



Popcorn > Raisinets

Inequalities With Two Variables



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Grade Level	9th Grade	Time Frame	80-90 minutes
Subject	Mathematics	Duration	2 class periods
Course	Algebra 1		

Essential Question

How can two-variable inequalities be used to represent relationships?

Summary

This lesson is an extension of the "Pie > Everything" lesson series, adding a second variable to the equation. The goal is to understand and find possible solutions for two-variable inequalities. Students will translate real-life problems into linear inequalities and make the connection between the two. They will also write and graph two-variable inequalities.

Snapshot

Engage

Students watch a video and discuss questions to get them thinking about variables.

Explore

Students consider a real-world scenario and find multiple solutions to the problem.

Explain

Students resolve misconceptions to gain a deeper knowledge about inequalities.

Extend

Students elaborate on their knowledge of inequalities by playing a Desmos Classroom polygraph activity.

Evaluate

Students write linear inequalities represented by the given graphs.

Standards

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

- [Guided Notes—Popcorn>Raisinets - Spanish.docx](#)
- [Guided Notes—Popcorn>Raisinets - Spanish.pdf](#)
- [Guided Notes—Popcorn>Raisinets.docx](#)
- [Guided Notes—Popcorn>Raisinets.pdf](#)
- [Lesson Slides—Popcorn_Raisinets.pptx](#)
- [Movie Snacks—Popcorn>Raisinets - Spanish.docx](#)
- [Movie Snacks—Popcorn>Raisinets - Spanish.pdf](#)
- [Movie Snacks—Popcorn>Raisinets.docx](#)
- [Movie Snacks—Popcorn>Raisinets.pdf](#)

Materials

- Lesson Slides (attached)
- Movie Snacks handout (attached; one per student; printed front/back)
- Guided Notes handout (attached; one per student; printed front only)
- Student devices with internet access (tablets, laptops, or desktops recommended)

5 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Briefly introduce the essential question on **slide 3**. Move to **slide 4** to identify the lesson's learning objectives. Review each of these with students to the extent you feel necessary.

Move to **slide 5** and show the short "[Let's All go to the Lobby](https://www.youtube.com/watch?v=lm6IU6V-dE8)" video.

Embedded video

<https://youtube.com/watch?v=lm6IU6V-dE8>

After showing the video, pose the following questions.

Would you rather...

1. Have two boxes of candy and no drink, or a small popcorn and unlimited drinks?
2. Invite two more friends to watch a movie with you and have no snacks, or go with one friend and have the money to buy snacks?

Ask students to reflect on whether they would answer the question the same way every time, or differently depending on the circumstances.

20 minutes

Explore

Display **slide 6** and have students find an [Elbow Partner](#) to analyze the following scenario:

Scenario 1: Your family goes to the movies. The snack bar is all out of large popcorn containers and large cups. The only size they have left is small. Your family has \$30 to spend. How many orders of popcorn and drinks can they buy if a popcorn costs \$6 and a drink costs \$5? Your family does not want any change.

Pass out a copy of the attached **Movie Snacks** handout to each student. Have students work in pairs to figure out how many different combinations of popcorn orders and drinks can be bought for \$30 without receiving change. Have them put their answers in the blank chart provided on Part A of the handout.

Once they think they have found all possible combinations, have them move on to Part B where they can plot the points on the graph. After students plot their points, direct them to answer the questions in Part C, connect their dots with a line, and explain their thinking.

Teacher Note: Blank Column Headers

The first two column headers on Part A of the Movie Snacks handout are left blank, giving students the freedom to label these as "Popcorn" and "Drinks." The results of their linear graphs will differ depending on the order that they label the columns. This will serve as a great discussion topic during the Explain portion of the lesson.

Go to **slide 7** and direct students' attention to Scenario 2 on their handout:

Scenario 2: Your family decided it was way too difficult to determine the number of orders of popcorn and drinks they need to buy to get back no change. Now, they do not mind if they get change back from their \$30. How many different combinations of popcorn orders and drinks can your family buy?

Have students figure out the new combinations based on this scenario and record them in the second blank chart on the handout. Once they have figured out all the new combinations, ask them to plot the points on the graph and complete the handout.

20 minutes

Explain

Teacher's Note: Meeting Your Students' Needs

Slides 8-18 cover how to graph linear inequalities and provide example problems. Feel free to add more problems if necessary.

Edit **slide 8** to meet the needs of your students. Step 1 for graphing linear inequalities in your classroom might look different per class period. The slide is currently designed to meet the needs of any class, so you may leave the slide as is. This also applies to Step 1 on the Guided Notes handout. The first step of graphing linear inequalities is the same as the first step of graphing linear equations. Consider encouraging students to start by always making a table, always writing the inequality in slope-intercept form, or maybe you are ready to push students to become more flexible with how they graph lines, recognizing the given form and using it to determine how to start. Use this slide to meet your students' needs, but be sure to tell students that there are many ways to begin graphing linear inequalities, just like linear equations. Have students record notes about Step 1 on their Guided Notes handout.

Pass out a copy of the **Guided Notes** handout to each student and transition through **slides 8–9**. Explain to students that graphing linear inequalities is much like graphing linear equations: the first step is the same but the difference is they need to consider solid or dashed lines and shading with inequalities.

Display **slide 10** and explain the difference between solid and dashed lines and when they occur. Have students record when to use solid lines and when to use dashed lines on their handout by writing the \geq to and \leq symbols in the table under the graph of the solid line and writing $<$ and $>$ in the table under the graph of the dashed line.

