Sample Lesson Plan: Transforming Other Parent Graphs

A. Grade Level: 10th grade

Topic: Algebra: Transformations of Functions

Aim of lesson: Students will determine how to make the graph of any function move left, right, up, and down and how they can stretch it vertically, compress it vertically, and flip it. Students will investigate (sketch the graph, identify the domain and range, and label any important points of asymptotes): $y = x^3, y = \frac{1}{x}, y = \sqrt{x},\ and\ y = b^x$. Students will use Geogebra to help them write a general equation to demonstrate each parent function.

B. HSCEs:

- A2.1.3 Represent functions in symbols, graphs, tables, diagrams, or words and translate among representations.
- A2.1.6 Identify the zeros of a function, the intervals where the values of a function are positive or negative, and describe the behavior of a function as x approaches positive or negative infinity, given the symbolic and graphical representations.
- A2.1.7 Identify and interpret the key features of a function from its graph or its formula.
- A2.2.2 Apply given transformations to basic functions and represent symbolically.
- A2.3.1 Identify a function as a member of a family of functions based on its symbolic or graphical representation; recognize that different families of functions have different asymptotic behavior

C. National 21st Century Skills

1. promote student reflection using collaborative tools to reveal and clarify students' conceptual understanding and thinking, planning, and creative processes

   The group discussion at the end of the lesson will promote student reflection and clarify any outstanding questions students may have after completing the task. During the discussion the teacher will use Geogebra on the Smartboard to aid in classroom discussion. Students will be able to demonstrate their findings on the board and explain their findings.

2. incorporate digital tools and resources to promote student learning and creativity

   Students will use Geogebra (http://www.geogebra.org/webstart/geogebra.html) to plot their functions and learn how to move it left, right, up, and down and stretch it vertically, compress it vertically, and flip it. Geogebra lets the students alter the functions and see how the graph responds to the equation. You can also do the reverse

and move the graph and see how the equation changes due to the movement of the graph.

3. enable all students to pursue their individual curiosities and become active participants in setting their own educational goals, managing their own learning, and assessing their own progress

   The individual work within the class period will give time for students to personally work with the technology to individually learn about the material and applet. They will be responsible for one of the parent graphs and will have to manage their time to complete their part of the task.

4. address students' diverse learning styles, working strategies, and abilities using digital tools and resources

   Over the course of this lesson students work in small groups, individually and participate in large group discussions. This allows the students to work in many different environments throughout one class. The individual work allows students to discover the material on their own in their own way. The small group work allows all levels of students to bounce ideas off of each other and collaborate on the material together. The class discussion will promote student to student and student to teacher discourse within the classroom and pull together the lesson. By having students work in small groups and then individually allows them to discover the technology on their own. The teacher will be able to circulate the room to assist any students who may need help with the material. This will allow different learning styles to be present at the same time in the class.

What is the substance of the lesson/unit?

D. Describe what students will be asked to do and the desired learning outcomes.

Students will be asked to make the graph of the following parent functions to investigate: $y = x^3, y = \frac{1}{x}, y = \sqrt{x},\ and\ y = b^x$ and move them to left, right, up, and down and how you can stretch them vertically, compress them vertically, and flip them. They will fully investigate the graphs by sketching the graphs, identify the domain and range, and label any important points of asymptotes. Then graph and check their work using Geogebra and write an equation to demonstrate each transformation found. Finally, you will find a general equation for each parent function.

As a result students will be able to explain the relationships between a functions equation and its graph. They will be able to manipulate the parent functions equation to move

and stretch the graph in specific ways. Students will be able to also identify key features of each of the four parent functions given in the task.

E. Include a detailed description of what you will do and precisely how you will do it.

1. As students walk into class they start on a warm up that is on the board.

   Warm-up:

   2. Find the x- and y- intercepts of the graphs of the two equations:
      a. $y = 2x^2 + 3x - 5$
      b. $y = \sqrt{2x - 4}$
   3. The vertex of a parabola (h,k) locates its position on the axes. Sketch the graph of the following equation and locate the vertex.
      a. $y = 3x^2 + 5$

2. Teacher will then discuss the warm up with the class and then introduce the day's lesson. Then he/she splits the class into groups of four.
3. Students go into individual work time. Teacher circulates.
4. Student then go into groups and work while teacher circulates for questions.
5. Teacher brings students back together for final group discussion using Geogebra on the Smartboard to aid in student to student and student to teacher discourse. At the end of the class students will be asked to complete a follow-up assessment for homework.

