## 4.2 Percents of Increase and Decrease

Essential Question What is a percent of decrease? What is a percent of increase?

1 ACTIVITY: Percent of Decrease

Each year in the Columbia River Basin, adult salmon swim up river to streams to lay eggs and hatch their young.

To go up the river, the adult salmon use fish ladders. But, to go down the river, the young salmon must pass through several dams.

There are electric turbines at each of the eight dams on the main stem of the Columbia and Snake Rivers. About 88% of the young salmon pass through these turbines unharmed.
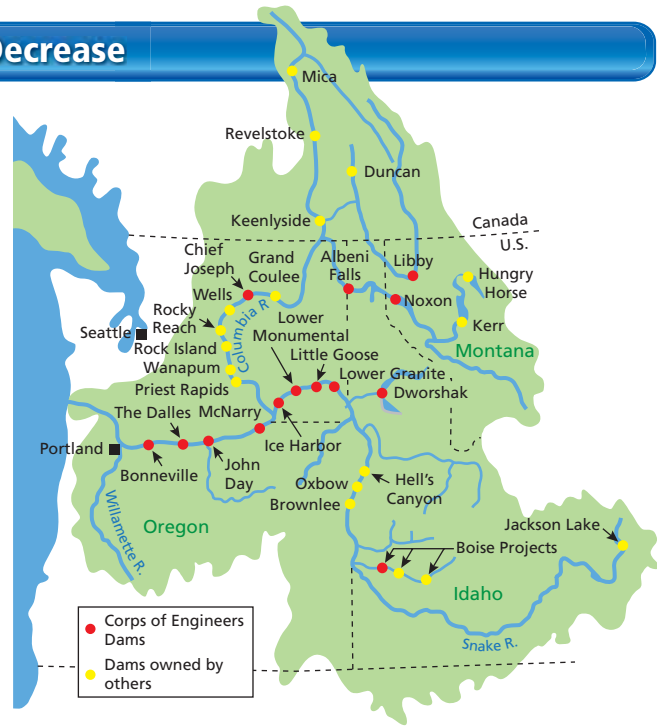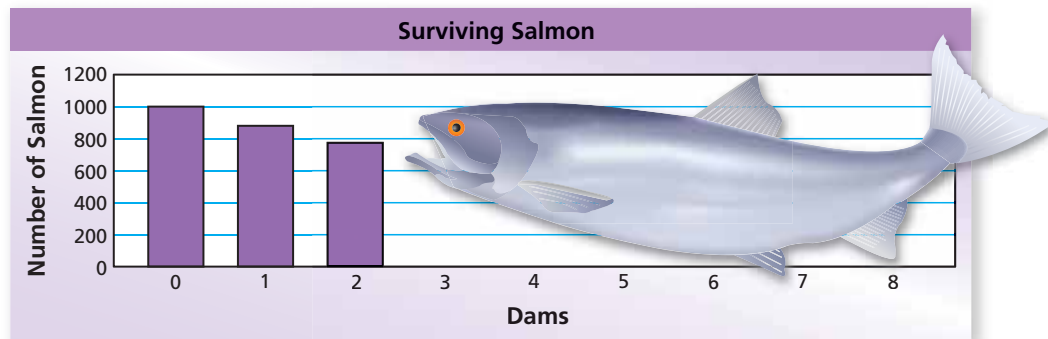
Copy and complete the table and the bar graph to show the number of young salmon that make it through the dams.

Dam	0	1	2	3	4	5	6	7	8
Salmon	1000	880	774						

88% of $1000 = 0.88 \cdot 1000$
$= 880$

88% of $880 = 0.88 \cdot 880$
$= 774.4 \approx 774$

**Surviving Salmon**

Number of Salmon

Dams

ACTIVITY: Percent of Increase

From 2000 to 2006, the population of Florida increased about 2% each year. Copy and complete the table and the bar graph using this pattern. Predict the population in 2015.
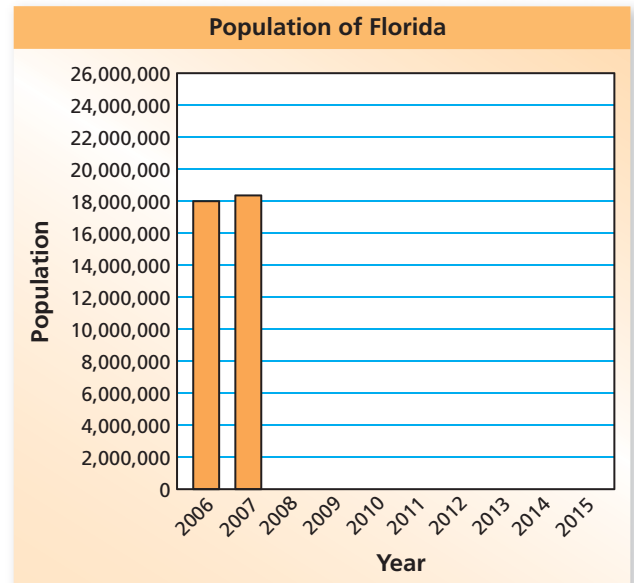
For 2007:

