Transformers

ID: 11931

Time required
45 minutes

Activity Overview

In this activity, students will explore different transformations of the polynomial functions $f(x)=x^2$, $f(x)=x^3$, and $f(x)=x^4$. First they use a spreadsheet to investigate the changes in y-values as a value is added to or multiplied by the function. Then, students will confirm their conjectures using a minimized slider on a graph page. Several questions are given to assess students' understanding.

Topic: Polynomials

- *Transformations*
- *Visualizing Graphs*

Teacher Preparation and Notes

- *This activity is intended to be explored on the TI-Nspire handheld or computer software. The student worksheet is provided for students to record conjectures and answers.*
- *This activity should be explored with teacher guidance and instruction; however the student TI-Nspire document provides sufficient instruction for students to complete the activity individually.*
- ***To download the student TI-Nspire document (.tns file) and student worksheet, go to education.ti.com/exchange and enter "11931" in the quick search box.***

Associated Materials

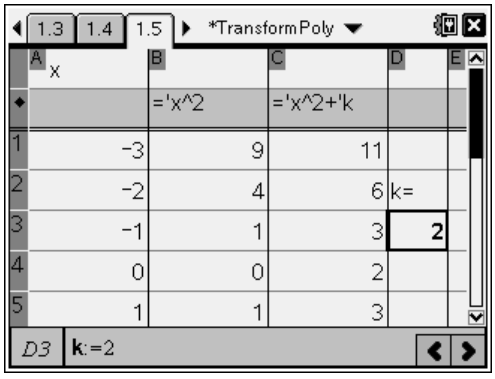
- *TransformPoly_Student.doc*
- *TransformPoly.tns*

Suggested Related Activities

To download any TI-Nspire technology activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

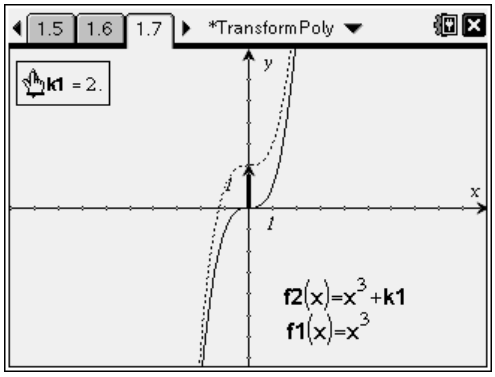
- *U Move Me (TI-Nspire technology) — 9987*
- *Introduction to Transformations (TI-Nspire technology) — 9558*
- *Just Move It (TI-Nspire technology) — 11486*

In each problem, students are to change the value of the variable in the spreadsheet trying to determine how the graph changes. The parent function is $f(x) = x^2$, a graph that all students should be familiar with. They should compare the *y*-values of the parent function and the transformed function (Columns B and C), looking for a change in *y*-intercept, *x*-intercept, or shifts of the values to the left or to the right.



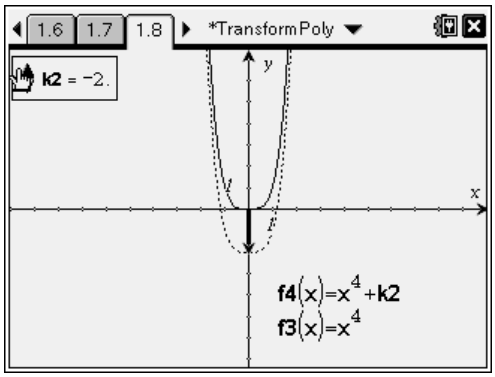
Be sure to have students try negative and positive values for each problem.

Then, students will test their conjectures on *Graphs* pages by clicking the up and down arrows of the minimized slider. There are two pages, one with the parent function $f(x) = x^3$ and one with $f(x) = x^4$. The parent function will appear solid and the transformed function will appear dotted.



