Introduction

The lessons in this section focus on relating percents to decimals and fractions, comparing and ordering, solving multistep practical problems and determining the percent of increase or decrease for a give situation. Students are expected to understand the relationship between fractions, decimals and percents and that rational numbers can be expressed as fractions, decimals and percents.

These lessons form an outline for your ARI classes, but you are expected to add other lessons as needed to address the concepts and provide practice of the skills introduced in the *ARI Curriculum Companion.*

Some of the lessons cross grade levels, as indicated by the SOL numbers shown below. This is one method to help students connect the content from grade to grade and to accelerate.

Standards of Learning

6.2 The student will
- a) investigate and describe fractions, decimals, and percents as ratios;
- b) identify a given fraction, decimal, or percent from a representation;
- c) demonstrate equivalent relationships among fractions, decimals, and percents; and
- d) compare and order fractions, decimals, and percents.

7.1 The student will
- c) compare and order fractions, decimals, percents, and numbers written in scientific notation;

8.1 The student will
- b) compare and order decimals, fractions, percents, and numbers written in scientific notation.

8.3 The student will
- a) solve practical problems involving rational numbers, percents, ratios, and proportions; and
- b) determine the percent increase or decrease for a given situation.

Table of Contents

Lesson plans pertaining to the following Standards of Learning are found in this section. Click (or CTRL+click) on each to jump to that lesson.

❋ SOL 6.2a

Lesson Summary

Students will determine what percent of the time their right index finger will come to rest on land or water when catching a tossed globe. Students will develop percent number sense by first estimating and then actually catching the globe and recording where the right index finger lands each time.

Materials

One inflatable plastic globe for each of three groups of students and a copy of the handout "Around-the-World Recording Sheet 1" for each student.

Vocabulary

percent. Means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*.
ratio. A comparison of any two quantities. It is used to represent relationships within and between sets.

Lesson

1. *Initiating Activity:* Have students predict the percent of land versus water found on the globe. Record a few of these predictions on the board for future reference.
2. *Explain* to students that they will be collecting data to verify their predictions. Organize students into three groups, and give each group a plastic globe and a set of recording sheets.
3. Prior to beginning the tosses, have the students record their individual predictions on their recording sheet. The prediction is a guess as to how many times out of 100 catches the student's right index finger will touch land and how many times it will touch water.
4. Explain the data collecting process to the students. Have each group form a circle and toss the globe back and forth among the members for a total of 100 tosses. For each toss, have one student in each group record the data by putting a tally mark in the appropriate space on his/her recording sheet.
5. After the 100 tosses and all data collecting are completed, have the students in each group transcribe the total of the tally marks onto their own recording sheets. Then show them how to convert the data into the correct percents. Model the conversion with the following example: 72 tosses came to rest on water; 28 tosses came to rest on land. Record the data as 72 out of 100 equals $\frac{72}{100}$, .72, and 72%; and 28 out of 100 equals $\frac{28}{100}$, .28, and 28%. Students may represent the fraction and decimal by using place value materials or 100 grids.
6. Have each group share their results, and display all the data in a class chart.
7. *Closing Activity:* Using the results on the class chart, have students compare the results to the original predictions. If large differences exist between the predictions and the actual results, discuss why the differences exist.

Reflection

During the activity**,** observe students as you walk around the room and check for understanding. At the end of the activity, students may respond to the following prompts in their math journals, "How are fractions, decimals, and percents related?" "What connections are there among fractions, decimals, and percents?"

Follow-up/Extensions

This activity can be extended so that students make predictions about what percent of land is occupied by the individual continents and what percent is occupied by individual oceans. Refer to chart "Area of Land and Water around the World," and have the students use the "Around-the-World Recording Sheet 2." The class could be divided into two groups, each of which does 50 tosses, and then the results can be added together (averaged).

Around-the-World Recording Sheet 1

1. Estimate the number of times out of 100 catches that your right index finger will come to rest on water.
2. Estimate the number of times out of 100 catches that your right index finger will come to rest on land.
3. Toss and catch the globe 100 times.
4. Keep a tally or actual count and make a record of where your right index finger comes to rest each time.
5. Figure the fraction, decimal, and percent representations of the number of times your finger came to rest on land; then figure the same representations for water.

	Estimate	Actual	Fraction	Decimal	Percent
Land		Tally marks: Total:			
Water		Tally marks: Total:			
Total	100	100	$\frac{100}{100}$	1.00	100%

Around-the-World Recording Sheet 2

1. Estimate the number of times out of 100 catches that your right index finger will come to rest on each of the continents shown below.
2. Toss and catch the globe 100 times.
3. Keep a tally or actual count and make a record of where your right index finger comes to rest each time.
4. Figure the percent representations of the number of times your finger came to rest on each continent.
5. Explain any discrepancies between your estimated and actual counts.

	Estimate	Actual	Percent
Asia			
Africa			
Antarctica			
Australia			
Europe			
North America			
South America			
All Land			
All Water			

Area of Land and Water around the World

Total Square Miles on Earth = 195,331,609

Continent	Square Miles	Percent of Earth
Asia	16,957,000	9%
Africa	11,704,000	6%
Antarctica	5,100,000	3%
Australia	2,967,909	2%
Europe	4,063,000	2%
North America	9,416,000	5%
South America	6,888,000	4%
Land Total	57,095,909	31%

Water	Square Miles	Percent of Earth
Pacific Ocean	64,186,000	32%
Atlantic Ocean	33,420,000	17%
Indian Ocean	28,350,000	14%
Arctic Ocean	5,105,700	2%
Seas, Gulfs, and Bays	7,174,000	4%
Water Total	138,235,700	69%

✱ SOL 6.2a, 8.3a

Lesson Summary

Students apply proportions to solve problems that involve percents. (45–60 minutes)

Materials

Colored pencils
Copies of the attached worksheets

Vocabulary

percent. Means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*.
ratio. A comparison of any two quantities. It is used to represent relationships within and between sets.

Warm-up

Begin a class discussion to find out what kind of number sense the students have about percents. Ask them what "50 percent" means. What is the definition of *percent*? What does 50 percent look like as a ratio? What would a picture of 50 percent look like? Explain that a good example of what 50 percent looks like is a grid of 100 squares with 50 (or half) of the squares shaded.

Distribute the "Understanding Percents" worksheet. Have students shade in the three grids to represent the given percents. Ask students to explain the shadings. They should say that since "25 percent" means 25 out of 100 and since there were 100 boxes, they shaded 25 boxes.

