



Lesson 24: Percent and Rates per 100

Student Outcomes

- Students understand that percents are related to part-to-whole ratios and rates where the whole is 100.
- Students model percents and write a percent as a fraction over 100 or a decimal to the hundredths place.

Classwork

Example 1 (5 minutes)

Class begins with a discussion to gather prior knowledge and to show a relationship to real-world applications.

- Imagine that you are shopping. You want to purchase an item for \$100, but today it is 20% off. What does this mean?
 - *It means that \$20 out of every \$100 dollars will be subtracted from the total.*
- How can this situation be modeled?
 - *We could use a tape diagram that represents \$100 divided into ten sections of \$10. Two of the sections represent the discount and eight of the sections represent the amount paid for the item. It could also be shown on a 10×10 grid, where 20 of the squares represent the discount and 80 squares represent the amount paid.*
- How are percent problems related to the types of problems we have been working with involving ratios and rates?
 - *Answers will vary depending on prior knowledge. Some students may see that 20% of \$100 is \$20 off. Other students may see that we are trying to find part of a whole.*

Use the following website on a projector to visually explore percents in a 10×10 grid model.

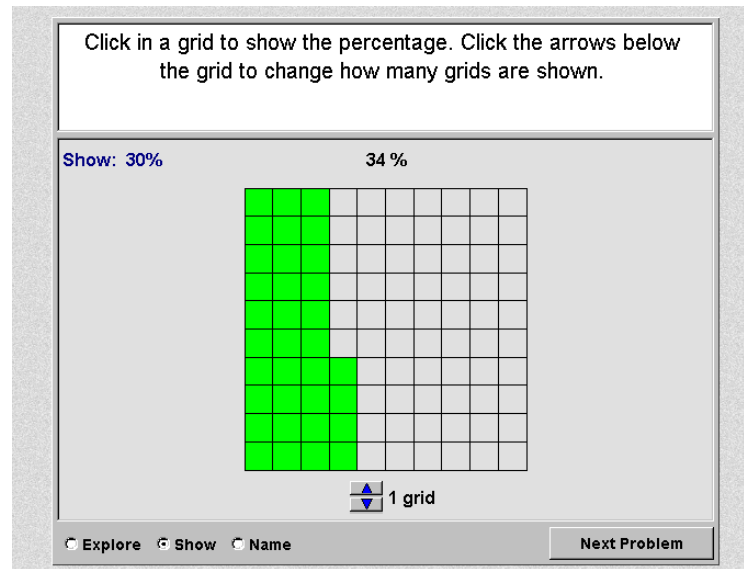
http://nlvm.usu.edu/en/nav/frames_asid_333_g_3_t_1.html?from_category_g_3_t_1.html

Click the explore button on the website to be able to show 20%. This will provide students with the visual for making the connection that 20% means 20 out of 100.

- What does this grid show?
 - *100 blocks*
- How many are shaded in?
 - *20 blocks*
- How many are not shaded in?
 - *80 blocks*
- How can we use this model to help us think through 20% off of \$100?
 - *From the grid, I can see that when I save 20%, I am paying 80% of the original value.*

Now, they can see that since each block represents one dollar, they would be saving the 20 and spending the 80 when a \$100 item is 20% off the original price.

Here is an example of what the website will look like in use:



If time allows, add more grids to model percents greater than 100% so that students further build an understanding.

Exercises 1–2 (8 minutes)

Solve the following two exercises with student input in order to model the process of working with percents. Students will need coloring utensils in order to complete the remaining activities.

Exercise 1

B	B	G	G	G	G	G	P	P	P
B	B	G	G	G	G	G	P	P	P
B	B	G	G	G	G	G	P	P	P
B	B	G	G	G	G	G	P	P	P
B	B	G	G	G	G	G	P	P	P
B	B	B	G	G	G	G	P	P	P
B	B	B	G	G	G	G	P	P	P
B	B	B	G	G	G	G	P	P	P
B	B	B	G	G	G	G	P	P	P
B	B	B	G	G	G	G	P	P	P

Robb's Fruit Farm consists of 100 acres, on which three different types of apples grow. On 25 acres, the farm grows Empire apples. McIntosh apples grow on 30% of the farm. The remainder of the farm grows Fuji apples. Shade in the grid below to represent the portion of the farm each apple type occupies. Use a different color for each type of apple. Create a key to identify which color represents each type of apple.

