Two Worlds Collide, Part 1

Systems of Linear Equations: Graphing

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Grade Level	9th – 11th Grade	**Time Frame**	50-75 minutes
Subject	Mathematics	**Duration**	1-2 class period(s)
Course	Algebra 1, Algebra 2		

Essential Question

How can systems of equations be used to represent situations and solve problems?

Summary

This lesson focuses on how to analyze and solve systems of linear equations by using the graphing method. The goal is for students to use prior knowledge to expand their understanding of equations and how they connect to real-world scenarios. Students will be able to identify, solve, and write equations using graphing as their tool. This is the first lesson of three in the "Two Worlds Collide" lesson series.

Snapshot

Engage

Students evaluate a statement by using the Always, Sometimes, or Never True strategy.

Explore

Students discover intersection points through a Desmos activity.

Explain

Students formalize their understanding of different types of systems of equations: consistent and independent, consistent and dependent, and inconsistent.

Extend

Students solve a problem based on a real-world scenario.

Evaluate

Students reflect on their understanding of the lesson.

Standards

Oklahoma Academic Standards Mathematics (Algebra 1)

A1.A.1.3: Analyze, use and apply mathematical models to solve problems involving systems of linear equations with a maximum of two variables by graphing, substitution, and elimination. Graphing calculators or other appropriate technology may be utilized. Interpret the solutions in the original context.

Oklahoma Academic Standards Mathematics (Algebra 1)

A2.A.1.7: Represent and evaluate mathematical models using systems of linear equations with a maximum of three variables. Graphing calculators or other appropriate technology may be used.

Attachments

- Lesson-Slides-Two-Worlds-Collide-Part-1.pptx
- Note-Catcher-Two-Worlds-Collide-Part-1 - Spanish.docx
- Note-Catcher-Two-Worlds-Collide-Part-1 - Spanish.pdf
- Note-Catcher-Two-Worlds-Collide-Part-1.docx
- Note-Catcher-Two-Worlds-Collide-Part-1.pdf
- Skate-Park-Two-Worlds-Collide-Part-1 - Spanish.docx
- Skate-Park-Two-Worlds-Collide-Part-1 - Spanish.pdf
- Skate-Park-Two-Worlds-Collide-Part-1.docx
- Skate-Park-Two-Worlds-Collide-Part-1.pdf

Materials

- Lesson Slides (attached)
- Note Catcher handout (attached; one per student; printed front only)
- Skate Park handout (attached; one per student; printed front only)
- Paper
- Pencil
- Laptop or tablet with internet access

5 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to share the lesson's essential question. Display **slide 4** to go over the lesson's learning objectives. Review these slides with students to the extent you feel necessary.

Go to **slide 5**. Using the Elbow Partners strategy, have students discuss the first Always, Sometimes, or Never True statement: *Two lines cross at only one point.*

Give student pairs a couple minutes to analyze the statement and choose their claim. Once students have had time to discuss their claims, conduct a whole-class discussion by asking different pairs to share their viewpoints on the statement.

Teacher's Note: Guiding the Activity

During this part of the lesson, accept all responses with justifications, as students may come into this lesson with misconceptions. Make note of these misconceptions and make sure they are resolved by the end of the lesson.

10 minutes

Explore

Teacher's Note: Desmos Activity Preparation

To use this Desmos Classroom activity, select the following link: "Solutions to Systems of Linear Equations." 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/.

For more detailed information about Desmos features and how-to tips, go to https://k20center.ou.edu/externalapps/desmos-home-page/.

Display **slide 6** and provide students with your session code. Then, have students go to student.desmos.com and enter the session code.

Teacher's Note: Sign-in Options

If students sign in with their Google or Desmos accounts, then their progress is saved, and they can resume the activity or view their work later. If students continue without signing in, they can complete the activity, but they must do so in one sitting. It is strongly recommended that students sign in; otherwise, they risk losing their work.

Pass out the attached **Note Catcher** handout to each student. Invite students to take notes on the top portion of the handout as they work through the activity.

Teacher's Note: Guiding the Activity

Students should use their prior knowledge to navigate through the Desmos activity. Remind students not to focus on the answer—instead, ask them to focus on their process. This is a time for them to work individually and reflect on their knowledge while they figure out a process that works best for them.

If students struggle on screen 6, where they no longer have a graph to look at, encourage them to make a table of values or to graph those equations.

20 minutes

Explain

Assign student pairs or have each student find a partner. Display **slide 7** and give student pairs time to read the definitions for *consistent*, *inconsistent*, *dependent*, and *independent*. Remind students these definitions are also on the Note Catcher handout for later reference.

Go to **slide 8** and have student pairs use the definitions to match each graph on the slide with what they think is the best description: consistent and independent, consistent and dependent, or inconsistent. Ask students to draw, in pencil, a rough sketch of each graph in the corresponding columns on the Note Catcher handout.