Lesson

1. Discuss percent as a ratio, reminding students that a ratio is a comparison of two numbers and that with percents, one of the numbers is always 100. Therefore, the ratio for 25% is 25 to 100, or 25:100, or $\frac{25}{100}$. Have the students write 30% as a ratio. (30 to 100, 30:100, $\frac{30}{100}$) Have them write 80% as a ratio. Tell students that they will be using the fraction form of the ratio for solving percent problems.
2. Distribute the "Percents as Ratios" worksheet. Have students do problems 1 through 5, and check their answers. It is not important for students to simplify the ratios.
3. Have the students apply the concept of percent to solve some simple problems. Ask them what the grade for a test means, reminding them that 100% is the basis for most test grades. Show students that a grade of 90% that means that $\frac{90}{100}$ points were scored.
4. Give students the following problem: "Your friend tells you that he made a 90% on a test that had 20 questions. How many questions did your friend answer correctly?" Tell students that we know that if he had answered all 20 questions correctly, he would have made 100 percent. Have them use that information to set up a proportion, keeping in mind that a proportion means that two ratios are equal. Hence, 90% is $\frac{90}{100}$, and all 20 correct is 100%. Since the 20 corresponds to 100 and we do not know how many questions were correct, the proportion will be $\frac{90}{100} = \frac{n}{20}$. Make sure students understand that the total number on the test always corresponds to the 100 and that the number of correct answers always corresponds to the grade. Have students solve the proportion:

   $\frac{90}{100} = \frac{n}{20}$ $\quad 90 \times 20 = 100 \times n$ $\quad 1{,}800 = 100n$ $\quad 18 = n$
5. Ask students to determine how many questions a student got correct if the test had 25 questions and the students got a grade of 76%. Help them set up the proportion, if necessary:

   $\frac{76}{100} = \frac{n}{25}$ $\quad 76 \times 25 = 100 \times n$ $\quad 1{,}900 = 100n$ $\quad 19 = n$
6. Have students do problems 6 through 9 on the worksheet. Review the answers with the class.

7. Ask students how a teacher uses proportions to determine grades on the test. For example, Mrs. Jones gives a test with 25 questions. If Sarah answers 20 questions correctly, what grade does she earn on the test? Help students set up the proportion, if necessary:

   $\frac{20}{25} = \frac{n}{100}$ $20 \times 100 = 25 \times n$ $2{,}000 = 25n$ $80 = n$ Sarah's grade is 80%.

8. Point out that the only difference from the proportion in step 5 is the location of the missing number (*n*) in the ratio.
9. Ask students to solve this problem: "Mrs. Jones gave a test with 20 problems, and Marcie got 15 correct. What is Marcie's grade?"

   $\frac{15}{20} = \frac{n}{100}$ $15 \times 100 = 20 \times n$ $1{,}500 = 20n$ $75 = n$ Marcie's grade is 75%.

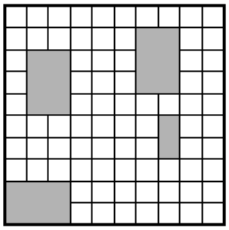
10. Assign problems 10 through12 on the worksheet. Review the answers with the class.

Reflection

Ask students to explain what the 100 in the ratio for percent corresponds to on a test. (The total number of questions on the test) Then, have them write how they can use that information to solve problems about test grades, using proportions.

Sample Assessment

Released 2001 grade 8 mathematics SOL test question



The shaded part of the square can be expressed by —

A 0.02

***B** 20%

C $\frac{1}{4}$

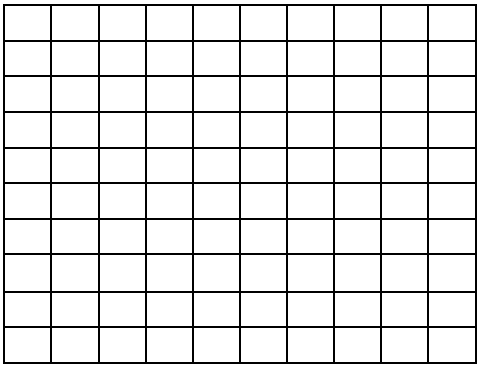
D $\frac{2}{5}$

Name: _____

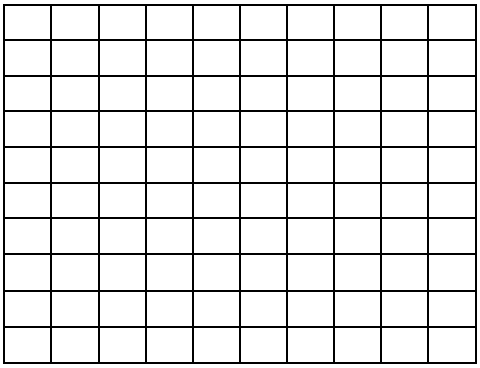
Understanding Percents

Each grid below has 100 squares. Shade in the appropriate number of squares to create a picture of the given percent.

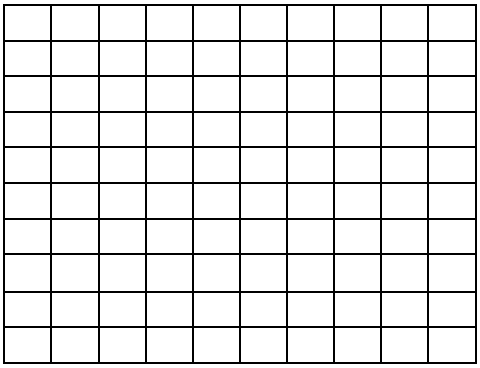
25%



30%



80%

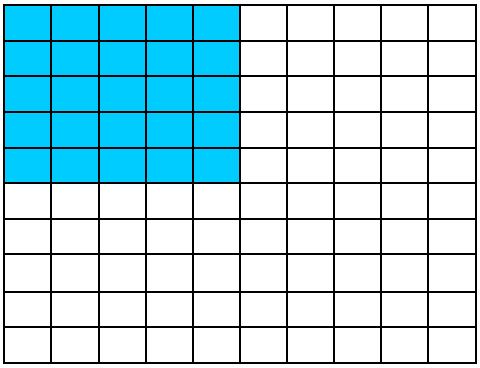


Name: *ANSWER KEY*

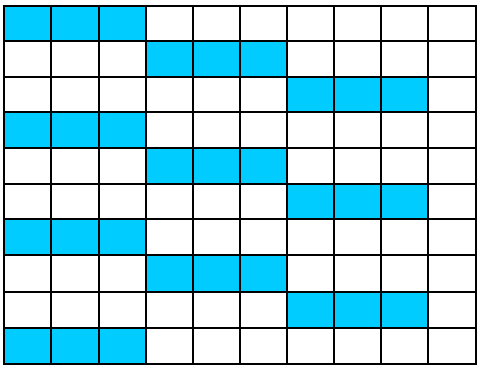
Understanding Percents

Each grid below has 100 squares. Shade in the appropriate number of squares to create a picture of the given percent.