2% of 18,000,000 = 0.02 · 18,000,000

= 360,000

18,000,000 + 360,000 = 18,360,000

2006 Population   Increase   2007 Population

2006 Population 18,000,000
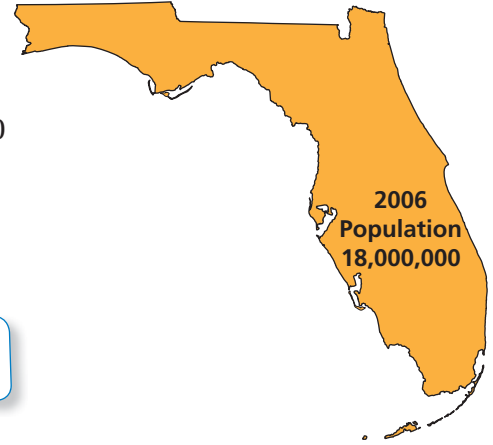
Year	Population
2006	18,000,000
2007	18,360,000
2008	
2009	
2010	
2011	
2012	
2013	
2014	
2015	

Population of Florida

What Is Your Answer?

3. In Activity 1, by what percent does the number of young salmon decrease with each dam?

4. Describe real-life examples of a percent of decrease and a percent of increase.

5. **IN YOUR OWN WORDS** What is a percent of decrease? What is a percent of increase?

Practice Use what you learned about percent of increase and percent of decrease to complete Exercises 13–18 on page 168.

Key Vocabulary 🔊
percent of change,
    p. 166
percent of increase,
    p. 166
percent of decrease,
    p. 166

A **percent of change** is the percent that a quantity changes from the original amount.

$$\text{percent of change} = \frac{\text{amount of change}}{\text{original amount}}$$

🔑 Key Idea

Percents of Increase and Decrease

When the original amount increases, the percent of change is called a **percent of increase**.

$$\text{percent of increase} = \frac{\text{new amount} - \text{original amount}}{\text{original amount}}$$

When the original amount decreases, the percent of change is called a **percent of decrease**.

$$\text{percent of decrease} = \frac{\text{original amount} - \text{new amount}}{\text{original amount}}$$

EXAMPLE 1   Finding a Percent of Increase

The table shows the number of hours you spent online last weekend. What is the percent of change in your online time from Saturday to Sunday?

Day	Hours Online
Saturday	2
Sunday	4.5

The number of hours on Sunday is greater than the number of hours on Saturday. So, the percent of change is a percent of increase.

$$\text{percent of increase} = \frac{\text{new amount} - \text{original amount}}{\text{original amount}}$$

$$= \frac{4.5 - 2}{2} \qquad \text{Substitute.}$$

$$= \frac{2.5}{2} \qquad \text{Subtract.}$$

$$= 1.25, \text{ or } 125\% \qquad \text{Write as a percent.}$$

⋮ Your online time increased 125% from Saturday to Sunday.

On Your Own

Find the percent of change. Round to the nearest tenth of a percent, if necessary.

1. 10 inches to 25 inches   **2.** 57 people to 65 people

🔊 Multi-Language Glossary at BigIdeasMath.com.

EXAMPLE 2 **Finding a Percent of Decrease**

The bar graph shows a softball player's home run totals. What was the percent of change from 2007 to 2008?

Softball

Season	Home Runs
2005	18
2006	10
2007	28
2008	20

Home Runs (0, 5, 10, 15, 20, 25, 30, 35)
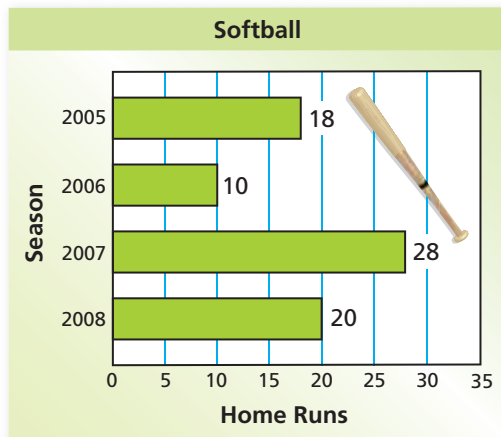
The number of home runs decreased from 2007 to 2008. So, the percent of change is a percent of decrease.

$$\text{percent of decrease} = \frac{\text{original amount} - \text{new amount}}{\text{original amount}}$$

$$= \frac{28 - 20}{28} \qquad \text{Substitute.}$$

$$= \frac{8}{28} \qquad \text{Subtract.}$$

$$\approx 0.286, \text{ or } 28.6\% \qquad \text{Write as a percent.}$$

∴ The number of home runs decreased about 28.6%.

