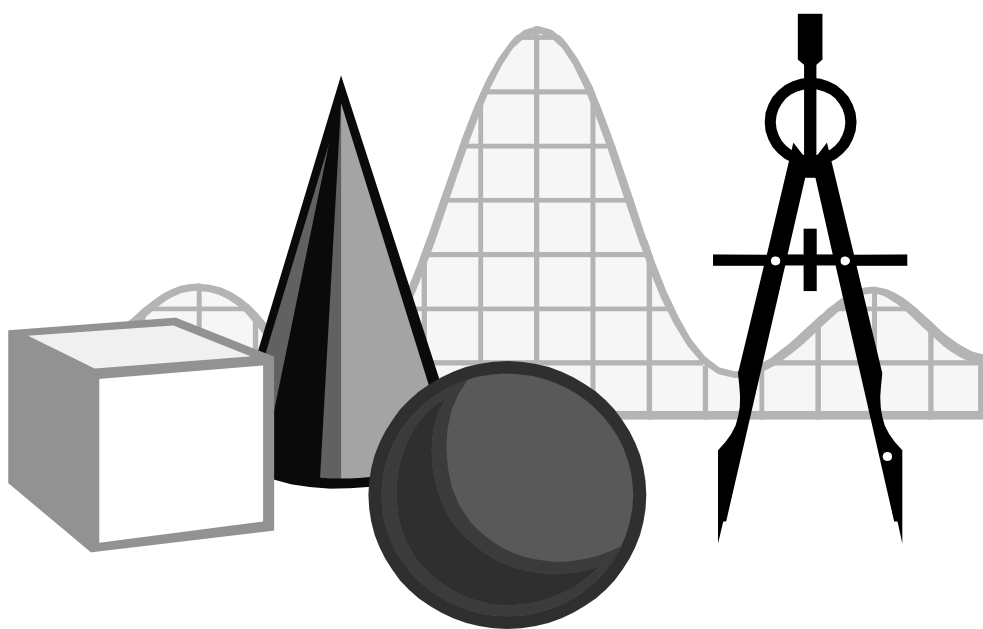


MATHEMATICS STANDARDS OF LEARNING ENHANCED SCOPE AND SEQUENCE

Grade 2



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Superintendent of Public Instruction

Jo Lynne DeMary

Assistant Superintendent for Instruction

Patricia I. Wright

Office of Elementary Instructional Services

Linda M. Poorbaugh, Director

Karen W. Grass, Mathematics Specialist

Office of Middle Instructional Services

James C. Firebaugh, Director

Office of Secondary Instructional Services

Maureen B. Hjar, Director

Deborah Kiger Lyman, Mathematics Specialist

Edited, designed, and produced by the CTE Resource Center

Margaret L. Watson, Administrative Coordinator

Karen T. Westermann, Writer/Editor

Richmond Medical Park

Phone: 804-673-3778

2002 Bremo Road, Lower Level

Fax: 804-673-3798

Richmond, Virginia 23226

Web site: <http://CTEresource.org>

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Introduction

The *Mathematics Standards of Learning Enhanced Scope and Sequence* is a resource intended to help teachers align their classroom instruction with the Mathematics Standards of Learning that were adopted by the Board of Education in October 2001. The Mathematics Enhanced Scope and Sequence is organized by topics from the original Scope and Sequence document and includes the content of the Standards of Learning and the essential knowledge and skills from the Curriculum Framework. In addition, the Enhanced Scope and Sequence provides teachers with sample lesson plans that are aligned with the essential knowledge and skills in the Curriculum Framework.

School divisions and teachers can use the Enhanced Scope and Sequence as a resource for developing sound curricular and instructional programs. These materials are intended as examples of how the knowledge and skills might be presented to students in a sequence of lessons that has been aligned with the Standards of Learning. Teachers who use the Enhanced Scope and Sequence should correlate the essential knowledge and skills with available instructional resources as noted in the materials and determine the pacing of instruction as appropriate. This resource is not a complete curriculum and is neither required nor prescriptive, but it can be a valuable instructional tool.

The Enhanced Scope and Sequence contains the following:

- Units organized by topics from the original Mathematics Scope and Sequence
- Essential knowledge and skills from the Mathematics Standards of Learning Curriculum Framework
- Related Standards of Learning
- Sample lesson plans containing
 - Instructional activities
 - Sample assessments
 - Follow-up/extensions
 - Related resources
 - Related released SOL test items.

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Longwood University

Karen Dorgan
Mary Baldwin College

Sharon Emerson-Stonnell
Longwood University

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College of William and Mary

Marcella McNeil
Portsmouth City

Judith Moritz
Spotsylvania County

Sandi Murawski
York County

Elizabeth O'Brien
York County

William Parker
Norfolk State University

Lyndsay Porzio
Chesterfield County

Patricia Robertson
Arlington City

Christa Southall
Stafford County

Cindia Stewart
Shenandoah University

Susan Thrift
Spotsylvania County

Maria Timmerman
University of Virginia

Diane Tomlinson
AEL

Linda Vickers
King George County

Karen Watkins
Chesterfield County

Tina Weiner
Roanoke City

Carrie Wolfe
Arlington City

Organizing Topic Whole Numbers: Representations, Relationships, Operations, and Estimation

Standards of Learning

- 2.1 The student will
- read, write, and identify the place value of each digit in a three-digit numeral, using numeration models; and
 - round two-digit numbers to the nearest ten.
- 2.2 The student will compare two whole numbers between 0 and 999, using symbols ($>$, $<$, or $=$) and words (*greater than*, *less than*, or *equal to*).
- 2.3 The student will identify the ordinal positions first through twentieth, using an ordered set of objects.
- 2.5 The student will
- count forward by twos, fives, and tens to 100, starting at various multiples of 2, 5, or 10, using mental mathematics, paper and pencil, hundred chart, calculators, and/or concrete objects, as appropriate;
 - count backward by tens from 100;
 - group objects by threes and fours; and
 - recognize even and odd numbers, using objects.
- 2.6 The student will recall basic addition facts — i.e., sums to 18 or less — and the corresponding subtraction facts.
- 2.7 The student, given two whole numbers whose sum is 99 or less, will
- estimate the sum; and
 - find the sum, using various methods of calculation (mental computation, concrete materials, and paper and pencil).
- 2.8 The student, given two whole numbers, each of which is 99 or less, will
- estimate the difference; and
 - find the difference, using various methods of calculation (mental computation, concrete materials, and paper and pencil).
- 2.9 The student will create and solve one-step addition and subtraction problems using data from simple tables, picture graphs, bar graphs, and practical situations.

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Demonstrate the understanding of the ten-to-one relationships among ones, tens, and hundreds, using manipulatives (e.g., beans and cups, base-10 blocks, bundles of 10 Popsicle sticks).
- Determine the place value of each digit in a three-digit numeral presented as a pictorial representation (e.g., a picture of base-10 blocks) or as a physical representation (e.g., actual base-10 blocks).

- Write numerals, using a base-10 model or picture.
- Read three-digit numbers when shown a numeral, a base-10 model of the number, or a pictorial representation of the number.
- Identify the place value (ones, tens, hundreds) of each digit in a three-digit numeral.
- Round two-digit numbers to the nearest ten.
- Identify numbers that are greater than or less than a given number between 0 and 999.
- Compare two numbers between 0 and 999, represented pictorially or with concrete objects (e.g., base-10 blocks), using the terms *greater than*, *less than*, or *equal to*.
- Compare the numerical value of two whole numbers between 0 and 999 by identifying one as greater than, less than, or equal to the other.
- Write the symbols for less than (<), greater than (>), and equal to (=) to compare two numbers between 0 and 999.
- Count an ordered set of objects, using the ordinal number words *first* through *twentieth*.
- Identify the ordinal positions first through twentieth, using an ordered set of objects.
- Identify the ordinal positions first through twentieth, using an ordered set of objects presented in lines or rows from
 - left to right;
 - right to left;
 - top to bottom; and
 - bottom to top.
- Determine patterns created by counting by twos, fives, and tens on a hundred chart.
- Skip count by twos, fives, and tens to 100, using manipulatives, a hundred chart, mental mathematics, and/or paper and pencil.
- Skip count by twos, fives, and tens to 100, using the constant feature on the calculator.
- Count backward by tens from 100.
- Group objects by threes.
- Group objects by fours.
- Use objects to determine whether a number is odd or even.
- Recall and write the basic addition facts for sums to 18 or less and the corresponding subtraction facts.
- Recall and write the basic addition facts for sums to 18 or less and the corresponding subtraction facts, when addition or

subtraction problems are presented in either horizontal or vertical written format.

- Regroup 10 ones for 1 ten, using base-10 models, when finding the sum of two whole numbers whose sum is 99 or less.
- Estimate the sum of two whole numbers whose sum is 99 or less and recognize whether the estimation is reasonable.
- Determine the sum of two whole numbers whose sum is 99 or less, using base-10 models, such as base-10 blocks and bundles of tens.
- Solve problems presented vertically or horizontally that require finding the sum of two whole numbers whose sum is 99 or less, using paper and pencil.
- Solve problems, using mental computation strategies, involving addition of two whole numbers whose sum is 99 or less.
- Regroup 1 ten for 10 ones, using base-10 models, such as base-10 blocks and bundles of tens.
- Estimate the difference of two whole numbers each 99 or less and recognize whether the estimation is reasonable.
- Determine the difference of two whole numbers each 99 or less, using base-10 models, such as base-10 blocks and bundles of tens.
- Solve problems presented vertically or horizontally that require finding the difference between two whole numbers each 99 or less, using paper and pencil.
- Solve problems, using mental computation strategies, involving subtraction of two whole numbers each 99 or less.
- Identify the appropriate data and the operation needed to solve an addition or subtraction problem where the data is presented in a simple table, picture graph, or bar graph.
- Solve addition and subtraction problems requiring a one-step solution, using data from simple charts, picture graphs, bar graphs, and everyday-life situations.
- Create a one-step addition or subtraction problem using data from simple tables, picture graphs, and bar graphs. For subtraction, the difference will be between two whole numbers each 99 or less.
- Determine the missing number in a number sentence (e.g., $3 + _ = 5$ or $_ + 2 = 5$; $5 - _ = 3$ or $5 - 2 = _$).
- Write the related facts for a given addition or subtraction fact (e.g., given $3 + 4 = 7$, write $7 - 4 = 3$ and $7 - 3 = 4$).

Race to 100

Reporting category

Whole Numbers

Overview

Students play the *Race to 100* game in order to practice demonstrating the ten-to-one relationship among ones, tens, and hundreds.

Related Standards of Learning

2.1, 2.6

Objectives

- The student will demonstrate the understanding of the ten-to-one relationships among ones, tens, and hundreds, using manipulatives.
- The student will compare the numerical value of two numbers between 0 and 100, represented with concrete objects, using the terms greater than, less than, or equal to.
- The student will recall basic addition facts with sums to 10 or less.
- The student will determine the missing number in a number sentence (e.g., $7 + \underline{\quad} = 10$).

Materials needed

- Variety of manipulatives (e.g., single beans and 10 beans in cups, base-10 blocks, single and bundles of 10 popsicle sticks, pennies and dimes)
- One pair of dice per team of students

Instructional activity

1. Divide students into groups of at least two. Provide students with manipulatives with which they will create sets of tens and then ultimately 100 in order to win the game. Distribute one pair of dice per team.
2. Explain and demonstrate the game. Students may choose to roll one or both dice. They will add the numbers shown on the dice and the sum will determine the amount of the manipulative they receive. For example, if I roll a 6 and a 3, I would get 9 beans or 9 pennies. Then it is the other player's turn. When it is my turn again, I add the new sum to my pile. I see if I can regroup for a set of ten of my manipulative. For example, I roll a 2 and a 5 on my next turn. I add 7 to my previous 9 and now have 16. I would regroup and create a pile of 10 beans in a cup or trade in for a dime and still have 6 pennies left. Play continues to alternate. The first person who earns and demonstrates that s/he has exactly 100 is the winner.
3. Have students exchange manipulatives after completing the game. The goal is for them to see the ten-to-one relationship using a variety of manipulatives.

Sample assessment

- Circulate among students, and observe as they are adding to find the sum of the numbers shown on the two dice. Note who needs to use the concrete objects or his/her fingers to find the sums and those that have memorized the facts. Check for understanding and have students demonstrate how to regroup the objects by tens (both from ones to tens and from tens to hundreds) and their system of organization. Ask students to explain the strategies being used to determine how many more are needed before they can regroup or before they will win the game. Ask students to tell who is winning and to explain how they know this, using the *greater than*, *less than*, or *equal to* terminology. Determine who will need additional follow-up.

Follow-up/extension

- In a journal, have students write a summary of how to play the game. They should also describe the strategies they used in playing the game.
- The game can be stopped at predetermined points (after both players have had 3 rolls, 6 rolls, 9 rolls, etc.) and data can be recorded. For example: After our 3rd roll, I have 27 and you have 21. We would write $27 > 21$ or “27 is greater than 21.” After our 6th roll, I have 46 and you have 44. We would write $46 > 44$ or “46 is greater than 44.” After our 9th roll, I have 62 and you have 74. We would write $62 < 74$ or “62 is less than 74.”
- This game can also be played by going backward from 100. Students will be subtracting from 100. The goal would then become reaching 0 first.

Three-Digit Place Value

Reporting category

Number and Number Sense

Overview

Students identify and compare the place value of three-digit numbers using concrete and abstract representations.

Related Standards of Learning

2.1, 2.2

Objectives

- The student will determine the place value of each digit in a three-digit number presented as a physical and pictorial representation.
- The student will write numbers, using a base-10 model or picture.
- The student will read three-digit numbers when shown a number, a base-10 model of the number, or a pictorial representation of the number.
- The student will identify the place value (ones, ten, hundreds) of each digit in a three-digit number.
- The student will compare two numbers between 0 and 999, represented pictorially or with concrete objects using the terms *greater than*, *less than*, or *equal to*.
- The student will write the symbols for less than ($<$), greater than ($>$), and equal to ($=$) to compare two numbers between 0 and 999.

Materials needed

- Base-10 blocks and place-value workmats for each student
- Decks of playing cards with all 10s and face cards removed
- 3-digit place value recording sheet and pencil for each student

Instructional activity

Note: An activity where the students can demonstrate an understanding of the ten-to-one relationships between ones, tens, and hundreds using manipulatives is required before using this lesson.

1. Divide class into pairs. Give each student a workmat, base-10 blocks, playing cards, and recording sheet.
2. Have one student draw a card and place it above the hundreds' place on the workmat. The student will create that number using the hundreds on the workmat. The partner will go next and do the same. A second card will be drawn and placed above the ten's place on the workmat. The student will create that number using the tens on the workmat. The partner will go next and do the same. A third card will be drawn and placed above the ones' place on the workmat. The student will then create that number using the ones on the workmat. His/her partner will go next and do the same.
3. Write the symbolic and pictorial representations of the 3-digit number on the recording sheet. The $<$, $>$, or $=$ sign will be placed in the circle between the numbers. The justification for the comparison will be written underneath. Students should use base-10 models to help make the justification.
4. Stop the activity when the class period is almost over, regroup as a whole class, and review what they did that day.

Sample assessment

- Circulate among students during the lesson. Observe the strategies and rationale for creating the models of the three digit numbers and comparisons. Note who is having difficulty identifying the values, making the models of them, and/or comparing the three-digit numbers. Give help as necessary. Collect the papers as an assessment.

Follow-up/extension

- Have students select three cards and place them in any order they wish or to meet a specified goal (i.e. the smallest three-digit number/the largest three-digit number).
- Have students do this activity using only two-digit numbers. They can then find the difference between the largest two-digit number and smallest two-digit number (e.g., if I drew a 2 and a 7, I would have 72 for my largest two-digit number and then 27 for my smallest. I would then find the difference between 72 and 27.)

Three-Digit Place Value

_____	_____	_____		_____	_____	_____
□	□	□	○	□	□	□

I know that _____, because _____.

_____	_____	_____		_____	_____	_____
□	□	□	○	□	□	□

I know that _____, because _____.

_____	_____	_____		_____	_____	_____
□	□	□	○	□	□	□

I know that _____, because _____.

_____	_____	_____		_____	_____	_____
□	□	□	○	□	□	□

I know that _____, because _____.

Estimation Jar

Reporting categories

Number and Number Sense, Computation and Estimation

Overview

Students use the estimation jar to estimate, sort objects by attributes, count by various groupings, determine place value, determine odd and even, determine the difference between two whole numbers, and divide a set into smaller, equal groups.

Related Standards of Learning 2.5, 2.8

Objectives

- The student will count forward by twos, fives, and tens to 100.
- The student will group objects by threes and fours.
- The student will recognize even and odd numbers using objects.
- Given two whole numbers, each of which is 99 or less, the student will estimate and find the difference between the numbers using various methods of calculation.
- The student will estimate the sum.

Materials needed

- A jar filled with 100 or fewer items of the same size and shape (e.g., wrapped candy, pencil erasers)
- One small piece of paper (approximately 3" by 3") for each student

Instructional activity

1. Have students gather in a circle. Place the Estimation Jar in the center. Explain that they will be writing down an estimate of the number of items in the jar. The person that comes the closest will win half the contents in the jar. The rest of the class will share the remaining half. Allow students a few minutes to write their names and estimates on the slips of paper. When finished, students will place folded estimates in the circle next to the jar.
2. Allow one person to select an estimate. This person will read the name and the estimate aloud. That student will then select the next estimate, read the name and estimate and then place it on the floor in the correct sequence using an appropriate distance from the first one. This will continue until all estimates have been read and placed accordingly. A sample is shown.



3. Ask students to determine what the smallest estimate was. Ask students to determine what the largest estimate was. Ask students to determine what the most popular and least popular estimates were. Always have the students explain how they determined their answers. Ask students to compare the estimates, e.g., “How many more people picked 54 than 65? How many more people picked 44 than 42? How many more people picked 36 than 17? How do you know?”
4. Empty the contents of the jar. Allow students to discuss and model several ways of sorting/classifying the items. Select one way and have students count the items together. Practice

having students group and count by twos, threes, fours, fives, and tens. Leave the items in groups of tens and ones.

5. Have a student write the actual number of items on the board. Have another label the place value and compare it to the piles of tens and ones on the floor.
6. Have another student write the actual number on a slip of paper and then sequence it in the row of estimates. Have students select the two estimates on either side of the actual number. Have students discuss the process to find the difference. Have students estimate and then actually determine the difference between the estimate and the actual number. Have students determine who the winner is.
7. Have students look at the actual number again. Have them discuss if the number is odd or even and their rationale.
8. Divide the items in half. Ask for strategies about how to make it fair. (For example, give one pile of ten to the winner and one pile to the class until you have run out of piles of tens. Then figure out what would be a fair way to divide up the ones.) Discuss if the number is odd or even by determining if there is anything left over after dividing the items into two equal piles.
9. Have the winner take home his/her goodies, while the rest of the class divides the remaining half equally.

Sample assessment

- Guide students in the activity. Ask them probing questions to have them justify their responses. Determine who needs additional assistance with making reasonable estimates, writing numbers, sequencing, sorting by attributes, counting, determining odd and even, finding the difference, and dividing a set into equal parts.

Follow-up/extension

- Have students write in a journal about how to determine if a number is odd or even.
- This activity can be redone the following week. The items can be the same size or smaller/larger. Students should be reminded to take that factor into consideration when making their estimates.
- This activity might also be done as a learning center activity in the room using other objects. However, you may not want the students to “win” these items. The students could keep a record in their journals naming the item of the week, their estimate, the actual number, and the difference. Over time their estimation skills should improve if they look back at their previous data and use that to guide them in making their new estimates. See the recording chart attached.
- Have students write their numbers, counting by twos, threes, fours, fives, and tens to 100.

Estimation Jar Recording Sheet

Date	Item	My Estimate	Actual Number	Difference

Fact Family Patterns

Reporting category

Computation and Estimation

Overview

Students identify and create fact families while recalling and writing addition facts for sums up to 18 and the corresponding subtraction facts using manipulatives.

Related Standard of Learning

2.6

Objectives

- The student will recall and write the basic addition facts for sums up to 18 and the corresponding subtraction facts.
- The student will recall and write the basic addition facts for sums up to 18 and the corresponding subtraction facts, when addition or subtraction problems are presented in either horizontal or vertical written format.
- The student will write the related facts for a given addition or subtraction fact.