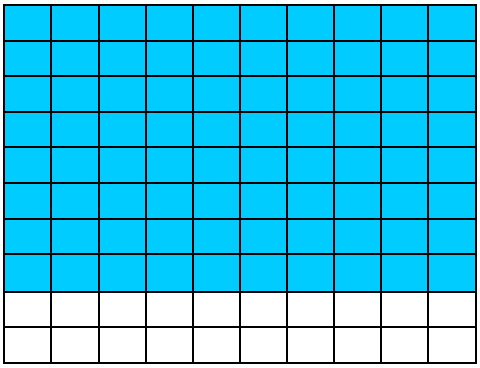
25%



30%



80%



Name: _____

Percents as Ratios

Write each percent as a ratio in fraction form. Remember the definition of percent. If you need a picture, use the grids provided.

1. 40% _____
2. 75% _____
3. 15% _____
4. 33% _____
5. 20% _____

Set up a proportion for each problem below, and determine the number of test questions each student got correct for each test.

6. Sue receives a score of 75% on a test with 20 questions. How many did she get correct?

_____

7. John received a score of 68% on a test with 50 questions. How many did he get correct?

_____

8. Anne received a score of 84% on a test with 25 questions. How many did she get correct?

_____

9. Adam received a score of 90% on a test with 40 questions. How many did he get correct?

_____

Set up a proportion for each problem below, and determine the score earned by the student on each test.

10. Ms. Smith gave a test with 25 questions, and John got 22 correct. What is John's score?

_____

11. Ms. Smith gave a test with 30 questions, and Jim got 21 correct. What is Jim's score?

_____

12. Ms. Smith gave a test with 40 questions, and Mark got 32 correct. What is Mark's score?

_____

Name: *ANSWER KEY*

Percents as Ratios

Write each percent as a ratio in fraction form. Remember the definition of percent. If you need a picture, use the grids provided.

1. 40% $\frac{40}{100}$
2. 75% $\frac{75}{100}$
3. 15% $\frac{15}{100}$
4. 33% $\frac{33}{100}$
5. 20% $\frac{20}{100}$

Set up a proportion for each problem below, and determine the number of test questions each student got correct for each test.

6. Sue receives a score of 75% on a test with 20 questions. How many did she get correct?

$\frac{75}{100} = \frac{n}{20}$ $1{,}500 = 100n$ $n = 15$

7. John received a score of 68% on a test with 50 questions. How many did he get correct?

$\frac{68}{100} = \frac{n}{50}$ $3{,}400 = 100n$ $n = 34$

8. Anne received a score of 84% on a test with 25 questions. How many did she get correct?

$\frac{84}{100} = \frac{n}{25}$ $2{,}100 = 100n$ $n = 21$

9. Adam received a score of 90% on a test with 40 questions. How many did he get correct?

$\frac{90}{100} = \frac{n}{40}$ $3{,}600 = 100n$ $n = 36$

Set up a proportion for each problem below, and determine the score earned by the student on each test.

10. Ms. Smith gave a test with 25 questions, and John got 22 correct. What is John's score?

$\frac{22}{25} = \frac{n}{100}$ $2{,}200 = 25n$ $n = 85$

11. Ms. Smith gave a test with 30 questions, and Jim got 21 correct. What is Jim's score?

$\frac{21}{30} = \frac{n}{100}$ $2{,}100 = 30n$ $n = 70$

12. Ms. Smith gave a test with 40 questions, and Mark got 32 correct. What is Mark's score?

$\frac{32}{40} = \frac{n}{100}$ $3{,}200 = 40n$ $n = 80$

❋ SOL 6.2b, c

Lesson Summary
Students will discuss common uses of fractions, decimals, and percent and their meanings. Using a museum-walk model, groups will rotate around the room and share findings with one another.

Materials
Chart paper, colored markers of 3 to 6 different colors.

Vocabulary
percent. Means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*.

Lesson
1. *Initiating Activity:* Make three charts, headed as follows: "Real-Life Uses of Fractions," "Real-Life Uses of Decimals," and "Real-Life Uses of Percent." Model the use of the charts by listing some examples of ways we use these kinds of numbers. Divide the students into three groups, and assign one group to each chart. If dividing the class into three groups would make the groups too large, then make two charts of each type and have six groups, two groups per each type of chart.
2. Give each group a different colored marker. Have the groups rotate to the three different charts to record their uses.
3. Give the students approximately five minutes at each station. Continue until the groups are back to their starting places.
4. After walking and recording, ask students to compare the lists. Ask questions such as: "In what ways are fractions, decimals, and percents alike?" "In what ways are they different?" Compare answers and lists.
5. *Closing Activity:* Write the fraction "one-half" on the board in the three notations: $\frac{1}{2}$, 0.5, 50%. Ask:
    a. What do you know about these three numbers?
    b. How are they the same?
    c. How are they different?
    d. Where do you see these numbers on our charts?

Reflection
Listen to student discussions about the use of fractions, decimals, and percents. In certain cases, one representation may be more commonly used than others. For example, a hitter can have a .265 batting average, but we do not say he has a "265 thousandth" average. In some situations, one form may not make sense to us. For example, we say "$\frac{1}{2}$ inch" but not "50% of an inch." Sale prices may be 25% or $\frac{1}{4}$ off, but not 0.25 off. A jogger runs 3 and $\frac{1}{2}$ miles, but not 3 and 50% miles. The language of their answers and comparisons of different uses is an important discussion to assess understanding of the representations of rational numbers.

Follow-up/Extensions
Students may make a collage of fractions, decimals, and percents that they find in print media. The "Real-Life Uses" may also be extended following future activities.

❋ SOL 6.2c

Lesson Summary

Students will color 10-by-10 grids in different patterns to identify and represent equivalent fractions, decimals, and percents.

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Materials

"Base-Ten Grids" transparencies, with and without shading; copy of the handout "Base-Ten Grids," without shading, for each student; colored pencils/crayons; overhead markers; base-ten 100 flat

Vocabulary

percent. Means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*.

