Just Move It

ID: 11485

Time Required
40 minutes

Activity Overview

In this activity, students will explore translations, compressions, and stretches of the parent function graph $f(x) = x^2$ and $f(x)=x^3$.

Topic: Functions & Their Representations

- *vertical and horizontal shifts of graphs*
- *vertical compression and stretching*

Teacher Preparation and Notes

- *Problems 4 and 5 can be done as an extension if time is limited.*
- *The multiple-choice boxes on the worksheet can be deleted to make the activity more challenging.*
- *This activity can be done without the program. To graph the quadratic and cubic functions, enter* ***(X–B)^2+C*** *in Y1 and* ***(X–B)^3+C*** *in Y2. Press* [ENTER] *on the = sign to choose the function to graph.*
- *The program turns the function expression off on the graph. To turn this on after having completed the activity, press* ([2nd] [FORMAT] *and then press* [ENTER] *when* ***ExprOn*** *is selected.*
- ***To download the calculator program and student worksheet, go to education.ti.com/exchange and enter "11485" in the keyword search box.***

Associated Materials

- *JustMoveIt_Student.doc*
- *MOVEIT.8xp*

Suggested Related Activities

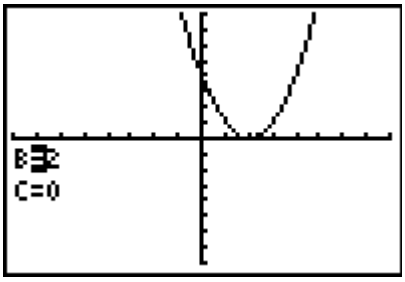
To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- *Investigation of Exponential Functions (TI-Nspire technology) — 9667*
- *How Changing Parameters in a Function Affects Aspects of a Function (TI-Nspire technology) — 9363*

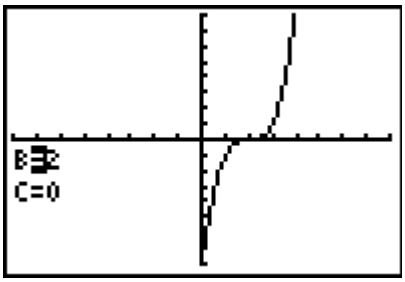
Students proceed through the activity graphing transformations of the parent function, making predictions about changes to the parent function graph, and answering questions related to their predictions and observations. The graphs and questions contained in this activity lead students to make generalizations about patterns observed as they work through the activity.

Problem 1 – $f(x) \rightarrow f(x-b)$

On the worksheet, the concept of transformations of parent functions is introduced. Students will begin their investigation of the transformation $f(x) \rightarrow f(x-b)$ or more commonly known $f(x) \rightarrow f(x-h)$. They need to graph the quadratic function first and then graph the cubic function.



You may want to discuss with students that $f(x-b)$ in function notation is $f(x)=(x-b)^2$ or $f(x)=(x-b)^3$, replacing where the x would normally go.



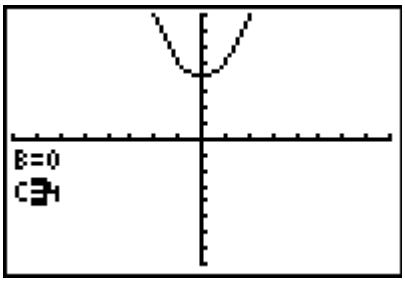
They are to **only change B** in their investigation.

Students should understand the following for all types of graphs:

- When b is positive, the graph will shift right (i.e. positive x-values).
- When b is negative, the graph will shift left (i.e. negative x-values).

Problem 2 – $f(x) \rightarrow f(x)+c$

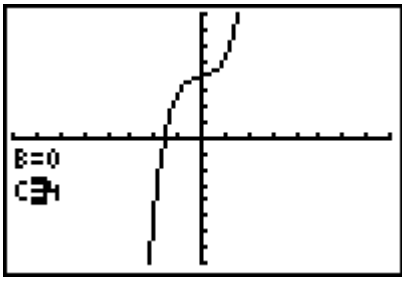
Students will now investigate the transformation $f(x) \rightarrow f(x)+c$, or more commonly known as $f(x) \rightarrow f(x)+k$. They should notice that c is the opposite of b in that $f(x)+c$ means that c is positive, but $f(x+b)$ means that b is negative.



They are to **only change C** in their investigation.

Students should understand that for all types of graphs:

- when c is positive, the graph will shift up (i.e. positive y-values)
- when c is negative, the graph will shift down (i.e. negative x-values)

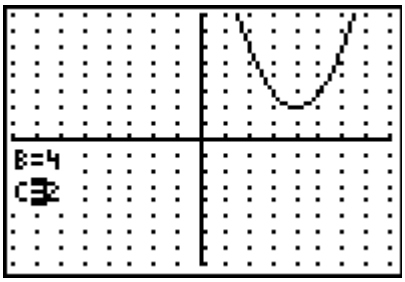


Problem 3 – $f(x) \rightarrow f(x-h)+k$

This problem sums up Problems 1 and 2 by exploring *b* and *c* together. Students need to explain how the graph shifts for positive and negative values of *b* and *c*.

