Transformers

ID: 11930

Time required
45 minutes

Activity Overview

In this activity, students will explore the different transformations of the polynomial functions $f(x) = x^2$, $f(x) = x^3$, and $f(x) = x^4$. First they will use the table feature to investigate the changes of the y-values as a value is added to or multiplied by the function. Then, students will confirm their conjectures using the Transformational Graphing application. Several questions at the end of the activity assess students' understanding of the transformations.

Topic: Polynomials

- *Transformations*
- *Visualizing Graphs*

Teacher Preparation and Notes

- *This activity should be explored with teacher guidance and instruction*
- *Make sure all graphing calculators have the Transformational Graphing application installed. To download the app, go to* ***eduction.ti.com****.*
- ***To download the student worksheet, go to education.ti.com/exchange and enter "11930" in the keyword search box.***

Associated Materials

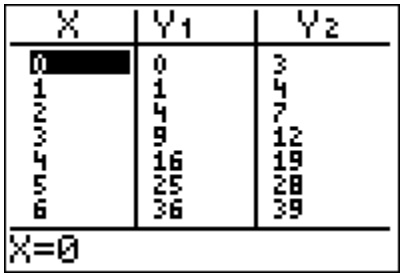
- *Transformers_Student.doc*

Suggested Related Activities

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

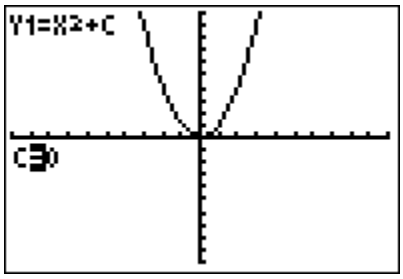
- *Guess How I Move The Graph (TI-Navigator) — 8709*
- *Just Move It (TI-84 Plus family) — 11485*

In each problem, students are to change the value of the variable in the GRAPH window trying to determine how the graph changes. The parent function is $f(x) = x^2$, a graph that all students should be familiar with. When viewing the table, they should compare the *y*-values of the parent function and the transformed function (Columns Y1 and Y2), looking for a change in *y*-intercept, *x*-intercept, or shifts of the values to the left or to the right.



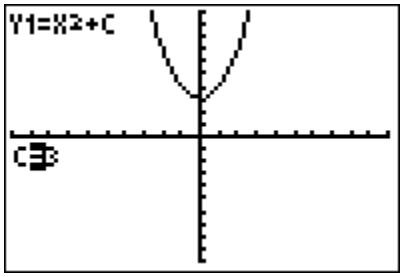
Be sure to have students try negative and positive values for each problem.

Then, students will test their conjectures using the Transformational graphing application. After the students have graphed the expression, they will be able to input any value for the variable and observe the changes on the graph to test their conjecture.



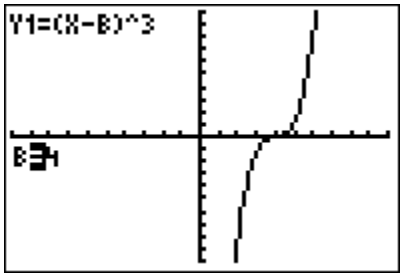
Problem 1 – f(x) → f(x) + C

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



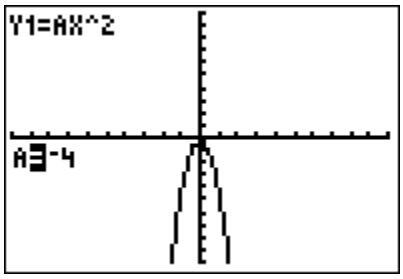
Problem 2 – f(x) → f(x–B)

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 *B* is negative or positive. The *y*-values will not change in value but will change which *x*-value each is associated with. This should indicate to students a horizontal shift in the graph.



Problem 3 – f(x) → A*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.

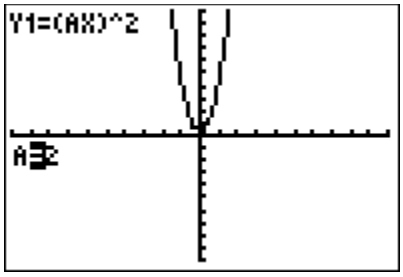


If students have problems visualizing this change, tell them to think about slope, i.e., the steeper the slope the faster the values increase or decrease.

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) → f(a*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 $\mathbf{Y_1=3X^2}$ and $\mathbf{Y_2=(3X)^2}$ in the same graphing window (after they have uninstalled the transformation graphing application. They should see that multiplying the value by *x* inside the parentheses results in a bigger transformation. (Students could also press 2nd [TABLE] to compare the table of values.)

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.