Lesson

1. *Initiating Activity:* Discuss how many squares make up a 10-by-10-squares grid. Present the 10-by-10 base-ten 100 flat and the 10-by-10-squares grid. Emphasize that the two are equal. For purposes of this activity, the students are going to use a representation of the base-ten 100 flat — i.e., a 10-by-10-squares grid. This is a representation that they could draw, but a handout has already been created that would save time. Remind the students that one grid represents 1 whole that has been divided into 100 equal-sized parts. (*Note*: Remember that we are again working from the concrete [base-ten flat] to representational [grid] to abstract.)
2. Show the base-ten transparency grid that has been shaded in and ask, "Who has a quick estimate of the percent of the squares that are shaded?" Record responses and ask, "How did you determine how many squares? How did you estimate the percent of the whole that is shaded?"
3. Write below the grid on the transparency the percent and the equivalent fraction and decimal of the shaded portion. Ask volunteers to come up to the overhead and shade in a portion of the three remaining grids. Next, have the volunteers ask the class what percent of each grid is shaded.
4. It is important to write each decimal in "regular" fraction form, "expanded" base-ten fraction form, decimal form, and percent form — for example, $\frac{3}{8} = \frac{37}{100} + \frac{5}{1{,}000} = .375 = 37.5\%$. Continue to have volunteers participate in shading the transparency in order to produce a variety of fractions, decimals, and percents so that students have ample practice as an entire class before they move into individual work.
5. *Closing Activity:* Distribute colored pencils and a handout "Base-Ten Grids" to each student. Assign each student four *different* percents to color in their four grids and to label appropriately with the percent, the common and expanded base-ten fractions, and the decimal representation. For example, assign 2%, 5%, 7%, 13%, 25%, and 48% and common fractions such as thirds, fourths, fifths, sixths, and eighths. Grids should be displayed in the classroom.

Reflection

During the activity, observe the students as they complete their grids, and ask them to explain the steps they are taking. Check for accurate expression of fractions, decimals, and percents, both in written form and in conversation. Encourage students to share their explanations with the rest of the class.

Follow-up/Extensions

Promote relative thinking by introducing "Fraction Islands" to familiarize students with another way to "see" the relationships among fractions, decimals, and percents. Students should be encouraged to generate equivalent forms of commonly used fractions, decimals, and percents. These could be displayed in "Poster Proof" format and presented to the class.

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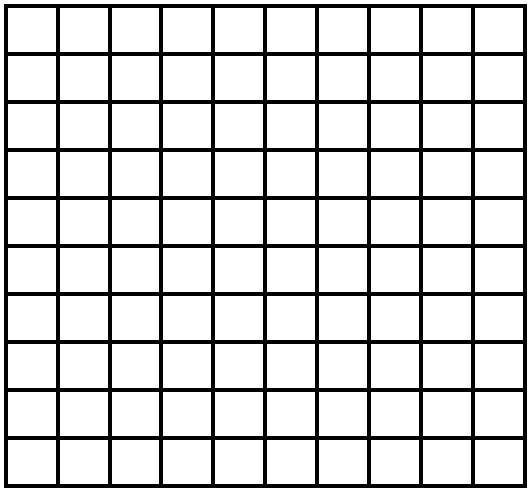
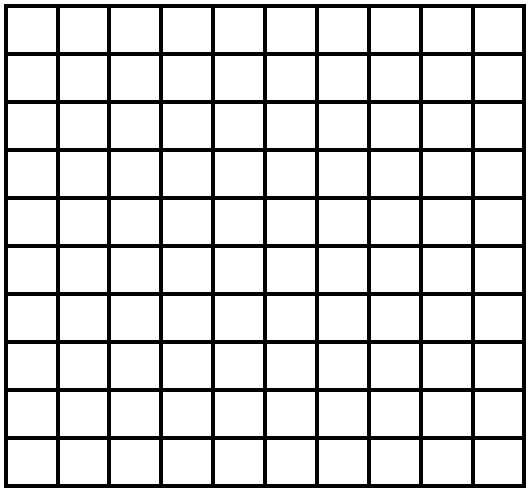
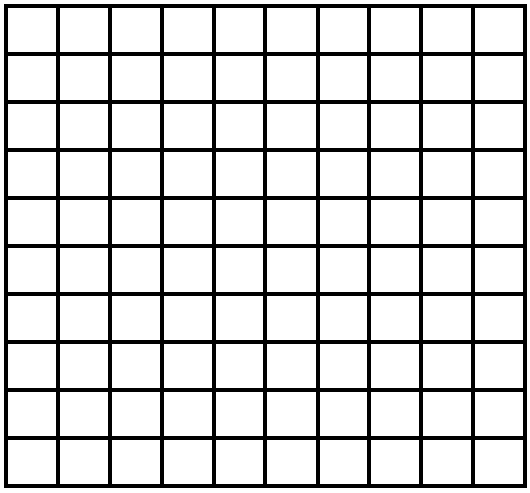
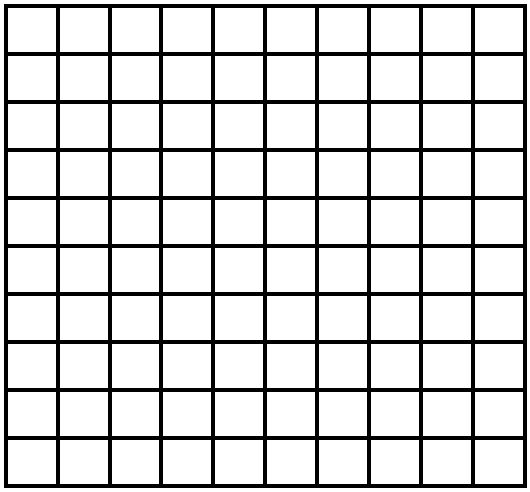
Base-Ten Grids