   Homework:

   1. Draw the graph of $y = 2x^2 + 3x + 1$.
      a. Find the x- and y-intercepts.
      b. Where is the line of symmetry of this parabola? Write its equation.
      c. Find the coordinates of the vertex.

   2. Change the equation in the previous problem so that the parabola has only one x-intercept.

   3. Use Geogebra to graph a line with a slope of 3 and a y-intercept at (0, 2).
      a. Graph the same line moved down 5 units.
      b. Graph the same line flipped over the x-axis.
      c. Print (or email to me) the graph and turn in attached to your homework.

How will you know students have accomplished the aims/goals of the lesson? What will the performance products look like?

F. Describe in detail what students will do to demonstrate competency.

- Students will answer questions that I pose to each group as I circulate around the classroom in small group/individual work time. They will also demonstrate competency by actively participating (volunteering, asking questions, answering questions, taking notes, etc) in group discussion.
- At the end of the class students will hand in all parent graphs, general equations and identify the domain and range, and label any important points of asymptotes.
- Students will complete homework correctly for the next class.

G. How will you differentiate between novice, advanced and expert work?

- Formally: Students will hand in parent graphs, general equations and identify the domain and range, and label any important points of asymptotes. They will also submit homework for grading. This work will be graded based on the class grading scale. Full credit work will consist of correct answers with explanation and correct graphs. Partial credit will be giving accordingly. Little to no credit will be giving to work with little to no effort and incomplete parts.
- Informally: Students will participate in all parts of class and give thoughtful and insightful answers to questions posed in small group discussion. This will not be graded but used as a guide for the full group discussion.

*See next page for task***

Name: _____

Transforming Other Parent Graphs

We have been learning how to move a parabola around a set of axes, write equations, sketch graphs, and model situations. The graph of $y=x^2$ is called the **parent graph** for the family of parabolas because every other parabola can be seen as a transformation of that one graph. In this investigation we will use what we have learned about transforming the graph of $y=x^2$ to transform four new parent graphs. We will also be using Geogebra, an online graphing tool, to aid our learning of functions.

Your task:

As a group, determine how you can make the graph of any function move left, right, up, and down and how you can stretch it vertically, compress it vertically, and flip it. Each team member should choose one of the following parent functions to investigate: $y = x^3, y = \frac{1}{x}, y = \sqrt{x}, \ and \ y = b^x$. Remember that to investigate completely, you need to sketch the graph, identify the domain and range, and label any important points of asymptotes. Then graph and check your work using Geogebra (http://www.geogebra.org/webstart/geogebra.html) and write an equation to demonstrate each transformation you find. Finally, you will find a general equation for your parent function. (If you have $y = b^x$ the instructor will give you a value to use for b)

4. As a group: investigate the parent graphs.
   a. Graph your equation on a full sheet of graph paper.
   b. As a team, place your parent graphs into the middle of your workspace. For each graph, identify the domain and range and label any important points or asymptotes.

5. As an individual: For your parent graph use Geogebra to:
   a. Find and graph an equation that will shift your parent graph left or right.
   b. Find and graph an equation that will shift your parent graph up or down.
   c. Find and graph an equation that will stretch or compress your parent graph vertically.
   d. Find and graph an equation that will flip your parent graph upside-down.

6. As a group:
   - Find general equations for the parent functions. (much like how we found the general equation for $y=x^2$)

- **At the end of the class hand in all parent graphs, general equations and identify the domain and range, and label any important points of asymptotes.

7. Full Class Discussion:
   - How can we move a parabola?
   - How can we use our ideas about moving parabolas to move other functions?
   - What changes can we make to the equation?

Lesson adapted from: CPM Algebra 2 Connections; (4.59)
http://secmath.wiki.educ.msu.edu/file/view/CPM+-+4.59+Transforming+Other+Parent+Graphs.pdf