Materials needed

- Markers (blue, red, black, and purple)
- Chart paper or a markerboard
- Unifix cubes
- One-inch graph paper, crayons, and pencil for each student

Instructional activity

1. Ask the students to brainstorm different ways to determine how many students are in the class. Let the students share several strategies. Then have all the boys stand up, count and record that number in blue on the board. Have all the girls stand up, count and record that number in red on the board. Ask what could be done with those two numbers to find the total number of students in the class. When someone says, “Add”, allow a student to demonstrate the symbol and its placement in the addition problem. Ask what else is missing from the number sentence. Allow another student to place the = symbol in the correct location using the black marker. Have students add the two numbers to find at the total. Have another student write the total in purple. (Blue and red make purple.) Have students check the answer by using some of the other strategies that were mentioned at the beginning of the lesson. Ask what would happen if we write the number of girls first. Select different students to rewrite the problem. Using red, write the number of girls first. Using blue, write the number of boys second. Using black, add the addition and equal signs. Using purple, write the total. Ask students if they have noticed anything interesting.

$$12 + 13 = 25$$

$$13 + 12 = 25$$

2. Ask a student to point it out. Then draw the arrows to accentuate it.

$$\begin{array}{c}
 12 + 13 = 25 \\
 \swarrow \quad \searrow \quad \downarrow \\
 13 + 12 = 25
 \end{array}$$

3. Ask what would happen if we started with the total and wanted to take the number of boys away, leaving only the number of girls in the class. Allow students to develop the problem. Record it on the board using the designated colors. Have students model it to check the answer. Do the same with the girls leaving. Ask students if they see a pattern. Then draw the arrows to accentuate it.

$$\begin{array}{c}
 25 - 12 = 13 \\
 \downarrow \quad \swarrow \quad \searrow \\
 25 - 13 = 12
 \end{array}$$

4. Key points for the students to recognize and articulate are:
- Four number sentences are created.
 - Two number sentences are addition.
 - Two number sentences are subtraction.
 - The same three numbers are used in all four number sentences.
5. Recreate this sequence to reinforce these key points using no more than 18 unifix cubes per student (9 of one color and 9 of another). Have students practice identifying, drawing, and writing the fact families. The teacher should model at least 3 more and then have the students create some of their own (e.g., the teacher tells the students to connect 3 unifix cubes of one color and to that, add 4 of a second color to create a train.) On a piece of paper, the students record their fact family as seen below.

Blue	Blue	Blue	Red	Red	Red	Red						
			+								=	
3			4								=	7

6. The students will flip their unifix cube train over and record the number sentence again.

Red	Red	Red	Red	Blue	Blue	Blue						
				+							=	
4				3							=	7

7. The students will start with the whole (7) and break off the 4 red, leaving the 3 blue. They will record this as follows:

$$7 - 4 = 3$$

They will then do the other problem.

$$7 - 3 = 4$$

8. The teacher may want to have the children draw the arrows to reinforce the concept of the same three numbers being used and how their locations are modified.
9. Allow students time to create their own fact families, using the unifix cubes and then recording.
10. When the class period is almost over, regroup as a whole class, and review the activity.

Sample assessment

- Circulate among students as they are creating and recording their own fact families. Observe the strategies and rationale the students use. Ask questions to determine if students are internalizing the key points noted above. Note who is having difficulty, and give help as necessary. Collect the papers as an assessment.

Follow-up/extension

- Have students create word problems and illustrations to go along with a particular fact family. Each student can be responsible for one and then the pages can be laminated and turned into a class book. The answers can be hidden underneath a flap so that it is variation of a pop-up book.

Ordinals

Reporting category

Number and Number Sense

Overview

Students identify the ordinal positions *first* through *twentieth* using an ordered set of objects.

Related Standard of Learning

2.3

Objectives

- The student will count an ordered set of objects, using the ordinal number words *first* through *twentieth*.
- The student will identify the ordinal positions *first* through *twentieth*, using an ordered set of objects presented in lines or rows from left to right, right to left, top to bottom, and bottom to top.

Materials needed

- Blank transparency
- Overhead counters (at least six)
- Overhead markers
- Sets of twenty objects
- Ordinal numbers on Post-It notes or paper with sticky tack
- Paper and pencil for each student

Instructional activity

1. Begin by having students do some activities in which there will be a first, second, and third place. For example, have the entire class line up and count off using ordinal terminology. It may be necessary for the teacher to begin and say, “I am first,” in order for the students to understand what you are looking for. Have a group of six students run a short race, and have the others determine who finished first, second and third. Using little toy cars and a predetermined raceway, allow six students to race the cars and determine which one finished first, second, and third. Take an ordinal field trip: Take your class out into the hall and send an individual/pair of students to the third door on the right; send two others to the second door to the left, etc. Have every student participate in at least one of the activities.
2. Ask students what all of these activities have in common. Explain that today they will be talking about numbers that indicate a position in a series or order. Ask the students to explain how ordinals were used in each activity.
3. Select 20 items from around the room, and place them in a line/row. Pass out the Post-It papers with ordinals written on them. Select students to come up and label the items by placing the Post-Its on the actual item so that the entire class can see. Once one direction has been started (e.g., left to right), make sure students continue to use that as a guideline. Then remove the ordinal Post-Its, pass them out again, and have students label the positions of the items, but in the opposite direction (right to left).
4. Place six colored counters on the overhead transparency. Arrange the counters horizontally. Have students come up and label the ordinal positions from left to right using a dry erase marker. Ask them to predict what would happen if you turned the transparency from horizontal to vertical. Then turn the transparency clockwise and have students discuss what has changed and what has not changed. Students should realize that the ordinal position has not changed as long as you are going

from bottom to top. Erase the ordinal positions. Ask other students to come up to the overhead and label the six counters with ordinals from top to bottom. Ask them to predict what will happen when you change it back to a horizontal orientation (counter-clockwise). Change it back to a horizontal orientation and have them discuss what has changed or what has not changed.

5. Place students in groups of four to six. Have one student from each group select 20 items from around the room to bring back the group. Each student in the group will draw a pictorial representation of those 20 items and label the picture of the objects with ordinal numbers. They will then add a written explanation of what will happen if you change the orientation from horizontal to vertical. Allow the students to physically change their viewpoint (get up and move so that the row becomes a column) and then write their explanations. Refer back to the rotation of the counters on the transparency on the overhead if students need further guidance.
6. When the class period is almost over, regroup as a whole class and review what they did that day. Have students share their pictorial representations and written explanations.

Sample assessment

- Circulate among students during the drawing and labeling of the pictorial representations. As the students are working, observe the strategies and rationale for determining the ordinals. Check for understanding about the impact of going from left to right versus right to left and top to bottom versus bottom to top. Give help as necessary. Collect the papers as an assessment.

Follow-up/extension

- Have students draw the students in class in a line going from the classroom door to the teacher desk. Have them choose and denote their place in line. Have them explain their rationale for picking that location. Ask if it would change depending on what the activity is (e.g., getting ready to go outside, having your teacher check your work before going to learning centers). Would they choose to be in a different spot if the order was always going to be the same?
- Have students write in their journals about real-life applications of ordinals.
- Have students explain how sports would be different in a world without ordinals.
- Have students try to write directions for how to make an art project or how to solve a problem that requires sequencing without using ordinals. Then they can write it using the ordinals. Discuss the impact and have students explain why ordinals were invented/created.
- Have students ask an adult family member for directions to their house and tally the number of ordinals that are used in the explanation.
- Have students create a collage of pictures (drawings or ones cut out from magazines/newspapers) of instances where ordinals are used (e.g., calendar, sports, floors of buildings, rooms in long hallways).

Two-Digit Addition Using Cafeteria Lunches

Reporting categories

Number and Number Sense, Computation and Estimation

Overview

Given two whole numbers whose sum is 99 or less, students estimate, using rounding to the nearest ten, and find the sum, using various methods of calculation.

Related Standards of Learning

2.1, 2.7

Objectives

- The student will round two-digit numbers to the nearest ten.
- The student will estimate the sum of two whole numbers whose sum is 99 or less and recognize whether the estimate is reasonable.
- The student will regroup 10 ones for 1 ten, using base-10 models, when finding the sum of two whole numbers whose sum is 99 or less.
- The student will determine the sum of two whole numbers whose sum is 99 or less, using base-10 models, such as base-10 blocks and bundles of tens.
- The student will solve problems presented vertically or horizontally that require finding the sum of two whole numbers whose sum is 99 or less, using paper and pencil.

Materials needed

- Base-10 models and workmats
- Paper and pencil for each student

Instructional activity

Note: It would be best if this activity is done prior to lunchtime. Enlist help from the other second-grade teachers by having them collect the data for your class about how many students are getting school lunch that day. Ask if it would be okay to send a student to collect this data during the beginning of your mathematics lesson. Ask for help from the cafeteria workers by having them be prepared to answer your students when they come through the lunch line asking how many lunches were prepared for the second grade on that particular day.

1. Pose this problem: The cafeteria manager needs to know how many lunches to prepare for the second grade. Have students brainstorm how they can determine it. Then send students to collect the data and record it in a table on the board.

Class	Number of Students Ordering Lunch Today
Mrs. Smith	14
Mrs. Williams	8
Miss Jackson	17
Mr. Davis	9

2. Ask students how they might figure out the total number of lunches ordered. Students may suggest other strategies for estimation. For today's lesson, focus on estimating the total number of lunches by having them round to the nearest ten for each class and adding using mental mathematics or base-10 blocks if necessary.

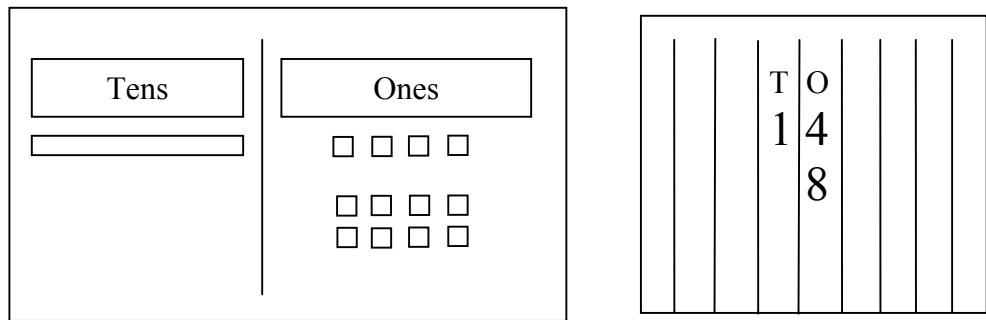
Class	Number of Students Ordering Lunch Today	
Mrs. Smith	14	10
Mrs. Williams	8	10
Miss Jackson	17	20
Mr. Davis	9	10

Our estimate for the number of lunches that the cafeteria workers need to make for second grade today is 50.

3. Erase the rounded numbers. Model how to add two classes at a time using the base-10 blocks and workmats.

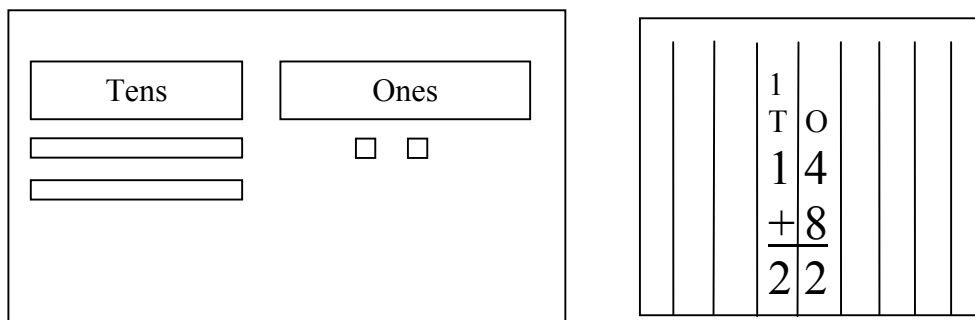
Class	Number of Students Ordering Lunch Today
Mrs. Smith	14
Mrs. Williams	8
Miss Jackson	17
Mr. Davis	9

4. Have students use the base-10 blocks to model 14 on their workmats. Record on chart paper or lined writing paper turned so that the lines are vertical (to help students align for place value). Have them record the place value above the number putting an O above the ones place and a T above the tens place. Be sure the students understand what the O and T represent. Have students make 8 underneath in their workmats using the base-10 blocks and then record on chart paper.



5. Ask students how to find the total of these two numbers. Students will explain that they have to add. They will need to record the + and ____ on their chart paper. Have students push the pieces together and regroup the 12 ones into 1 ten and 2 ones. Have students record on their chart paper as well. Check for understanding about where the numbers originate. Be sure to have the students

explain the correlation between what is being done with the manipulatives and what is being recorded on the chart paper.



6. Continue this sequence until all of the numbers have been added to determine the total number of lunches needed for the second grade that day. If students are ready, allow them to continue the process independently. Circulate among students and monitor their progress. Give assistance as necessary. Allow students to compare answers and help one another by explaining their process/reasoning.
7. Have students estimate the difference and then find the actual difference between the total number of lunches served and the estimated total. In a journal, have students debate whether using rounding to the nearest ten is appropriate in this context. Students should be able to share their writing or the teacher should respond individually.

Sample assessment

- Circulate among students during the independent phase of the lesson. Watch for correct use of the base-10 blocks and the correct recording of information. Ask students to explain what they are doing and how the manipulatives correlate with the written work. Assist students as necessary. Collect the papers as an assessment.

Follow-up/extension

- Have students redo this lesson after making predictions based on the type of lunch that is served a particular day (e.g., pizza days versus fish stick days).
- Have students create tables, bar, and picture graphs using their results. The students may then write a letter to the cafeteria manager requesting that certain meals be served more often based on the data about the preferences of the lunch buyers. Students may also relate this to economics by explaining that the cafeteria will make more money and demonstrate their theory by providing the data about the income generated on certain days.
- In a journal, have students explain the process of adding two two-digit numbers by using words and drawings of the base-10 blocks.
- Write a two two-digit addition problem on the board that has an error. Have students explain verbally or in writing what the error is (why it is an error) and how it needs to be fixed.
- Give students other instances in which they may use rounding to estimate, and have them evaluate whether or not it is appropriate (e.g., buying popsicles for the class on field day. There are 26 students in the class. Popsicles don't come packaged in sets of 26. What should I buy?

Problem Solving Using Tables, Picture Graphs, and Bar Graphs

Reporting categories

Number and Number Sense, Probability and Statistics

Overview

Students create and solve one-step addition and subtraction problems, using data from simple tables, picture graphs, bar graphs, and practical situations.

Related Standards of Learning

2.9, 2.23

Objectives

- The student will identify the appropriate data and the operation needed to solve an addition or subtraction problem where the data is presented in a simple table, picture graph, or bar graph.
- The student will solve addition and subtraction problems requiring a one-step solution, using data from simple charts, picture graphs, bar graphs, and everyday life situations.
- The student will create a one-step addition or subtraction problem using data from simple tables, picture graphs, and bar graphs that they have created.

Materials needed

- Two sheets of one-inch grid paper for each student
- Crayons, markers, pencils
- Something to be graphed (e.g., lunch choices, transportation to school, favorite colors, favorite PE activity)
- Additional paper for the students to write word problems about the graphs

Instructional activity

1. Have each student develop a question that can be answered by creating a graph. They will then create a survey with at least four categories. The students will go around the classroom and collect data from at least 12 people. The data will be recorded using tally marks. Model your expectations for the students.
2. Have students use their tables to create a picture and a bar graph, using one-inch grid paper. Review the expectations for the components of the picture and bar graphs. Each graph should include a title, labels for both the horizontal and vertical axes, defined categories, equal/labeled increments for the vertical axis (if this is the first time this activity is being done, limit students to increments of one), an equal space between the vertical axis and first category, equal space between each category, and an additional space after the last category.
3. Discuss the difference between telling and asking someone something. Model by having a student tell something about himself/herself. Write it on the board. Have students determine the appropriate capitalization and punctuation. Then have another student ask the first student a question about himself/herself. Write this on the board as well, having the students determine the appropriate capitalization and punctuation. Repeat with at least two more students. Have the class compare and contrast telling and asking sentences. Explain that this is what they are going to do today with the table, picture, and bar graphs that they have created. They are to write questions that can be answered by using the data. Give examples and non-examples of appropriate types of questions, e.g., EXAMPLE: “How many students like blue and purple? How many more people like green than yellow?” NON-EXAMPLE: “What is your favorite color? What color are you

wearing today?”. The students must write at least six questions that can be answered using the graph. At least three of them must require addition or subtraction sentences to answer the question. Allow students to create their questions. Circulate among students, and help those who are unclear about the assignment.

4. As students complete the assignment, have them switch papers and answer each other’s questions. The creator needs to put his/her name on the paper, and the student who answers the questions needs to record his/her name on the paper as well. When done, have the student who answered hand back the paper to the creator and have the creator evaluate. The student who answered the questions is responsible for explaining/justifying answers to the creator/evaluator, and the evaluator is responsible for explaining/helping correct any errors. Collect the graphs, questions, and answers as an assessment.
5. When the class period is almost over, have students regroup as a whole and summarize what they did that day. Have students debate either verbally or in a journal whether it is easier to summarize a table/graph or create questions based on them.

Sample assessment

- Watch to make sure that the students make the three representations of the data equal, e.g., the picture graph should not have increments of two while the bar graph has increments of one. Ensure that the components of the picture and bar graphs are present and correct. Each should include a title, both the x and y axes labeled, defined categories, equal/labeled increments going up the y axis (if this is the first time this activity is being done limit them to increments of one), an equal space between the y axis and first category, equal space between each category, and an additional space after the last category. Assist as necessary.
- Closely monitor as the students write at least six questions that can be answered using the graph. At least three of the questions must use addition or subtraction sentences to solve. Allow students to create their questions, but walk around and help students who are unclear about the assignment giving guidance as necessary.
- Listen as the student who answered the questions is explaining/justifying the answers to the creator/evaluator, and the evaluator is explaining/helping to correct any errors.
- Use the collected papers as assessments for graphing skills, interpretations of graphs, and the ability to answer one-step addition and subtraction problems using the data given.
- In a journal, have students summarize what they did that day and debate whether it is easier to summarize a table/graph or create questions based on them. Allow students to share aloud with partners/whole class, or the teacher should read and respond individually.

Follow-up/extension

Collect information, and organize and represent the data, using picture and bar graphs related to topics in reading (favorite character in a story), social studies (favorite famous American, distance from Virginia to China and Egypt), and science (height of a plant as it grows from a seed, daily temperature). Create graphs in both horizontal and vertical formats with increments in multiples of 1, 2, or 5. Limit the number of categories to four, and include a key for the picture graphs. Be sure to label the axes and include a title. Have students write at least one statement that describes the categories of data and the data as a whole and identifies the parts of the data that have special characteristics (greatest, least, same). Have students write questions that require one-step addition or subtraction problems based on the data and switch with a partner to complete, explain, and then evaluate.

Using graphs from everyday life (e.g., newspaper, back of soup can label, weather report, news articles), have students write at least one statement that describes the categories of data and the data as a whole and identifies the parts of the data that have special characteristics (greatest, least, same). Have students write questions that require one-step addition or subtraction problems based on the data and switch with a partner to complete, explain, and then evaluate.

Sample resources

<http://standards.nctm.org/document/chapter4/numb.htm> – NCTM Principles and Standards for School Mathematics chapter on the Number and Operations Standard for PreK-2.

http://illuminations.nctm.org/lessonplans/prek-2/begin_with_buttons/lesson1.html – a lesson that reviews ordinal number names as well as patterns.

http://standards.nctm.org/document/eexamples/chap4/4.5/calc_full/part2.htm – a lesson that uses an interactive calculator and hundred chart to demonstrate patterns on the hundred chart.

<http://www.utm.edu/~cesme/K-2.pdf> – lesson using grids/arrays to count objects by ones, twos, fours, fives and tens; fact families using unifix cubes, place value lesson that includes copies of workmats, lessons and models of 10 frames, lessons that encourage the reasonableness of estimations

<http://www.mathcats.com/explore/factfamilycards.html> – demonstrates how to make fact family cards in the shape of hexagons

http://www.mathcats.com/microworlds/subtractionquiz_overview.html – subtraction using virtual base 10 manipulatives

Sample test items from the spring 2002 released test

5



Who is 14th in line from the pony?