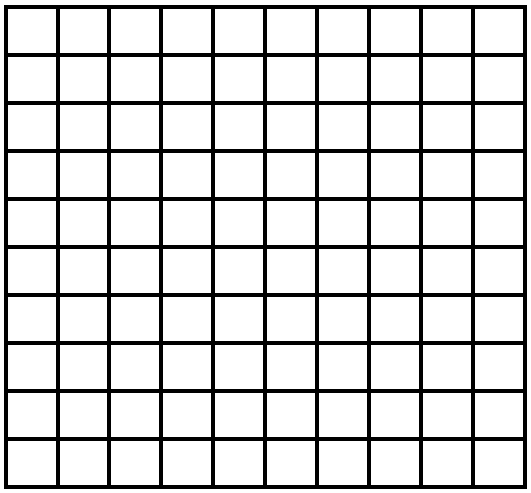


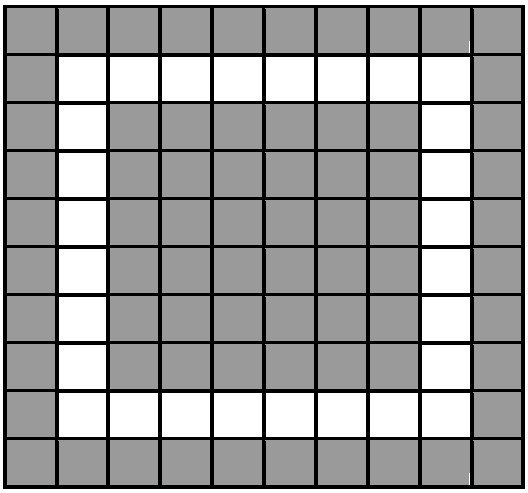


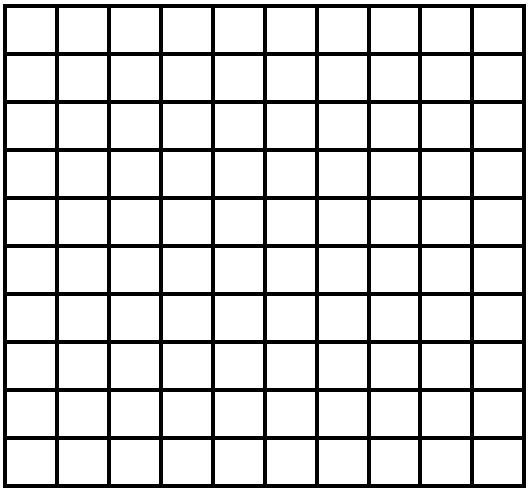


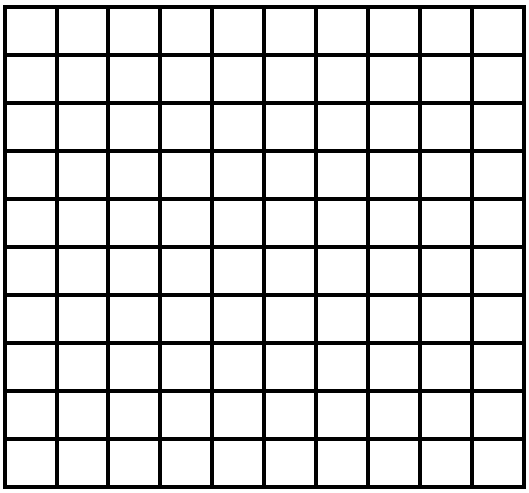


Base-Ten Grids









❋ SOL 6.2a,b,c

Lesson Summary

Students will create a fraction number line and use it to find equivalent fractions, decimals, and percents. Students will develop decimal number sense by forming different subsets of 100 objects. Students will also make connections among different representations (fractions, decimals, and percents) for the same amount.

Materials

Rolls of adding machine tape, one pre-cut meter strip of adding machine tape for each student; markers; scissors; 100 similar objects packaged for each small group; a copy of the handout "Table of 100 Things" for each small group; a transparency of the handout "Table of 100 Things" for each small group; yarn, string, or jump ropes; three pieces of string two-to-three feet long; chart paper; protractors (optional); a copy of the handout "Mosaic Art" for each student for use in the extension activity

Vocabulary

percent. Means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*.

Lesson

Part I

1. *Initiating Activity:* Have each student estimate a length of adding machine tape that is one meter long and cut that estimate from a roll of tape. Have each student decorate his/her "meter" strip in some manner that he/she will be able to recognize. After the strips have been decorated, have the students tape their strips to a tape stripe on the wall. Strips should be taped from the shortest to the longest in bar-graph fashion. Measure the strips with a meter stick to determine which one is closest to one meter long. Now is a good time to talk about ways to estimate a meter: a meter is a little bit longer than a yard; it is about the distance from the floor to a doorknob; or it is the about the width of a twin bed.
2. After a brief discussion about a meter, distribute a pre-cut meter strip of tape to each student. Have the students place their strip horizontally on the desk or table in front of them.
3. Have the students write "0" on the left end of the strip and "1" on the right end of the strip. Discuss briefly that the strip now represents one unit. Model the labeling as you go.
4. Have the students fold the right end of their strip over to the left end and crease. Have them open their strip and observe that the crease makes it appear to be divided into two equal parts. Have the students write "$\frac{0}{2}$" under the 0 on the left end, "$\frac{1}{2}$" on the crease, and "$\frac{2}{2}$" under the 1 on the right end. Model this as you go. After this step, discuss briefly with the students that they now have two ways to write the quantity zero — 0 and $\frac{0}{2}$ — and two ways to write the quantity one — 1 and $\frac{2}{2}$.
5. Have students fold the strip in half again and then fold it a second time and crease. Have them open their strip and observe that it appears to be divided into four equal parts.
6. Have the students write "$\frac{0}{4}$" under the 0 and $\frac{0}{2}$, "$\frac{1}{4}$" at the first crease, "$\frac{2}{4}$" under the $\frac{1}{2}$, "$\frac{3}{4}$" at the third crease, and "$\frac{4}{4}$" under the 1 and $\frac{2}{2}$. After this step, discuss briefly with the students that they now have three ways to write the quantity zero — 0, $\frac{0}{2}$, and $\frac{0}{4}$. Point out that they now have two ways to express the quantity one-half — $\frac{1}{2}$ and $\frac{2}{4}$ — and three ways to express the quantity one — 1, $\frac{2}{2}$, and $\frac{4}{4}$.

7. If you wish, the same procedure can be done for eighths. Have the students fold their strip in half, in half again, and in half a third time. The strip will now look like it has been divided into eight parts. Have them follow the same procedure for labeling. After labeling, point out equivalent fractions.
8. Folding into thirds is a bit tricky. Have the students think of the strip as a belt and lap the two ends toward the each other, adjusting until the folded lengths are of equal length. Model this folding for them. Have them crease and then label the three parts as they have done before. Be sure to point out that no thirds line up with halves, fourths, or eighths.
9. Have the students turn their strip over to the blank side, making sure that the 0 end is still to the left and the 1 end is to the right. Have them label the left end 0 and the right end 100. Now is the time to discuss the fact that one meter is equivalent to 100 centimeters and that is why 100 was chosen for the label.
10. Have the students fold their strip into two parts, open it, and label the parts. Have them write "$\frac{0}{100}$" under the 0 on the left end, "$\frac{50}{100}$" on the crease, and "$\frac{100}{100}$" under the 100 on the right end. To the side of each label, have them write the decimal represented: 0, .5, and 1. Remind them that percent literally means "out of a hundred" so that writing the percent from the fraction for each is easy. Directly under each label, have the students write the equivalent percent: 0%, 50%, and 100%. Now have students start the association with the first side of the strip: zero is zero as a fraction, decimal or percent. One-half can be expressed many ways: $\frac{1}{2}$ or $\frac{50}{100}$ or .5 or 50%.
11. Continue this process until the students have completed all the fractions on the first side of the strip. Explain to the students that they have now completed a fraction number line on one side of their meter strip and a decimal and percent equivalency line on the other side.

