Using the Percent Equation

LAUNCH (7 MIN)

Before
• How can your personality affect a decision like this one?

During
• What are the advantages of Offer A? Offer B?

After
• Which option would you choose?

KEY CONCEPT (4 MIN)

Have students explain the process for finding the total cost of an item or the base price of an item.

PART 1 (7 MIN)

Javier Says (Screen 1) Use the Javier Says button to begin a discussion about meals tax rates and sales tax rates. Ask students to identify those tax rates in your area. You may want to extend the discussion to tip, and how Americans do not typically tip on the tax.

Before solving the problem
• How do you find the total cost of a meal in a restaurant?
• Will the tax be greater or less than $142? What about the bill?

While solving the problem
• If the tax is a percent of the cost of food, how can you use percents to solve this problem?

After solving the problem
• Does the final answer, $149.10, make sense? Explain.

PART 2 (8 MIN)

Javier Says (Screen 1) Use the Javier Says button to help students understand that when they buy from people who are earning commission, they need to keep in mind that other factors are in play when they are directed toward a particular purchase.

Before solving the problem
• Why does the salesman direct the consumer to the most expensive car?

While solving the equation
• How can the commission rate be a constant if it changes based on the price of the car?

After solving the problem
• Is the base price the amount of profit the car dealership earns? Explain

PART 3 (8 MIN)

Before solving the problem
• How might Taylor have arrived at an estimate of $200 per day?
• How can you compare the two options?

After solving the problem
• Which option do you think the store would prefer?
• Which option would you take if you were in Taylor’s shoes?
• What are some incentives used to motivate you to work harder as a student?

CLOSE AND CHECK (8 MIN)

• What are some questions the movie star in the Launch or the car buyer in Example 2 should ask before they make a decision?
LESSON OBJECTIVES

1. Recognize and represent proportional relationships between quantities.
2. Use proportional relationships to solve multi-step ratio and percent problems involving taxes and gratuities (tips).
3. Use proportional relationships to solve multi-step ratio and percent problems involving commissions and fees.

_FOCUS QUESTION_

In what situations are fixed numbers better than percents of an amount? In what situations are percents better than fixed numbers?

MATH BACKGROUND

In the previous lesson, students were introduced to the percent equation. They learned to identify parts of that equation and to use the equation to find an unknown value in a percent problem. In doing so, students drew upon their understanding of proportional relationships between quantities and of the concept of the constant of proportionality, both of which they learned in the previous topic, Proportional Relationships.

In this lesson, students use the percent equation, \( y = mx \), to solve multi-step real-world problems. The main focus of this lesson is to find tax or commission based on a quantity and then calculate the total payment or salary. In addition, the Launch and Part 3 ask students to make a decision between a fixed salary and one based on sales. To solve these kinds of problems, students will use the percent equation to compare money earned in each arrangement.

In the next two lessons, students learn how to apply percents in order to calculate interest. They learn formulas for both simple and compound interest and apply their knowledge of solving equations and working with exponents.

_LAUNCH (7 MIN) ____________________________________________________________

Objective: Compare salary based on commission and a flat fee.

_Author Intent_

Students have previously worked with the percent equation to find unknown values or percents. Now they compare a fixed value with a percent of a whole, which requires making a prediction and ultimately deciding the better deal.

_Instructional Design_

Discuss the various types of workers who face situations similar to this one. In addition to the film industry, you can mention investors, salespeople, writers, or artists.

Ask students to explain the meaning of the following idiom: _A bird in the hand is worth two in the bush_. Have a conversation about how this expression may not always be true.
Questions for Understanding

Before

• How can your personality affect a decision like this one? [Sample answer: A person who likes a sure bet may opt for the $3 million, but someone who is a risk taker might take a chance on the success of the movie.]

During

• What are the advantages of Offer A? [Sample answer: The movie star is sure to get $3 million and gets it right away. The star could invest it and earn more over time. Also, this offer avoids the risk of the movie bomb.]

• What are the advantages of Offer B? [Sample answers: If you have confidence in the movie and experience of ticket sales for other movies, you might decide that the risk is not very large. The star might also be someone who enjoys the excitement of the risk. The star can promote the movie to help boost ticket sales and make more money.]

After

• Which option would you choose? [Sample answers: Offer A; you do not need to worry about how well the movie sells. Offer B; If the movie does well, there’s a potential to make much more than $3 million.]

Connect Your Learning

Move to the Connect Your Learning screen. Start a discussion about real-world decisions and how it is often not possible to be certain which option is the “right” decision. Let students brainstorm factors that affect the decision in the Launch; for example, an individual’s decision might be based on projections about how well the movie will do or personal financial circumstances.

You may wish to point out that many people in sales, as well as waitpersons, often have payment arrangements in which they receive both a fixed amount and a percentage of sales (tips, in the case of the waitperson; commission, in the case of salespersons).