A



C

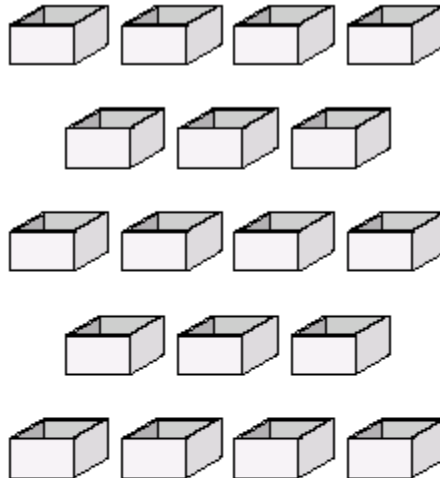


B



D

11



Ben put 5 cookies in each box for the bake sale. How many cookies did he use in all?

- A 18
- B 45
- C 90
- D 95

12 Going from left to right, in which group is the heart in the last position?



46 Lexi had 6 fish in her fish tank. Her dad bought her some more fish. After that, Lexi had 14 fish in her tank. How many fish did Lexi’s dad buy for her?

- F 8
- G 9
- H 12
- J 20

15 The chart shows the number of rocks each student collected during a field trip.

Name	Number of Rocks Collected
Karla	19
Jeff	15
Mark	27
Shauna	18


How many rocks did Jeff and Mark collect all together?

- A 32
- B 42
- C 45
- D 79

For #46, determine the missing number in a number sentence, for example, $6 + \underline{\quad} = 14$, or SOL 2.8

Use adaptations of the following questions to assess appropriate concepts.

SAMPLE



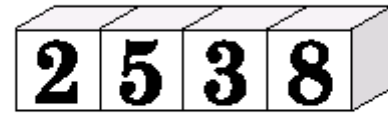
David Greg Keiko Betsy

Who is holding a card with an even number on it?

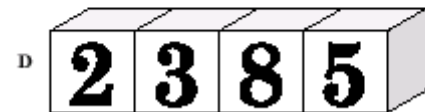
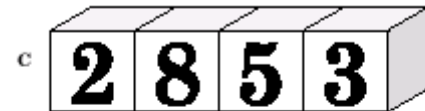
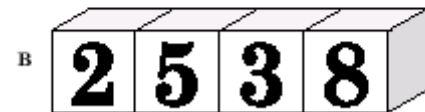
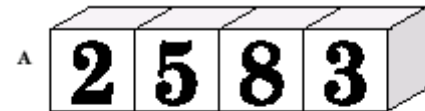
A David
B Greg
C Keiko
D Betsy

Have students use manipulatives to justify. Use three digits instead of four.

1 John made a number with the blocks shown below.



Sonya used the same blocks to make a number LESS THAN John's number. Which could be the number Sonya made?



10



There are 368 buttons in a jar. What is that number rounded to the nearest hundred buttons?

- F 300
- G 360
- H 370
- J 400

Use 2 digit numbers instead of 3 digit and round to nearest 10 instead of nearest 100.

13 A news story reported that 713,298 people watched the play-off game. What is the value of the 3 in 713,298?

- A 300
- B 3,000
- C 30,000
- D 300,000

Use a 3-digit number instead of larger ones.

- 18 Sara bought 3 boxes of crackers. There were 48 crackers in each box. How many crackers did she buy in all?**

F 45
G 51
H 124
J 144

Adapt to sum of whole numbers equaling 99 or less.

- 20 Lisa learned that the Caribbean Sea is 8,173 feet deep and the Black Sea is 3,826 feet deep. How many feet deeper is the Caribbean Sea than the Black Sea?**

F 5,753
G 5,357
H 4,947
J 4,347

Adapt to find the difference between two whole numbers 99 or less

Organizing Topic Fractions: Representations and Relationships

Standard of Learning

2.4 The student will identify the part of a set and/or region that represents fractions for one-half, one-third, one-fourth, one-eighth, and one-tenth and write the corresponding fraction.

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Recognize fractions as representing equal-size parts of a whole. _____
- Identify the fractional parts of a whole or a set for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$. _____
- Identify the fraction names for the fraction notations $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$. Represent fractional parts of a whole for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$, using
 - region/area models (e.g., pie pieces, pattern blocks, geoboards);
 - sets (e.g., chips, counters, cubes); and
 - measurement models (e.g., fraction strips, cuisenaire rods, connecting cubes). _____

Don't Answer the Door!

Reporting category

Number and Number Sense

Overview

Students demonstrate the set model by role-playing a fraction story with the use of manipulatives and pictorial representations.

Related Standard of Learning 2.4

Objectives

- The student will recognize fractions as representing equal-size parts of a whole.
- The student will identify the fractional parts of a set for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$.
- The student will identify the fractional notations for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$ using the set model.

Materials needed

- An appropriate story related to the fair-shares concept of fractions
- 1 chocolate chip cookie per student (12 set aside for the role playing presentation and then the extras for everyone to have one at the end)
- Paper and pencil for each student

Instructional activity

1. Begin by telling the students that you will need some actors. Ask for some volunteers to role-play the fraction story as you read it.
2. Begin with 2 actors. As you read the story, have students predict how the characters will solve each dilemma, e.g., What should they do as more people arrive to share? Read the next section to see if their predictions were correct. Have students role play what the characters in the story do. Add more actors as needed. Discuss what is happening to the whole set (e.g., first it gets divided into halves, then thirds, etc.). Draw a pictorial representation on the board for the first division and then call on students to come up and draw pictorial representations on the board for each successive division. Write the fractional notation on the board underneath the pictorial representations. *Do not* erase the pictorial representations. Draw lines to separate them and keep them in the proper sequence.
3. At the end of the story, discuss what happened to the set of items being shared in the story. (It was divided up more and more as more and more people came.) Discuss the fair shares (equal-size portions) that each person received. Explain that fractions are fair shares of a whole or a set. Relate it to how the students would feel if their parent gave them a treat and they had to share it with a brother or sister. The parent would expect them to be fair and divide it equally (fair shares).
4. Ask the students, “What do you notice happening to the fair shares that the children receive as the number on the bottom of the fraction gets larger?” When the set of 12 items was divided in half, each child got $\frac{1}{2}$ of 12 items or a total of 6 items. When the set of 12 items was divided in sixths, each child got $\frac{1}{6}$ of the 12 items or a total of 2 items. Have students look for the pattern. Use the think-pair-share strategy. Students think about the patterns they see, talk about it with a partner,

and then share as a whole class what they have discovered: the larger the denominator, the smaller the fair share. Compare this with what they know about the region/area model (fraction circles) of fractions. Does the conclusion still fit? Have the students justify their conclusions by using the fraction overhead pieces to explain their rationale.

5. As a review and summary of the activity, have students do a written and pictorial retelling of the fraction story that was shared at the beginning of class. Key components that must be included are the title, author, correct sequence of events, pictorial representations with the fractional notations of what happens each time new people join the original characters, and at least one sentence telling about each picture using the correct capitalization and punctuation.

Sample assessment

- Listen to the discussion as students predict what will happen each time more people arrive in the story. Watch for the strategies they use to divide up the items evenly. Are they able to make fair shares? Listen to the terminology used and connections being made. Watch the pictorial representations and fractional notations that are written on the board. Ask leading questions if students need guidance. Listen to the conclusions being made about the effect of the size of the denominator on the size of the fair share. Help students make the connections between the area and set models of fractions.

Follow-up/extension

- In groups, have students create their own variations of the fraction story as a dramatic presentation activity. The plays can then be presented to the class with the fractional parts and fractional notation being drawn on the board or by having the group members present them on posters as props during the presentations.
- Have students use real cookies or counters to represent the items in the story. Reinforce that fractions are fair. Give examples and non-examples of fractions, and have students justify their reasoning. Have students create drawings of examples and non-examples.
- Use region/area models (e.g., fraction circles, pattern blocks, geoboards) to model and create fractions that represent the same thing. Have learning centers set up where students can rotate and make and then trace or draw the representations. For example, show $\frac{1}{2}$ using fraction circles, the hexagon pattern block (a trapezoid), and the geoboard (create a square and use a rubber band to divide it in $\frac{1}{2}$). Provide students with dot paper to draw the geoboard representation.
- Create templates that the students can fill with pattern blocks. For example, a fish shape can be made by tracing around the hexagon for the body and tracing around a trapezoid for the tail. Ask, “If this is the whole, what fractional part does the red trapezoid represent?” (thirds) Students must demonstrate their answers using the pattern blocks.
- Have students create their own pattern block pictures (templates) by saying, “If the green triangle is $\frac{1}{6}$, what is the whole?” There can be a variety of answers with this type of questioning, but they all must meet the guidelines of using 6 green triangles to create the picture.
- Model and create fractions that represent the same thing using set models (e.g., chips, counters, cubes, 6 packs of soda cans, packs of gum, snack-size packages of M&Ms). Have learning centers set up where students can rotate and make/then trace or draw the representations (e.g., if 10 chips

is the whole, show $\frac{1}{2}$ by dividing the chips into two equal piles encircling each group with yarn).

A pictorial representation of the set model can be made by drawing or by stamping with bingo markers and then circling the fractional parts.

- Model and create fractions that represent the same thing using measurement models (e.g., fraction strips, cuisenaire rods, connecting cubes). Have learning centers set up where students can rotate and make/then trace or draw the fractional representations. For example when using cuisenaire rods, if the orange rod is the whole, what fractional part does the red rod represent (fifths)? If the white rod/cube is $\frac{1}{3}$, what piece represents the whole (purple)?

Fraction Fish

Reporting category

Number and Number Sense

Overview

Students demonstrate the area model with the whole being made up of more than one pattern-block piece.

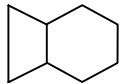
Related Standard of Learning 2.4

Objectives

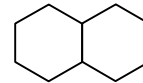
- The student will recognize fractions as representing equal-size parts of a whole.
- The student will identify the fractional parts of a whole for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$.
- The student will identify the fractional notations for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$ using the area model.

Materials needed

- One-half tub of pattern blocks per 4 students
- Copies of pattern-block picture patterns for each student
- Paper and pencil for each student
- Fraction fish and peanut outline for each student
- Create outline of fraction fish by tracing around one hexagon and one trapezoid pattern block:



- Create outline of peanut by tracing around two hexagon pattern blocks:



Instructional activity

1. Group students in fours with the pattern blocks in the middle of each group.
2. Begin by telling the students that you found this picture of a fish (place outline on overhead) and you're wondering how it was made. Ask them to help you figure out how it was made using the pattern blocks. Let students use whatever strategies they want. Give students a few minutes to come up with different solutions.
3. Discuss as a class several of their strategies. Have students come up to the overhead and model the different solutions. As each solution is modeled, use sticky tape stuck to the back of the real pattern blocks to recreate it on the board so that a record is being kept of the different solutions. If students use more than one type of pattern block (e.g., two trapezoids and three triangles), accept the answer, but ask them if they can now make it using only one type of piece (e.g., all trapezoids or all triangles). Students will be trading in/making equivalent fractions to achieve this. Only record with sticky tape the solutions that show the use of one type of pattern block (e.g., three trapezoids or nine triangles).
4. Using the records on the board, discuss the fractional parts of the fish. Discuss the importance of the fair shares or the equal-size parts of a whole. Model the fractional notation for each piece. On the overhead, trace the trapezoids inside the fish shape. As you remove each piece, write $\frac{1}{3}$, explaining that this is one out of the three equal-size pieces that make up the fish.

5. Repeat step four using nine triangles.
6. Model the strategy and steps again as you have the students make the peanut outline shape. Repeat steps two through four.
7. Pass out blank white paper. Have students fold it in half, open it, and draw a line on the fold. Discuss how they started out with one whole sheet of paper and now they folded it to create two halves. Draw a pictorial representation on the board and write the fractional notation: one-half and $\frac{1}{2}$ on each half of the paper.
8. Explain to the students that they will now create their own picture shapes using three blue rhombuses. They must follow one guideline: the rhombuses must touch one another on at least one side. Review the geometry terminology of sides. (This is important to keep it a region/area model; otherwise it could become the set model.) Students should then trace the outline of the completed shape and then pass it to their partner who will then fill it in with other equal-size pattern blocks. The partner will trace the other equal-size pattern blocks into the outline writing the fractional notation as they remove each piece (Six green triangles will fit in the shape so each traced piece should be marked as $\frac{1}{6}$.) When the puzzle is solved, have students pass back their pictures and explain what they did. Allow students to discuss, explain, and verify their solutions.
9. Have students demonstrate their creations, solutions, and fractional notations on the overhead. (Note: Students can create and then trace their shapes on the overhead or be given overhead transparencies to trace their shapes on before coming up to the overhead to demonstrate.)
10. Have students create another shape on the other half of their papers using any eight identical pattern block pieces. Repeat steps eight and nine.
11. Summarize the lesson by having students explain that the whole can be made up of more than one piece. It does not need to be one hexagon or one fraction circle. Fractions are equal-size pieces of a whole. Have students quickly identify and write the fractional parts of a whole for $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, and $\frac{1}{10}$.

Sample assessment

Listen to the discussion and observe as students solve the fraction fish problem. Observe the changes in terminology used between the first problem and then the ones the students create and solve on their own. Provide additional assistance for those who need clarification of the guidelines and/or assistance in identifying and writing correct fractional notations.

Follow-up/extension

Have students create their own pattern-block puzzles to be laminated and used as a learning center activity for the whole class. Students should create the puzzle, develop the answer key for the puzzle, and show the solutions and the fractional notations of each equal-size piece.

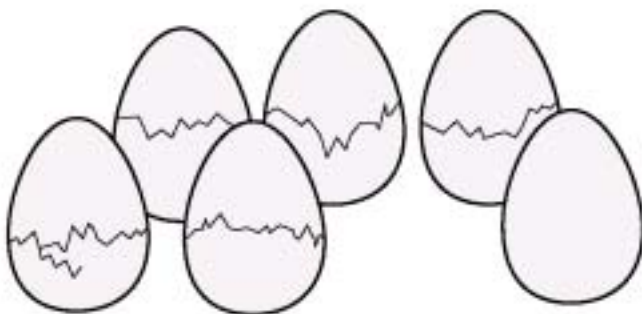
Sample resources

<http://standards.nctm.org/document/chapter4/numb.htm> – NCTM Principles and Standards for School Mathematics chapter on the Number and Operations Standard for PreK-2.

<http://www.utm.edu/~cesme/K-2.pdf> – lesson (pages 10–12) using the area model of fractions by dividing snack cakes evenly between various numbers of students

Sample test items from the spring 2002 released test

6 What fraction of the group of eggs is cracked?



F $\frac{1}{6}$

G $\frac{5}{6}$

H $\frac{5}{1}$

J $\frac{6}{5}$

Organizing Topic Measurement: Money, Length, Weight/Mass, Volume (Liquid), Temperature, Time, Perimeter, Area, Volume

Standards of Learning

- 2.11 The student will
- count and compare a collection of pennies, nickels, dimes, and quarters whose total value is \$2.00 or less; and
 - identify the correct usage of the cent symbol (¢), dollar symbol (\$), and decimal point (.)
- 2.12 The student will estimate and then use a ruler to make linear measurements to the nearest centimeter and inch, including measuring the distance around a polygon in order to determine perimeter.
- 2.13 The student, given grid paper, will estimate and then count the number of square units needed to cover a given surface in order to determine area.
- 2.14 The student will estimate and then count the number of cubes in a rectangular box in order to determine volume.
- 2.15 The student will estimate and then determine weight/mass of familiar objects in pounds and/or kilograms, using a scale.
- 2.16 The student will tell and write time to the quarter hour, using analog and digital clocks.
- 2.17 The student will use actual measuring devices to compare metric and U.S. Customary units (cups, pints, quarts, gallons, and liters) for measuring liquid volume, using the concepts of *more*, *less*, and *equivalent*.
- 2.18 The student will
- use calendar language appropriately (e.g., months, today, yesterday, next week, last week);
 - determine past and future days of the week; and
 - identify specific dates on a given calendar.
- 2.19 The student will read the temperature on a Celsius and/or Fahrenheit thermometer to the nearest 10 degrees.

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Identify all coins and a one-dollar bill, recording the value, using the cent symbol (¢), dollar symbol (\$), and decimal point (.)
- Determine the value of a collection of coins and one-dollar bills whose total value is \$2.00 or less.
- Compare the values of two sets of coins and one-dollar bills (each set having a total value of \$2.00 or less), using the terms *greater than*, *less than*, or *equal to*.

- Simulate everyday opportunities to count and compare a collection of coins and one-dollar bills whose total value is \$2.00 or less.

- Identify an inch as a U.S. customary unit for measuring length.

- Estimate and measure the length of various line segments and objects to the nearest inch.

- Identify a centimeter as a metric unit for measuring length.

- Estimate and measure the length of various line segments and objects to the nearest centimeter.

- Measure each side of a variety of concrete polygons and add them to determine the distance around the polygon (its perimeter).

- Determine the distance around a polygon (its perimeter), given the measurements of the sides in centimeters or inches.

- Investigate covering a given surface with square units, using concrete materials (e.g., inch tiles, geoboards, grid paper).

- Determine the area of a given surface on grid paper by estimating and then counting the number of square units needed to cover the surface.

- Investigate the concept of volume by filling boxes and building box shapes, using cubes.

- Determine the volume of a rectangular box by counting the number of cubes needed to fill it.

- Determine the volume of a rectangular box by
 - counting the number of cubes in the top layer of cubes; and
 - adding that number for each layer of cubes.

- Identify a pound as the U.S. customary unit for measuring weight.

- Estimate and then measure the weight of familiar objects to the nearest pound, using a scale.

- Identify a kilogram as a metric unit for measuring mass.

- Estimate and then measure the mass of familiar objects to the nearest kilogram, using a scale.

- Show and tell time to the quarter hour, using a model analog clock.

- Write the time indicated on a digital clock to the nearest quarter hour.

- Write the time indicated on an analog clock to the nearest quarter hour.

- Match a written time to a time shown on a clock face to the quarter hour.

- Identify the metric and U.S. customary units for measuring liquid volume (e.g., cups, pints, quarts, gallons, and liters).
- Compare customary and metric units of liquid volume (e.g., cups to quarts, liters to quarts), using actual measuring devices and the concepts of *more*, *less*, and *equivalent*.
- Read a calendar to locate a given day or date.
- Identify the seven days in a week.
- Determine the days/dates before and after a given day/date.
- Determine the date that is a specific number of days or weeks in the past or in the future from a given date, using a calendar.
- Identify specific dates (e.g., the third Monday in a given month).
- Read temperature to the nearest 10 degrees from real Celsius and Fahrenheit thermometers and from physical models (including pictorial representations) of such thermometers.

Let's Make a Date

Reporting category

Measurement

Overview

Students create their own calendars for the month to use in identifying days and dates.

Related Standard of Learning

2.18

Objectives

- The student will read a calendar to locate a given day or date.
- The student will identify the seven days in a week.
- The student will determine the days/dates before and after a given date.
- The student will determine the date that is a specific number of days or weeks in the past or in the future from a given date, using a calendar.
- The student will identify specific dates (e.g., the third Monday in a given month).

Materials needed

- Chart paper
- One blank calendar copy and pencil for each student
- Transparency of blank calendar and overhead markers
- At least one commercial calendar for the whole class to see (preferably one that you use that has notations of special dates)
- Extra commercial calendars for each group (optional)
- Calendar poem on chart paper, found at <http://www.enchantedlearning.com/rhymes/30days.shtml>
- Stickers, crayons, markers (optional)

Instructional activity

Note: The night before doing this lesson, have students survey at least three people, asking why having a calendar is useful. Students should record the responses.