Part II

1. Organize the students into small groups, and give each group 100 similar objects, e.g. colored beads, an assortment of buttons, colored marshmallows, M & Ms, small screws and nuts, tricolor dry pasta noodles, a collection of different coins, or different colored marbles. You might wish to place more than 100 objects on the table and ask the students to count out the 100 and store the rest.
2. Give each group a copy of the handout "Who Has 100 Things?." Ask each group to sort their 100 objects into at least three groups and then complete the chart and answer the question on the recording sheet. For example, one collection of 100 beads might consist of 25 red beads, 60 green beads, and 15 blue beads and should be recorded as follows:

	Title of Each Group	**Number of Items in Group**	**Fraction**	**Decimal**	**Percent**
Group #1	Red Beads	25	$\frac{25}{100}$	.25	25%
Group #2	Green Beads	60	$\frac{60}{100}$	.60	60%
Group #3	Blue Beads	15	$\frac{15}{100}$	.15	15%
TOTAL:		100	$\frac{100}{100}$	1.00	100%

3. Have each group present their data to the class on a transparency of the handout "Who Has 100 Things? Recording Sheet."

4. Encourage students to make the connection between representing their data in the chart or table and representing it graphically in a “rough” circle graph. As they do this, be certain that they understand that this is possible because they know what percent (or part) of the whole is represented by each group.
5. At each table, ask the students to outline the circumference of a circle with their 100 objects, making sure to keep each group of objects together. For example, using the 100 beads, they would begin the circle with the 25 red beads forming one arc of the circle, continue with the 60 green beads connected to the last red bead, and finish with the 15 blue beads completing the circle.
6. Have each group move from table to table to see the other groups’ “circle graphs” that have been created. If the circle graphs have been made on a piece of chart paper, each group can label their graph appropriately and include a creative title.

Reflection

As students work, circulate and watch carefully as they follow instructions. Answer any questions, and clarify any procedures that may be problematic.

Follow-up/Extensions

Extensions for Part II

1. Discuss how the “rough” circle graphs can be transformed into exact circle graphs by knowing how many degrees are in each wedge or section. Ask students how to determine the number of degrees in each wedge. There are many methods for doing this. One is to set up and solve a proportion. Another is to multiply each percent times 360°. In the bead example, 25% of 360° is 90°, 60% of 360° is 216°, and 15% of 360° is 54°. Have the groups of students calculate the degrees needed for each wedge in their circle graph and use a protractor to draw an exact circle graph.
2. Distribute copies of the handout “Mosaic Art,” and assign the “Mosaic Art” project. Ask the students to display their mosaic art picture and chart at the next class session

Who Has 100 Things? Recording Sheet

1. Sort your 100 objects into at least three groups.
2. Fill in the chart, and answer the question.

	Title of Each Group	Number of Items in Group	Fraction	Decimal	Percent
Group #1					
Group #2					
Group #3					
Group #4					
Group #5					
Group #6					
Group #7					
TOTAL:					

3. How can you find the percent in group #2 without counting?

Mosaic Art

1. Make a picture that uses exactly 100 pieces of different colored paper. (The pieces of paper do not have to be the same size.)
2. Fill in the chart and attach it to your picture. If you use more colors, just add more rows to your chart.
3. Display your mosaic art at the next class meeting.

Color	Number of Pieces That Same Color	Fraction	Decimal	Percent

* SOL 8.3a

Lesson Summary

Students practice solving practical problems involving fractions, decimals, and percents; and converting fractions to decimals. (45 minutes)

Materials

Copies of the attached worksheets

Vocabulary

discount. A percent of the original price. The discount price is the original price minus the discount.

Warm-up

Distribute copies of the “Percents to Decimals Warm-up” worksheet. Review the procedure if needed, and then allow students time to complete the problems. Review the answers with the students.

Lesson

1. Distribute copies of the "A Problem Involving a Discount” worksheet. Discuss with students how best to approach a word problem such as this one. Review the list of steps to take, which was created by the class in the previous lesson.
2. Work though the steps in the problem with the students, emphasizing the importance of the steps that are being taken, not just the solution to this particular problem. Informally assess the students to find out whether they need additional help with this task.
3. Distribute copies of the "More Problems Involving Discounts” worksheet, and, based on your informal assessment, allow students to solve the problems in pairs or individually. Provide assistance as needed.

Reflection

Have students write 10 numbers as percents and their decimal equivalents.

Name: _____

Percents to Decimals Warm-up

Write these percents as decimals.

1. 20% _____

2. 35% _____

3. 97% _____

4. 50% _____

5. 75% _____

Name: ANSWER KEY

Percents to Decimals Warm-up

Write these percents as decimals.

1. 20% .20

2. 35% .35

3. 97% .97

4. 50% .50

5. 75% .75

Name: _____

A Problem Involving a Discount

A store is selling flat-screen TVs for one-third of the original price. How much money is the discount on a $600 flat-screen TV?

1. Explain how you would find the sale price.

_____

_____

2. Explain how you would find the amount of the discount.

_____

_____

3. Show how you would solve this problem, and write the answer in the space provided.

_____

_____

The discount is $ _____.

Name: ANSWER KEY

A Problem Involving a Discount

A store is selling flat-screen TVs for one-third of the original price. How much money is the discount on a $600 flat-screen TV?

1. 1. Explain how you would find the sale price.

   Find 1/3 of $600.

2. Explain how you would find the amount of the discount.

   Subtract the cost of the TV from the original price or find 2/3 of $600.

3. Show how you would solve this problem, and write the answer in the space provided.

   $\frac{1}{3} \times 600 = \frac{600}{3} = 200$

   600 − 200 = 400

   The discount is $400.

Another way:

1. TV sells for 1/3.
2. The discount is 2/3 (3/3 – 1/3 = 2/3)

2/3 x 600 = $400..

Name: _____

More Problems Involving Discounts

Show the steps for solving each of the following problems, and write the answer in the space provided.

1. During a sale, a skateboard is reduced by 50%. If the original price was $70, what is the discounted price?

   _____

   _____

   The discount price is $ _____

2. Ford Trucks is having a GIANT sale! All trucks are 20% off. The original price of a truck is $14,000. What is the discount?