As students finish sketching the graphs, go to **slide 9**. On the handout, ask student pairs to describe each type of system of equations. The goal is for each student to have both visual and verbal representations of the different types of systems of equations on their handout.

As students finish writing their descriptions, bring the class together to go through **slides 10–12**. Have students use these slides to confirm that they put the graphs in the right columns. Encourage students to write down any information from the slides that they may be missing on their handouts.

Ask for volunteers to share anything they wrote that was not on the slides. Use students' responses to check for misunderstandings.

10 minutes

Extend

Display **slide 13**. To expand students' knowledge of using graphs and equations to solve real-world problems, read aloud the following scenario: *You and your friend want to go to a skate park this weekend. There are two parks in the area, Scissortail and Silverstone. Scissortail costs 3 dollars to enter and 1 dollar for every hour you stay. Silverstone costs 5 dollars to enter and 50 cents for every hour you stay. Which skate park will you and your friend attend? Explain your reasoning.*

Pass out the attached **Skate Park** handout to each student. Have students work individually to create and graph their own equations based on the given scenario. Using their findings, have students determine which skate park they want to attend and explain why on their handouts.

Teacher's Note: Creating the System of Equations

Students can approach the problem in multiple ways. They should use their prior knowledge to determine which dollar value represents the slope and which dollar value represents the y-intercept. If some students get stuck on how to create the system of equations, do not write the equations for them; instead, guide them by asking them to make a table. Consider asking students what the independent and dependent variables are for each equation. Then, let students use their tables to either graph or write the equations. To ensure these students don't get lost, be sure to come back to them after they have written their equations and help them see the connection between their equations and the dollar values from the scenario.

After providing time for students to work through the problem, go to **slide 14**. Ask students to share with the class which park they decided to attend and why.

Teacher's Note: Guiding the Activity

Depending on how students respond, make sure students understand that Scissortail Skate Park is cheaper at first; then, as time increases, the cost at the two parks becomes the same (at 4 hours, the cost is 7 dollars at each park). After 4 hours, Silverstone Skate Park is the better value.

Emphasize that the solution to this system of equations is the point where the two parks cost the same dollar amount for the same amount of time—in other words, the point where they have the same y-value for the same x-value.

If time allows, consider asking the class to come up with a skate park example where there would not be a solution to that system of equations: Both parks would need to have the same rate (price per hour) while having different entrance fees.

For an extra challenge, ask the class if they can think of a skate park example where there would be infinitely many solutions: If Silverstone kept its 5 dollar entry fee and a rate of 50 cents per hour, but Scissortail had a 5 dollar entry fee and a rate of 1 dollar per 2 hours, then the cost at the two parks would always be the same.

The purpose of asking students to think about these situations is to help them see the connection between the slope and the possible number of solutions. If the slopes (rates) are the same, then that system of linear equations either has no solution or has infinitely many solutions. The y-intercepts are then used to determine which is correct. If the slopes are the same and the y-intercepts are the same, then there are infinitely many solutions. If the slopes are the same and the y-intercepts are different, then there is no solution. If the slopes are different, then that system has only one solution. Recognizing this relationship is a great way for students to check if their answer is reasonable.

5 minutes

Evaluate

To wrap up the lesson, have students use the How Am I Feeling? What Am I Thinking? strategy to reflect on their learning. Display **slide 15** and ask students to recreate the table on the slide on the back of their Skate Park handouts.

Go to **slide 16**. In the "How Am I Feeling?" column of the table, ask students to draw or write a description of how they feel about the content they've explored. In the "What Am I Thinking?" column, have students write a sentence that explains what they understand or think about the content they've explored. This could be a question or a comment about their learning or a description of the experience itself.

Use students' responses to give you an understanding of how well they comprehend the material and what you might have to tweak moving forward. Make sure students have a clear understanding of the visual representation of how a system of equations works before the next lesson: "Two Worlds Collide, Part 2."

Resources

K20 Center. (n.d.). Always, sometimes, or never true. Strategies. https://learn.k20center.ou.edu/strategy/145

K20 Center. (n.d.). Elbow partners. Strategies. https://learn.k20center.ou.edu/strategy/116

K20 Center. (n.d.). How am I feeling? What am I thinking? Strategies. https://learn.k20center.ou.edu/strategy/187

K20 Center. (n.d.). Desmos Classroom. Tech tools. https://learn.k20center.ou.edu/tech-tool/1081

Zimmermann, M. (n.d.). Solutions to Systems of Linear Equations [Interactive activity]. Desmos. https://teacher.desmos.com/activitybuilder/custom/564a325345d9115d06270607?collections=5da6485a83c0877d4b5708dd