1. Show students pages from a commercial calendar, and explain that they are going to discuss calendars today. In groups, have students read their survey results from the night before about the usefulness of a calendar. Create a class list on chart paper to be displayed in the room.
2. Explain that they are going to make a calendar for this month to use the same way that the people they surveyed use a calendar. Pass out blank calendar worksheets.
3. Ask students what is missing and list on the board (name of month, numbers, days of the week, special dates). If they do not mention all of these items, flip through the commercial calendar again and ask guiding questions.
4. Using the overhead, begin with the name of the month at the top. Ask students what month should be put there and write it. Cross it off the list on the board of the missing items on the blank calendar. Review the number of, order, and names of the other months of the year. (Note: Students will fill in this month as you model it for them.)
5. Tell students we are now going to add in the days of the week. Review the number, order, and names of the days of the week. Model the placement on the overhead calendar and have students copy it onto theirs. Stress the importance of correct spelling and capitalization. Review the rule for

capitalizing proper nouns. Have students look for and note the repeating pattern in the spellings of the days of the week (all end in day). Cross days of the week off the list on the board.

6. Ask students which category we should do--numbers or special dates? Does it matter? Students should be able to tell you that the numbers have to be filled in first so that you know when and where to put the special dates. Ask students where to start putting the numbers. Most will probably say to put the one in the first box, but have them look at the commercial calendar to see where the number one really is. Have them use the inquiry method to determine why it is placed where it is. Have them develop a hypothesis and test using the data from the other months of the year. Students should come to the realization that the first of the month is impacted by where the last day of the previous month falls. Model the correct placement and have students fill in the rest of the dates.
7. Ask students how they know when to stop filling in numbers for dates. Have them use the inquiry method to determine. Have them collect data for three months and develop a hypothesis. Then have them test their hypothesis using the commercial calendars to collect data for all 12 months. Have students develop a conclusion in groups. Allow groups to share their conclusions. Show students the poem about the calendar. Students should recite at least two times. Check and make sure students stopped at the correct place.
8. Begin modeling and having the students fill in special dates (e.g., class birthdays, field trips, holidays, early dismissals, end of grading periods, PTA functions). Students may add stickers and/or color their calendars.
9. Have students use their calendars to practice
 - locating a given day or date
 - identifying the seven days of the week
 - determining the days/dates before and after a given day/date
 - determining the date that is a specific number of days or weeks in the past or in the future from a given date
 - identifying specific dates (e.g., the third Monday in a given month).Each time you ask questions, have students justify their answers.
10. When the class period is almost over, have the students summarize what they did that day. Ask students in groups to develop the main idea of the lesson. Allow groups to share.

Sample assessment

- Circulate among students during the completion of the calendars. Observe the strategies, rationale, and conclusions as students develop and test their hypotheses about how the numbering of the calendar works for both the start days of individual months and lengths of months. Note who is having difficulty, and give help as necessary. Collect the papers to use as an assessment on the following day.

Follow-up/extension

- Return student calendars. Students will use them to answer the questions on the written assessment sheet. (Note: A sample written assessment sheet is attached, but it may need to be modified. Check to be sure that the questions can be answered using the calendar the students created. Some questions will need to be changed depending on what time of the month you are doing this lesson.)
- Have students create and print their own calendars for the next month on the computer. Use these to assess their abilities in
 - locating a given day or date

- identifying the seven days of the week
- determining the days/dates before and after a given day/date
- determining the date that is a specific number of days or weeks in the past or in the future from a given date
- identifying specific dates (e.g., the third Monday in a given month).
- Have students memorize the calendar poem and recite it in front of their peers as an oral presentation.
- In a journal, have students write about their favorite day/date of the year and explain why it is a favorite.
- Have a large classroom calendar displayed in the room. Place special date markers to signify special activities (e.g., birthdays, holidays, field trips). Use the calendar to have students locate a given day or date, identify the seven days in a week, determine the days/dates before and after a given day/date, determine the date that is a specific number of days or weeks in the past or in the future from a given date, and identify specific dates (e.g., third Monday in a given month).
- Create a class calendar for each month for the students take home and share with their families. Try to include something on each school day such as units of study, test dates, project due dates, special activities, birthdays, and holidays. Encourage students to hang it on the refrigerator and refer to it each day. Encourage them to use it to answer questions such as, “How much longer until our field trip? When is spring break? How old are you? — 8 years, 2 weeks, and 3 days.”

Name _____

Date _____

1. List the seven days of the week in order.
2. What **day** is it today?
3. What **day** was it yesterday?
4. What **day** will it be tomorrow?
5. What **date** is today?
6. What **date** was it yesterday?
7. What **date** will it be tomorrow?
8. What **day** and **date** will it be two weeks from today?
9. What **day** and **date** was it one week from yesterday?
10. Write one special event that is happening during this month.
11. Write both the **day** and **date** of this special event.
12. Write how long you have to wait for it to arrive or how many days have passed since it occurred.

Let's Go Shopping

Reporting category

Measurement

Overview

Students identify and count coins and compare values in order to go shopping in a class store.

Related Standard of Learning

2.11

Objectives

- The student will identify all coins and a one-dollar bill, recording the value, using the cent symbol, dollar symbol, and decimal point.
- The student will determine the value of a collection of coins and one-dollar bills whose total value is \$2.00 or less.
- The student will compare the values of two sets of coins and one-dollar bills (each set having a total value of \$2.00 or less), using the terms greater than, less than, or equal to.
- The student will simulate everyday opportunities to count and compare collections of coins and one-dollar bills whose total value is \$2.00 or less.

Materials needed

- One ziplock bag with coins and a dollar bill in it totaling up to \$2 for each student plus a few extra coins (Label the bags with numbers or letters and record the value in each for your information for assessment purposes later.)
- Items in the classroom with price stickers on them (a few more than the total number of students in your class). These items are for the simulation and will not actually be for sale.
- Paper and pencil for each student

Instructional activity

Note: Place price stickers on the classroom items before students come in for the day.

1. Group the students in pairs. Give students a bag with the coin and dollar bill collection in it and tell them they will be going shopping today.
2. Students will write their names and the bag number or letter on their papers. Students will then open their bags and trace the money (or do a coin rubbing) onto a sheet of paper. They must write the value of each coin in its circle or directly below it. The value of the collection must be added together and the total must be written two ways: (1) using the cent sign and (2) using the dollar sign and decimal point.
3. Students will check their partner's work. The students will compare the values of the two sets using the terms *greater than*, *less than*, or *equal to* and will write a comparison statement on their paper (e.g., \$1.90 is greater than \$1.75. \$1.75 is less than \$1.90).
4. Students will then go shopping in the classroom with their partners. Using the price stickers, students will determine if their sums of money are greater than, less than, or equal to the price of the item. When each student in the pair finds an item that costs less than or is equal to the sum of money they have, they will take their money and the item to the cashier (the teacher). Students must count out the correct amount of money to the cashier to "buy" the item. If students have less than the needed amount, tell them to return the item and go shopping again for a less expensive item.
5. As pairs finish, provide them with new bags of money and repeat the process.

6. When the class period is almost over, stop the shopping, regroup as a whole class, and review what they did that day.

Sample assessment

- Circulate among students during the tracing/rubbing of coins. Observe the strategies and rationale for counting the value of the coins as the students are working. Note who is having difficulty identifying the coins, value, counting, writing of the value, and/or comparing amounts. Give help as necessary. Collect the papers as an assessment.

Follow-up/extension

- Have students create their own class stores as a learning center activity.
- Read to students an appropriate book containing pictures of money. Identify all coins in the pictures and record the value using the cent symbol, dollar symbol, and decimal point.
- Using actual coins, plastic manipulatives, overhead pieces, coin stamps, and rubbings, have students identify all coins and record the value using the cent symbol, dollar symbol, and decimal point.
- Using actual coins, plastic manipulatives, overhead pieces, coin stamps, rubbings, and pictures of a collection of coins and one-dollar bills whose total is \$2 or less, have students count all coins and record the value using the cent symbol, dollar symbol, and decimal point.
- Review counting by ones, fives, and tens to 100 using actual coins, overhead pieces, plastic manipulatives, and pictorial representations of pennies, nickels, and dimes.
- Have students develop a rhythm for counting by 25s. Allow them to clap their hands, stomp their feet, or march around to the beat while repeating “25, 50, 75, a dollar, 25, 50, 75, a dollar, etc.”
- Create several learning centers around the room. At each learning center, have two ziplock bags containing coins valued at \$2 or less using collections of coins and one-dollar bills. Pairs of students will visit each learning center, determine the value of each bag, and compare value of the two bags using the terms *greater than*, *less than*, or *equal to*.
- Have students count collections of coins and one-dollar bills when the opportunity arises in real life (e.g., lunch money, ice cream money, in the gift shop on a field trip).

Does Area Equal Perimeter?

Reporting category

Measurement

Overview

Students find and compare the perimeters and areas of pentominoes.

Related Standards of Learning

2.12, 2.13

Objectives

- The student will estimate and then use a ruler to make linear measurements to the nearest inch, including measuring the distance around a polygon in order to determine perimeter.
- The student will estimate and count the number of square units needed to cover a given surface in order to determine area.
- The student will compare and draw a conclusion about the areas and perimeters of the different pentominoes.

Materials needed

- One pentomino for each student
- A ruler marked in inches for each student
- Square inch tiles, paper square inch tiles that can be glued into the traced shape, and/or square inch grid paper
- Paper and pencil for each student

Instructional activity

1. Give each student a piece of paper, one pentomino, a ruler, a handful of square-inch tiles and/or grid paper. Review with students the definitions of perimeter and area. Compare and contrast the two terms. Explain today that they are going to do an investigation to determine if all of the pentominoes (show several examples) have the same area and perimeter. Have students make predictions and explain their reasoning.
2. Have students fold their papers in half like a card and draw a line down the fold line.
3. Have students trace their pentomino onto one half of the paper. Students will measure each side to the nearest inch and record. Students will add the side measurements to determine the perimeter of their pentomino.
4. Have students find the area of their traced shape. They may use one-inch square tiles (tracing them) or glue construction paper one-inch squares into the traced pentomino shape. They will discover that the area equals five square inches.
5. Have students trade with another student to get a different shaped pentomino. Students will use the data from their first pentomino to predict the perimeter and area of the second one.
6. Have students repeat the steps from three and four. Have students make observations and then turn their papers over. They will draw the line down the fold and switch with another classmate to get a different pentomino. Students will use the data from their first two pentominoes to predict the perimeter and area of the third pentomino.
7. Have students repeat the steps from three and four. Have students make observations and record their conclusions in the last part of the paper. They should discover that while the area of the pentominoes remains constant, the perimeter varies.

Sample assessment

- Circulate among students during the activity. Observe the strategies used for making the predictions about the next pentomino. Note who is having difficulty, and give help as necessary. Allow the students to share their observations and conclusions. Collect the papers as an assessment.

Follow-up/extension

- Have students create other shapes using six square tiles (shapes with the same area) and then investigate and compare the perimeters.
- Have students create templates using tracings of pattern blocks with the same area then investigate to see if the perimeters are different.
- Read to students an appropriate piece of literature that discusses the need for customary or standard units of measure. Discuss measurement terminology (e.g., inch, foot, yard, centimeter, meter).
- Have students go on a scavenger hunt for items around the room that are a certain number of inches or centimeters. They will use estimation skills first to decide whether or not to bother actually measuring the item.
- Have students find something on their body (e.g., length of one finger from the knuckle to the end or width of fingernail on the pinky finger) that is equivalent to one inch and one centimeter. These things will serve as benchmarks for future estimations.
- Allow students to trace concrete polygons and then measure each side to determine the perimeter in inches or centimeters. Have students estimate the perimeter before actually measuring, again after measuring one side, and again after measuring two sides. Have them discuss their strategies for refining estimates.
- Investigate finding the area of items around the classroom using square-inch tiles. Have students trace items on regular paper and find the area using square-inch tiles or by gluing paper square-inch tiles to cover the space. Have students trace items on grid paper to find the area.

Are All Containers Created Equal?

Reporting category

Measurement

Overview

Students order grocery store boxes from least to greatest volume, using estimation, and then determine the actual order by filling the containers with cubes.

Related Standard of Learning

2.14

Objectives

- The student will investigate the concept of volume by filling boxes and building box shapes, using cubes.
- The student will determine the volume of a rectangular box by counting the number of cubes needed to fill it.
- The student will determine the volume of a rectangular box by counting the number of cubes in the top layer of cubes and adding that number for each layer of cubes.

Materials needed

- At least five different empty boxes from the grocery store (e.g., cereal box, graham cracker box, snack cake box)
- Enough same-size cubes to fill each empty box
- Recording sheet, pen or crayon, and pencil for each student

Instructional activity

1. Create five learning center areas in the classroom. The five learning center areas should be set up with cubes that the students will use to find the volumes of boxes.
2. Write the word *volume* on the board. Ask students to think quietly about what they believe volume means, and then allow them to share their idea with a partner. Students will use the Think-Pair-Share strategy. Then ask students where they can find the definitions or meanings of unfamiliar words (dictionary). The teacher or a student will use the dictionary to find and read the definition of volume. If necessary, reword it so that students can understand it and write it on the board.
3. Explain to students that they will be working in groups to rotate through learning centers. First they will be predicting the volume or the amount that each container can hold inside it, they will predict the arrangement from least to greatest, and then they will actually measure the volume to determine if their predictions and estimates were correct. This will be done with the boxes.
4. Show students the five boxes. Students will write on the recording sheet, using a pen or crayon, their estimates of how many cubes they think will fit into each container. They will then write the order of their estimated volumes from least to greatest volume. Explain that they will not be changing these answers once they find the actual answer. They will use this information so that they can do better next time. Compare it to when we/scientists make a hypothesis. The hypothesis does not get changed once the experiment is over. It is used to learn and to create a new hypothesis for another experiment. Scientists/people learn just as much from their mistakes as they do from their successes.
5. Ask students for ideas about how to find the volume of the boxes. Let them respond and remind them that in mathematics there is always more than one way to solve a problem. Explain and model how it will be done today. At each learning center, students will work together to find the

volume of each container by carefully layering the cubes in the box and then counting the cubes. Review how to fill the box, how to record the information, and how to clean up.

6. Divide the class into groups and allow students to rotate through the learning centers.
7. When the class period is almost over, regroup as a whole class, and review what they did that day. Have students review the procedures, their estimates, and predictions and discuss their results. Students should write something that they discovered about volume.

Sample assessment

- Circulate among students during the learning center rotations. Note who is having difficulty with understanding the process and/or aligning the cubes. Give help as necessary. As the students are working, observe their strategies and rationale for how to measure the volume of the various items. Determine who is able to make the connection between finding the area in the top of the box and then finding the volume by adding that number for each layer of cubes. When students regroup at the end of the lesson, have them share this strategy as part of the summary. Collect the papers as an assessment, paying close attention to the written conclusion.

Follow-up/extension

- In a journal, have students write a definition of volume and the reason they would want to know the volume of an object. Give examples.
- Have students redo this lesson using different containers to see how much their prior knowledge has helped them become better at estimating volume.
- In science lessons, compare how making predictions and estimates are like making a hypothesis. Scientists use it as a basis to create their experiments. They run the experiment and draw conclusions based on their data. The students have done the same thing in this lesson in mathematics.

Are All Containers Created Equal?

I predict that the volume of the boxes from *smallest* to *greatest* is

1. _____ 2. _____ 3. _____
4. _____ 5. _____

Names of Containers	Estimated Volume in Cubes	Actual Volume in Cubes

The actual volume of the boxes from smallest to greatest is:

1. _____ 2. _____ 3. _____
4. _____ 5. _____

Today I discovered that _____

A Weigh We Will Go

Reporting category

Measurement

Overview

Students estimate and then determine the weight/mass of familiar objects in pounds and/or kilograms, using a scale.

Related Standard of Learning

2.15

Objectives

- The student will identify a pound as the U.S. customary unit for measuring weight.
- The student will estimate and then measure the weight of familiar objects to the nearest pound, using a scale.
- The student will identify a kilogram as a metric unit for measuring mass.
- The student will estimate and then measure mass of familiar objects to the nearest kilogram, using a scale.

Materials needed

- At least three scales that measure using pounds
- Three items at each scale (one that weighs one pound and then two others)
- At least three scales that measure using kilograms
- Three items at each scale (one that weighs one kilogram and then two others)
- Six signs to denote clearly whether the station is for pounds or kilograms
- Recording sheet, pen or crayon, and pencil for each student

Instructional activity

1. Create the six learning center areas in the classroom. Six areas should be set up with scales that the students will use to find the weight/mass of familiar objects.
2. Write the words weight/mass on the board. Ask students to think quietly about what they think weight/mass mean, and then allow them to share their idea with a partner. Students will use the Think-Pair-Share strategy. Then ask students where they can find the definitions or meanings of unfamiliar words (dictionary). The teacher or a student will use the dictionary to find and read the definition of weight and mass. If necessary, reword it so that students can understand it and write it on the board.
3. Explain to students that they will be working in groups to rotate through learning centers. First they will estimate the weight/mass of each familiar item and then they will measure the weight/mass to determine how close their estimates were.
4. Show students something that weighs one pound. Model how to weigh the item, read the scale, and record the data. Write on the board, “The ____ weighs one pound.” Pass the item around so that each student feels how much a pound weighs. Explain to students that at each of the pound stations, something will weigh exactly one pound. They are to guess which item weighs one pound. Record the guesses. Have students decide which of the other two items weighs more than one pound and which weighs less than one pound.
5. Explain to students that just as when we measure the length of an object using more than one measure (U.S. Customary inches or metric centimeters), when measuring the weight or mass of an object, we might use pounds (U.S. Customary) or kilograms (metric).

6. Repeat step four using an item that is equivalent to one kilogram. Model how to weigh the item, read the scale, and record the data. Write on the board, “The ____ has a mass equivalent to one kilogram.” Explain to students that at each of the kilogram stations, one of the objects will weigh one kilogram. They are to estimate which item’s mass is equal to one kilogram and then estimate which of the other two items weighs more than one kilogram and which weighs less than one kilogram.
7. Divide the class into groups, and allow students to rotate through the learning centers.
8. When the class period is almost over, regroup as a whole class and review what was done that day. Have students review the procedures, their estimates, and the data, and then discuss. Have groups of students order the items according to their weights/mass from lightest to heaviest. Have students use the *less than*, *equal to*, *greater than* terminology to compare and contrast. Students should write a conclusion about what they discovered about weight/mass and pounds/kilograms that day.

Sample assessment

- Circulate among students during the learning center rotations. Note who is having difficulty with understanding the process of estimating and comparing weight/mass. Give help as necessary. As the students are working, observe their strategies and rationale for how to measure the weight/mass of various items. Determine who is able to make the connections by using their prior knowledge to make future estimates. When students regroup at the end of the lesson, be sure to have them share this strategy as part of the summary. Collect the papers as an assessment, paying close attention to the written conclusions.

Follow-up/extension

- In a journal, have students write an explanation of weight/mass and why they would want to know the weight/mass of an object. Give examples.
- Have students redo this lesson using different items to see how much their prior knowledge has helped them to make better estimates of weight/mass.
- Have students go on a scavenger hunt at home looking for items whose weight equals exactly one pound or whose mass equals exactly one kilogram. These items can be brought in the next day for actual measurement. Then a scavenger hunt can be done for items that equal five pounds or five kilograms.
- Create a bulletin board of clearly labeled familiar items that are equivalent to one pound or one kilogram. These will serve as benchmarks for the students when making future estimates about weight and mass.
- Compare pounds and kilograms to inches and centimeters and Fahrenheit and Celsius so that students understand the connections between U.S. customary and metric measurement.
- During science lessons, compare how making predictions and estimates is like making a hypothesis. Scientists use it as a basis for experimental design. They do the experiment and then draw conclusions based on their data. The students have done the same thing in this lesson in mathematics.

A Weigh We Will Go

Pound Station 1

	Less Than One Pound	Equal to One Pound	Greater Than One Pound
Estimate			
Actual			

Pound Station 2

	Less Than One Pound	Equal to One Pound	Greater Than One Pound
Estimate			
Actual			

Pound Station 3

	Less Than One Pound	Equal to One Pound	Greater Than One Pound
Estimate			
Actual			

Today I discovered that _____

Kilogram Station 4

	Less Than One Kilogram	Equal to One Kilogram	Greater Than One Kilogram
Estimate			
Actual			

Kilogram Station 5

	Less Than One Kilogram	Equal to One Kilogram	Greater Than One Kilogram
Estimate			
Actual			

Kilogram Station 6

	Less Than One Kilogram	Equal to One Kilogram	Greater Than One Kilogram
Estimate			
Actual			

Today I discovered that _____

Time's A-Tickin'

Reporting category

Measurement

Overview

Students tell and write time to the quarter hour using analog and digital clocks.

