com
Infoseek	http://www.infoseek.com
Dogpile	http://www.dogpile.com
Metacrawler	http://www.metacrawler.com
Ask Jeeves	http://www.ask.com

Search Engines Especially for Kids

Yahooligans	http://www.yahooligans.com
Surfnet for Kids	http://www.surfnetkids.com
Cyber Kids	http://www.cyberkids.com

Mathematics Websites

Math in Daily Life
http://www.learner.org/exhibits/dailymath/

Algebra Buster
http://www.algebra-online.com/

Geometry Basic
http://www.mathleague.com/help/geometry/geometry.htm

Web Math
http://www.webmath.com/

Hamilton's Math to Build On
http://mathforum.org/~sarah/hamilton/ham.contents.html

Gallery of Interactive Geometry
http://www.geom.uiuc.edu/apps/gallery.html

Math2
http://www.math2.org/

Ask Dr. Math
http://mathforum.org/dr.math/abt.drmath.html

Math Archives
http://archives.math.utk.edu/

Click on Bricks Multiplication from 1 to 4
http://kathyschrock.net/clickonbricks/index2.htm

Discovery School Mathematics
http://school.discovery.com/lessonplans/math.html

Frank Potter's Science Gems in Mathematics
http://www.sciencegems.com/math.html

Math Goodies
http://www.mathgoodies.com/

Math Teacher Link
http://mtl.math.uiuc.edu/classroom_resources.htm

Math World
http://mathworld.wolfram.com/

Mega Mathematics
http://www.c3.lanl.gov/mega-math/

Purple Math
http://www.purplemath.com/internet.htm

Super Kids Math Worksheet Creator
http://www.superkids.com/aweb/tools/math/index.shtml

Algebra Help
http://www.algebrahelp.com

AAA Math
http://www.aaamath.com/index.html

Academic Info - Mathematics
http://www.academicinfo.net/math.html

The Educator's Reference Desk - Mathematics
http://www.eduref.org/cgi-bin/lessons.cgi/Mathematics

Cool Math
http://www.coolmath.com/

Math Magic
http://mathforum.org/mathmagic/

Fun Brain
http://www.funbrain.com/numbers.html

Biographies of Women Mathematicians
www.agnesscott.edu/lriddle/women/women.htm

Math Stories
www.mathstories.com

A+ Math
www.aplusmath.com/

Math Activities
www.activitiesforkids.com/teacher.htm

Hershey Fractions
http://mathforum.org/paths/fractions/hershey.frac.html

Mathematical Interactive
http://mathematics.hellam.net/

Money Factory
http://www.moneyfactory.com/

The Mint Part of Money
www.usmint.gov

Education 4 Kids
http://edu4kids.com/

Place Value: K-3
http://mathcentral.uregina.ca/RR/database/RR.09.96/mcleod1.html

GLOSSARY

This glossary is designed to help teachers understand mathematics terminology. The following terms cover the major terms associated with assessment and the curriculum guide.

absolute value - the distance of a number from zero on the number line.
$|4| = 4; |-4| = 4$

acute angle - an angle with a measure greater than 0^{o} and less than 90^{o} .

addend - any number being added; 4 + 3 = 7 where 4 and 3 are addends.

additive inverse - the opposite of a number. When a number is added to its additive inverse, the sum is zero. 15 and -15 are additive inverses because 15 + (-15) = 0.

algebraic expressions - a group of numbers, symbols, and variables that express an operation or series of operations. For example, $5x^2 + 6$ is an expression.

algebraic thinking - thinking skills which are developed by working with problems which require students to describe, extend, analyze, and create a variety of oral, visual, and physical patterns such as ones based on color, shape, number, sounds from real life and other subjects such as literature and music.

algorithm - a step-by -step procedure for performing a given type of calculation or solving a given type of problem.

angle - two rays that share an endpoint.

area - the measure in square units, of the interior region of a two dimensional figure or the surface of a three-dimensional figure.

Associative Property of Addition - the sum stays the same when the grouping of addends is changed. (a + b) + c = a + (b + c), where a, b, and c stand for any real numbers.

Associative Property of Multiplication - the product remains the same when grouping of factors is changed. (a • b) • c = a (b • c), where a, b, and c stand for any real numbers.

attribute - quality or characteristic.

authentic assessment -assessment tasks that elicit demonstrations of knowledge and skills in ways that resemble "real-life" as closely as possible, engage students in the activity, and reflect sound instructional practices.

bar graph - a representation of data in which the length of a rectangle or bar is used to represent a numerical amount; a bar graph typically has spaces between the bars.

