

## Teacher Information

### Writing & Solving Linear Inequalities - 7th Grade Math

#### Introduction

This lesson is for use as an introduction to writing and solving linear inequalities. Students should already know how to write and solve one- and two-step linear equations. The lesson will bring the students further, helping them to determine the difference between an equation and an inequality, as well as identify which of the two should be used in given situations.

The opener can be shared with students before or after the warm-up to engage them in the lesson. Small groups for the Student Task should be differentiated ensuring each group includes students with a range of skill levels.

#### Aligned Standards

##### CCSS Mathematical Practices

MP1 Make sense of problems and persevere in solving them.

MP2 Reason abstractly and quantitatively.

MP4 Model with mathematics.

##### CCSS.MATH

7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

7.EE.B.4.A Solve word problems leading to equations of the form  $px + q = r$  and  $p(x + q) = r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm, its length is 6 cm. What is its width?*

7.EE.B.4.B Solve word problems leading to inequalities of the form  $px + q > r$  or  $px + q < r$ , where  $p$ ,  $q$ , and  $r$  are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid \$50 per week plus \$3 per sale. This week, you want your pay to be at least \$100. Write an inequality for the number of sales you need to make, and describe the solutions.*

#### Objectives

The lesson is designed to be part of a unit on solving inequalities.

- Students will be able to solve a one-step inequality.
- Students will be able to solve a two-step inequality.
- Students will be able to determine and write an inequality to represent quantities in a word problem.
- Students will understand the difference between solutions to equations and inequalities.

**Suggested Length:** 90 minutes; one block lesson or a two-day lesson (a break-point before step 5 or step 7 is suggested).

### Materials

- Index cards for each student with a unique number from -15 to 15 (can be adjusted to class size)
- A spinner with the four inequality symbols on it (if not available, the four inequality symbols can be put on pieces of paper to be pulled out of a hat)
- Computers with Internet access

### Opener (Motivation)

*Create a Field Trip Proposal.* Your teacher has announced that your class will be going on a field trip this semester. She does not know where, or when, or the cost, or anything about it at all! She explains that the class will be able to decide on any field trip they want, but there *is* a catch. The trip can be to any location as long as the class creates a sound plan and budget. This will require writing linear equations and inequalities representing the cost of the trip. Think you're up for it?

[Note: If the school does not allow field trips, this can be conveyed as an after-school club activity.]

### Lesson Instructions

1. *Warm-Up:* Have the warm-up problems written on the board for students to work on as they arrive. These serve as review for solving two-step equations.

Solve for the variable.

$$4x + 15 = 75$$

$$0.5m - 4 = 20$$

$$9(p + 2) = 54$$

The laser tag arena charges groups a flat fee of \$25 and then \$2.50 per person.

Write an equation that represents the total cost.

If our group has \$63, how many people would be able to play?

**[Answers: 1. 15; 2. 48; 3. 4; 4a.  $C = 2.5x + 25$ ; 4b. 15 people]**

- As you are going over the warm-up questions, review *inverse operations*, *variables*, and *constants* and what it means to be a *solution*. Ask students to share different ways to solve these problems and compare the approaches.
- For warm-up question 4 (laser tag), ensure students define variables to represent the cost and number of people. Ask students how they answered part (b). Did they guess and check? Would 14 people be an acceptable answer? How about 16? What does it mean to be a *solution* to this problem as opposed to the first two questions?
- Activity: Am I a Solution?**  
Provide each student with an index card with a unique number from -15 to 15 (can be adjusted for your class size). Label one end of the classroom as “solution” and the other end as “not a solution.” Have a spinner with all four inequality symbols on it. If a spinner is not available, the four inequality symbols can be pulled out of a hat.

