

Represent and Solve Equations and Inequalities

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TOPIC
4

REPRESENT AND SOLVE EQUATIONS AND INEQUALITIES

? Topic Essential Question

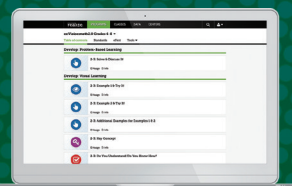
What procedures can be used to write and solve equations and inequalities?

Topic Overview

- 4-1 Understand Equations and Solutions
- 4-2 Apply Properties of Equality
- 4-3 Write and Solve Addition and Subtraction Equations
- 4-4 Write and Solve Multiplication and Division Equations
- 4-5 Write and Solve Equations with Rational Numbers
- 4-6 Understand and Write Inequalities
- 4-7 Solve Inequalities
- 3-Act Mathematical Modeling:
Checking a Bag
- 4-8 Understand Dependent and Independent Variables
- 4-9 Use Patterns to Write and Solve Equations
- 4-10 Relate Tables, Graphs, and Equations

Topic Vocabulary

- Addition Property of Equality
- dependent variable
- Division Property of Equality
- equation
- independent variable
- inequality
- inverse relationship
- Multiplication Property of Equality
- solution of an equation
- Subtraction Property of Equality



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Lesson Digital Resources

- INTERACTIVE ANIMATION** Interact with visual learning animations.
- ACTIVITY** Use with *Solve & Discuss It*, *Explore It*, and *Explain It* activities, and to explore Examples.
- VIDEOS** Watch clips to support 3-Act Mathematical Modeling Lessons and STEM Projects.
- PRACTICE** Practice what you've learned.

3-ACT MATH



Checking a Bag

A large plane flying across the ocean can weigh almost 1 million pounds! The heavier an airplane is, the more fuel it needs for a flight. The cost of fuel has led many airlines to add a weight restriction on luggage. If you were to fly somewhere, what would you bring? What would you leave at home to minimize the weight of your luggage? Packing light is important, not only to avoid a fee but also to do your part to conserve fuel. Think about this during the 3-Act Mathematical Modeling lesson.



Additional Digital Resources

- TUTORIALS** Get help from *Virtual Nerd*, right when you need it.
- KEY CONCEPT** Review important lesson content.
- GLOSSARY** Read and listen to English/Spanish definitions.
- ASSESSMENT** Show what you've learned.

- MATH TOOLS** Explore math with digital tools.
- GAMES** Play Math Games to help you learn.
- ETEXT** Interact with your Student's Edition online.

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Topic Essential Question

What procedures can be used to write and solve equations and inequalities?

Revisit the Topic Essential Question throughout the topic. See the Teacher's Edition for the Topic Review for notes about answering the question.

3-Act Mathematical Modeling

Generate excitement about the upcoming 3-Act Mathematical Modeling lesson by having students read about the math modeling problem for this topic.

See the Teacher's Edition lesson support for notes about how to use the lesson video in your classroom.



Video



Activity

3-ACT MATH

3-Act Mathematical Modeling: Checking a Bag

Lesson Overview

Objective

Students will be able to:

- ✓ use mathematical modeling to represent a problem situation and to propose a solution.
- ✓ test and verify the appropriateness of their math models.
- ✓ explain why the results from their mathematical models may not align exactly to the problem situation.

Essential Understanding

Many real-world problem situations can be represented with a mathematical model, but that model may not represent a real-world situation exactly.

Earlier in this topic, students:

- used properties of equality to write and solve equations.

In this lesson, students:

- develop a model to represent and propose a solution to a problem situation involving a one-step inequality.

Later in this course, students will:

- refine their mathematical modeling skills.

This mathematical modeling lesson focuses on application of both math content and math practices and processes.

- Students draw on their understanding of equality and inequality concepts to develop a representative model.
- Students apply their mathematical model to test and validate its applicability to similar problem situations.

Math Anytime



Today's Challenge

Use the Topic 4 problems any time during this topic.

The screenshot shows a digital interface for 'Today's Challenge'. At the top, there's a 'Go back' button and a progress bar for 'Day 1' with buttons for days 2, 3, 4, 5, and a 'DIY' button. The main content area is titled 'Morgan's Tessellation' and includes a text block: 'Morgan created a tessellation using the number and type of shapes shown in the table. Then she made a copy of the tessellation to give to her sister. Write an expression for the total number of shapes in both tessellations.' Below the text is a table with three columns: 'Shapes Used', 'Number of Shapes', and 'Length of Each Side'. The table contains three rows: a hexagon with 6 shapes and side length n , a square with 12 shapes and side length $2n$, and a triangle with 17 shapes and side length n . To the right of the table is a vertical toolbar with various icons for editing and navigation. At the bottom right, it says '2 of 7'.

Shapes Used	Number of Shapes	Length of Each Side
	6	n
	12	$2n$
	17	n

FOCUS

COHERENCE

RIGOR



Mathematics Overview

In this lesson, students will develop and use a mathematical model to represent and propose a solution to a real-world problem involving a one-step inequality. Students will reinforce both their procedural skills as well as their understanding of the limitations of some mathematical models for real-world situations.

Applying Math Practices

Model with Math

The focus of this lesson is on mathematical modeling. To solve the problem situation presented, students will identify variables and the relationship among variables, develop a model that represents the situation, and use the model to propose a solution.

As students carry out mathematical modeling, they will also engage in sense-making, abstract and quantitative reasoning, and mathematical communication and argumentation. In testing and validating their models, students look for patterns and structure.



3-Act Mathematical Modeling

ACT 1 The Hook



Students will be tasked with determining how many shoes someone can pack in a suitcase.