KEY CONCEPT (4 MIN)

Teaching Tips for the Key Concept

Real-world applications of percent often require a multi-step solution, involving multiplication and either addition or subtraction. You can have students click each radio button to show an example of using multiplication and either addition or subtraction in a real-world problem. Have students explain the process for finding the total cost of an item or the base price of an item.

The total cost of dinner in a restaurant is a three-step process: finding the tax as a percent of the cost of food, finding the tip as a percent of the cost of food, and adding all three quantities together.

PART 1 (7 MIN)

Objective: Use the percent equation to solve problems involving tax and tip.

Author Intent

Students use the percent equation to calculate taxes and tips in order to find the total cost of a meal in a restaurant.
Questions for Understanding

**Javier Says (Screen 1)** Use the Javier Says button to begin a discussion about meals tax rates and sales tax rates. Ask students to identify those tax rates in your area and to tell what they know about the general range of these tax rates elsewhere. You may want to extend the discussion to tip, and how Americans do not typically tip on the tax of a bill.

Before solving the problem

- How do you find the total cost of a meal in a restaurant? [Sample answer: Add the tax and tip to the cost of the food.]
- Will the tax be greater or less than $142? What about the bill? [The tax will be much less than the cost of food, but the bill will be greater. The tax is only 5% of the total, but the bill is the sum of $142 and the tax.]

While solving the problem

- If the tax is a percent of the cost of food, how can you use percents to solve this problem? [Sample answer: You can solve the percent equation for the part using 142 for the whole and 0.05 for the percent.]

After solving the problem

- Does the final answer, $149.10, make sense? Explain. [Sample answer: Yes; the cost of the food is about $140. Since 10% of 140 is 14, 5% of 140 is 7. The total should be slightly more than $140 + $7 = $147.]

**Solution Notes**

Some students may suggest solving this problem by converting 5% to a decimal rather than to a fraction:

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5% • $142 = 0.05($142) = $7.1, or $7.10
$7.10 + $142 = $149.10
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Ask them which form they prefer.

**Differentiated Instruction**

Elicit from students that the total price of a meal in a restaurant is the price of the food plus the amount of the food tax. Consider having students first solve a similar problem, but with simpler numbers, such as a 10% tax and a food bill of $50.

For advanced students: Have students come up with an easy procedure for calculating 5% tax on a given amount using mental math. For instance, students might recognize that they can calculate 10% of an amount by moving the decimal point one place to the left, and then find half of that amount to get 5%. When they need to find the tip, they can use a similar method to add 10% and 5% of an amount to calculate a 15% tip.

**Error Prevention**

Students may think that they are done when they find the tax (or the tip in the Got It). You can use a Know-Need-Plan organizer to help students think about what they need to find and emphasize that the goal is to find the total bill.

**Got It Notes**

Note that the tax from the Example is not considered in this problem. The goal is to find the sum of the price of service and the tip. Discuss with students that when they tip, the tip is based on the price of service only, not on the total including the tax. Emphasize that when they eat at a restaurant, the total cost is a significantly more than the price of the food, perhaps even 25–30% more.
Objective: Use the percent equation to solve problems involving commissions.

Author Intent
In Part 1, students found the total of a base cost and a percent of that base. In this problem, they are given the total and subtract a percent of the total to find the base price. They are presented with another real-world application of percents: commission. This problem introduces what commission is and how to calculate it, and it educates students about the sales industry and how business owners set their prices.

Instructional Design
You may need to define the word commission for students. Emphasize that the rate of commission is often fixed, so it depends only on the amount of sales.

For the first car, call on two volunteers, one to solve each part of the problem. Once you agree on the commission the salesman makes, have the second student find the base price of each car. For the other two cars, you may choose to have students work in groups or individually as needed.

Questions for Understanding

** Javier Says (Screen 1) ** Use the Javier Says button to help students understand that when they buy from people who are earning commission, they need to keep in mind that other factors are in play when they are directed toward a particular purchase. Some clothing stores pay a commission to salespeople, and realtors earn a commission on each house they sell.

Before solving the problem
• Why does the salesman direct the consumer to the most expensive car? [Sample answer: His rate of commission is constant, so he earns more money for selling a more expensive vehicle.]

While solving the problem
• How can the commission rate be a constant if it changes based on the price of the car? [Sample answer: The commission rate is a percent of the price of the car. That percent is a constant: 6%.]

After solving the problem
• Is the base price the amount of profit the car dealership earns? Explain. [No; you need to consider many factors, including the cost of the car to the dealership, the salaries of the salespeople, the rent and utilities of the building, advertising costs, health care costs, and other factors.]

Solution Notes
If students wish to use decimals for the commission rate, or you show the provided solution, you may want to use the Calculator tool in the tools menu to accelerate the solution.

Consider using the Proportionality & Percents mode of the Fraction and Percents tool to visually illustrate the problem. Consider dividing every quantity by 100 since the maximum input for the whole in the tool is 500.

