Transformers, Part 1

Function Transformations

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Grade Level	8th – 10th Grade	**Time Frame**	2-3 class periods
Subject	Mathematics	**Duration**	120 minutes
Course	Algebra 1, Intermediate Algebra		

Essential Question

How are the transformations of parent graphs related?

Summary

Students will use a graphing tool to analyze basic transformations on linear, absolute value, and quadratic parent graphs in order to create general rules about function transformations.

Snapshot

Engage

Students begin their exploration of function transformations by analyzing linear functions with which they should already be familiar.

Explore

Small groups explore function transformations through a guided investigation with a graphing utility on absolute value and quadratic functions with the goal being for them to generalize the transformation rules.

Explain

Students come to consensus on the general transformation rules in a class discussion.

Extend

Students create their own graphs and equations before switching with another group to determine the corresponding equations or graphs.

Evaluate

Students predict the effects of a negative leading coefficient.

Standards

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

AF604: Given an equation or function, find an equation or function whose graph is a translation by a specified amount up or down

Oklahoma Academic Standards Mathematics (Algebra 1)

A1.F.2.2: Recognize the parent functions f(x) = x and f(x) = |x|. Predict the effects of vertical and horizontal transformations f(x + c) and f(x) + c, algebraically and graphically.

Attachments

- Exploring Graphs—Transformers, Part 1 - Spanish.docx
- Exploring Graphs—Transformers, Part 1 - Spanish.pdf
- Exploring Graphs—Transformers, Part 1.docx
- Exploring Graphs—Transformers, Part 1.pdf
- Lesson Slides—Transformers, Part 1.pptx

Materials

- Lesson Slides (attached)
- Exploring Graphs handout (attached; one per student; printed front/back)
- Pencil
- Paper
- Graphing calculator (or other graphing utility)

15 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. **Slide 3** displays the lesson's essential question: *How are the transformations of parent graphs related?* **Slide 4** identifies the lesson's learning objectives. Review each of these with your class to the extent you feel necessary.

Before starting the activity, have students pick a partner. Students need a graphing calculator or access to the Desmos Studio graphing calculator to complete the activity. Go to **slide 5** and display the equations $y = x$, $y = 2x$, and $y = \frac{1}{2}x$ for the students. Have the students use the graphing calculator to graph each function and ask them to compare and contrast the resulting graphs. Using Think-Pair-Share, have students share their answers. Choose a few students and ask them to share their answers with the class.

Go to **slide 6** and pose the same question using $y = x + 1$, $y = x - 2$, and $y = x + 3$. Discuss how these changes resulted in different graphs than the previous ones.

Discuss with students the idea of a parent graph.

45 minutes

Explore

Go to **slide 7** and have students continue to work with their partner to complete the attached **Exploring Graphs** handout. Allow students to work in their pairs independently but monitor their progress.

Teacher's Note: Graphing Tools

If this is the students' first chance to use the graphing utility, a short introduction may be required.

It is best practice to have students regularly use the same graphing utility so that they become familiar with the tool. If a class set of graphing calculators is not available, consider using Desmos Studio by having students go to www.desmos.com/calculator or have them use Graphing Calculator X84 on their iPad.

In Part I, students should make predictions about graphing and comparing $y = |x|$, $y = |x - 1|$, $y = |x + 3|$, $y = |x| - 2$, and $y = |x - 2| + 3$.

Students do this again in Part II, but with quadratic functions: $y = x^2$, $y = (x - 3)^2$, $y = (x + 1)^2$, $y = x^2 + 4$, and $y = (x - 2)^2 + 3$.

In Part III, students are asked to compare their absolute value and quadratic graphs to list observations and patterns.

In Part IV, each group then joins another group to compare what they observed.

Sample Student Responses:

- The graphs in Part I all have the same shape. The graphs in Part II all looked similar.
- Maybe the type of equation tells us what the shape of the graph will be.
- When there's a number inside the grouping symbols, the graph moves opposite of the direction I thought it would. It moved left or right.
- If there was a number added outside the grouping symbols, the graph moved up. If that number outside was subtracted, the graph moved down.
- If there are numbers both inside and outside the grouping symbols, then the vertex was not on an axis anymore.
- I think $(x - 2)$ moves the vertex right 2 and the + 3 on the end moves it up 3 units.

25 minutes

Explain

Go to **slide 8** and have students share what they observed from the Exploring Graphs handout with the class.

- What were the changes to the absolute value function?
- What were the changes to the quadratic function?
- What are the general rules of transformations?

Make sure there is consensus on the transformation general rules.

Teacher's Note: Scaffolding

If students struggle to come to consensus, more time and examples may be needed for them to generalize the transformations. If students are struggling with the idea of the number in the parenthesis having the opposite effect, like how $y = |x - 2|$ shifts the function 2 units to the right, this can often be clarified by showing students that if they set what is in the parenthesis equal to zero and solve; the result will describe the shift (i.e. $x - 2 = 0 \Rightarrow x = +2 \Rightarrow$ shifting right 2 units). *Why do we set it equal to zero? Because that’s the minimum value of the parent function; the minimum is where we find the vertex.

25 minutes

Extend

Go to **slide 9** and have students create their own graphs and equations in pairs to trade with another pair. Have students work with their original partner to create:

- 1 absolute value equation (no graph)
- 1 absolute value graph (no equation)
- 1 quadratic equation (no graph)
- 1 quadratic graph (no equation)

After they have completed this task, have pairs trade their creations with another pair. Each pair now needs to find the missing graph and equation for each provided equation and graph.

10 minutes

Evaluate

Go to **slide 10**. Again, using Think-Pair-Share, have students predict how the graph of $y = -|x + 3| - 5$ would differ from the parent function.

After giving students time to think about the answer (and writing something down), ask for a few volunteers to share their predictions. Then move to **slide 11** and facilitate a class discussion comparing the graph of given absolute value function compares to the parent graph. Use this time to answer any clarifying questions.

Teacher's Note: Scaffolding

If students are struggling with coming to consensus, scaffold by having students graph $y = -|x|$ and compare it to the parent function.

Resources

- IncptMobis. (2024). *Graphing Calculator X84* (Version 3.2) [Mobile app]. App Store. https://iphonecalculator.com/

- K20 Center. (n.d.). Desmos Studio. Tech Tools. https://learn.k20center.ou.edu/tech-tool/2356
- K20 Center. (n.d.). Think-Pair-Share. Strategies. https://learn.k20center.ou.edu/strategy/139
- Pixabay. (December 9, 2018). Figurine [Photograph]. Pixabay. https://pixabay.com/images/id-3871893/