



LESSON 3

Scaling Up

In this lesson, students solve a multi-step problem by using ratio and rate reasoning to scale for large quantities and compare costs.

CONNECTIONS TO THE CORE

- Interpret multiplication as scaling (resizing). **5.NF.B.5**
- Add, subtract, multiply, and divide decimals to hundredths. **5.NBT.B.7**
- Use ratio and rate reasoning to solve real-world and mathematical problems. **6.RP.A.3**
- Represent proportional relationships by equations. **7.RP.A.2c**

LANGUAGE SUPPORT

MATH TERMS

rate
ratio comparing two quantities with different units

scale
change quantity by a constant ratio

ACADEMIC LANGUAGE

budget
plan for revenue and expenses

ratatouille
dish with simmered vegetables and herbs

SET UP

Introduce Chapter 4 from *Math Meets Culinary Arts*.

Ask questions to review Lesson 2 and connect to Lesson 3.

For example: **How did we use proportional reasoning to scale the recipe down and convert from grams to ounces?** (We divided the quantities by 4 and set up a proportion to find the converted quantities.)

Have students make a list of costs that people in the food industry need to consider. (salaries, fresh food costs)

Today, we'll analyze rate to discover how a small difference in price can result in large cost savings when scaling up a meal to serve 500 people.

Play Chapter 4: Scaling Up.



[Pause at 01:57.]

PLAN

Create a plan to solve the problem.

Jacob's ratatouille has about 950 g fresh bell peppers and squash, which costs \$8.45. It serves 6 people. A bag of frozen vegetables weighs 454 g and costs \$2.99. If Jacob makes ratatouille for 500 students, how much money would the school save using frozen instead of fresh vegetables?

Read the problem aloud to students.

Have students use proportional reasoning to analyze the quantities and serving sizes.

For example: **How can we express the ratio in this problem?** (cost: quantity: servings)
What do we need to find? (the total cost difference of using frozen instead of fresh vegetables for 500 servings)

Guide students to organize the information by setting up ratios to solve the problem.

What is the first step you could take to solve the problem? (find the cost difference for 6 servings)



LESSON

3

Scaling Up, *continued*

STANDARDS FOR MATHEMATICAL PRACTICE

Persevere and Solve Problems

Students apply logical thinking to scale up the quantities in the problem and plan a solution pathway.

Use Tools Strategically

Students choose between different tools such as proportions and tables to find an efficient strategy.

SOLVE

Have student pairs solve the problem as you circulate.

Encourage students to come up with multiple strategies and represent the problem situation in different ways. Guide students to work backwards to check their work.

SUPPORT

Ask questions based on common errors to support student understanding.

- **About how many bags of vegetables will Jacob need to make 6 servings?**
- **How much will Jacob save by substituting frozen vegetables to make 6 servings?**
- **How much would the school save per person? per 100 people? per 500 people?**

EXTEND

Ask questions to encourage students to extend their thinking.

- **Why is there a range of acceptable answers instead of just one answer?**
- **How much money could Jacob's school save with frozen vegetables over 180 days?**
- **Write an equation to show the cost savings for any number of people.**

SHARE

Have students present their solutions.

Ask students from each pair to explain their solutions to the class. Show at least two different approaches to solving the problem and one incorrect solution. To extend classroom discussion, call on students to explain the reasoning of the student who is presenting.

Possible student work:

Fresh vegetables (6 servings) → \$8.45

Frozen vegetables (6 servings) → $\frac{\$2.99}{454\text{ g}} (950\text{ g}) \approx \6.26

Difference for 6 servings → $\$8.45 - \$6.26 = \$2.19$

Difference for 500 servings → $\frac{\$2.19}{6\text{ servings}} (500\text{ servings}) = \182.50

The school would save \$182.50.*

*Answers may vary with different methods. Accept all reasonable answers: \$180–\$185.



Play the Chapter 4 Solution from Math Meets Culinary Arts.

Have students complete the Practice and Reflect sections on Student Page 2.

HOMEWORK IDEAS

Have students plan the budget for a meal!

Students choose items they would like to see on their school lunch menu.

