Just Move It

ID: 11486

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.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "11486" in the keyword search box.***

Associated Materials

- *MoveIt_Student.doc*
- *MoveIt.tns*
- *MoveIt_Soln.tns*

Suggested Related Activities

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

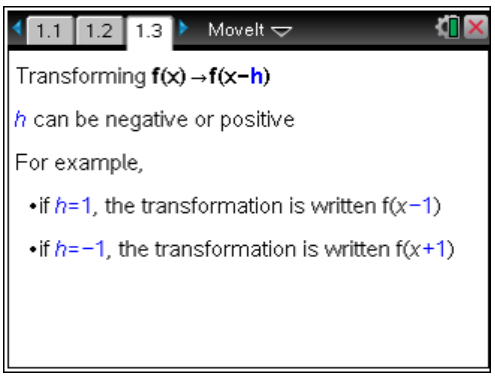
- *Investigation Of Exponential Functions (TI-Nspire technology) — 9667*
- *How Changing Parameters in a Function Affects Aspects of a Function (TI-Nspire technology) — 9363*

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.

Questions contained in this document may be answered either on the handheld, or on the associated student worksheet.

Problem 1 – $f(x) \rightarrow f(x - h)$

On page 1.2, the concept of transformations of parent functions is introduced. Students will begin their investigation of the transformation $f(x) \rightarrow f(x - h)$ on page 1.5. They need to graph the quadratic function on the left and the cubic function on the right.



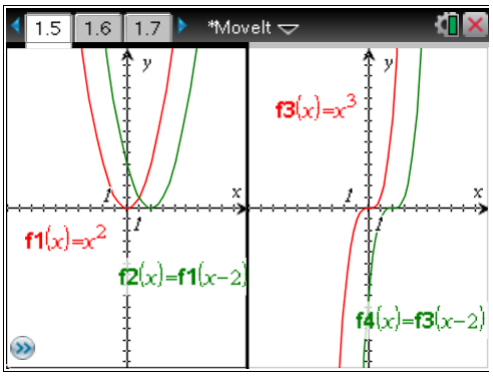
You may want to discuss with students that $f(x - h)$ in function notation is $f(x) = (x - h)^2$ or $f(x) = (x - h)^3$, replacing where the x would normally go.

Students may change the window settings for graphs using features available in the Window menu. They can hide the function entry line by pressing ctrl + G.

Students should understand that for all types of graphs:

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

On the graph at the right, the red line is the parent function and the green line is the transformation.



TI-Nspire Navigator Opportunity: *Live Presenter*

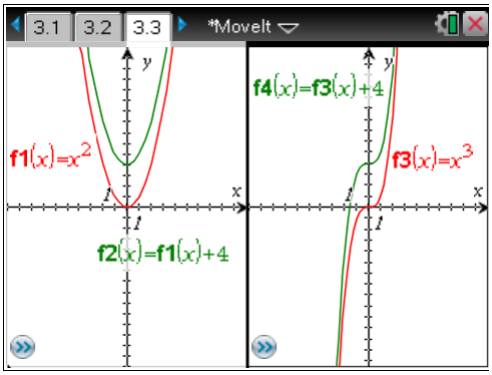
See Note 1 at the end of this lesson.

TI-Nspire Navigator Opportunity: *Screen Capture*

See Note 2 at the end of the lesson.

Problem 2 – $f(x) \rightarrow f(x) + k$

Students will now investigate the transformation $f(x) \rightarrow f(x) + k$ on page 3.3. They should notice that k is the opposite of h in that f(x) + k means that k is positive, but f(x + h) means that h is negative.