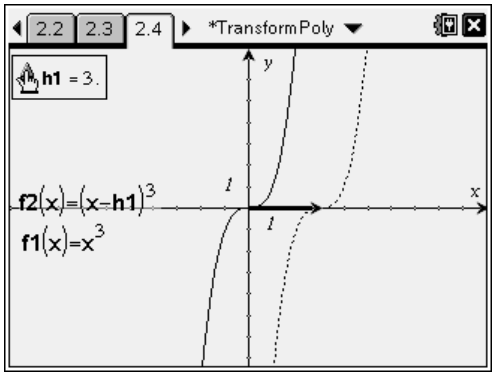
Problem 1 – $f(x) \rightarrow f(x) + k$

In this problem, students should see a change in the *y*-intercept and an overall increase or decrease in *y*-values depending on if *k* is negative or positive. This should indicate to students a vertical shift in the graph.



Problem 2 – $f(x) \rightarrow f(x - h)$

In this problem, students should see a change in the *x*-intercept (or zero) and a shift left or right of the *y*-values depending on if *h* is negative or positive. However, the *y*-values will not change in value. This should indicate to students a horizontal shift in the graph.

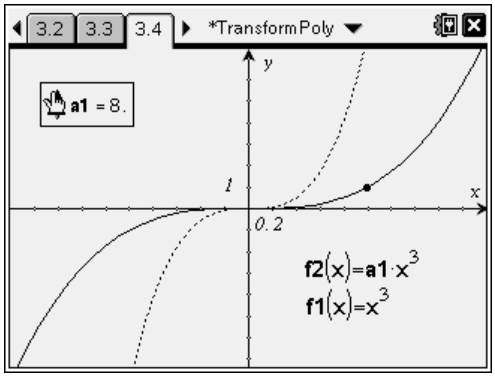


Problem 3 – $f(x) \rightarrow a \cdot f(x)$

In this problem, students should see an overall increase or decrease in the *y*-values depending on if *a* is negative or positive. This should indicate to students narrowing of the graph.

If students have problems visualizing this change, tell them to think about slope, i.e., the steeper the slope the faster the values increase or decrease.

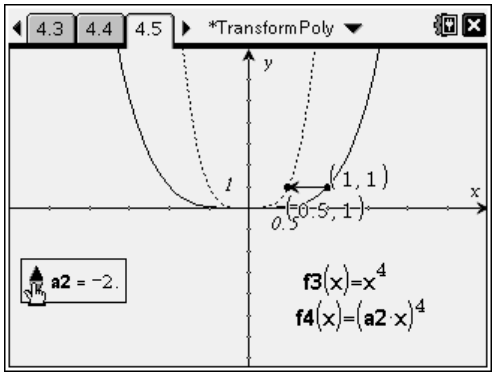
For negative values, the graph will be reflected about the *x*-axis. Also, challenge students to look at values between 0 and 1 on the graphs. These values will widen the graph.



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

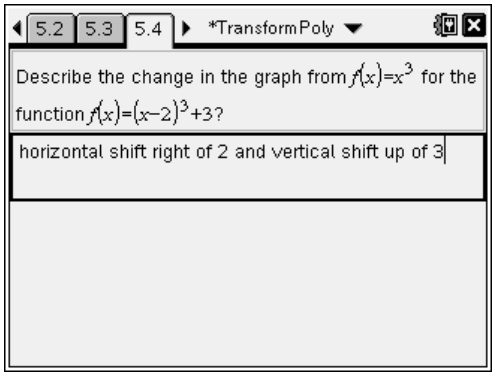
Students should again see an overall increase or decrease in the *y*-values indicating a narrowing of the graph. However, the graph will only be reflected about the *x*-axis for odd powers.

To compare the difference in the transformations of $f(x) \rightarrow f(a*x)$ and $f(x) \rightarrow a*f(x)$, have students graph **f5(x)=a1*x^3** on page 4.3 and **f6(x)=a1*x^4** on page 4.4. They should see that multiplying the value by *x* inside the parentheses results in a bigger transformation. (Students could also press ctrl + T to add a table of values to the screen.)



Problem 5

In this problem, students will answer questions based on their observations from the investigations of transformations.



Student solutions

1. $p(x) \rightarrow p(x) + a$
2. Sometimes
3. Horizontal shift right of 2 and vertical shift up of 3
4. $p(x) \rightarrow p(ax)$ where $a = 2$ or $p(x) \rightarrow a*p(x)$ where $a = 16$
5. $p(x) \rightarrow p(x+a)$ where $a = 1$
6. $f(x) = (x–2)^3 – 3$
7. Answers will vary: Coefficient should be negative.