Related Standard of Learning

2.16

Objectives

- The student will show and tell time to the five minutes, using a model analog clock.
- The student will write the time indicated on an analog clock to the nearest five minutes.
- The student will match a written time to a time shown on a clock face to the five minutes.

Materials needed

- One paper plate per student
- One straw per student
- Two bobby pins per student
- One copy of a clock face per student
- Real and model analog clock (e.g., Judy clock)
- Real digital clock
- Inch rulers
- Scissors, pencil, and paper for each student

Instructional activity

1. Have students brainstorm in small groups for two minutes about why clocks are important and/or useful. Create a list of student comments, and display them in the classroom.
2. Explain to students that they are going to make clocks in order to practice telling time.
3. Model how to cut out the analog clock face and glue it onto the paper plate. The teacher should poke the hole in the center of the plate using scissors to eliminate the risk of harm to students. Demonstrate to students how to slip the bobby pins through the hole. (Note: Tell them *not* to bend the bobby pins open. They will become too loose and fall out of the hole.)
4. Demonstrate how to measure and cut the straw into two pieces. One should be approximately 4 inches long (the minute hand), and the other should be approximately 2 inches long (the hour hand). Demonstrate how to slip the straws onto the bobby pins. (Note: Tell them *not* to bend the bobby pins open. They will become too loose and fall out of the hole.)
5. Explain how to read an analog clock. Explain how the minute hand works, and demonstrate using both the real and model analog clock. Explain that each of little lines going around the face of the clock equals one minute. Have students count the little lines going around the face of the clock with you. Students will realize that there are 60 of them. Explain that there are 60 minutes in one hour. Using a model of an analog clock, direct the students' attention to the hour hand as the minute hand goes around 60 minutes. Explain how the hour hand works, and demonstrate using a real clock and then a model of an analog clock.
6. Direct the students' attention to the minute hand. Have them count how many little lines are in between each number. Have them discuss with a partner, then in a small group, and lastly as a

class, a generalization that can be made. Have students come up with the idea to count the minute hand by fives using the numbers on the clock.

7. Review once again how to read the analog clock using the hour and minute hands to the nearest five minutes.
8. Have students compare and contrast reading an analog clock to reading a digital clock.
9. Set times on the model analog clock, have students recreate those times using their own analog clocks, and then tell/write the times on the board or on paper. Give the students times orally, and have students represent them on their model analog clocks. Have them write the times on the board or on paper. Have students justify their answers.
10. Compare the concept of four quarters equaling one dollar to four quarters on an analog clock equaling one hour. On a model analog clock, divide the clock face into fourths. Explain that each little line on the side represents one minute. Have students count the little lines to discover how many minutes are in each quarter. Discuss, model, and practice an easier way to count the quarters (by fives).
11. Have students develop a rhythm for counting by quarter hours on the clock. Allow them to move one of their arms (representing the minute hand) to the beat while repeating “15, 30, 45, an hour, 15, 30, 45, an hour, etc.” Their arms should be straight out to the right when saying 15, straight down when saying 30, straight out to the left when saying 45, and straight up when saying an hour. Have them use this movement for the division of the clock face into quarters to explain how to write time to the nearest quarter hour.
12. When the class period is almost over, review what they did that day. Have students review the process for telling time using an analog versus a digital clock. Students should write an explanation to a kindergartner or a younger sibling about how to tell time using a digital and then an analog clock.

Sample assessment

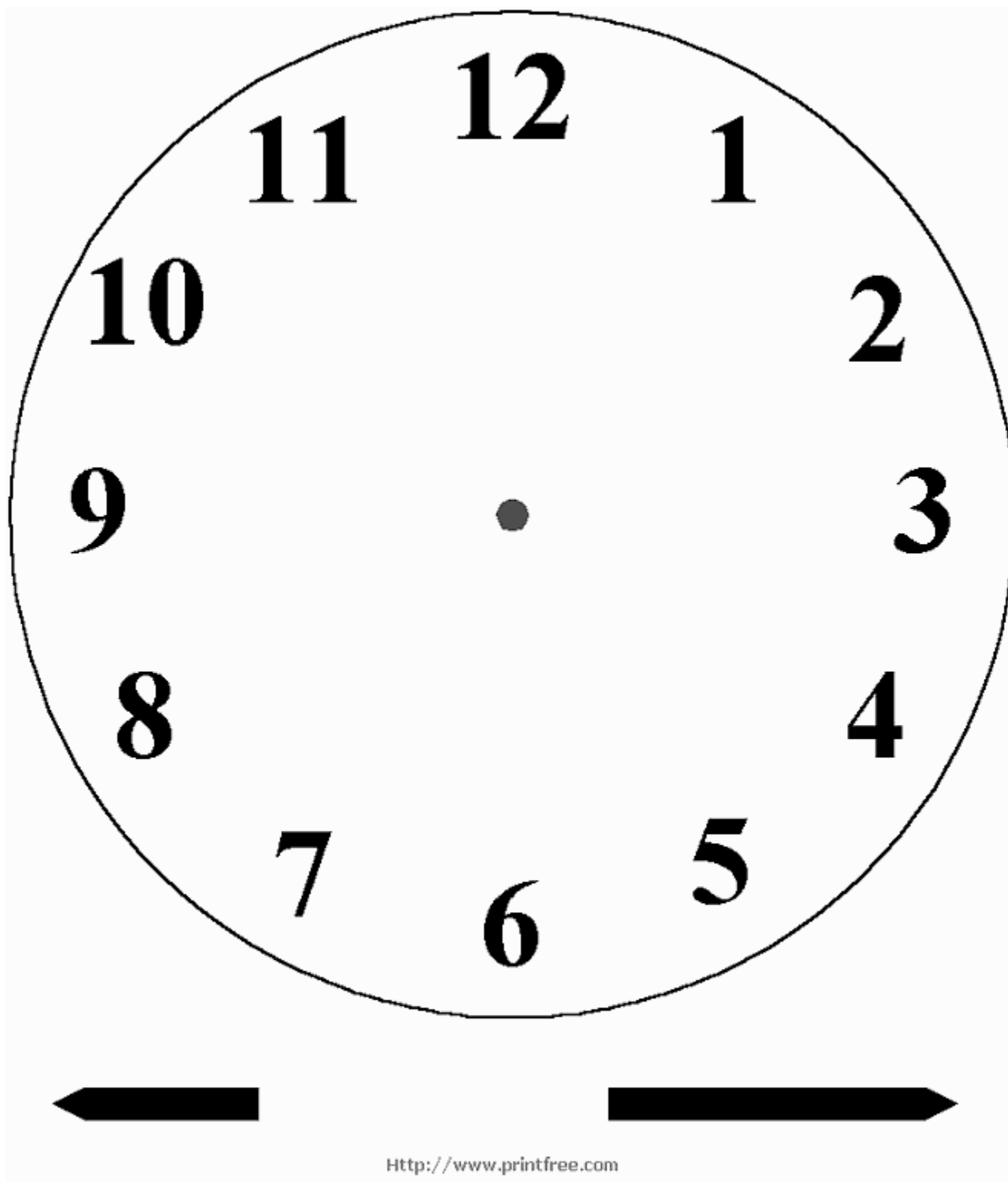
- Circulate among students during the lesson. Note who is having difficulty with understanding how to tell time using analog and/or digital clocks. Give help as necessary. As the students are working, observe their strategies and justifications. Determine who is able to make connections between telling time on an analog clock and a digital clock. Be sure to have students share this strategy when they regroup at the end of the lesson as part of the summary. Collect the written explanation of how to tell time using digital and analog clocks to a kindergartner or younger sibling as an assessment.

Follow-up/extension

- Have students redo this lesson by drawing pictorial representations of clocks rather than using the models.
- Have students create a class book about times that are important/enjoyable to them. Students may draw a picture of something they love to do and show the time that the activity occurs on an analog and digital clock. Students should write a sentence to describe the activity and the time it takes place. (e.g., My favorite thing to do at 4:30 P.M. is to go to dance class.)
- Create a learning center where one student sets a time using the model analog clock and the other writes the digital time to the nearest five minutes. Then the students switch. (Note: If students are weak at this, you may want to create a self-checking learning center where the analog clock is drawn on the outside of a pocket. On the inside of the pocket on an index card, the digital time is written.)

- During language arts, have students write explanations of how to tell time using a digital or analog clock in the form of a friendly letter. Students may also practice and reinforce the importance of sequencing by explaining the process step-by-step.
- Stop and ask students to tell and write the time throughout the day. Ask students to let you know when a certain time approaches. Have students explain the importance of being able to tell time and its relevance to their everyday lives.

Clock Face



Does Volume Really Matter?

Reporting category

Measurement

Overview

Students order plastic bottles according to volume from least to greatest using estimation and then determine the actual volume by filling the containers with beans or rice.

Related Standard of Learning

2.17

Objectives

- The student will identify the metric and U.S. customary units for measuring liquid volume (e.g., cups, pints, quarts, gallons, and liters).
- The student will compare customary and metric units of liquid volume (e.g., cups to quarts, liters to quarts) using actual measuring devices and the concepts of more, less, and equivalent.

Materials needed

- At least five different empty liquid volume containers (e.g., $\frac{1}{2}$ pint container of school milk, quart of buttermilk, gallon of milk, 1 liter bottle of water) (Note: It would be best to use these types of containers at first so that you can build a base knowledge for the students. When someone says a pint or a quart, the students will have something to picture in their minds as a frame of reference.)
- At least five one-cup measuring cups
- Enough beans or rice to fill each liquid volume container
- Recording sheet, pen or crayon, and pencil for each student

Instructional activity

1. Create the five learning center areas in the classroom. Each area should be set up with beans (or whatever is being used for the liquid volume measurement) and a measuring cup.
2. Write the word *volume* on the board. Ask students to think for a minute about what volume means, and then allow them to share their idea with a partner. Students will use the Think-Pair-Share strategy. Then ask students where they can find the definitions or meanings of unfamiliar words (dictionary). The teacher or a student will use the dictionary to find and read the definition of *volume*. If necessary, reword the definition so students can understand it and write the definition on the board.
3. Explain to students that they will be working in groups to rotate through the learning centers. First they will be predicting the volume or the amount that each container can hold inside it. They will predict the arrangement from least to greatest, and then they will actually measure the volume to determine if their predictions and estimates are correct. This will be done with the liquid volume containers.
4. Show students the five liquid volume containers and the one-cup measuring device. Students will write their estimates of how many cups they think will fit into each container on the recording sheet using a pen or crayon. They will then order the containers from least to greatest volume. Explain that they will not be changing these guesses once they determine the actual volume. They will use this information so that they can do better next time. Compare it to when we/scientists make a hypothesis. The hypothesis does not get changed once the experiment is over. Scientists/people learn just as much from mistakes as from successes.

5. Ask students for ideas about how they could find the volume of the liquid containers. Let them respond, and remind them that in mathematics there is always more than one way to solve a problem. Explain and model the process for today. At each learning center, students will work together to find the volume of the container using the measuring cup and beans (or whatever filler has been chosen). Review and model how to fill the measuring cup, how to be careful, how to count, how to record the information, and how to clean up.
6. Divide the class into groups, and allow students to rotate through the learning centers.
7. When the class period is almost over, regroup as a whole class, and review what they did that day. Have students review their estimates and predictions and discuss. Students should write what they discovered about volume that day.

Sample assessment

- Circulate among students during the learning center rotations. Note who is having difficulty with understanding the process and/or being exact in their use of measuring cups. Give help as necessary. As the students are working, observe their strategies and rationale for how to measure the volume of the various items. When students regroup at the end of the lesson, be sure to have them share their strategies as part of the summary. Collect the papers as an assessment, paying close attention to the written conclusion.

Follow-up/extension

- In a journal, have students write the definition of volume and why they would want to know the volume of an object. Give examples.
- Have students redo this lesson using different containers to see how much their prior knowledge has helped them become better at making estimations and predictions regarding volume.
- During science lessons, compare how making predictions and estimates is like making a hypothesis. Scientists use it as a basis to create their experiments. They do the experiment and then draw conclusions based on their data. The students have done the same thing in this lesson in mathematics.

Does Volume Really Matter?

I predict that the volume of the containers from *smallest* to *greatest* is:

1. _____ 2. _____ 3. _____
4. _____ 5. _____

Names of Containers	Estimated Volume in Cups	Actual Volume in Cups

The actual volume of the containers from smallest to greatest is:

1. _____ 2. _____ 3. _____
4. _____ 5. _____

Today I discovered that _____

Feelin' Hot, Hot, Hot

Reporting category

Measurement: Temperature

Overview

Students read, record, and compare temperatures, using Celsius and Fahrenheit thermometers.

Related Standard of Learning

2.19

Objective

- The student will read temperature to the nearest 10 degrees from real Celsius and Fahrenheit thermometers and from physical models (including pictorial representations) of such thermometers.

Materials needed

- Chart paper
- Celsius/Fahrenheit thermometer for each student
- Cup of ice per each group of four students
- Copy of empty thermometer worksheet and pencil/ red crayon for recording data for each student
- (Sheets following lesson contain thermometer clip art that can be used)
- Transparency of student thermometer worksheet and red overhead marker
- Feelin' Hot, Hot, Hot song (optional) <http://www.musiclegacy.com/hothot.htm>

Instructional activity

Note: The lesson could begin with listening to the song and having students describe what it makes them think of. Steer the conversation toward talking about temperature.

1. Have students do a Think-Pair-Share about why knowing the temperature is important. Record their list on chart paper to be displayed in the room.
2. Show students a thermometer, and discuss safety precautions and consequences if students do not handle it correctly.
3. Groups students into fours, and discuss for three minutes what characteristics they notice about their thermometers. As a whole class, have students share their observations and record observations on the board. Leave this list so that you can add new observations during the summary portion of the lesson.
4. Demonstrate how to read the thermometer in Celsius and Fahrenheit to the nearest 10 degrees.
5. Model and then have students record the room temperature on the student worksheet. Have students color in the thermometer in pencil first. After you have checked their work, they may color over it in red crayon.
6. Pass out cups of ice to groups of four. Before students place their thermometers into the cup of ice, have them predict what is going to happen to the temperature. Allow students to place the thermometers into the cup of ice for one minute and observe. Have students take their thermometers out and place them on their desks. Have them discuss what happened to the temperature when the thermometer was in the cup and what is happening now that the thermometer is outside of the cup. Ask them to predict again what will happen if they place it back into the cup of ice. Have students return the thermometer to the cup of ice for two minutes. When the thermometer comes out of the cup of ice, students will need to read the thermometer quickly

and record the temperature on the data sheet. Model on the overhead. Allow students to color over the pencil in red crayon after you have checked their work.

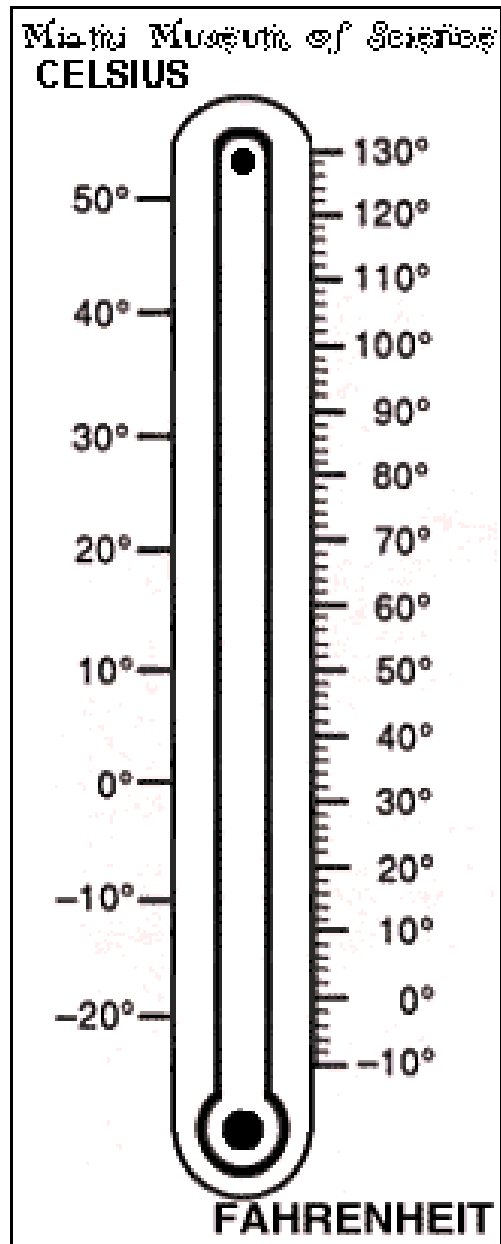
7. Explain that the temperature of the ice is lower than the temperature of the air in the room. Ask students to brainstorm some ideas to locate places where the temperature is higher. Then actually do so by having students rub their hands together very quickly for 30 seconds and hold the thermometer in their palms. Have students discuss their observations.
8. Have students place the thermometer back into the cup of ice for 30 seconds while they create friction again with their hands. This time the students will record how high they can make the temperature go by holding it in their hands.
9. Locate a real Celsius and Fahrenheit thermometer somewhere inside the classroom and another outside the classroom window. Have students read the thermometer to the nearest 10 degrees, record the data, and graph it. Use the graph to make comparisons and predictions. Use this process throughout the year.
10. As a whole class, review what they did that day and have students write a conclusion about how thermometers work, their usefulness, and one place in the world that they are curious about the temperature.

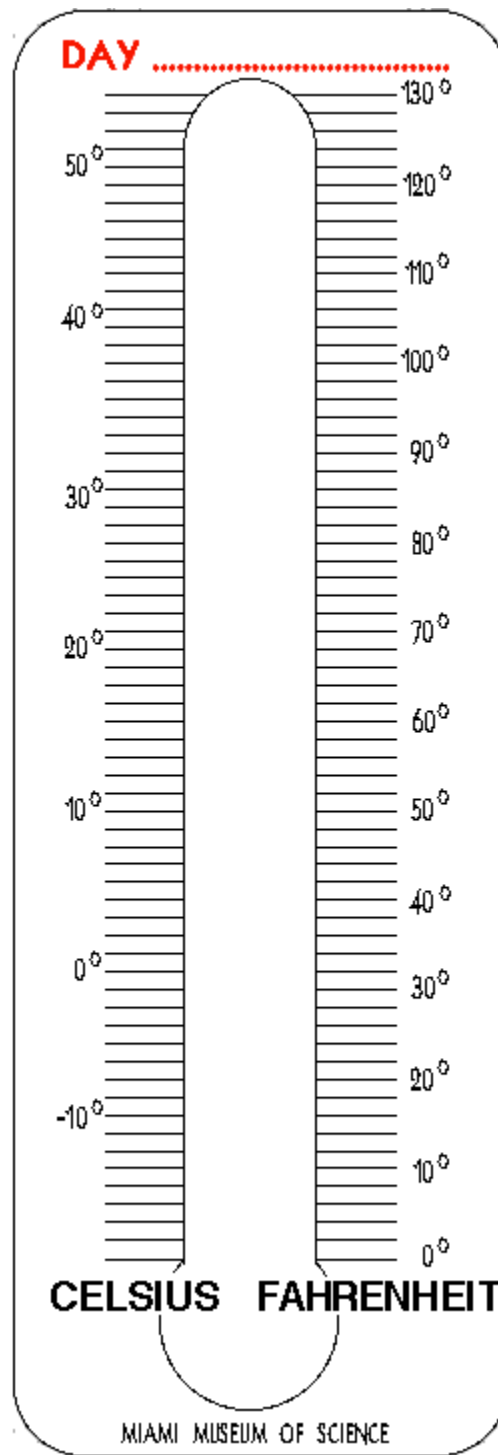
Sample assessment

- As the students are working, observe their observations about the thermometers. Circulate among students during the reading and recording of temperatures. Note who is having difficulty reading and recording temperatures. Give help as necessary. Collect the papers as an assessment.