   _____

   The discount is $ _____

3. Aunt Karin always gives Jessica $10 for her birthday. Next year, she plans to give Jessica 20% more than she usually gives. How much will Jessica get for her birthday next year?

   _____

   _____

   Jessica will get $ _____ for her birthday next year.

4. A pair of shoes costs $109 at Sneaker City. At the Labor Day sale, they are 20% off. What is the sale price of the shoes?

   _____

   _____

   The sale price of the shoes is $ _____

Name: ANSWER KEY

More Problems Involving Discounts

Show the steps for solving each of the following problems, and write the answer in the space provided.

1. During a sale, a skateboard is reduced by 50%. If the original price was $70, what is the discounted price?

   .50 × 70 = 35

   70 − 35 = 35

   The discount price is $35.00.

2. Ford Trucks is having a GIANT sale! All trucks are 20% off. The original price of a truck is $14,000. What is the discount?

   14,000 × .20 = 2,800

   The discount is $2,800.

3. Aunt Karin always gives Jessica $10 for her birthday. Next year, she plans to give Jessica 20% more than she usually gives. How much will Jessica get for her birthday next year?

   .20 × 10 = 2

   10 + 2 = 12

   Jessica will get $12 for her birthday next year.

4. A pair of shoes costs $109 at Sneaker City. At the Labor Day sale, they are 20% off. What is the sale price of the shoes?

   .20 × 109 = 21.80

   109 − 21.80 = 78.20

   The sale price of the shoes is $78.20.

* SOL 8.3a

Lesson Summary

Students will use data involving favorite ice cream flavors to predict the amount of each flavor that would be needed to serve a crowd of people.

Materials

A copy of the handout "Scoop-on-Ice-Cream Recording Sheet" for each student; calculators

Lesson

1. *Initiating Activity:* Give each student a copy of the handout "Scoop-on-Ice-Cream Recording Sheet," and discuss the information about favorite ice cream flavors. Ask, "What percent of the people prefer chocolate ice cream?" "Vanilla ice cream?" "Strawberry?"
2. Review with the class the important measurement equivalents that will help them solve the problem.
3. Read the Scrumptious Scoops problem with the class.
4. Have the class work in pairs to solve the problems concerning amounts of ice cream.
5. *Closing Activity:* When students have completed the problems, share their solutions and strategies for solving.

Reflection

Pay particular attention to the conversions of units and the proportions used to find answers. Make sure students recognize amounts that "make sense" when their answers are calculated.

Follow-up/Extensions

Do the "The Ice Cream Recipe" activity found on the handout, either as an individual activity or as a whole-class activity.

Name: _____

Scoop-on-Ice-Cream Recording Sheet

The Three Favorite Flavors of Ice Cream*

Flavor	Percent of Those Polled
Vanilla	55%
Chocolate	29%
Strawberry	16%

Scrumptious Scoops is a very popular ice cream parlor in a small town in Virginia. To celebrate the Fourth of July, the store decided to serve free single scoops of its three most popular flavors to the audience at the Independence Day outdoor band concert.

Mr. Scrumptious decided that he could determine how much ice cream he would need by using the data provided by the International Ice Cream Association. The town estimated that approximately 650 people would attend the band concert.

1. Assuming everyone will want a free scoop of ice cream, how many people would you expect to prefer chocolate?
2. How many half-gallons of chocolate ice cream should Mr. Scrumptious plan to have on hand to give to those people?
3. If the representatives from Scrumptious Scoops serve everyone at the band concert a scoop of ice cream, how many half-gallons of ice cream will they serve? How many pounds will that be?

Important Measurement Equivalents

A gallon of ice cream weighs about 5 pounds and contains 4 quarts.

One scoop of ice cream is $\frac{1}{2}$ *cup or about 68 grams.*

One gallon contains 16 cups, so one half-gallon contains 8 cups.

*International Ice Cream Association Data

Name: ANSWER KEY

Scoop-on-Ice-Cream Recording Sheet

1. Assuming everyone will want a free scoop of ice cream, how many people would you expect to prefer chocolate?
2. How many half-gallons of chocolate ice cream should Mr. Scrumptious plan to have on hand to give to those people?
3. If the representatives from Scrumptious Scoops serve everyone at the band concert a scoop of ice cream, how many half-gallons of ice cream will they serve? How many pounds will that be?

Solution

1. How many people will prefer chocolate ice cream?
   a. If 29% of the people prefer chocolate, then 29% of 650 people = (.29)(650) = 188.5 or 189. Hence, 189 people prefer chocolate.
   or
   b. If 29% of the people prefer chocolate, then $\frac{29}{100} = \frac{x}{650}$; therefore, $x = \frac{(650)(29)}{100} =$ 188.5 or 189. Hence, 189 people prefer chocolate.
2. How many half-gallons of chocolate ice cream will be needed?
   a. If $\frac{1}{2}$ cup is needed for each person, then $\frac{.5 \text{ cups}}{1 \text{ person}} = \frac{x \text{ cups}}{189 \text{ people}}$; therefore, $x =$ (189)(.5) = 94.5. Hence, 94.5 cups of chocolate ice cream are needed for 189 people.
   b. If one half-gallon equals 8 cups, then $\frac{1 \text{ half-gallon}}{8 \text{ cups}} = \frac{x \text{ half-gallons}}{94.5 \text{ cups}}$; therefore, $x = \frac{94.5}{8} = 11.81$
   or 12. Hence, 12 half-gallons of chocolate will be needed.
3. If everyone is served a scoop, how many half-gallons of ice cream will be served? How many pounds will that be?
   a. If one scoop of ice cream equals $\frac{1}{2}$ cup, then the number of cups of ice cream needed for 650 people is (.5)(650) = 325 cups. If one half-gallon equals 8 cups, then the number of half-gallons of ice cream needed for 650 people is 325 ÷ 8 = 40.6 or 41 half-gallons of ice cream.
   b. If one gallon weighs 5 pounds, then one half-gallon weighs 5 ÷ 2 = 2.5 pounds. Therefore, 40.6 half-gallons weigh 101.5 or 102 pounds of ice cream.

Ice Cream Recipe

Make ice cream in plastic zip-lock bags as follows:

1. Combine 3 tablespoons of sugar, a few drops of vanilla extract, and 1 cup of milk in a 1-quart zip-lock bag, and seal the bag tightly. You may add cookie pieces or well-drained fruit to your ice cream mixture if you wish.
2. Put about 2 cups of ice and $\frac{1}{2}$ cup of rock salt in a 1-gallon zip-lock bag. Use small ice cubes, or break the ice into small pieces.
3. Put the smaller bag into the larger bag, and seal it tightly. Then shake the large bag until the ice cream mixture freezes. This step takes some time.

