# When Life Gives You Negatives...Flip It!

## Inequalities With One Variable

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| **Grade Level** | 8th – 9th Grade | **Time Frame** | 85 minutes |
| **Subject** | Mathematics | **Duration** | 2 class periods |
| **Course** | Algebra 1 | | |

## Essential Question

When and why would we change the inequality?

## Summary

In this lesson, students will use their pattern-recognition skills to determine when they must "flip" (reverse) the inequality symbol, which is when they are multiplying or dividing by a negative number. Students will work with inequalities in real-world scenarios throughout the lesson.

## Snapshot

**Engage**

Students consider the real-world applications of an inequality through a purchasing activity where they can spend at most their remaining balance.

**Explore**

Students perform operations on an inequality and look for a pattern.

**Explain**

Students use the pattern they found and formalize their understanding of when to reverse the inequality symbol when solving inequalities.

**Extend**

Students apply their knowledge to create their own scenario and then complete a Pass the Problem activity to solve the inequality.

**Evaluate**

Students find the mistake of a given problem and focus on the importance of learning from mistakes.

## Standards

*ACT College and Career Readiness Standards - Mathematics (6-12)*

**A602:** Solve linear inequalities when the method involves reversing the inequality sign

*Oklahoma Academic Standards Mathematics (Algebra 1)*

**A1.A.2.1:** Represent relationships using mathematical models with linear inequalities; solve the resulting inequalities, graph on a coordinate plane, and interpret the solutions.

## Attachments

- Exploring Inequality Rules—When Life Gives You Negatives.docx
- Exploring Inequality Rules—When Life Gives You Negatives.pdf
- Lesson Slides—When Life Gives You Negatives.pptx
- My Favorite Mistakes—When Life Gives You Negatives.docx
- My Favorite Mistakes—When Life Gives You Negatives.pdf
- Pass the Problem—When Life Gives You Negatives.docx
- Pass the Problem—When Life Gives You Negatives.pdf
- Purchase Options—When Life Gives You Negatives.docx
- Purchase Options—When Life Gives You Negatives.pdf
- Wants Are Greater Than Cash—When Life Gives You Negatives.docx
- Wants Are Greater Than Cash—When Life Gives You Negatives.pdf

## Materials

- Lesson Slides (attached)
- Wants Are Greater Than Cash handout (attached; one per student; print one-sided)
- Purchase Options signs (attached; one set per class; print one-sided)
- Exploring Inequality Rules handout (attached; one per student; print one-sided)
- Pass the Problem handout (attached; one per student; print one-sided)
- My Favorite Mistake handout (attached; one per student; print one-sided)
- Hasbro's Crocodile Dentist board game (optional)
- Individual whiteboards (one per student)
- Dry erase markers and erasers (one per student)

10 minutes

# Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to read aloud the essential question: "When and why would we change the inequality?" Show **slide 4** to share the lesson objectives. Review these slides with students to the extent you feel necessary.

Display **slide 5** and give each student a copy of the attached **Wants Are Greater Than Cash** handout. Have students select between the four cell phone options shown on the slide and record their selection and its cost on their handout.

Move to **slide 6** and explain to students that their cell phone selection has determined their spending limit for today's activity. Direct students to record their balance after their phone purchase on their handout; this will be their spending limit.

- Those who selected Phone A have a balance of $20.
- Those who selected Phone B have a balance of $60.
- Those who selected Phone C have a balance of $80.
- Those who selected Phone D have a balance of $100.

Show **slide 7** and guide students' attention to the **Purchase Options** signs displayed around the classroom. Inform students that they will be visiting four different "stores" (signs) to purchase necessities for their phones, but they cannot go over their spending limits.

Divide students into four relatively equal groups and have them take their handout and pencil to their first store. Direct students to read through the different options available, record what they want to purchase, and subtract the cost from their balance. Give students approximately 60 seconds at their first store. Have students repeat this as they rotate through all four stores. Play the 1-minute timer on the slide to help manage time.