Follow-up/extension

- Show students seasonal pictures from books or magazines, and have them record a reasonable temperature for each in both degrees Celsius and degrees Fahrenheit.
- Have students predict the temperature for tomorrow and the next five days. Record and then determine their accuracy. Students can create generalizations based on prior knowledge of what the temperature has been. If done throughout the year, students can look for seasonal patterns.
- Have students research the temperatures of other places in the world and compare and contrast them with ours. Students can make inferences about how temperature can affect things such as clothing, outside activities, housing needs, jobs, and recreation.
- The next two pages contain clip-art of thermometers that can be used with these activities.





Sample resources

<http://standards.nctm.org/document/chapter4/meas.htm> – NCTM Principles and Standards for School Mathematics chapter on the Measurement Standard for PreK-2.

<http://standards.nctm.org/document/eexamples/chap4/4.3/Part3.htm> – lessons on Learning Geometry and Measurement Concepts by Creating Paths and Navigating Mazes: Ladybug Mazes

<http://mathforum.org/paths/measurement/e.measlessons.html> – elementary measurement lessons and materials for teachers

<http://illuminations.nctm.org/swr/list.asp?Ref=1&Std=3Grd=-1> – measurement lessons endorsed by NCTM

<http://youth.net/cec/cecmath/cecmath.21.txt> – lesson using *Jack and the Beanstalk*, estimation and measuring with centimeters

<http://www.utm.edu/~cesme/K-2.pdf> – lesson and worksheet moving from nonstandard measurement to inches

http://www.mathcats.com/microworlds/usingmoney_overview.html – interactive site that allows students to read a problem and use virtual money manipulatives to solve it

<http://www.mathcats.com/explore/weather.html> – displays weather from around the world

<http://www.mathcats.com/explore/polygons.html> – compare sizes of virtual 2d shapes

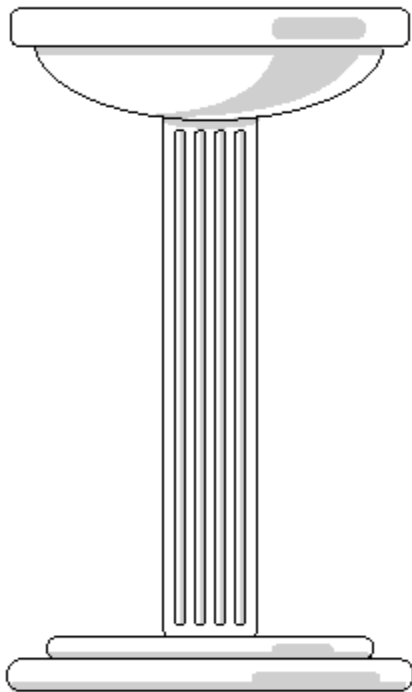
<http://www.usmint.gov/kids/index.cfm?Filecontents=/kids/games/index.cfm&pick=4> – games and facts that deal with coins

<http://www.time-for-time.com/swf/myclox.swf> – excellent interactive clock that has digital and analog faces.

Sample test items from the spring 2002 released test

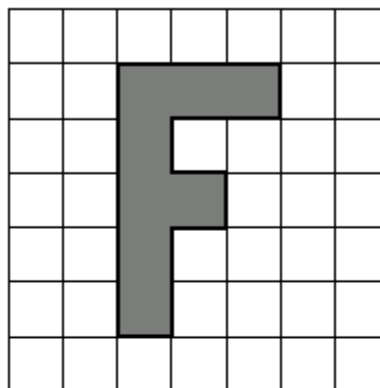
- 25** Use your centimeter ruler to help you answer this question.

Which is **CLOSEST** to the height of the birdbath in the picture below?



- A 13 centimeters
- B 12 centimeters
- C 11 centimeters
- D 10 centimeters

- 26** Each small square on the grid is 1 square unit.



How many square units are needed to make the shaded figure shown on the grid?

- F 7
- G 8
- H 15
- J 18

28 Rob said that the time was 10:30. Which of the following clocks shows closest to 10:30?



32



The length of the fish from nose to tail is closest to —

- F 2 paper clips
- G 3 paper clips
- H 5 paper clips
- J 8 paper clips

33 Which is CLOSEST to the amount of water Shelby’s watering can will hold when full?



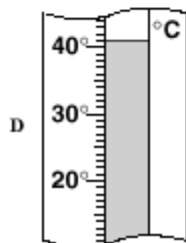
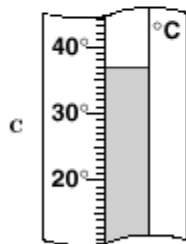
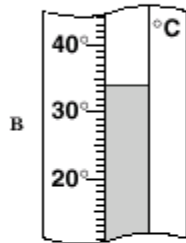
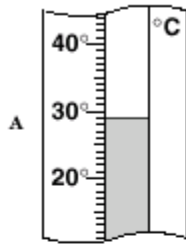
- A 1 gram
- B 1 pint
- C 1 cup
- D 1 gallon

34 On Saturday, Tad took exactly 60 minutes to finish his chores. How many hours did it take Tad to do his chores?

- F 1
- G 2
- H 3
- J 4

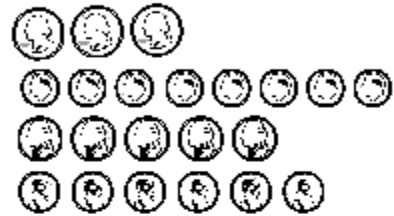
Adaptations of SOL test items

29 Which of the following thermometers shows closest to 37 degrees Celsius?



Students should be able to read the thermometer to the nearest 10 degrees.

14 Ronnie has the money shown below

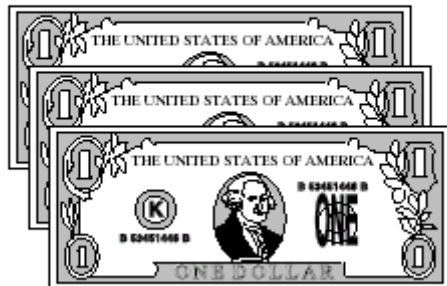


If the prices shown include tax, which of the following shirts can Ronnie buy with this money?



The total value of the coins and bills should be \$2 or less.

- 21 Mr. Colton paid Alice the money shown for shoveling the snow from his sidewalk.



What is the total value of the money?

- A \$3.95
- B \$4.16
- C \$4.95
- D \$6.15

Organizing Topic Geometry: Two-Dimensional (plane), Three-Dimensional (solid), Transformations

Standards of Learning

- 2.20 The student will identify, describe, and sort three-dimensional (solid) concrete figures, including a cube, rectangular solid (prism), square pyramid, sphere, cylinder, and cone, according to the number and shape of the solid’s faces, edges, and corners.
- 2.21 The student will identify and create figures, symmetric along a line, using various concrete materials.
- 2.22 The student will compare and contrast plane and solid geometric shapes (circle/sphere, square/cube, and rectangle/rectangular solid).

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Compare three-dimensional (solid) shapes (i.e., cube, rectangular solid [prism], square pyramid, sphere, cylinder, and cone) to similar objects in everyday life (e.g., a party hat is like a cone).
- Identify and name cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones by their appearance.
- Identify and describe cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones according to the number and shape of their faces (sides, bases), edges, and corners.
- Investigate symmetry, using paper folding, mirrors/miras, pattern blocks, wax paper, patty paper or tracing paper.
- Identify and demonstrate a line of symmetry in an object or an arrangement of objects.
- Draw the line(s) of symmetry — horizontal, vertical, and diagonal — in a figure.
- Identify and create figures that are symmetrical along a line, using various concrete materials.
- Determine similarities and differences between plane and solid shapes (e.g., circle/sphere, square/cube, and rectangle/rectangular solid), using models and cutouts.
- Trace faces of solid shapes (e.g., cube and rectangular solid) to create the set of plane figures related to the solid shape.
- Compare and contrast plane and solid geometric shapes (e.g., circle/sphere, square/cube, and rectangle/rectangular solid)

according to the number and shape of their faces (sides, bases),
edges, and corners.

Comparing Figures

Reporting category Geometry: Two-Dimensional (plane) and Three-Dimensional (solid)

Overview Students investigate three-dimensional figures by rotating through six learning centers and recording information about their attributes in a chart.

Related Standards of Learning 2.20, 2.22

Objectives

- The student will compare three-dimensional (solid figures) to similar objects in everyday life.
- The student will identify, name, and describe cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones by their appearance and according to the number and shape of their faces (sides, bases), edges, and corners.
- The student will determine similarities and differences between plane and solid figures using models and cutouts.
- The student will trace faces of solid figures to create the set of plane figures related to the solid figure.
- The student will compare and contrast plane and solid geometric figures according to the number and shape of their faces (sides, bases), edges, and corners.

Materials needed

- Six learning centers through which groups of students can rotate
 - Learning Center One – plain wooden geometric block cube labeled, several examples of cubes from everyday life, paper to trace the sides
 - Learning Center Two – plain wooden geometric rectangular solid (prism) labeled, several examples of rectangular solids from everyday life, paper to trace
 - Learning Center Three – plain wooden geometric square pyramid labeled, several examples of square pyramids from everyday life, paper to trace
 - Learning Center Four – plain wooden geometric sphere labeled, several examples of spheres from everyday life, paper to try to trace
 - Learning Center Five – plain wooden geometric cylinder labeled, several examples of cylinders from everyday life, paper to trace
 - Learning Center Six – plain wooden geometric cone labeled, several examples of cones from everyday life, paper to trace the sides
- Chart and pencil for each student to record data from each learning center

Instructional activity

1. Divide students into groups so they can rotate to each learning center. Explain your expectations for their behavior at each learning center, what they are to accomplish, the amount of time they will be given, and the rotation progression.
2. Allow each group to go to a learning center. Give them approximately 10 – 15 minutes at each learning center. At each learning center, each student should identify the wooden three-dimensional figure and discuss how the attributes of the everyday items are the same. Each student should fill in their own chart to record the number and shape of the faces (sides, bases), edges, and

corners of the three-dimensional object. The students will also be responsible for tracing the faces of the solid figures to create the set of plane figures related to the solid figure. You must model this and monitor it as the groups rotate through each learning center so that it is possible to cut out the traced two-dimensional figures and tape them together to create the three-dimensional figure once more.

3. (Note: This can be an activity for the following day.) Have students, at the end of the day, compare and contrast the three solid geometric figures they recorded information on that day according to the number and shape of their faces (sides, bases), edges, and corners. Students should then make predictions, based on the data they have already collected, about what they will find the next day for the three remaining figures.
4. Repeat steps 1–3 on the second day, allowing students to finish all six learning centers.
5. Come back together as a class, after all groups have gone to every learning center, and create a large class chart based on their findings to display in the classroom. Compare and contrast plane and solid geometric figures according to the number and shape of their faces (sides, bases), edges, and corners.

Sample assessment

- Circulate among students during the learning center work. Observe as students are identifying the figures, comparing the attributes to the everyday items, and determining the number and shape of the faces (sides, bases), edges, and corners. Note who is having difficulty identifying the figures, comparing the attributes, and determining the number and shape of their faces (sides, bases), edges, and corners. Monitor closely the tracing of the three-dimensional figures. Be available to help students cut out the traced two-dimensional figures and tape them together to create the three-dimensional figure once more. Have students complete any or all of the suggested assessments listed below.
- Have students fill in a blank chart in which they identify plane and solid geometric figures according to the number and shape of their faces (sides, bases), edges, and corners.
- Have students find a particular geometric solid in the room and identify/show you the faces (sides/bases), edges, and corners. You may use a rubric or an anecdotal record to record the information.
- Have students create Venn diagrams comparing and contrasting two solid geometric figures according to the number and shape of their faces (sides, bases), edges, and corners.

Follow-up/extension

- Have students bring in three-dimensional figures from home. Students may categorize these figures in a learning center.
- Have students cut out the traced two-dimensional figures and tape them together to create the three-dimensional figures once more.
- Discuss with students each three-dimensional solid. Have students describe and list the attributes of each solid. You might have students go on a scavenger hunt to locate items in the classroom that have that same shape. Data can be collected on the number of each figure that is found. This data can be used to create a graph showing which figures are the most and least common in the classroom. Students must justify their findings by reviewing the attributes of each solid. For homework, students may also bring in items from home that can be used as a review the next day.

- Have students create and complete a chart that identifies and describes cubes, rectangular solids (prisms), square pyramids, spheres, cylinders, and cones according to the number and shape of their faces (sides, bases), edges, and corners.
- Have students use a Venn diagram to compare and contrast/list the similarities and differences between plane and solid figures (e.g., circle/sphere, square/cube, rectangle/rectangular solid) determined by using models and cutouts. Items that should be addressed are the number and shape of the faces (sides, bases), edges, and corners.

Comparing Figures Chart

Name of Shape	Shape of Faces	Number of Faces	Number of Edges	Number of Corners

I have traced a three-dimensional figure called a _____.

It is made up of _____ two-dimensional figures called _____.

Defining Symmetry

Reporting category

Geometry

Overview

Students define and investigate symmetry using example/non-examples and paper folding.

Related Standards of Learning

2.21 (related 2.4)

Objectives

- The student will investigate symmetry using paper folding.
- The student will identify and demonstrate a line of symmetry in an object.
- The student will draw the line(s) of symmetry — horizontal, vertical, and diagonal in a figure.

Materials needed

- Examples and non-examples of symmetry (at least 3 of each)
- Pieces of yarn approximately 1 foot in length
- Paper, pencil, and scissors for each student

Instructional activity

1. Write the word *symmetry* on the board. Ask students, “What do you think this word means?” If some students would like to share, allow them, but do not comment at this time. Explain that you are going to give them examples and non-examples to help them figure out what the word means.
2. Begin by making a T-chart on the board.

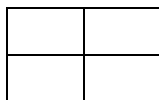
Example	Non-Example

Write “Example” on one side and “Non-Example” on the other. Explain that items on the “Example” side do show symmetry. Items on the “Non-example” side do not. Tell the students that you want them to be thinking about what the definition of symmetry could be. When they have an idea, they should raise their hands, but do not allow anyone to share yet. (This is to give you an idea of who and how many students think they have solved the problem.)

3. Place one of your prepared items with a piece of yarn showing the line of symmetry in the “Example” column, and explain that this item shows symmetry. Place one of your prepared items with a piece of yarn that does not show symmetry in the “Non-Example” column, and explain that this item does not show symmetry. Pause for a few moments, and let students start to formulate their ideas. They may talk with a partner, but do not allow them to share aloud with the class yet.
4. Place another one of your prepared items with a piece of yarn showing the line of symmetry in the “Example” column and explain that this item shows symmetry. Place another one of your prepared items with a piece of yarn that does not show symmetry in the “Non-Example” column, and remind them that this item does not show symmetry. Pause for a few moments and let students evaluate/alter their initial ideas. They may talk with a partner, but do not allow them to share aloud with the class yet.
5. Place another one of your prepared items with a piece of yarn showing the line of symmetry in the “Example” column and explain that this item shows symmetry. Place another one of your prepared items with a piece of yarn that does not show symmetry in the “Non-example” column, and remind

them that this item does not show symmetry. Pause for a few moments, and let students evaluate/alter their ideas and discuss with a partner.

6. Allow students to share their definitions of symmetry. Then have partners get dictionaries and look up the definition of symmetry. Write the definition on the board. (Teacher Notes from Curriculum Framework: A figure or shape is symmetric along a line when one-half of the figure is the mirror image of the other half; a line of symmetry divides a symmetrical figure, object, or arrangement of objects into two parts that are congruent if one part is reflected [flipped] over the line of symmetry.)
7. Have students go on a scavenger hunt to look for examples and non-examples of symmetry in the room. Have them use their pieces of yarn to demonstrate and justify their answers.
8. Regroup students at their desks. Students will fold a piece of paper in half, open, and draw a line down the fold. Ask students what fractional parts they see (halves or $\frac{1}{2}$ and $\frac{1}{2}$). Have students place their piece of yarn on the line, and ask what it shows (symmetry). Students should justify. Have students refold the paper in half and then fold in half the other way, so that when it is unfolded they have fourths.



9. Have students place their piece of yarn on the new line, and ask what it shows (symmetry). Students should justify. Have students draw on the line and identify the fractional parts (fourths or $\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{4}$, $\frac{1}{4}$). Have students cut on the lines of symmetry that they drew.
10. Have students determine how many different lines of symmetry they can find using $\frac{1}{4}$ of the paper. Then have the students, as a class, show the lines of symmetry using a piece of yarn (vertically, horizontally). Be alert to students who think that the diagonal of the rectangle is a line of symmetry. Fold the rectangle along a diagonal, and show that the triangles formed do not lie on top of one another — one is not the reflection of the other.
11. Have students save the four pieces of paper, or collect them for a paper-folding lesson on creating different figures with symmetry.
12. Have students write a definition of symmetry in their journals. They should explain it by drawing an example and telling why it works. They should draw a non-example and explain why it doesn't work.

Sample assessment

- Observe as students discuss their ideas for the definition of symmetry. Determine who is making the connections between the examples. Circulate among students and note how they use their dictionary skills to look up the definition. Also note who is having difficulty identifying examples and non-examples during the classroom scavenger hunt for examples and non-examples. Give help as necessary. Note the students' understanding of the fractional parts of the paper and their abilities in finding the symmetry in each way. Use their journal writing to assess who understands and who needs additional assistance.

Follow-up/extension

- Have students go on a scavenger hunt at home and bring in examples and non-examples of symmetry. In groups or at learning centers, have students categorize or draw the items they brought from home and explain the rationale for placing them in each category.
- Have students use the four little pieces of paper from the instructional activity, step 11, in a lesson the next day to create and cut out symmetrical pictures. The paper pieces can be black construction paper — connections can be made with the German paper cutting art. Examples of this may be found at: <http://images.google.com/images?hl=en&lr=&ie=UTF-8&oe=UTF-8&q=scherenschnitte&btnG=Google+Search>. Students can identify which show symmetry and which do not. The paper pieces can be any colored construction paper with lines of symmetry drawn down the fold line. Alternatively, the paper pieces could be done with white paper. Students would be responsible for coloring the items to show symmetry after cutting them out.
- Have students make symmetrical butterflies by having them fold a white piece of paper in half and thickly painting on one half. While the paint is wet, have students fold and close the blank side down onto the painted side. The paper needs to be unfolded and allowed to dry. When the paint is dry, refold the paper and use a tracer (half a butterfly pattern) to trace the two wings. Students will cut on the traced lines and then unfold. Add pipe cleaner antennas, and a symmetrical butterfly has been created. These may be displayed in the classroom. Have students find other things in nature that have symmetry. (This activity is good when you are doing the life cycle of the butterfly as part of the requirements for the Science Standards of Learning.)
- Have students identify and create figures (e.g., heart, circle, rectangle, rhombus) that are symmetrical along a line by having them cut out half-figures (half of a symmetrical figure that has been drawn on a folded piece of paper, using the crease as the line of symmetry). When they open their folded paper, have them use chalk or marker to draw the line of symmetry where the crease is. After modeling and having the students complete at least three easy examples, allow them to be creative and come up with more elaborate designs. Remind them to draw the line of symmetry and then share with their classmates how their picture shows symmetry. Glue their designs to construction paper, have students write a caption underneath each, laminate, and create a class symmetry book.
- Use mirror/Miras™, pattern blocks, wax paper, patty paper, or tracing paper to investigate and create drawings with symmetry.
- Draw a line on a piece of paper. Allow students to use pattern blocks to create a picture that shows symmetry along the initial line that was drawn. Students may then trace or glue paper pattern blocks on the sheet of paper to make the pictorial representation.
- Cut out a magazine picture that demonstrates symmetry, and photocopy it. Cut this copy in half along the line of symmetry, and glue each half to a separate sheet of paper. Give the halves to two students, and ask them to “complete” the missing part by drawing it — drawing the reflection of the half they have. When complete, allow the students to look at the original picture and compare their drawings to the halves they were missing.
- Using a square as a model, ask students to show the lines of symmetry, using a ruler on its edge (so it appears to be a straight, thin line) or a piece of yarn. (There are four.) Compare to the two lines of symmetry in a non-square rectangle. Encourage students to find other items in the room that are symmetrical in more than one direction, and have them demonstrate it using a ruler or piece of yarn.
- Have students print in their journals all the letters of the alphabet and the numerals 0–9. Show the lines of symmetry by using different colored markers.