Play the Video and Brainstorm Questions

Have students complete **Question 1**. Encourage them to consider the situation and ask any questions that arise. Listen for interesting mathematical *and* non-mathematical questions. Ask students what makes each question interesting.

Q: What questions do you have? [Sample answer: Where is he going? Why does he need so many shoes? How many shoes fit inside the suitcase? How much will that bag weigh?]

Pose the Main Question

After the question brainstorming, pose the Main Question students will be tasked with answering. Have students complete **Question 2**.

Main Question

Q: How many pairs of shoes can he pack?

Ask about Predictions

Have students complete **Questions 3–5**. You can survey the class for the range of predictions.

Q: Why do you think your prediction is the answer to the Main Question?

Q: Who had a similar prediction?

Q: How many of you agree with that prediction?

Q: Who has a different prediction?

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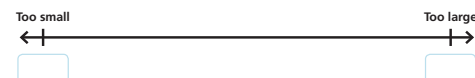
ACT 1

1. After watching the video, what is the first question that comes to mind?

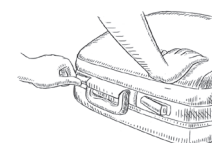
2. Write the Main Question you will answer.

3. **Construct Arguments** Predict an answer to this Main Question. Explain your prediction.

4. On the number line below, write a number that is too small to be the answer. Write a number that is too large.



5. Plot your prediction on the same number line.



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3-Act Mathematical Modeling *continued*



Activity

ACT 2 The Model



Identify Important Info

Have students complete **Question 6**.

Q: What information would be helpful to solve the problem?

[Sample answer: What the weight limit is; how much a pair of shoes weighs; how much the suitcase weighs]

Q: How could you get that information?

Q: Why do you need that information?

Reveal the Information

Reveal the information provided below using the online interactivity. Have students record information in **Question 7**.

Weight limit: 50 lb

Shoe weights: 2.2 lb, 2.5 lb, 2.2 lb, 2.3 lb

Suitcase weight: 6.2 lb

Develop a Model

As students answer **Questions 8 and 9**, look at methods that they are using and prompt them to think about whether they need an equation or an inequality.

Q: How can you describe the relationship between the number of shoes and the weight limit? [Write an inequality; The weight of the shoes plus the weight of the suitcase must be no more than 50 pounds.]

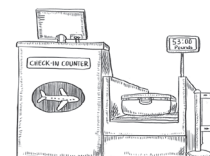
Use the Model to Propose a Solution

After students answer **Questions 8 and 9**, facilitate a discussion about solution methods. If needed, project the possible student solutions (shown below).

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ACT 2

6. What information in this situation would be helpful to know? How would you use that information?



7. Use Appropriate Tools What tools can you use to get the information you need? Record the information as you find it.

8. Model with Math Represent the situation using the mathematical content, concepts, and skills from this topic. Use your representation to answer the Main Question.

9. What is your answer to the Main Question? Is it higher or lower than your prediction? Explain why.



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Possible Student Solutions

Karina's Work

p = number of pair of shoes

$$2.3p + 6.2 \leq 50$$

$$2.3p \leq 43.8$$

$$p \leq 19.04$$

He can pack 19 pairs.

Karina uses an average weight to write and solve a two-step inequality.

Malik's Work

Subtract the bag

$$50 - 6.2 = 43.8$$

$$2.5x \leq 43.8$$

$$x \leq 17.52$$

The answer is 17.52

Malik uses subtraction and the greatest weight to write a one-step inequality. He does not round his answer.



Video

ACT 3 The Solution and Sequel



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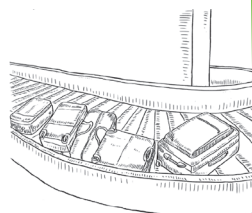
ACT 3

10. Write the answer you saw in the video.

11. **Reasoning** Does your answer match the answer in the video? If not, what are some reasons that would explain the difference?



12. **Make Sense and Persevere** Would you change your model now that you know the answer? Explain.



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ACT 3 Extension

Reflect

13. **Model with Math** Explain how you used a mathematical model to represent the situation. How did the model help you answer the Main Question?

14. Was an *equation* or an *inequality* more useful to answer the Main Question? Explain.

SEQUEL

15. **Be Precise** A different airline has a weight limit of 40 pounds for a checked bag. Explain how the answer would change for this airline.



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Use the Video to Reveal the Answer

The final part of the video shows the entire process of packing shoes and weighing the suitcase. Have students complete **Question 10**. Offer praise to the students who were closest to the actual answer.

Main Question Answer

19 pairs of shoes

Validate Conclusions

After students complete **Questions 11** and **12**, encourage them to discuss possible sources of error inherent in using math to model real-world situations. Look for students to point out that their models are still useful even though they are not perfect.

Q: Why does your answer not match the answer in the video?

[Sample answer: Each pair of shoes has a slightly different weight. The ones we didn't weigh must have been lighter.]

Q: How useful was your model at predicting the answer?

Q: How could your model better represent the situation?

Reflect on Thinking

Use Appropriate Tools If time allows, have students complete **Questions 13** and **14** as an extension. Use this opportunity to discuss how students incorporate mathematical processes during the task.

Pose the Sequel

Be Precise Use **Question 15** to present a similar problem situation involving inequalities. You can assign to early finishers or as homework so students can test the usefulness of their models.

Q: A different airline has a weight limit of 40 pounds for a checked bag. Explain how the answer would change for this airline.

Using their models and the answer in the video, look for student solutions around 13 or 14 pairs of shoes.

Q: If the weight limit were 100 pounds, would your answer be twice the answer in the video? [No; Sample answer: Twice as many pairs of shoes wouldn't fit in the suitcase.]