Calculus - the mathematics of change and motion. The main concepts of calculus are limits, derivatives, and areas under curves.

capacity - the amount that a given container can hold expressed in unit such as milliliters, cups, liters, quarts.

circumference - the perimeter of a circle; ($C = \pi 2 r$ where r is the radius).

Commutative Property of Addition - the sum remains the same when the order of the addends is changed. a + b = b + a, where a and b are any real numbers.

Commutative Property of Multiplication - the product remains the same when the order of the factors is changed. a • b = b • a, where a and b are any real numbers.

conditional statements - a logical statement consisting of two parts, a hypothesis and a conclusion.

congruent (E**) -** having the same size and shape.

conjecture - an unproven statement based on observations.

deductive reasoning - the process of reasoning where specific cases are tested against a specific rule.

dilation - a proportional shrinking or enlargement of a figure.

Discrete mathematics - the study of mathematical properties of sets and systems that have a countable number of elements.

Distributive property – each term inside a set of parentheses can be multiplied by a factor outside the parentheses. $a (b + c) = (a \bullet b) = (a \bullet c)$ and $a (b - c) = (a \bullet b) - (a \bullet c)$, where a, b, and c stand for any real number.

domain - in a function, f(x), the possible values of x in the given situation.

equation - a mathematical sentence with an equal sign. The amount on one side of the equal sign has the same value as the amount on the other side.

estimation - an approximation of a measure or calculation based on a strategy such as rounding, front-end estimation, compatible numbers (see also reasonableness of results).

Euclidean Algorithm - a algorithm to determine the greatest common divisor of two integers.

even number - a whole number that has 2 as a factor. All even numbers end with 0, 2, 4, 6 or 8 and are divisible by 2.

expanded form - a way to write numbers that shows the place value of each digit.

experimental probability - the actual number of occurrences of a particular (favorable) outcome divided by the total number of trials or outcomes for a particular experiment.

exponent -The number that tells how many equal factors there are.

exponential function - a function in which the independent variable is an exponent. Exponential functions have the general form $f(x) = a^n$, where $a > 0$ and $a \neq 1$.

exponential form - a way of writing a number using exponents.

expression - a variable or combination of variables, numbers, and symbols that represent a mathematical relationship.

factor - an integer that divides another with no remainder.

function - a relation in which each element of one set (the domain) is paired with exactly one element of a second set (range).

hypothesis - the "if" part of a conditional statement.

indirect measurement - measurement in which measures cannot be calculated directly but must be determined by finding other direct measures; for example: rates such as miles per hour.

Identity Property of Addition and Multiplication - for any real number, a: $a + 0 = a$ and $0 + a = a$; $a\ 1 = 1$ and $1\ a = a$.

Inductive reasoning - making a generalization based on observation of specific cases and consideration of a pattern.

inequality - a mathematical sentence that compares two unequal expression using one of the symbols $\neq$, $<$, $>$, $\leq$, or $\geq$.

inference - a generalization based on statistical data; a prediction based on sample or experimental data.

integer - the set of whole numbers and their opposites

$$\{\ldots -4, -3, -2, -1, 0, 1, 2, 3, 4, \ldots\}$$

irrational number - a real number that cannot be written as a ratio of two integers.

line plot - a diagram showing frequency of data on a number line.

linear equation - an equation in one or two variables with no exponents other than one and with no products of the variables.

mass - the quantity of matter in an object.

mean - the sum of a set of numerical data divided by the number of items in the set.

measures of central tendency - numbers used to describe sets of data. The mean, median, and mode are measures of central tendency.

median - the middle number of a set of numbers when the numbers are arranged from least to greatest or the mean of two middle numbers when the set has two middle numbers.

mode - the most frequent occurring number in a set of data. There may be one, more than one, or no mode.

model - a representation that uses physical objects or drawings and their actual manipulations to illuminate concepts or problems.

monomial - an expression that is a number, a variable, or the product of a number and one or more variables.

multiple - the product of a whole number and any other whole number.