Differentiated Instruction
** For struggling students: ** Use the Proportionality & Percents mode of the Fractions & Percents tool to illustrate the problem. Consider dividing every quantity by 1,000 since the maximum input for the whole in the tool is 500.
For advanced students: Ask advanced students how you would find the commission rate given the commission and selling price. They should describe the relationship as proportional and may cite the equation \( y = mx \). If you know both \( x \) and \( y \), you can solve for \( m \), the commission rate.

**Error Prevention**

Students may want to add the commission to the selling price, rather than subtract it, when solving part (b). Remind them that the commission is not part of the profit, because the dealership pays commission to the salesman.

**Got It Notes**

Each answer choice assumes students subtract correctly in part (b) using their answer from part (a). If you show answer choices, consider the following possible errors:

Students who choose B or D are either multiplying by 0.3% or 30%, respectively. If students choose A, they moved the decimal in the selling price over three places.

**Got It 2 Notes**

In this problem, make sure students understand that the commission rate only depends on the whole (the selling price) and is a constant rate, while the flat fee is a constant value. The provided solution uses two examples to demonstrate how the commission can vary. Compare this situation to the one from the Launch.

**PART 3**

Objective: Use proportional relationships to make decisions involving commissions.

**Author Intent**

This problem combines elements of the previous problems in this lesson. Students are given the total sales for a situation and asked to decide between two options: a flat fee and commission. They have the information needed to calculate quantities and make a single decision, which extends the reasoning they used in the Launch and Got It in Part 2.

**Instructional Design**

Discuss with students how some of the real-life situations involving percent in this lesson (such as sales commission, tips, and wages) use percentage to motivate someone to work hard. Explain that in these cases, the percent is an incentive.

**Questions for Understanding**

Before solving the problem

- How might Taylor have arrived at an estimate of $200 per day? [Sample answer: She could have calculated her average sales per day over the last few months.]

- How can you compare the two options? [Sample answer: You can use multiplication to find the total wages for Option A and use the percent equation to find the total commission for Option B.]

After solving the problem

- Which option do you think the store would prefer? [Sample answers: The store might prefer Option A because they will have to pay Taylor less. The store might also prefer Option B because Taylor would be driven to sell more clothing.]

- Which option would you take if you were in Taylor’s shoes? [Sample answers: I would take Option B because I probably will make more money. I would take Option A in case I had trouble selling clothing suddenly.]

- What are some incentives used to motivate you to work harder as a student? [Sample answers: grades, end-of-year awards; field trip]
Solution Notes
Because this problem has two options to compare, use the animated solution to separate the two options and keep the solution for each option organized.

An alternate way to calculate the commission Taylor would earn on her weekly sales would be to find the amount of commission for one day, and then multiply that amount by 5. Make sure students understand that this is an application of the Associative Property of Multiplication.

Students may also find and compare the wages for one day. They can multiply the hourly wage by 4 for Option A and find 18% of $200 for Option B. Ask students to explain why this method also works, stressing that both options involve multiplying by 5.

Error Prevention
You can use a Think-Write organizer to help students work through each step carefully. You might ask students to fill in the entire Think column before beginning to solve the problem.

Students may need to review writing a percent as a decimal. A common error is to move the decimal point two places in the wrong direction. Encourage students to check that their decimal value is reasonable.

Got It Notes
Students can work on either option first as long as they clearly label their work and do not mix up the options.

Students may get the correct answer using incorrect reasoning, such as comparing the 16 for the hourly wage in Option A and the 16 for the commission rate in Option B. Make sure students justify their decisions and show all work.

Got It 2 Notes
Remind students that Jon’s estimate is $3,500 in sales per week. Stress that this number is purely an estimate and that Jon may sell an amount either less than or greater than $3,500.

Students may disagree about the best option in this problem. Some students will prefer the steady paycheck each week, and others will prefer the opportunity to make more money. Discuss any outside factors that might influence Jon’s decision.

CLOSE AND CHECK (8 MIN)

Focus Question Sample Answer
Fixed numbers do not change, while the percent of an amount depends on the amount. Percents are good when you can take risks with what the resulting quantity is. Fixed numbers are good if you want to have a reliable quantity every time.

Focus Question Notes
Listen for students to describe financial situations from this lesson in which percent is commonly used: sales commission, tax, tips, and negotiating wages. Help them talk about when percents are better than fixed amounts. You can use the housing market as another example to generate discussion.

Emphasize that percents are not always better than numbers. If quantities are the same or similar, you can use numbers to compare parts of an amount, which may be faster than finding percents.
Essential Question Connection

To connect to the Essential Question about plans and decisions, you might want to talk with students about things to consider before taking a risk on the percentage of an amount: they should analyze givens, hear various pro and con arguments, ask questions, and make informed projections/estimations. Then they can make an educated decision.

Use the following question to connect percent amounts and fixed amounts to the Essential Question about making comparisons with percents.

- What are some questions the movie star in the Launch or the car buyer in Example 2 should ask before they make a decision? [The movie star might ask who else is starring in the movie before he determines whether it will be a blockbuster; The car buyer might ask the salesman which car he drives.]