Why do you think this method works for making ice cream?

Using the recipe above, how many students could make ice cream using 8 cups of sugar and 4 gallons of milk? To solve the problem you need to know: 1 cup = 16 tbsp. and 1 gallon = 16 cups. Show your calculations in the box below:

Would there be any ingredients left over? If so, how much? Show your thinking below:

* SOL 8.3a

Lesson Summary

Students practice solving practical word problems involving rational numbers. (45 minutes)

Materials

Copies of the attached worksheets

Vocabulary

percent. Means "per 100" or how many "out of 100"; *percent* is another name for *hundredths*.
ratio. A comparison of any two quantities. It is used to represent relationships within and between sets.
principal. The amount of money borrowed or invested.
rate. The percent of interest per year.
t*ime.*The number of years the money is borrowed or invested.

Warm-up

Distribute copies of the "Warm Up with Percents" worksheet. If the students need a review of changing a percent to a fraction, do a few together, and use the warm-up sheet for individual practice.

Lesson

1. Distribute copies of the "Word Problems" worksheet. Begin a discussion with students about what they should do when they encounter a word problem involving rational numbers. Create a list of their suggestions, and use their list and the list below to generate a class list.
   a. Read the problem twice.
   b. Highlight the important pieces of information.
   c. Decide on a strategy.
   d. Decide whether you need to use an operation(s), and if so, which one(s).
   e. Decide whether you need to represent the data in a graphic organizer, such as a chart or picture.
   f. Solve the problem.
   g. Go back and check the answer to the problem.
2. Have the students apply steps *a* and *b* individually to problem 1 on the worksheet. Discuss.
3. Have the students decide on a strategy. Discuss.
4. Allow students to carry out the strategy. Discuss.
5. Check results as a group.
6. Decide whether you want to repeat this process for problem 2, or whether the students are ready to work on their own.

Reflection

Ask students to write a word problem on their own and solve it. Have them exchange problems with a partner and solve. You may wish to use the "Solving Simple Interest Problems" worksheet as an extension of this lesson.

Name: _____

Warm Up with Percents

Fractions, decimals, and percents describe parts of a whole. Write each percent below as a fraction and simplify to its simplest form.

Example: 40% = $\frac{40}{100}$, simplified $\rightarrow \frac{4}{10} \rightarrow \frac{2}{5}$

80% = _____

3% = _____

94% = _____

75% = _____

Name: ANSWER KEY

Warm Up with Percents

Fractions, decimals, and percents describe parts of a whole. Write each percent below as a fraction in simplest form.

Example: 40% = $\frac{40}{100}$, simplified → $\frac{4}{10}$ → $\frac{2}{5}$

80% = $\frac{80}{100}$, simplified → $\frac{8}{10}$ → $\frac{4}{5}$

3% = $\frac{3}{100}$

94% = $\frac{94}{100}$, simplified → $\frac{47}{50}$

75% = $\frac{75}{100}$, simplified → $\frac{3}{4}$

Name: _____

Word Problems

Solve each of the following problems. Show your work.

1. On a map of Virginia, Tammy sees that the distance between Richmond and Virginia Beach is 3 inches. The scale of the map is $\frac{1}{2}$ **in. = 20 mi.** What is the actual distance in miles between Richmond and Virginia Beach?

2. The Gap is having a sale. They advertise $\frac{1}{5}$ off everything in the store. What percent is equal to $\frac{1}{5}$?

3. Jamie is $\frac{1}{4}$ as old as his father. If his father is 36, how old is Jamie?

4. Miles filled $\frac{1}{3}$ of his gas tank. His gas tank holds 12 gallons. How many gallons of gas did he put in his tank?

5. Macy's is having a sale in which everything is $\frac{2}{5}$ off. At the same time, The Gap is having a sale in which everything is 30% off. Which store is giving the greater percent off?

6. Michelle bought 3 yards of ribbon to make bows. Each bow requires $\frac{2}{3}$ yard of ribbon. How many bows can Michelle make?

Name: _____

Solving Simple Interest Problems

When money is borrowed or invested, interest is paid or earned on the money. Simple interest is computed using this formula:

Interest = Principal × Rate × Time ($i = p \times r \times t$)

The *principal* is the amount of money borrowed or invested. The *rate* is the percent of interest per year. The *time* is the number of years the money is borrowed or invested.

Example 1
Julian invested $2,000 at 4% simple interest. How much is his investment worth after one and a half years?

1. List the values, and write percents and fractions as decimals.
   $p = 2{,}000$
   $r = 4\% = .04$
   $t = 1\frac{1}{2} = 1.5$
2. Substitute the values into the formula for simple interest ($i = p \times r \times t$) and solve.
   $i = 2{,}000 \times .04 \times 1.5$
   $i = 120$
3. Add the simple interest to the principal.
   $2{,}000 + 120 = 2{,}120$

Julian's investment is worth $2,120 after one and a half years.

Example 2
Ashley invested $200 at 7% for 3 years. How much simple interest did her money earn?

1. List the values, and write percents and fractions as decimals.
   $p = 200$
   $r = 7\% = .07$
   $t = 3$
2. Substitute the values into the formula for simple interest ($i = p \times r \times t$) and solve.
   $i = 200 \times .07 \times 3$
   $i = 42$

Her money earned $42 in simple interest.

Practice

1. Martin invested the $800 he made at a summer job at 6% for one and a half years. How much simple interest did he earn on his investment?

2. Beth borrowed $350 at 10% simple interest for two and three-fourths years. How much interest did she have to pay?

Name: ANSWER KEY

Solving Simple Interest Problems

When money is borrowed or invested, interest is paid or earned on the money. Simple interest is computed using this formula:

Interest = Principal × Rate × Time ($i = p \times r \times t$)

The *principal* is the amount of money borrowed or invested. The *rate* is the percent of interest per year. The *time* is the number of years the money is borrowed or invested.

Practice

1. Martin invested the $800 he made at a summer job at 6% for one and a half years. How much simple interest did he earn on his investment?

   $p = 800$ $r = 6\% = .06$ $t = 1\frac{1}{2} = 1.5$ $i = 900 \times .06 \times 1.5$ $i = \$72$

2. Beth borrowed $350 at 10% simple interest for two and three-fourths years. How much interest did she have to pay?

   $p = 350$ $r = 10\% = .10$ $t = 2\frac{3}{4} = 2.75$ $i = 350 \times .10 \times 2.$