It may be helpful for students to turn the grid on (2nd [FORMAT] and then press ENTER on **GridOn**) so they can count the distance from the *x*- and *y*-axes.

On the graph at the right, the thin solid line is the parent function and the thick solid line is the transformation.



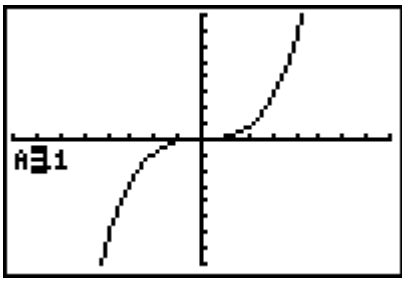
Problem 4 – $f(x) \rightarrow a*f(x)$

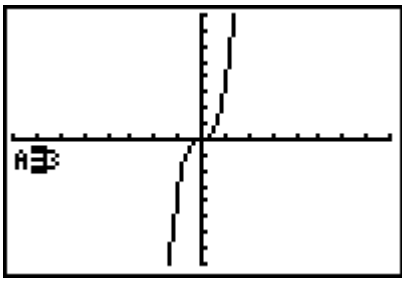
Students will explore the transformation of $f(x) \rightarrow a*f(x)$. They will use fractions as well as whole numbers in their investigation.

Students should understand that for all types of graphs:

- when *a* is between 0 and 1, the graph widens (i.e. smaller *y*-values)
- when *a* is greater than 1, the graph narrows (i.e. larger *y*-values)

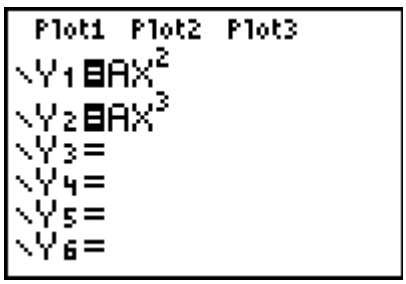
On the worksheet, $|a|$ is used in inequalities to guide the students in the understanding of the impact of the magnitude of *a* on the graph of the function. To help students see the need for the absolute value notation, discuss a graph comparing the positive and negative *a*-value.



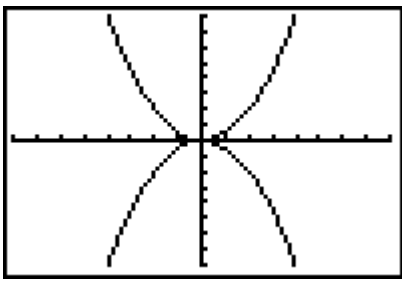


If using Mathprint OS:

When students enter AX^2 and AX^3 in the Y= screen, the cursor will move up to the exponent. Press the right arrow to exit out of the exponent.



Students are instructed to graph the quadratic and cubic functions with negative *a*-values. Having students graph the corresponding functions with positive *a*-values will help students see that the negative sign does not impact the width or vertical compression of the parent graph. To do this, students will have to uninstall the Transformation Graphing App.



The last graph at the right is $f(x) = 0.5x$ and $f(x) = -0.5x$.

Problem 5 – *f(x)→a*f(x–h)+k*

Discuss the generalization $f(x) = a(x-h)^2 + k$ with students. Relate this generalization to other functions.

It is often difficult for students to understand the vertical stretching/compressing impact of variable **a**. The vertical stretch/compression variable, **a**, has special meaning related to the basic trigonometric functions, sine and cosine. Ask students what special term for waves relates to the variable **a** (amplitude). This "link" may help students recall the impact of **a** in a function equation.

Further Exploration

Additional function transformation questions are provided on the student worksheet to provide added practice and application opportunities. These questions may be used as homework or to provide guided practice in the classroom.

Solutions – Student worksheet

1. 2 units right
2. 5 units left
3. Student responses will vary.
4. *b* units horizontally
5. *x*-values/inputs
6. 4 units up
7. down 3 units
8. *c* units vertically
9. *y*–values/outputs
10. 7 units right, 6 units up
11. Student responses will vary.
12. *b* units right and *c* units up
13. (1) *b* units left and *c* units down
    (2) *b* units right and *c* units down
    (3) *b* units left and *c* units up
14. wider
15. narrower/stretched vertically
16. wider/compressed vertically
17. narrower/stretched vertically
18. The graph is reflected across the *x*-axis.

Additional Exercises

1. It shifts the graph 6 units right.
2. It shifts the graph 6 units down.
3. It reflects the graph across the *x*-axis.
4. It stretches the graph vertically. amplitude
5. The graph is reflected across the *x*-axis.