- Divide students into groups of four. Each student in the group will create or write at least one example and one non-example of symmetry. Each group will make an answer key. Collect the examples and non-examples. Give them to another group to categorize. When done, justifications must be given for the sorting, and then the answer key will be checked. Switch until each group has solved all of the other groups' puzzles.

Sample resources

VDOE Geometry Instructional Module – professional development training module that contains activities that can be adapted for student use.

Navigating through Geometry in Prekindergarten through Grade 2 – available from NCTM. Contains additional lessons for geometric activities.

<http://standards.nctm.org/document/chapter4/geom.htm> – NCTM Principles and Standards for School Mathematics chapter on the Geometry Standard for PreK-2.

<http://standards.nctm.org/document/eexamples/chap4/4.2/index.htm#applet> – lesson that investigates the properties of triangles and polygons using geoboards

<http://standards.nctm.org/document/eexamples/chap4/4.4/index.htm#applet> – lesson on “Developing Geometry Understandings and Spatial Skills through Puzzlelike Problems with Tangrams: Tangram Puzzles”

<http://standards.nctm.org/document/eexamples/chap4/4.3/Part3.htm> – lessons on “Learning Geometry and Measurement Concepts by Creating Paths and Navigating Mazes: Ladybug Mazes”

<http://www.illuminations.nctm.org/pages/preK-2.html> – K-2 activities for geometry recommended by NCTM

<http://www.utm.edu/~cesme/K-2.pdf> – lessons that involve exploring and sorting geometric solids and identifying solids by their shadow and touch alone

<http://www.mathcats.com/explore/bodygeometry.html> – ideas to get your class making geometric figures using their bodies

<http://www.mathcats.com/explore/polygons.html> – make patterns and symmetrical pictures using the virtual 2d figures

Sample test items from the spring 2002 released test

27 Which is a model of a rectangular solid?

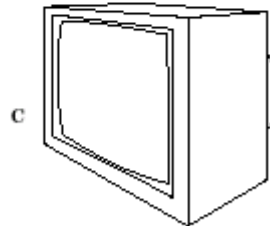
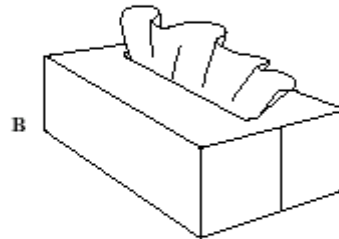
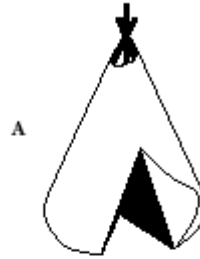


30 How many lines of symmetry does the figure below have?



- F 1
- G 2
- H 4
- J 6

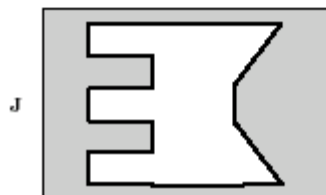
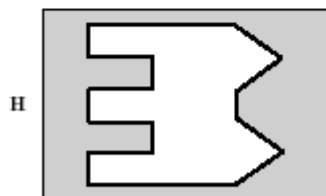
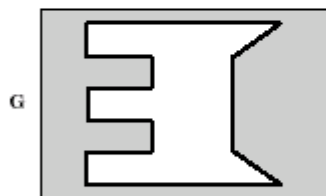
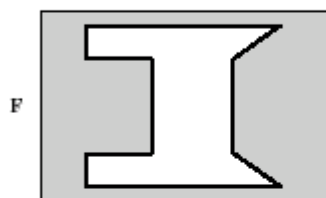
35 Which of the following is shaped most like a cylinder?



36 Wayne cut this shape out of a piece of paper.



Which of the following is missing a piece exactly the same size and shape as the piece shown above?



Organizing Topic Probability

Standard of Learning

2.24 The student will record data from experiments, using spinners and colored tiles/cubes, and use the data to predict which of two events is more likely to occur if the experiment is repeated.

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Conduct probability experiments, using multicolored spinners, colored tiles, or number cubes.
- Record the results of probability experiments, using tables, charts, and tally marks.
- Interpret the results of probability experiments (e.g., the two-colored spinner landed on red 5 out of 10 times).
- Predict which of two events is more likely to occur if an experiment is repeated.

Make Me a Winner/Make Me a Loser

Reporting category

Probability and Statistics

Overview

Students use the inquiry method with colored tiles to determine how to solve a problem related to *always* (100 percent chance) and *never* (0 percent chance).

Related Standard of Learning 2.24

Objectives

- The student will work in groups to record data from experiments using colored tiles/cubes.
- The student will use the data to predict which of two events is more likely to occur if the experiment is repeated.

Materials needed

- One lunch-size paper bag for each group
- Sets of colored tiles/cubes for each group
- Paper and pencil to record data for each group

Instructional activity

1. Divide class into groups of two, three, or four.
2. Give each group a handful of different colored tiles/cubes and a paper bag. Be sure to include at least one red tile/cube.
3. Explain to the groups that they are being given a challenge to complete. The challenge is to make you (the teacher) a winner every time. In order for you to be a winner, every time you put your hand in the bag and pull out a tile/cube, it must be red. Repeat the challenge. Tell them to begin working. Explain that when a group thinks they have met the challenge to raise their hands and you will come over to check by putting your hand in the bag and drawing out a tile/cube. If they are incorrect, encourage them to keep working at it.
4. Circulate among students as they are working, and see what strategies the groups are trying. Do not give them any hints. Let them work through the problem and test their theories. The groups will probably not figure out the strategy at first, but *do not* tell them how to solve the problem. Let them work it out. Tell them to have each group member test the bag before you do. Some group members may be concerned that they are cheating if they do not place all the tiles in the bag. Tell them that all you said was that you want to be a winner every time, and in order for you to be a winner, you must pull out a red tile every time.
5. Come together again as a large group when all or almost all groups have solved the challenge. Test each group's bag three times. Have the group members explain how they made you a winner every time. (There are only red tiles/cubes in the bag.)
6. Change the challenge into making the teacher a loser every time. Have students explain what this means. Every time a tile/cube is drawn from the bag, it should be any color but red. Have students get back into groups and meet the new challenge.
7. Have the members in a group raise their hands when they think they have met the challenge. Go to that group and check by putting your hand in the bag and drawing out a tile/cube. If they are incorrect, encourage them to keep working at it. Most groups solve this very quickly. Be sure to have them explain how they solved it.

8. Test each group's bag three times when all or almost all groups have solved the challenge. With the class listening, have the group members explain how they made you a loser every time. (There are no red tiles/cubes in the bag.)
9. Review, as a whole class, the strategy of making the teacher a winner every time. Discuss the terminology for this: a 100 percent chance means it will *always* happen. Have students explain why it will always happen and therefore there will be a 100 percent chance. (There are only red tiles/cubes in the bag; there are no other colors to pull out.)
10. Review, as a whole class, the strategy to make the teacher a loser every time. Discuss the terminology for this: a 0 percent chance means it will *never* happen. Have students explain why it will never happen and therefore there will be a 0 percent chance. (There aren't any red tiles/cubes in the bag; there are only other colors to pull out.)

Sample assessment

- Circulate among students as the groups work. Listen to their strategies and rationale. Note how quickly the students apply their new knowledge from the Make Me a Winner challenge to the Make Me a Loser challenge.
- In a journal, have students list examples of things in their lives that have a 100 percent chance and 0 percent chance of happening with an explanation of why. Allow students to share aloud with partners/whole class, or the teacher may read journals and respond individually.

Follow-up/extension

- Have students create their own Make Me a Winner/Make Me a Loser challenges using other colors and/or manipulatives (e.g., coins).
- Have students predict which color will be drawn from the bag most frequently by using predetermined amounts of colored tiles. For example, show students the tiles (four yellow and one green), and then place them in a bag. Have students pull one tile out at a time, record the results using tables, charts, and tally marks, and then replace the tile. Students should conduct the experiment 10 times. Have students explain why they made the initial prediction, and then have them interpret the outcome. For example: I pulled a yellow tile out eight out of 10 times. Have students use the data to make a prediction again, then test, and analyze the outcome.
- Have students create their own bags of tiles that meet certain requirements. For example: I must have a good chance of pulling out a red tile, a poor chance of pulling out a blue tile, and it should be impossible or a 0 percent chance of me pulling out a green or yellow tile. Then have them prove their success by completing the experiment 10 times and recording the data using tables, charts, and tally marks.
- Have students predict, using premade spinners, which color the spinner will land on the most or the least. Have students complete the experiment 10 times and record the data using tables, charts, and tally marks. Have students explain why they made that prediction, and have them interpret the outcome. For example: I predicted that I had a good chance of landing on green, because there was more green than red on the spinner. I landed on green seven out of 10 times. Have students use that data to make a prediction again, then test, and analyze the outcome.
- Have students create their own spinners that meet certain requirements. For example: I must have a good chance of landing on blue, a poor chance of landing on green, and it should be impossible or a 0 percent chance of me landing on brown or purple. Then have them prove their success by completing the experiment and recording the data using tables, charts, and tally marks.

Sample resources

<http://standards.nctm.org/document/chapter4/data.htm> – NCTM Principles and Standards for School Mathematics chapter on the Data Analysis and Probability Standard for PreK-2.

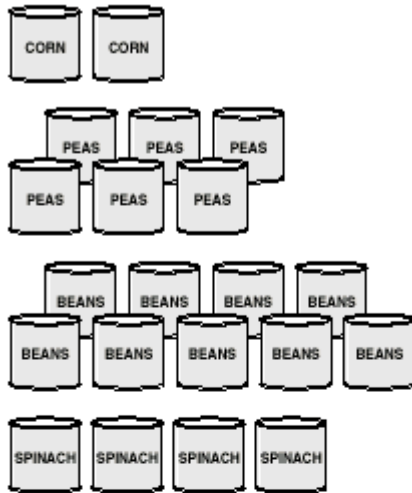
http://www.educate.org.uk/teacher_zone/classroom/numeracy/numeracy_34.htm – worksheets using probability terminology

<http://illuminations.nctm.org/lessonplans/prek-2/combinations-p2/index.html> – a lesson that has students generalize the number of clown faces that can be made from a given number of possibilities

<http://www.mathcats.com/microworlds/coinflipper.html> – experiments and records 100 flips of a virtual coin

Sample test items from the spring 2002 released test

43 Louis bought these cans of food.



If Louis picks one can from the bag without looking, which kind of can is he LEAST LIKELY to pick?



Organizing Topic Statistics

Standard of Learning

2.23 The student will read, construct, and interpret a simple picture and bar graph.

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Read the information presented horizontally and vertically on a simple bar or picture graph.
- Collect no more than 16 pieces of data to answer a given question.
- Organize data, using lists, tables, objects, pictorial representations, tally marks, and charts, in order to construct a graph.
- Represent data by constructing a simple picture or bar graph.
- Label the axes on a bar graph, limiting the number of categories (categorical data) to four and the increments to multiples of whole numbers (e.g., multiples of 1, 2, or 5).
- Label the axes on a picture graph, limiting the number of categories to four and including a key where appropriate.
- Interpret information from simple picture and bar graphs by writing at least one statement that covers one or both of the following:
 - Describe the categories of data and the data as a whole (e.g., the total number of responses).
 - Identify parts of the data that have special characteristics, including categories with the greatest, the least, or the same.
- Select the best interpretation of a graph from a set of possible interpretations of the graph.

Let's Picture Who's in Our Class

Reporting category

Probability and Statistics

Overview

Students create a picture graph and a bar graph of the class, using individually created portraits.

Related Standard of Learning

2.23

Objectives

- The student will collect pieces of data to answer a given question.
- The student will organize data using pictorial representations in order to construct a graph.
- The student will represent data by constructing a simple picture graph.
- The student will label the axes on a picture graph.
- The student will read the information presented horizontally on a simple picture graph.
- The student will interpret information from a simple picture graph by writing at least one statement that covers one or both of the following: describes the categories of data and the data as a whole (e.g., the total number of responses) and/or identifies parts of the data that have special characteristics, including categories with the greatest, the least, or the same.

Materials needed

- One-fourth of a sheet of 8-by-11 paper per student
- Crayons and/or markers for students
- Butcher paper and tape to create the picture graph
- Sentence strips to create labels for the axes and title
- Journals or paper for the students to write interpretations of the graphs

Instructional activity

1. Ask the students to close their eyes. Then ask, “How many boys and girls are in our class? Are there more boys or more girls? How many more?” Do not allow the students to count. Explain that they are going to learn about a method that mathematicians use to show these things called graphing. Tell them they are going to create a graph that will answer these questions for them without having to count.
2. Pass out 1/4 sheet of paper to each student. Explain to the students that they need to draw and color a portrait of themselves. Explain that a portrait is a picture of someone from the shoulders up. Tell them that they need to do their best so we can tell who it is by looking at it. The teacher should create a portrait of him/herself also. Request that they make the portrait with the paper placed vertically. (If someone makes it with the paper horizontal, it is okay.) The drawing will be used to demonstrate the importance of lining up the objects when graphing and how it can impact the answer. This will have a much more powerful impact on having the students remember this when they create their own graphs in the future.
3. Have students sit in a circle on the floor when all of them have completed their self-portraits. Ask them to put their pictures in the middle of the circle. Have students brainstorm ways that the pictures could be categorized. Let them share their ideas and move the pictures around.
4. Have students model several ways the pictures can be categorized, then explain that they are going to group the pictures into two categories — boys and girls. Make two labels on sentence strips —

Boys and Girls. Place the labels horizontally on the butcher paper. Have each student place his/her picture in the appropriate row watching for the correct placement. If students do it incorrectly, let it go for now. When all have placed their pictures, discuss what is being represented. Ask if there are more boys or girls. Ask how many more. Ask how many boys there are. Ask how many girls there are. If the placement of the pictures has been done incorrectly, the representation will also be incorrect, and students will realize the need to place them correctly. Model for the students, and then have them fix the alignment.

5. Discuss what kind of graph has been created (picture graph or pictograph). Have students discuss why they think it has been given this name. Have students talk in pairs about suggestions for a title for this graph. Explain that just like titles of books reflect what the book is about, titles of graphs do the same. After a minute, ask for suggestions and then allow the students to vote on the title for the graph. Write it on a sentence strip and affix it to the top of the picture graph.
6. Have students write at least one sentence about the picture graph. Have students brainstorm examples by asking, “What can we tell by looking at this picture graph?” Then have students write interpretations that describe the categories of data and the data as a whole (total number of responses) and/or identifying the parts of the data that have special characteristics, including categories with the greatest, the least, or the same. Allow students to share aloud.

Sample assessment

- Observe as the students discuss their categorization of the portraits. Ask questions to have students justify their groupings. Watch as the students create the picture graph for the correct alignment of the boys versus the girls. Ask students to explain the importance of the alignment. Have them explain what happens if they are not lined up.
- In a journal, have students write interpretations of the picture graph. Look in particular for descriptions of the categories of data and the data as a whole (total number of responses) and/or identifying the parts of the data that have special characteristics, including categories with the greatest, the least, or the same. Allow students to share aloud with partners/whole class or the teacher may read and respond individually.

Follow-up/extension

- Have students create their own picture graphs by having them develop and complete a survey which includes up to four categories and responses from at least 10 classmates. Sample topics could include such things as favorite animals, favorite colors, lunch choices, and transportation to school.
- In a journal, have students describe what a picture graph looks like and why people make them.
- Have students collect information, organize, and represent the data using picture and bar graphs related to topics such as reading (favorite character in a story), social studies (favorite famous American, comparison of distance from Virginia to China and Egypt), science (growth of a seed or plant, daily weather and temperature). Create graphs in both horizontal and vertical form with increments in multiples of the whole numbers, 1, 2, or 5. Limit the categories to four, and include a key where appropriate for the picture graphs. Be sure to label the axes, and include a title. Have students write at least one statement that describes the categories of data and the data as a whole and identifies the parts of the data that have special characteristics (greatest, least, same).
- Using graphs from every day life (e.g., newspaper, back of soup can label, weather report, Scholastic News articles), have students write at least one statement that describes the categories of data and the data as a whole and identifies the parts of the data that have special characteristics (greatest, least, same).

- Around Valentine’s Day, give each student a small box of valentine candy conversation hearts. Students will create a picture or bar graph of the hearts individually either horizontally or vertically using increments of 1, 2 or 5. Students will label the axes and select a title. They will write at least one statement about their own graphs. All graphs and statements will be collected and shuffled. The students will match the statements back to their original graphs by selecting the best interpretation. This activity can also be done using little bags of Lucky Charms cereal for St. Patrick’s Day and little bags of jellybeans for Easter.

Who's in Our Class?

Reporting category

Probability and Statistics

Overview

Students create a bar graph of the class that correlates to the picture graph created in “Let’s Picture Who’s in Our Class.”

Related Standard of Learning

2.23

Objectives

- The student will collect pieces of data to answer a given question.
- The student will represent data by constructing a simple bar graph.
- The student will label the axes on a bar graph.
- The student will read the information presented horizontally on a simple bar graph.
- The student will interpret information from simple bar graphs by writing at least one statement that covers one or both of the following: describes the categories of data and the data as a whole (e.g., the total number of responses) and/or identifies parts of the data that have special characteristics, including categories with the greatest, the least, or the same.

Materials needed

- Crayons and/or markers for students
- Sentence strips to create labels for the axes and title
- Butcher paper to create the bar graph
- Journals or paper for the students to write interpretations of the graph

Instructional activity

Note: “Let’s Picture Who’s in Our Class” should be completed the day before doing this lesson. The picture graph will be referenced and should be in close proximity to where this lesson will take place.

1. Review the “Let’s Picture Who’s in Our Class” lesson. Review the terminology (picture graph or pictograph) and the required elements (title, labeled axes, key, if necessary). Review the importance of aligning the items on the graph so that the graph accurately reflects the number of items being compared. Review the various ways of sorting items according to different attributes. Remind them that Boys and Girls were the attributes we graphed on the picture graph.
2. Explain that they are now going to create another type of graph that will use the same information but show it in a different way. Using the sheet of butcher paper, fold it in half the long way. Then fold it in thirds (again the long way). You should end up with six rows. Cut the last row off which should leave you with five rows. Label the axis with Boys and Girls (leave a space at the beginning, in between, and at the end). Have students come up and color their own blocks so that it “matches” the picture graph (e.g., if John’s picture was first in the picture graph, he should color in the first block; if Mike’s picture was second in the picture graph, he should color in the second block, etc.). You want the students to see the correlation between the two.

See the example below. Have students color in the same order as the picture graph:

Boys	1 st boy	2 nd boy	3 rd boy	4 th boy	5 th boy	6 th boy	7 th boy	8 th boy	etc.
Girls	1 st girl	2 nd girl	3 rd girl	4 th girl	5 th girl	6 th girl	7 th girl	8 th girl	etc.

- Ask students what this graph shows. Have students discuss the similarities and differences between the two graphs. Ask what is missing from this graph that the picture graph already has (the title). Write the title on a sentence strip and add it to the bar graph. Ask for ideas about what the name of this type of graph is. Explain that it is called a bar graph — compare it to the monkey bars on the playground so that students have something to remember it by.
- Have students write at least one sentence about the bar graph. Have students brainstorm examples by asking what we can tell by looking at the bar graph. Then have students write interpretations that describe the categories of data and the data as a whole (total number of responses) and/or identifying the parts of the data that have special characteristics, including categories with the greatest, the least, or the same. Allow students to share aloud or the teacher should respond individually.

Sample assessment

- Listen as the students summarize the picture graph lesson. Ask questions to have students explain and justify their responses. Students should be able to explain the importance of lining up the objects in a graph and be able to explain what happens if they are not lined up.
- In a journal, have students write interpretations of the bar graph. Look in particular for descriptions of the categories of data and the data as a whole (total number of responses) and/or identifying the parts of the data that have special characteristics, including categories with the greatest, the least, or the same. Allow students to share aloud with partners/whole class or the teacher should read and respond individually.

Follow-up/extension

- Have students compare and contrast the picture and bar graphs. Have them explain how to tell the difference and what strategies can help them remember the names. Have students create a Venn diagram that lists the attributes of each.