- **How much does each item cost per serving?**
- **What is the total cost of the meal?**
- **Now, compare this cost to what your school charges—can you make a profit?**

LESSON

3

Scaling Up

MATH TERMS

rate

ratio comparing
two quantities with
different units

scale

change quantity by a
constant ratio

Jacob's ratatouille has about 950 g fresh bell peppers and squash, which costs \$8.45. It serves 6 people. A bag of frozen vegetables weighs 454 g and costs \$2.99. If Jacob makes ratatouille for 500 students, how much money would the school save using frozen instead of fresh vegetables?

PLAN

Create a plan to solve the problem with your partner.

SOLVE

Use your plan to solve the problem.

LESSON

3

Scaling Up, *continued*

PRACTICE

Apply your skills to solve another problem.

The ratatouille recipe calls for exactly 2.09 bags of frozen vegetables to make 6 servings. This works out to 175 bags for 500 people. If Jacob makes an estimate and uses 2 bags for 6 people, how much less would it cost to serve 500 people? In grams, what is the total quantity of frozen vegetables that would be missing?

REFLECT

Explain how you made sense of the math.

How did you begin solving these problems?

I began solving these problems by _____

Why is scaling large quantities important for managing costs?

Scaling large quantities is important for costs because

LESSON

3

Scaling Up

POSSIBLE STUDENT WORK

MATH TERMS

rate

ratio comparing two quantities with different units

scale

change quantity by a constant ratio

Jacob's ratatouille has about 950 g fresh bell peppers and squash, which costs \$8.45. It serves 6 people. A bag of frozen vegetables weighs 454 g and costs \$2.99. If Jacob makes ratatouille for 500 students, how much money would the school save using frozen instead of fresh vegetables?

PLAN

Create a plan to solve the problem with your partner.

First, I will find the cost of using fresh vegetables for 500 people.
Then, I will find the cost of using frozen vegetables. I need to find the quantity of vegetables and the number of bags because the bags come in a different size.
Finally, I will compare the costs and subtract to find the savings.

SOLVE

Use your plan to solve the problem.

Fresh vegetables:

Total cost → \$8.45: 6 servings

$$\frac{\$8.45}{6 \text{ servings}} (500 \text{ servings}) = \$704.17$$

Frozen vegetables:

Grams → 950 g: 6 servings

$$\frac{950 \text{ g}}{6 \text{ servings}} (500) \approx 79,167 \text{ g}$$

Bags → 1 bag: 454 g

$$\frac{1 \text{ bag}}{454 \text{ g}} (79,167 \text{ g}) \approx 175 \text{ bags}$$

$$\text{Total cost} \rightarrow 175 \times \$2.99 = \$523.25$$

$$\text{Difference in cost} \rightarrow \$704.17 - \$523.25 = \$180.92$$

The school would save \$180.92.*

**Answers may vary with different methods.
Accept all reasonable answers: \$180–\$185.*

LESSON

3

Scaling Up, continued

POSSIBLE STUDENT WORK

PRACTICE

Apply your skills to solve another problem.

The ratatouille recipe calls for exactly 2.09 bags of frozen vegetables to make 6 servings. This works out to 175 bags for 500 people. If Jacob makes an estimate and uses 2 bags for 6 people, how much less would it cost to serve 500 people? In grams, what is the total quantity of frozen vegetables that would be missing?

First, I will find the number of bags needed to serve 500 using 2 bags per 6 people. Next, I will find the difference in the number of bags at 2.09 per 6 servings and 2 per 6 servings. I will use this to find the difference in the cost and quantity of vegetables for 500 people.

$$\frac{2}{6} = \frac{x}{500}$$

$$\frac{1}{3}(500) = x$$

$$x \approx 167$$

175 bags – 167 bags is 8 bags.

Difference in cost:

1 bag costs \$2.99.

$$8 \times \$2.99 = \$23.92 \text{ savings}$$

Difference in quantity:

1 bag weighs 454 g.

$$8 \times 454 \text{ g} = 3,632 \text{ g}$$

If Jacob rounds from 2.09 bags to 2 bags per 6 people, the ratatouille would cost \$23.92 less and contain 3,632 g less for 500 people.

REFLECT

Explain how you made sense of the math.

How did you begin solving these problems?

I began solving these problems by analyzing
the quantities carefully and setting up a
proportion.

Why is scaling large quantities important for managing costs?

Scaling large quantities is important for costs because
a small unit cost is always multiplied by a
scale factor when preparing a larger quantity.