multiplicative inverse - reciprocal of a number. When a number is multiplied by its multiplicative inverse, the product is always one. Zero is the only number with no multiplicative inverse. $a \bullet {}^{1}/_{a} = 1,$ where $a \neq 0.$

natural numbers - the counting numbers: 1, 2, 3, 4, 5, ……

net - a two-dimensional shape that can be folded into a three-dimensional figure.

non-linear equation - an equation whose graph is not a line such as ${}^{1}/_{x} = 7,$ $y = 3xy + 4$ or $x^3 = 7.$

non-standard measurement - measuring using materials such as paper clips, different sized scoops of ice, thumbprints, footsteps, etc.

obtuse angle - an angle with a measure greater than 90° and less than 180°.

odd number - a whole number represented by the expression, 2n + 1 where n is a whole number. The ones digit of any odd number is 1, 3, 5, 7, or 9.

open-response tasks - the kind of performance required of students when they are required to generate an answer, rather than select it from among several possible answers, but there is still a single, correct response.

ordinal number - a whole number that names the position of an object in a sequence.

parallel -in Euclidean geometry, always the same distance apart. Parallel lines lie in the same plane and do not intersect. Parallel planes never intersect.

percent - a special ratio that compares a number to 100 and using the symbol % sign.

perimeter - the distance around an object or geometric figure.

perpendicular - intersecting to form right angles.

polygon - a closed, plane figure composed of line segments that meet at their endpoints or vertices.

polynomial - the sum of monomials.

portfolio - a purposeful, integrated collection of student work showing effort, progress, or degree of proficiency.

postulate - a mathematical statement that is accepted as true without proof. Also called an axiom.

prime number - a number that has exactly two positive factors, itself and one.

problem solving - applying or putting together knowledge and skills already learned in new situations or to derive new knowledge and/or solutions.

protractor - a tool or device for determining the measurement of angles.

Pythagorean Theorem - for any right triangle, the sum of the squares of the lengths of the two legs equals the square of the length of the hypotenuse. $a^2 + b^2 = c^2$.

quadratic function - a function described by an equation of the form $f(x) = ax^2 + bx + c$ where $a \neq 0$.

range - the difference of the lowest and highest value within a set of numbers.

rational number - a number that can be expressed as a ratio of two integers.

ratio - a comparison of two numbers using division.

real graph - a graph created with actual objects.

reasonableness of results - acceptability of an estimated or approximate measurement or calculation based on its making sense.

reflection (flip) - a geometric transformation creating a mirror image of a figure on the opposite side of a line.

right angle - an angle that measures 90°.

rotation (turn) - a geometric transformation which a figure is turned a given angle and direction around a point.

rubric - an established and written-down set of criteria for scoring or rating students' performance on tests, portfolios, writing samples, or other performance tasks.

sample space - a list of all possible outcomes of an experiment.

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.

simulation - a model of an experiment that might be impractical to carry out.

translation (slide) - a geometric transformation, which involves moving the figure up, down, right or left without changing its orientation.

statistical data - qualitative or quantitative information collected through experimentation and/or observation for the purpose of analysis, presentation (such as graphic) interpretation, or inference.

straight angle - an angle with a measure of 180°.

straight edge - a tool similar to a ruler, but without markings.

theoretical probability - finding the probability of an event without doing an experiment or analyzing data.

variable - a letter or symbol that represents a number value in an expression.

volume - the number of cube units it takes to fill a three-dimensional space.

weight - a measure of the heaviness or force of gravity on an object.

whole number- the set of numbers that includes zero and the natural numbers {0, 1, 2, 3, 4 …}

Zero Product Property - the product of any number and zero is zero. $a \bullet 0 = 0$ and $0 \bullet a = 0$, where a is any real number.

Mathematics Resources

National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 22091

American Mathematical Association
201 Charles Street
Providence, RI 02904-2294
http://www.ams.org

Mathematical Association of America
1529 18th Street, N.W., Suite 600
Washington, DC 20036
http://www.maa.org

American Statistical Association
1429 Duke Street
Alexandria, VA 22314-3415
http://www.amstat.org

Association for Computing Machinery
ACM, 1515 Broadway
New York, NY, 10036
http://www.acm.org

Society of Actuaries
475 North Martingale Rd, Suite 800
Schaumburg, IL 60173-2226
www.BeAnActuary.org

Association for Women in Mathematics
4114 Computer and Space Sciences Bldg.
University of Maryland
College Park, MD 20742-2461
http://www.awm-math.org