	Color Key	Part-to-Whole Ratio
Empire	<u>Black (B)</u>	<u>25:100</u>
McIntosh	<u>Purple (P)</u>	<u>30:100</u>
Fuji	<u>Green (G)</u>	<u>45:100</u>

Exercise 2

The shaded portion of the grid below represents the portion of a granola bar remaining.

What percent does each block of granola bar represent?

1% of the granola bar

What percent of the granola bar remains?

80%

What other ways can we represent this percent?

$\frac{80}{100}$, $\frac{8}{10}$, $\frac{4}{5}$, $\frac{16}{20}$, $\frac{32}{40}$, $\frac{64}{80}$, 0.8

0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

In this example, the teacher can discuss how 0.01 is related to $\frac{1}{100}$ and 1%. There are many examples that could be used to represent this percent in the last question. Students should list several examples.

Exercises 3–6 (15 minutes)

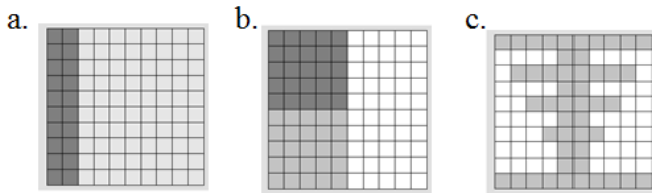
In predetermined pairs or groups, students solve the remaining problems.

Circulate around the room. Students may have varying answers for several questions in the practice. There is more than one possible answer for several questions to spark conversation between pairs or small groups.

For example, the second 10×10 grid used two different colors, so students could compare colored to total: light gray to total, dark gray to total. In addition, when they are asked to describe the different scenarios, some may use part-to-part ratios while others may use part-to-whole. This is a good time for a discussion on how part-to-part can lead to part-to-whole. In addition, it is important to remember that percents are out of a total 100, so you might want to ask students which form of the ratio is most helpful for getting a percent.

A percent is just another way to show the part-to-whole ratio for each picture.

Exercise 3



- a. For each figure shown, represent the gray shaded region as a percent of the whole figure. Write your answer as a decimal, fraction, and percent.

Picture (a)	Picture (b)	Picture (c)
20% is shaded darker than the rest, 0.20, $\frac{20}{100}$.	Answers will vary. Sample Answer (colored compared to total) – 50%, 0.50, $\frac{50}{100}$ (Students could also compare darker shading to total, lighter shading to total, light shading to darker shading, darker shading to lighter shading, etc.)	48%, 0.48, $\frac{48}{100}$

- b. What ratio is being modeled in each picture?

Picture (a) – Answers will vary. One example is the ratio of darker gray to total is 20 to 100.

Picture (b) – 50 to 100, or a correct answer for whichever description they chose.

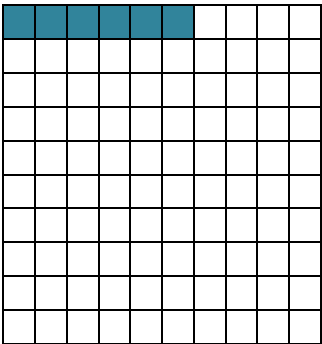
Picture (c) – The ratio of gray to the total is 48 to 100.



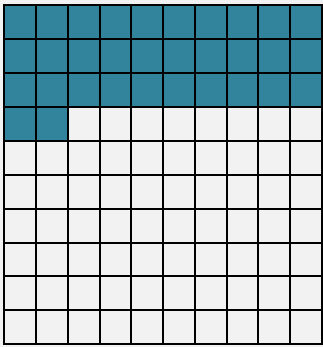
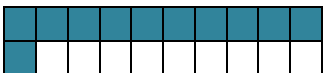
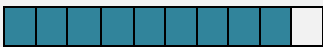

- c. How are the ratios and percents related?

Answers will vary.

Exercise 4

Each relationship below compares the shaded portion (or part) to the entire figure (the whole). Complete the table.