Sample resources

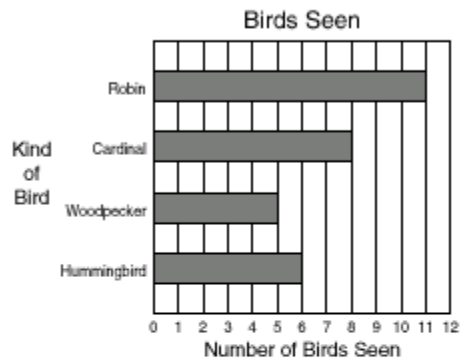
<http://standards.nctm.org/document/chapter4/data.htm> – NCTM Principals and Standards for School Mathematics chapter on the Data Analysis and Probability Standard for PreK-2.

<http://illuminations.nctm.org/swr/list.asp?Ref=1&Std=4&Grd=-1> – lessons that focus on data collection and representation with manipulatives such as shoes, M & Ms and personal characteristics

<http://illuminations.nctm.org/lessonplans/prek-2/button/index.html#16> – lesson that involves sorting, classifying, organizing and displaying data using buttons

Sample test items from the spring 2002 released test

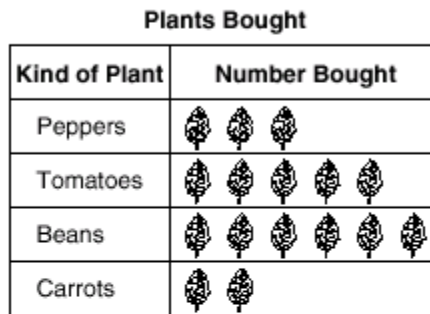
38 The bar graph shows the number of different kinds of birds that Karen saw at her bird feeder last week.




How many more robins than woodpeckers did she see?

- F 11
- G 6
- H 5
- J 3

39 The picture graph shows the numbers of 4 different kinds of plants Mr. Swan bought Saturday.

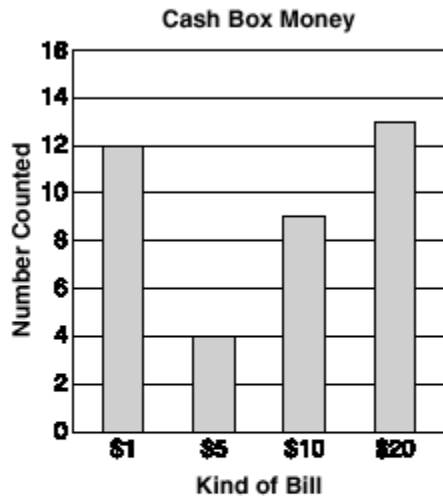


Key  = 5 plants.

How many pepper plants did Mr. Swan buy?

- A 15
- B 10
- C 8
- D 3

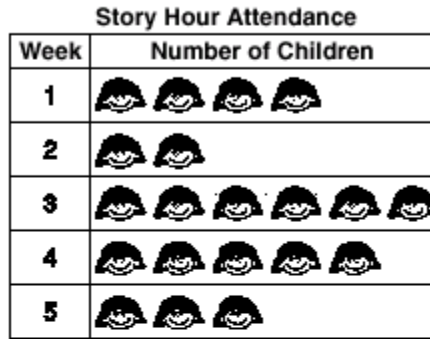
- 40 The bar graph below shows the number of each kind of bill that Kim counted.



How many \$10 bills did Kim count?

- F 4
- G 5
- H 9
- J 11

- 41 The picture graph shows the number of children who came to story hour each week.



KEY:  = 3 children.

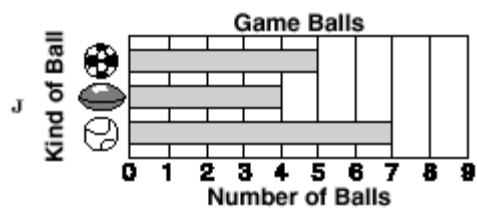
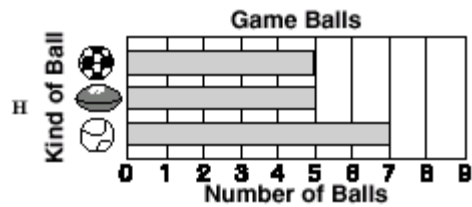
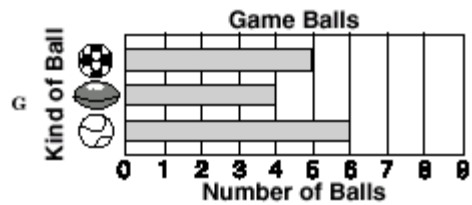
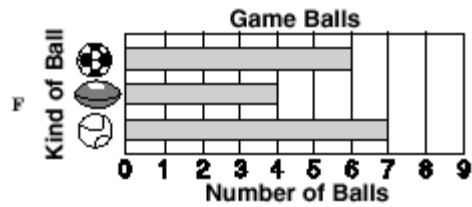
How many children came to story hour in week 4?

- A 5
- B 8
- C 12
- D 15

42 These are the game balls Coach Warner used for P.E. class.



Which graph shows the correct number of each kind of game ball?



Organizing Topic Patterns, Functions, and Algebra: Representations and Relationships

Standards of Learning

- 2.25 The student will identify, create, and extend a wide variety of patterns, using numbers concrete objects and pictures.
- 2.26 The student will solve problems by completing a numerical sentence involving the basic facts for addition and subtraction. Examples include: $3 + \underline{\quad} = 7$, or $9 - \underline{\quad} = 2$. Students will create story problems, using the numerical sentences.

Essential understandings, knowledge, and skills

Correlation to textbooks and other instructional materials

The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to

- Identify a growing and/or repeating pattern from a given geometric or numeric sequence.
- Predict the next number, geometric figure, symbol, or object in a given pattern.
- Extend a given pattern, using numbers, geometric figures, symbols, or objects.
- Create a new pattern, using numbers, geometric figures, symbols, or objects.
- Recognize the same pattern in different manifestations.
- Solve problems by completing a numerical sentence involving the basic facts for addition and subtraction (e.g., $3 + \underline{\quad} = 7$, or $9 - \underline{\quad} = 2$).
- Create a story problem for a given numerical sentence.

Pattern Predicting and Creating

Reporting category

Patterns, Functions, and Algebra

Overview

Students investigate and record repetitions of patterns, using various objects, geometric figures, and numbers.

Related Standard of Learning

2.25

Objectives

- The student will identify a repeating pattern from a given geometric or numeric sequence.
- The student will predict the next number, geometric figure, symbol, or object in a given pattern.
- The student will extend a given pattern, using numbers, geometric figures, symbols, or objects.
- The student will create a new pattern using numbers, geometric figures, symbols, or objects.
- The student will recognize the same pattern in different manifestations.

Materials needed

- Magical Pattern Tube (made out of an old paper towel tube covered with magical-looking wrapping paper)
- Various manipulatives (e.g., unifix cubes, pattern blocks, bottle caps, rubber stamps, buttons)
- Paper and pencil for each student

Instructional activity

1. Build a simple repeating pattern train made of nine unifix cubes attached together without the students seeing you (e.g., 1 white, 2 blue, 1 white, 2 blue, 1 white, 2 blue). Insert the pattern train into a Magical Pattern Tube. Show students the tube and explain that they are going to predict what is going to come out of the Magical Pattern Tube. Have several students predict what will come out first.
2. Push out the first unifix cube and record its color on the board (e.g., white). Have several students predict what will come out second. Push out the second unifix cube and record its color on the board (e.g., blue). Have several students predict what will come out third. Push out the third unifix cube and record its color on the board (e.g., blue). Continue in this manner until all cubes are out. The students' predictions should become more accurate. Students will then extend the pattern using their own unifix cubes. Students may record it by coloring it onto one-inch grid paper or by gluing one-inch squares of matching colored paper in the correct sequence.
3. Demonstrate to the students how to label this repeating pattern.

White, blue, blue, white, blue, blue, white, blue, blue
 A B B A B B A B B

Have students label their extensions of the pattern on their papers.

4. Explain that this is called a repeating pattern. Ask students to explain why they think it is called this. Explain that the part that repeats is called the core. Circle the core.

White, blue, blue, white, blue, blue, white, blue, blue
 A B B A B B A B B

5. Repeat steps 1– 4 without using the Magic Pattern Tube, but using the same repeating pattern with different objects. (e.g., students — boy, girl, girl, boy, girl, girl, boy, girl, girl and then create another pattern such as 1, 2, 2, 1, 2, 2, 1, 2, 2). Add only one person/number at a time allowing students to predict what will come next. Record the pattern on the board. When the pattern is complete, have students extend it on their own papers, label, and then have students identify/circle the core. Do the same to the ones on the board. Ask students what they realize about patterning. (The same pattern may be made using different objects or numbers.)
6. Have students create their own ABB patterns using pattern blocks or any other geometric shapes. Students will then extend it on their papers, label, and circle the core.
7. Repeat steps 1–4 using a different repeating pattern. Have students create the same pattern two more times using different geometric shapes, objects, and/or numbers. Allow students to get up from their seats to go on a mini field trip around the room to look at the different ways their peers solved this problem. Have students evaluate whether or not their peers met the requirements and have the creators justify their solutions.
8. Collect students’ papers with their representations of the pattern extensions, labeling, and identification of the core for assessment purposes.
9. Have students summarize the lesson by explaining how and why their predictions became more accurate as they got more information, defining a repeating pattern, identifying what the core is, and explaining how to label a repeating pattern.
10. In a journal, have students argue the statement, “There is only one way to make an ABC pattern.” They must agree or disagree with the statement, explain why, and give examples to justify. Allow students to share with their classmates or respond to them individually.

Sample assessment

- Observe the strategies and rationale for the patterning predictions. Note who is having difficulty identifying the pattern. Predictions should get more accurate as more of the unifix cubes are shown and recorded on the board. Circulate among students as they are making their extensions, creating their own manifestations using a variety of manipulatives, recording, and labeling them. Give help as necessary. Collect the papers as an assessment. Determine who will need additional follow-up.
- Have students complete the journal assessment in step 10. Allow students to share with their classmates, or respond to them individually.

Follow-up/extension

- Have students find patterns in magazines, cut them out, label, and categorize them.
- Have each student create a page for a pattern book using paper colored tiles, paper colored pattern blocks, drawings, rubber stamps, or numbers that show the same pattern represented by using different things. The pages can be laminated and then put together to create a class book. When students are looking at the book they can use manipulatives or mini marker boards to show additional ways to represent the same pattern.
- Read to students an appropriate piece of literature that contains a repeating pattern in the story. Discuss the repeating pattern in the book. Have students create their own class book following this pattern, (e.g., Fortunately ____ happens, but unfortunately ____ happens.)
- Have students create repeating patterns using pattern blocks, unifix cubes, two-color counters, bingo stampers, or assorted stamps. Have them trade with a partner, and have the other person continue the pattern.

- Create growing patterns such as stair steps and pyramids using miniature one-inch tiles from the flooring store. Write sentences to describe how the pattern is growing. Draw or use colored paper cut into one-inch squares to glue and create a representation of the pattern. Laminate the pages to create a class book where the students can use the real manipulatives to continue the pattern while reading it.
- Write one pattern on the board using numbers or geometric shapes. Have students work in groups to come up with as many different ways to recreate the pattern using different manipulatives or pictures. Students should write a description of the pattern and justify how their newly created patterns show the same pattern.

Magic Number Machine

Reporting category

Patterns, Functions, and Algebra, Number and Number Sense

Overview

Students use the Magic Number Machine to solve problems by completing a numerical sentence with missing number.

Related Standards of Learning 2.26, 2.5

Objectives

- The student will solve problems by completing a numerical sentence involving the basic facts for addition and subtraction. Examples include: $3 + \underline{\quad} = 7$, or $9 - \underline{\quad} = 2$. The student will create story problems, using the numerical sentences.
- The student will skip count by twos, fives, and tens to 100, using manipulatives, a hundred chart, mental mathematics, and/or paper and pencil.
- The student will count backward by tens from 100.
- The student will group objects by threes and fours.

Materials needed

- Magic Number Machine (See explanation below.)
- Square inch tiles or unifix cubes
- Paper and pencil for each student

Instructional activity

1. Show students the Magic Number Machine and explain that we will be using it to discover some patterns. Explain how it works. Some cubes will be put in the “In” flap, the machine will do its magic, and then some cubes will come out of the “Out” flap. Our job is to figure out how the machine works (what pattern it is following). The teacher will be the machine operator at first, but as the students get accustomed to the activity they will become the operators and recorders of the data.
2. Draw a T-chart and label it with “In” and “Out.” Compare with the “In” and “Out” flaps on the Magic Number Machine.

In	Out

3. Select a student to come up and place three cubes in the top flap of the machine. Record the three on the “In” section of the T-chart. Go behind the box, make whirring noises, and then make five cubes come out from the bottom flap. Record the five on the “Out” section of the T-chart. Ask students to think about what has happened.

In	Out
3	5

- Select another student to come up and place five cubes in the top flap of the machine. Record the 5 on the “In” section of the T-chart. Go behind the box, make whirring noises, and then make seven cubes come out from the bottom flap. Record the 7 on the “Out” section of the T-chart. Ask students to think independently and then discuss with a partner what happened.

In	Out
3	5
5	7

- Ask students what is happening to the “In” number? (It’s getting bigger so we know the machine is adding cubes each time.) Is there a pattern to how many cubes the machine is adding each time? What do you think that pattern is?
- Select a student to come up and place one cube in the top flap of the machine. Record the 1 on the “In” section of the T-chart. Ask students to predict what will come out. Go behind the box, make whirring noises, and then make three cubes come out from the bottom flap. Record the 3 on the “Out” section of the T-chart. Ask students to think about what has happened and compare with their predictions. Discuss. Write the following:

In	Out	
3	5	$3 + \underline{\quad} = 5$
5	7	$5 + \underline{\quad} = 7$
1	3	$1 + \underline{\quad} = 3$

- Select another student to come up. Allow them to place any number they want, record it in the T-chart, and place them in the top flap. Students are to predict what will come out. The machine will do its thing, and then the output needs to be recorded on the T-chart. Add the missing addend equation to the T-chart as well. Students should be able to verbalize and explain the +2 pattern.
- Repeat this sequence with other patterns on new T-charts. (e.g., +3, +4). Change this lesson from being teacher-led to being student-led. Students should be able to take charge of creating and recording in the T-charts, creating and implementing the pattern behind the Magic Number Machine, and writing and solving the missing addend/subtrahend problems.
- Stop the activity when the class period is almost over, regroup as a whole class, and review what they did that day.

Sample assessment

- As the students are working, observe the strategies and rationale for determining the patterns. Encourage the use of various strategies, and allow time for student discussion and justification. Note who is having difficulty identifying patterns, making accurate predictions, creating the missing addend/subtrahend problems. Give help as necessary. Collect the papers as an assessment.

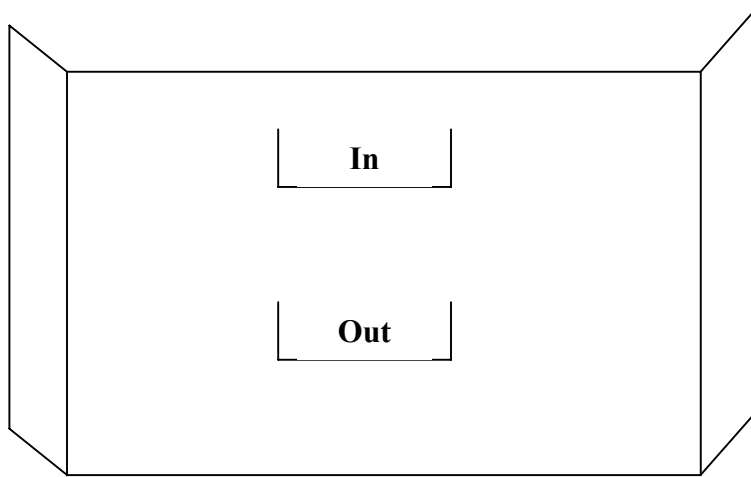
Follow-up/extension

- Have students use the large Magic Number Machine, or have them create their own mini versions using two file folders stapled together with two flaps cut out. This lesson can be used as a learning center activity with a partner.
- Have students complete an assessment worksheet such as the one that follows, or have them create some of their own problems and switch with a partner to answer.

- Teach students how to use a calculator as a mini Magic Number Machine using the + number function. Students will input a plus or minus, then any number (e.g., +2 and then push the + button at least 3 more times). Students will then trade calculators with a partner and push the + key to determine the pattern that was originally put in.
- Let students discover, record, and explain the patterns using a 100 chart to record the “In” and “Out” numbers.

Directions for making the Magic Number Machine

- A Magic Number Machine can be made by using a science project board or an empty box. A flap needs to be cut in the top third of the box and labeled “In.” A flap needs to be cut in the bottom third of the box and labeled “Out.” Decorate as “magically” as you would like.



Sample resources

<http://standards.nctm.org/document/chapter4/alg.htm> – NCTM Principals and Standards for School Mathematics chapter on the Algebra Standard for PreK-2.

<http://standards.nctm.org/document/eexamples/chap4/4.1/index.htm> – a lesson that has students creating, describing, and extending patterns

<http://www.utm.edu/~cesme/K-2.pdf> – lessons that use patterns on the 100s chart (includes a 100 chart puzzle worksheet), growing patterns using cubes, and patterns in songs such as Old MacDonald (includes pictures of the barn/animals and animal noises)

Magic Number Machine

Rule +3	
In	Out
3	
6	
15	

Explain how your last two numbers fit the pattern.

Rule -5	
In	Out
5	
15	
72	

Explain how your last two numbers fit the pattern.

Rule _____	
In	Out
4	8
8	12
12	16

Write the equation showing how you determined the missing number.
$4 + \underline{\quad} = 8$

Recreate the pattern above by coloring in the same numbers on the hundred chart below. Continue the pattern.

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

Describe what you have discovered.

Sample test items from the spring 2002 released test

- 44 Look at the pattern of shapes below.



If the pattern continues in the same way, what will be the next shape?



- 45 The table below shows the number of paddles Mr. Watson must order for different numbers of canoes.

Number of Canoes	2	4	6	8	10
Number of Paddles	4	8	12	16	?

If the pattern in the table continues, how many paddles must be ordered for 10 canoes?

- A 17
- B 18
- C 20
- D 23

- 47 The table below shows the cost of different numbers of rulers.

Ruler Costs

Number of Rulers	Total Cost
1	25¢
2	50¢
3	75¢
4	\$1.00
5	\$1.25
6	?

If the pattern in the table continues, what will 6 rulers cost?

- A \$1.30
- B \$1.50
- C \$1.75
- D \$2.00

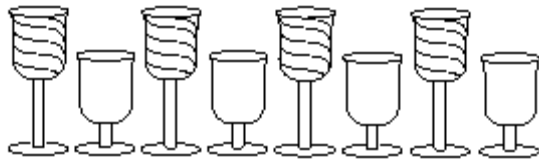
- 48 The table below shows the times that the train leaves from each station.

Station	Time
Westin	5:00
Lee	5:06
Carson	5:12
Burr	5:18
Madison	

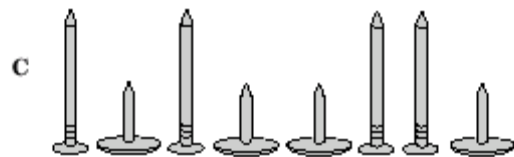
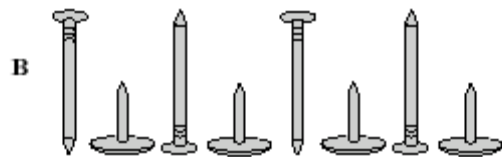
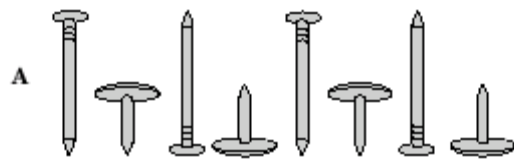
If the pattern continues, what time will the train leave the Madison station?

- F 5:19
- G 5:20
- H 5:24
- J 5:26

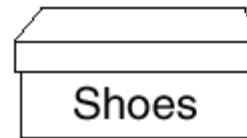
19 Look at the pattern of shapes below.



Which of the following shows the same kind of pattern?



50 Look at the group of objects below.



Which of the following best describes how these objects are alike?

- F Color
- G Size
- H Shape
- J Height