After everyone has visited all four stations, have students return to their seats and display **slide 8**. Facilitate a brief discussion, using the following reflective questions:

- What was most important to you in making your purchase decisions and why?
- Was it an easy decision, why or why not?
- Did you get everything you wanted? What could you do differently to make sure you get everything you want?

### Alternative Activity

If students need additional support understanding the meaning of the less than or greater than inequality symbols or if they need additional practice to help remember which symbol is which, consider using the following activity for the Engage portion of this lesson.

Unhide and show **slide 9**. Invite two volunteers, Student A and Student B, to come to the front of the room. Give Student A and Student B each a whiteboard and dry erase marker. Use a digital random number generator, like the one from CPM Probability Generator to generate two integers. Have Student A and Student B each write one of the numbers on their whiteboard.

Invite another volunteer, Student C, to compare the two numbers, and then stand between Student A and Student B and hold their arms like an inequality symbol to make the comparison true. For example, if Student A and Student B are holding 4 and 7 respectively, then Student C would hold their arms open towards Student B (the 7).

Then, poll the class to see if they think Student C has chosen the correct inequality symbol or not.

Repeat this with different volunteers until students have practiced with the following combinations:

- A positive and a positive
- A positive and a negative
- A negative and a negative

If you have access to the Hasbro's Crocodile Dentist board game, consider having Student C point the crocodile's mouth to represent the inequality symbol. If Student C is correct, the person the crocodile is facing must spin the wheel (that is included with the game) and press that number of teeth. If the crocodile chomps down, then that student is out and is replaced with a new volunteer.

15 minutes

# Explore

Place students into groups of 2–3 and give each student a copy of the attached **Exploring Inequality Rules** handout. Display **slide 10** with the true inequality: 12 > 4. Explain to students that they are to work within their group to complete the table, where they are to perform the indicated operation to both sides of the inequality, and then determine if the resulting inequality is still true or now false. If the inequality is false, they need to write what would make the inequality true. For example, in the first row, the operation is "+ 4," which would result in 16 > 8, which is still true. For each row, students should apply the operation to 12 > 4, not to the result of the previous row. However, if students do apply the operation to the previous row, their observations should be the same, just with different numerical values. Here students are also asked to apply the following operations: subtract 4, and multiply and divide by both positive and negative 4. Use the slide to show students how to complete their handout, then transition to **slide 11** to leave displayed as a reminder while groups work.

After students have completed the table, show **slide 12** and direct the students' attention to the empty table on the slide. Display **slide 13** to reveal the completed first row of the table (except the last column, which will be reviewed shortly) and ask for a volunteer to share the reasoning behind the results of that row. Repeat this for the remaining rows by transitioning through **slides 14–18**. Then ask the class for the rows that were false, what change(s) would make them true. As volunteers share, move to **slide 19**, which shows the language of "reverse" and "flip" as ways to describe the needed change for the inequality symbol.

Display **slide 20** and direct students to discuss the questions on the slide within their groups and be prepared to share.

- When does the inequality stay true?
- When does it become false?
- What do you notice or wonder about the situations where it became false?
- What conclusion can you create?

Call on different groups to share their groups' responses. If needed, ask clarifying questions:

- When did we have to reverse the inequality symbol?
- Why did we have to flip it?

30 minutes

# Explain

Give each student an individual whiteboard, dry erase marker, and eraser. Display **slide 21** and have students solve the inequality: $3x > -12$. Then show **slide 22** and discuss the solution as a class.

Repeat this using **slides 23–24**, having students solve: $-3x > 12$. Emphasize to students the difference between the two problems (dividing by a negative number). Ask the class to think about what they learned when completing the table on their Exploring Inequality Rules handout and what they are noticing here. Explain to the class that multiplying or dividing both sides of an inequality by a negative number reverses or "flips" the inequality symbol—it is like flipping the number line.