Display **slide 11**, define “test point,” and demonstrate how to use them.

Transition through **slides 12–14** and demonstrate to students how to shade towards the test point when it makes the inequality true and to shade away from the test point when it makes the inequality false. Remind students to continue completing their handout.

Teacher's Note: Guiding the Lesson

Use slide 14 to help students understand the idea of shading towards and away from the test point. If students are still struggling, consider giving pairs of students different points and having them share their results with the class. These extra examples should help students see that no matter what point they select, as long as it is not on the line, points in the shaded region made the inequality true, while those not in the shaded region made it false. This approach can also help students have a better understanding of the infinitely many solutions being represented by the shaded region (and the infinitely many points that are not solutions).

It is also important to avoid using language such as “above” and “below the line” since a test point being true (or false) does not consistently determine whether one should shade above or below the line. Also, if an inequality is written with y on the right side (instead of the traditional left side), this can also disagree with some rules of shading above or below the line. Shading towards or away from the test point is something that always works, so it is strongly recommended to use this language.

Display **slide 15** and work through graphing the example with students while asking the guiding questions on the slide.

Check students' understanding using the challenge question on **slide 16**. Allow students to work in groups or pairs to graph the linear inequality.

Move to **slide 17** and reflect on the activity from the Scenario 2, Part B section of the Movie Snacks handout completed earlier. Have groups or pairs share their thought process for creating the equation in Scenario 2. As they do, start making connections between the activity and the rules of inequalities by asking the students the following questions:

1. Where are all the points located on the graph you created for Scenario 2?
2. Could you shade a region that would contain all your points?

Display **slide 18** and see if students recognize this inequality from the Explore scenarios. Ask students what the numbers in the inequality represent. Repeat this with **slide 19**. Ask students to raise their hand if their graph looked like what they saw on slide 18. Repeat this with slide 19. Then have a class discussion about why they are both correct.

Sample Student Responses

- The 5 is the cost of a drink; 6 is the popcorn price; and 30 is the total.
- I let x be the popcorn and y the drinks.
- I let x be the drinks and y the popcorn.

Help students with academic language and better understanding by encouraging descriptions such as x was the **number of** popcorn orders and y represented the **number of** drinks.

30 minutes

Extend

Teacher's Note: Desmos Classroom Polygraph Activity Preparation

In this portion of the lesson, students complete a [Desmos Classroom](https://k20center.ou.edu/externalapps/polygraphs/) polygraph activity, which is similar to the games “Guess Who” or “20 Questions” and encourages students to strengthen their academic vocabulary. For more information about how Desmos Classroom polygraphs work, go to <https://k20center.ou.edu/externalapps/polygraphs/>.

To use this Desmos Classroom activity, select the following link: “[Polygraph: Linear Inequalities](https://k20center.ou.edu/externalapps/polygraphs/).” Create an account or sign in under the “Activity Sessions” heading. After you log in, the green “Assign” dropdown button will be active. Click the arrow next to the word “Assign,” then select “Single Session Code.” After making some setting selections, select “Create Invitation Code” and give the session code to students. For more information about previewing and assigning a Desmos Classroom activity, go to <https://k20center.ou.edu/externalapps/using-activities/>.

Display **slide 20** and provide students with your session code. Then, have students go to student.desmos.com and enter the session code.

Once students enter the session code, explain to students how the polygraph activity works:

1. The first round will be quick and is for students to understand how the game works.
2. Students will then be automatically assigned partners to complete the activity. If you have an odd number of students, consider logging in as a student to be someone’s partner.
3. One student will be assigned the role of “guesser” and the other will be assigned the role of “picker.” The picker selects one of the inequalities. Then, the guesser will ask the picker yes or no questions to try to determine which graph the picker selected.
4. Have students play the game two times and answer the prompted questions at the end of the game.

As students work, use the teacher dashboard to see what questions students are asking each other. Remind and encourage students to use the vocabulary that they learned during the lesson.

Sample Student Responses

Students can ask a variety of questions. You can try to add a competitive element by encouraging academic vocabulary, because that should help the guesser more quickly guess the selected graph. For example, students asking questions like the ones below helps encourage academic language.:

- Does the graph have a solid line?
- Does the graph have a dashed line?
- Does the line have a positive slope?
- Does the line have a negative slope?
- Does the line have a positive y -intercept?
- Does the line have a negative y -intercept?
- Is the origin a solution?
- Is the origin part of the shaded region?
- Is $(2,0)$ a solution?

5 minutes

Evaluate

Use the [Exit Ticket](#) strategy to individually assess what students have learned from the lesson. Display **slide 21** and have students write the inequality that is represented by the given graph. Have students write their answer on an index card, sticky note, piece of paper, etc.

Use student responses to determine if they need additional practice with graphing or writing linear inequalities or are ready for the next topic.

Resources

- Clker-Free-Vector-Images. (2014, August 3). Popcorn [Illustration]. Pixabay. <https://pixabay.com/vectors/pop-corn-popcorn-corn-food-snack-312386/>
- K20 Center. (n.d.). Bell Ringers and Exit Tickets. <https://learn.k20center.ou.edu/strategy/125>
- K20 Center. (n.d.). Elbow Partners. <https://learn.k20center.ou.edu/strategy/116>
- Illichman. (n.d.). Polygraph: Linear Inequalities [Interactive activity]. Desmos. <https://teacher.desmos.com/activitybuilder/custom/560ad6907701c30306330601>
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