Percentage	Decimal	Fraction	Ratio	Model
6%	0.06	$\frac{6}{100}$	6:100	

60%	0.6	$\frac{60}{100}, \frac{6}{10}$	60:100	
600%	6	$\frac{600}{100} = \frac{6}{1}$	6:1	
32%	0.32	$\frac{32}{100}$	32:100	
55%	0.55	$\frac{55}{100}, \frac{11}{20}$	11:20	
90%	0.9	$\frac{9}{10}$	9:10	
70%	0.7	$\frac{7}{10}, \frac{70}{100}$	7:10	

Exercise 5

Mr. Brown shares with the class that 70% of the students got an A on the English vocabulary quiz. If Mr. Brown has 100 students, create a model to show how many of the students received an A on the quiz.



$$70\% \rightarrow \frac{70}{100} = \frac{7}{10}$$

What fraction of the students received an A on the quiz?

$$\frac{7}{10} \text{ or } \frac{70}{100}$$

How could we represent this amount using a decimal?

0.7 or 0.70

How are the decimal, the fraction, and the percent all related?

The decimal, fraction, and percent all show 70 out of 100.

Exercise 6

Marty owns a lawn mowing service. His company, which consists of three employees, has 100 lawns to mow this week. Use the 10×10 grid to model how the work could have been distributed between the three employees.

Students choose how they want to separate the workload. The answers will vary. Below is a sample response.

G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B
G	G	G	P	P	P	P	P	B	B

Worker	Percentage	Fraction	Decimal
Employee 1 (G)	30%	$\frac{30}{100}$	0.30
Employee 2 (P)	50%	$\frac{50}{100}$	0.50
Employee 3 (B)	20%	$\frac{20}{100}$	0.20

Closing (12 minutes)

Students present their work. Each group presents a problem or a part of a problem in order for all groups to respond.

Students complete this closing activity.

- What are three things you learned about in this lesson?
- Share two ways that you can write 2%.
- What is one thing that you still want to know about from the lesson?

Lesson Summary

Percent means out of 100. Therefore, percents are fractions with a denominator of 100.

We can create models of percents. One example would be to shade a 10×10 grid. Each square in a 10×10 grid represents 1% or 0.01.

Exit Ticket (5 minutes)

Name _____

Date _____

Lesson 24: Percents and Rates per 100

Exit Ticket

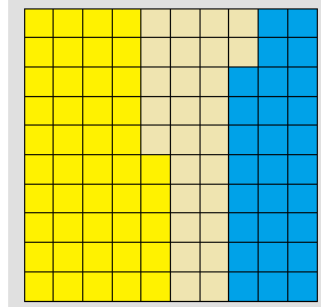
One hundred offices need to be painted. The workers choose between yellow, blue, or beige paint. They decide that 45% of the offices will be painted yellow; 28% will be painted blue, and the remaining offices will be painted beige. Create a model that shows the percent of offices that will be painted by each color. Write the amounts as decimals and fractions.

Color	%	Fraction	Decimal
Yellow			
Blue			
Beige			

Exit Ticket Sample Solutions

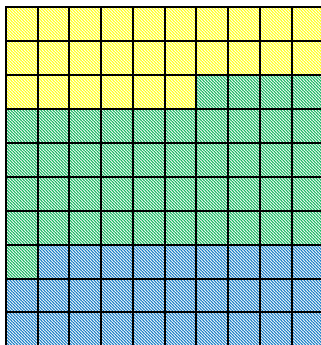
One hundred offices need to be painted. The workers choose between yellow, blue, or beige paint. They decide that 45% of the offices will be painted yellow; 28% will be painted blue, and the remaining offices will be painted beige. Create a model that shows the percent of offices that will be painted by each color. Write the amounts as decimals and fractions.

Color	%	Fraction	Decimal
Yellow	45	$\frac{45}{100}$	0.45
Blue	28	$\frac{28}{100}$	0.28
Beige	27	$\frac{27}{100}$	0.27



Problem Set Sample Solutions

- Marissa just bought 100 acres of land. She wants to grow apple, peach, and cherry trees on her land. Color the model to show how the acres could be distributed for each type of tree. Using your model, complete the table.



Tree	Percentage	Fraction	Decimal
Apple	26%	$\frac{26}{100}$	0.26
Peach	45%	$\frac{45}{100}$	0.45
Cherry	29%	$\frac{29}{100}$	0.29

Apple – Yellow, Peach – Green, Cherry – Blue

- After renovations on Kim's bedroom, only 30 percent of one wall is left without any décor. Shade the grid below to represent the space that is left to decorate.

- What does each block represent?

Each block represents $\frac{1}{100}$ of the total wall.

- What percent of this wall has been decorated?

30%

0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01