Direct students' attention back to their handout and show **slide 25**. Have students write the following rule in the "Write a Rule" section of their handout: *When you multiply or divide both sides of an inequality by a negative number, you must flip the inequality symbol.*

Display **slide 26** and read the scenario on the slide, "You have $400 that needs to at least cover the costs of the $76 activation fee that the cell phone company charges and 12 months of monthly payments." Ask students to write an inequality that represents the scenario where $m$ represents the maximum monthly payment they can afford. Have students write this on the back of their handout or on a piece of notebook paper.

Show **slide 27** and ask for volunteers to share how they knew how to write their inequality. This slide shows: $400 \geq 76 + 12m$, and if students have an equivalent variation, be supportive and encourage multiple correct answers.

Use this time to resolve misunderstandings before continuing.

Then ask students to solve the inequality by having them first move the variable term to the left side. Remind them that this is not a requirement for all problems, but that you would like to challenge them by asking that they start in this way. Starting in this way will ensure that they will later have a negative coefficient that they need to divide by. Once students begin, display **slide 28** to reveal the result of the first step. Give students time to ask questions, and then ask students to complete the problem.

After a couple of minutes, transition through **slides 29–30**. Use this time to ask volunteers to share their reasoning for those steps.

20 minutes

# Extend

Have students get into groups of four or assign groups. If you do not have a class that divides equally into groups of four, having a few groups of three would work as well. Show **slide 31** and introduce the Pass the Problem strategy. Give each student a copy of the attached **Pass the Problem** handout and let them know that they are going to create their own real-world example of an inequality.

Direct students' attention to their handout and explain that they will be given 2 minutes each round to complete the task in each row, and when the timer expires, they are to pass their paper to the person on their right. During those 2 minutes, they need to write their name and follow the directions in that row. They should also show work and complete the task in the second column of that row.

Display **slide 32** and remind students to write their name next to "Student A" on their handout, and that as Student A, they need to fill in the blanks to create their story problem. Then, begin the 2-minute timer on the slide.

Repeat this process for Rounds 2–4 using **slides 32–35**.

- **Student B:** Write the inequality.
- **Student C:** Check Student B's work and then write the first step in solving the inequality.
- **Student D:** Check Student C's work and then finish solving the inequality.

10 minutes

# Evaluate

Show **slide 36** and give each student a copy of the attached **My Favorite Mistake** handout. Introduce the My Favorite Mistake strategy and share how it can help them improve their problem-solving skills to help build their understanding. Tell students that the worked-out problem on the slide has a mistake. Ask them to quietly think about where the mistake is, giving everyone a chance to find the mistake. Encourage kids to write on their handout, as this is the first example. Move to **slide 37**. Here the identified mistake is circled and a description of what should have been done with the correct answer is shown. Explain that this slide is an example of what their work should look like.

**Teacher's Note: Purpose**

The purpose of using this strategy is to reinforce to students the importance of learning from mistakes and to encourage students to apply this thinking to future problem-solving tasks.

Invite students to complete examples 2–3. Once they have done so, have them turn in their responses. After all handouts have been collected, if time permits, unhide and share **slides 38–39** to show students the sample responses for Examples 2–3 from their handout. Walk through the problem with the students as needed.

## Resources


- Hasbro. (n.d.). *Crocodile dentist board game, Fun Surprise chomping game for 2-4 players, Preschool Games*. Crocodile Dentist Board Game. https://consumercare.hasbro.com/en-us/product/crocodile-dentist-game-for-kids-ages-4-and-up/B1DEE410-7392-4005-A22F-0B18DE44C8CF
- K20 Center. (n.d.). CPM probability generator. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2317
- K20 Center. (n.d.). My favorite mistake. Strategies. https://learn.k20center.ou.edu/strategy/115
- K20 Center. (n.d.). Pass the problem. Strategies. https://learn.k20center.ou.edu/strategy/151
- K20 Center. (2021, September 21). *K20 Center 1 minute timer* [Video]. YouTube. https://www.youtube.com/watch?v=6ilD555O_RE
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