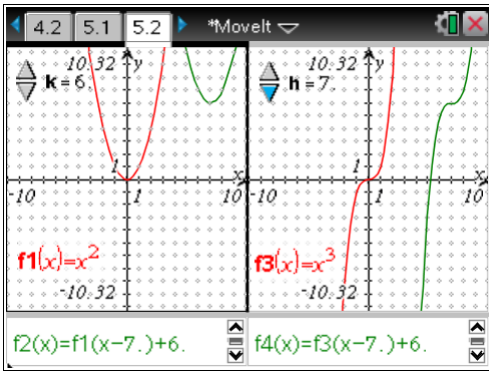
Students should understand that for all types of graphs:

- when k is positive, the graph will shift up (i.e. positive y-values)

when k 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 h and k together. Students need to explain how the graph shifts for positive and negative values of h and k.



It may be helpful for students to turn the grid on (**MENU > View > Show Grid**) so they can count the distance from the x- and y-axes.

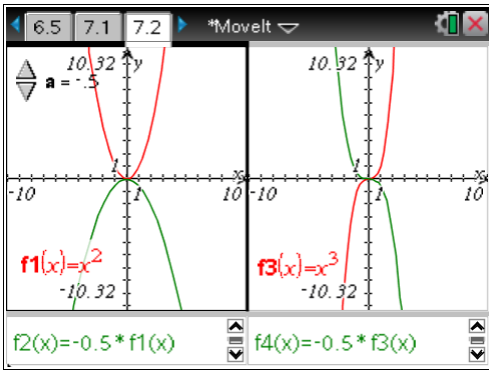
On the graph at the right, the thin solid line is the parent function and the thick solid line is the transformation.

TI-Nspire Navigator Opportunity: *Live Presenter*

See Note 3 at the end of this lesson.

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

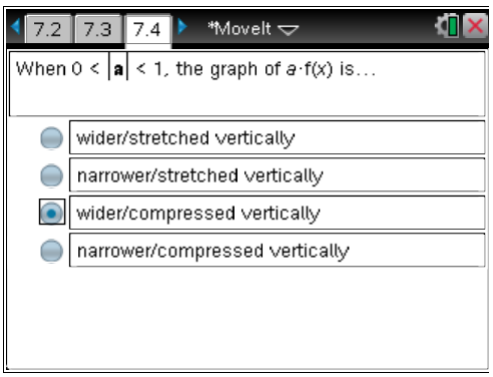
Students will explore the transformation of $f(x) \rightarrow a * f(x)$. They will use fractions as well as whole numbers in their investigation.



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 pages 7.4 and 7.5, $|a|$ 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 the graph on page 7.2.



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.

TI-Nspire Navigator Opportunity: *Live Presenter*

See Note 4 at the end of this lesson.

Problem 5 – *f*(*x*) → a * *f*(*x* – *h*) + *k*

Discuss the generalization $f(x) = a(x-h)+k$ 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. *h* units horizontally
5. *x*-values/inputs
6. 4 units up
7. down 3 units
8. *k* units vertically
9. *y*–values/outputs
10. 7 units right, 6 units up
11. Student responses will vary.
12. *h* units right and *k* units up
13. (1) *h* units left and *k* units down
    (2) *h* units right and *k* units down
    (3) *h* units left and *k* 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.

TI-Nspire Navigator Opportunities

Note 1
Problem 1, *Live Presenter*

On page 1.5. it may be a good idea to demonstrate to students how to enter the function notation into the entry lines, how variables are bold in format, and how to get the entry line back by clicking on the chevron symbol.

Note 2
Problem 1, *Screen Capture*

After page 1.5, it may be a good idea to do a screen capture to monitor students' progress through the lesson. In this way, you will be able to judge to pace and of the students to better time your questioning.

Note 3
Problem 3, *Quick Poll*

On page 5.3, send out a quick poll for students to respond to that question.
Then, select someone using ***Live Presenter*** to illustrate their reasoning by clicking on the arrows on page 5.2

Note 4
Problem 4, *Live Presenter*

As the class is discussing the affect *a* has on the resulting functions, it may be helpful to use **Live Presenter** on page 7.2. In this way, the class can use the dynamic visual to aide in the class discussion.