Provide the students with one equation at a time. They should solve the equation in their seats and determine the one solution. Then, spin the inequality spinner to change the equation to an inequality. Have the students determine whether they are a “solution” or “not a solution.” Make sure to enforce the understanding that the original solution to the equation only remains a solution to the inequality if the inequality includes the “or equal to” part.

$$15 + b = 23; b = 8$$

$$8n + 7 = 31; n = 3$$

$$d - 9 = -13; d = -4$$

$$\frac{m}{9} - 1 = -2; m = -9$$

*[Note: In addition to algebraic equations, try expressing each equation in words, such as “I’m a number that when added to 15 makes 23.” This activity could also be used as a review game or method for assigning students to groups.]*

5. Draw the four inequality symbols on the board. Have students come up and add verbal phrases to go with each one. They should easily add “less than” and “greater than,” etc. Try to lead them to phrases such as, “at most,” “no more than,” and “exceeds.”
6. *Individual Practice:* Provide students with the following problems and ask them to write an inequality statement for each one.
  - a. Avocados cost \$1.50 each; you have \$12.
  - b. The school needs to raise \$225. They are selling coupon books for \$10 each.
  - c. A movie ticket costs \$11 and each item from the concession stand is \$2. You have \$20 in your pocket.
  - d. Create a “story” that could be represented by  $9x + 2 \leq 74$ .

**[Answers:** a.  $1.50x \leq 12$ ; b.  $10x \geq 225$ ; c.  $2x + 11 \leq 20$ ; d. Answers will vary.]

7. Divide students into small groups to facilitate the culminating activity. Use the Student Task handout to help students structure their problem-solving. Students may struggle in deciding whether to use an equation or an inequality for each part.

**Field Trip:** Allow students to brainstorm on possible costs, but also help them decide on one flat fee and one variable fee of some sort. If there is no entrance fee, have them decide on an activity that everyone will participate in, and then an optional activity.

**Bus Fee:** Remind students that they must account for mileage going to AND returning from the location. *[Note: Actual transportation costs can be researched if your school policy is different or if private transportation must be booked.]*

**Fundraising:** Help students realize that the cost of materials is the fixed cost and should be subtracted from the total profit.

**Present:** Have each group present their ideas to the class. After all groups have presented, you could have the class vote on the best idea.

8. *Exit Ticket:* Write and solve an inequality for each problem.
  - a. Julie has been babysitting to save up money for a concert. She earns \$8 per hour and needs at least \$100 to go to the concert. How many hours should she babysit?
  - b. A cell phone company charges \$10 per month plus \$0.25 extra for each sent text; incoming texts are free. If your budget only allows for \$50 a month on cell phone charges, how many texts can you send each month?

**[Answers:** a.  $8x \geq 100$ ; b.  $x \geq 12.5$ ; c.  $0.25x + 10 \leq 50$ ; d.  $x \leq 160$ ]

## Student Task

### Create a Field Trip Proposal

1. Decide on an idea for a field trip. What costs are involved? Is there an entrance fee? Are there other costs for food, games, etc.? Brainstorm and list all possible costs before deciding on the answers to the following questions.

- a. What is the fixed cost for the trip?
  - b. What is the variable cost for the trip?
  - c. Write an equation or an inequality that estimates the total cost of the trip for each student.
  
2. The bus costs \$60 plus 0.50 per mile. The school budget for transportation is only \$100 per field trip.
  - a. Write an equation or an inequality that represents the total distance in miles that the school will travel.
  
  - b. How many miles will the school pay for?
  - c. Will your field trip fit within this limitation?
  
3. The class must pay for the costs of the field trip that are above the school transportation budget. To do this, the class can have a fundraiser! Decide on a fundraising idea (e.g., bake sale, car wash) and determine and list the cost of materials.
  - a. What will the price of each item or service be in order to cover the costs of materials and make a profit?
  
  - b. Write an equation or an inequality that represents the total profit of the fundraiser.
  
  - c. What is the goal profit of the fundraiser?
  
  - d. Write an equation or an inequality that represents the minimum number of items sold or services rendered in order to meet the goal.
  
  - e. Does the goal need to be adjusted or is it reachable?