On Your Own

Now You're Ready
Exercises 4–11

3. What was the percent of change from 2005 to 2006?

EXAMPLE 3 **Standardized Test Practice**

You have 250 songs on your MP3 player. You delete 20% of the songs. How many songs are left?

Ⓐ 50 Ⓑ 150 Ⓒ 200 Ⓓ 300

Find the amount of decrease.

$$20\% \text{ of } 250 = 0.2 \cdot 250 \qquad \text{Write as multiplication.}$$

$$= 50 \qquad \text{Multiply.}$$

The decrease is 50 songs. So, there are $250 - 50 = 200$ songs left.

∴ The correct answer is Ⓒ.

On Your Own

Now You're Ready
Exercises 13–22

4. WHAT IF? After deleting the 50 songs in Example 3, you add 10% more songs. How many songs are on the MP3 player?

4.2 Exercises

✓ Vocabulary and Concept Check

1. **VOCABULARY** How do you know whether a percent of change is a *percent of increase* or a *percent of decrease*?

2. **NUMBER SENSE** Without calculating, which has a greater percent of increase?
   - 5 bonus points on a 50-point exam
   - 5 bonus points on a 100-point exam

3. **WRITING** What does it mean to have a 100% decrease?

Practice and Problem Solving

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.

① ②
4. 12 inches to 36 inches
5. 75 people to 25 people
6. 50 pounds to 35 pounds
7. 24 songs to 78 songs
8. 10 gallons to 24 gallons
9. 72 paper clips to 63 paper clips
10. 16 centimeters to 44.2 centimeters
11. 68 miles to 42.5 miles

12. **ERROR ANALYSIS** Describe and correct the error in finding the percent increase from 18 to 26.

$$✗ \quad \frac{26 - 18}{26} \approx 0.31 = 31\%$$

Find the new amount.

③
13. 8 meters increased by 25%
14. 15 liters increased by 60%
15. 50 points decreased by 26%
16. 25 penalties decreased by 32%
17. 68 students increased by 125%
18. 1000 grams decreased by 94%
19. 62 kilograms decreased by 32%
20. 124 ounces decreased by 67%

21. **ERROR ANALYSIS** Describe and correct the error in using the percent of change to find a new amount.

> ✗ 25 is decreased by 40%.
> 40% of 25 = 0.4 • 25
> = 10
> So, 25 + 10 = 35.

22. **VIDEO GAME** Last week, you finished Level 2 of a video game in 32 minutes. Today, you finish Level 2 in 28 minutes. What is your percent of change?

Identify the percent of change as an *increase* or *decrease*. Then find the percent of change. Round to the nearest tenth of a percent, if necessary.

23. $\dfrac{1}{4}$ to $\dfrac{1}{2}$

24. $\dfrac{4}{5}$ to $\dfrac{3}{5}$

25. $\dfrac{3}{8}$ to $\dfrac{7}{8}$

**26.** $\dfrac{5}{4}$ to $\dfrac{3}{8}$

27. **CRITICAL THINKING** Explain why a change from 20 to 40 is a 100% increase, but a change from 40 to 20 is a 50% decrease.

28. **POPULATION** The table shows population data for a community.

Year	Population
2000	118,000
2006	138,000

   a. What is the percent of change from 2000 to 2006?

   b. Use this percent of change to predict the population in 2012.

29. **GEOMETRY** Suppose the length and width of the sandbox are doubled.
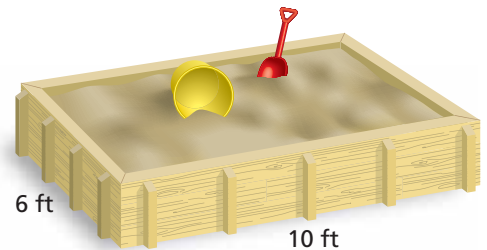
   a. Find the percent of change in the perimeter.

   b. Find the percent of change in the area.

6 ft

10 ft

30. **RUNNING** Find the percent of change in the time to run a mile from June to September.

7:45 June

5:51 September

31. **CRITICAL THINKING** A number increases by 10% and then decreases by 10%. Will the result be *greater than*, *less than*, or *equal to* the original number? Explain.

32. **DONATIONS** Donations to an annual fundraiser are 15% greater this year than last year. Last year, donations were 10% greater than the year before. The amount raised this year is $10,120. How much was raised 2 years ago?

33. **Reasoning** Forty students are in the science club. Of those, 45% are girls. This percent increases to 56% after new girls join the club. How many new girls join?

Fair Game Review *What you learned in previous grades & lessons*

Write and solve an equation to answer the question.

34. What number is 25% of 64?

35. 39.2 is what percent of 112?

36. 5 is 5% of what number?

37. 18 is 32% of what number?

38. **MULTIPLE CHOICE** Which equation shows direct variation?

   Ⓐ $y - x = 1$ Ⓑ $\dfrac{y}{x} = 10$ Ⓒ $y = \dfrac{4}{x}$ Ⓓ $xy = 5$