Lesson: Transformation of Functions

MASTERY FOCUS (PL-2, PL-3, I-1, I-6)

Essential Understanding: A family of functions is the foundation for transformations of graphs.

Standards: What will students know, understand, and be able to do?

TEKS SEs

Ⓡ **ALGII.1A Identify the mathematical domains and ranges of functions**, determine reasonable domain and range values for continuous and discrete situations, *and describe situations given domain and range values.*

Ⓡ**ALGII.4B** Extend parent functions with parameters including *a* in *g(x)* = a[*f(x)*], *k* in *g(x) = f(x) + k,* and *h* in *g(x) = f(x – h)*.

Ⓢ **ALGII.4A** Identify and sketch graphs of parent functions, including linear (f(*x*) = *x)*, quadratic (f(*x*) = x^2), exponential (f(*x)* = a^x), logarithmic (f(*x*) = $\log_a x$), absolute value of x (f(x) = lxl), square root (f(x) = √x), and reciprocal of x (f(x) = 1/x) functions**.**

CCRS

CCRS 3.B1 Identify and apply transformations to figures.
CCRS 7.A2 Recognize and distinguish between different types of functions.

ELPS

ELPS C.1e Internalize new basic and academic language by using and reusing it in meaningful ways in speaking and writing activities that build concept and language attainment.
ELPS C.3f Ask and give information ranging from using a very limited bank of high-frequency, high-need, concrete vocabulary, including key words and expressions needed for basic communication in academic and social contexts, to using abstract and content-based vocabulary during extended speaking assignments.
ELPS C.4c Develop basic sight vocabulary, derive meaning of environmental print, and comprehend English vocabulary and language structures used routinely in written classroom materials.
ELPS C.4i Demonstrate English comprehension and expand reading skills by employing basic reading skills such as demonstrating understanding of supporting ideas and details in text and graphic sources, summarizing text, and distinguishing main ideas from details commensurate with content area needs.

Key Vocabulary: What key terms will my students need to understand?

Parent functions: the set of basic functions used as the standard for more complex functions.
Transformations: operations that alter the size and/or position of a figure. Standard transformations include translations, reflections, dilations (stretches/expansions), compressions (contractions/shrinks), and rotations.
Monster graph: a generic piecewise function that may be used as a parent function.
Function notation: f(*x*), where the function f is evaluated for a specific value of *x*.
Domain and range: the sets of x- and y-coordinates, respectively, of a relation.
Set builder notation (for example, {-4 < x ≤3}) and interval notation (for example, (-4, 3]): two types of notation for representing the domain or range of a function.

Assessment Plan: How will I assess prior knowledge? How will I know my students mastered standards?

To assess prior knowledge, students will complete prompts of linear and quadratic functions.
Formative assessments will consist of kinesthetic (Function Dance) and written responses to various transformations of functions.

LESSON CYCLE (I-1, I-4, I-5, I-6, I-8)

How will I engage my students in learning? How will I lead my students to mastery?

CHECKS FOR UNDERSTANDING (I-2)

1 Engage and Connect (5 min):

Do Now: Think-pair-share.

Have graphing calculators available. Give students basic linear and quadratic functions with specific transformations as would have been seen in Algebra I: f(x) = x, f(x) = x + 1, f(x) = x + 2, etc., and $f(x) = x^2$, $f(x) = x^2 + 1$, etc. Students summarize in pairs, then as entire class.

Facilitate students' responses and reaction to students' generalizations of what is happening with the functions.

2 Introduce New Learning (15 min):

Connect vocabulary students may have used in the engagement activity on to geometric transformations they would have seen in middle school.

Provide a copy of the "Monster Graph" activity to students. Have students look for connections between the table of values and the graph. Evaluate students' knowledge of function notation, and provide additional explanation as necessary. (Additional strategies and questions may be found on page 1 of the teacher appendix of "Monster Graphs.")

Develop in problem #1 one function notation, table, and graph that will demonstrate a horizontal shift or translation. Ask, *"How do these transformations change the domain and range? How do we write the domain and range?"* Discuss set builder notation and interval notation.

Conduct a quick check of student understanding of function notation with a simple function, such as f(*x*) = *x* + 1. Ask, "*What is f(2*)" and have students answer by holding up the correct number of fingers (3).

3 Lead Guided and Independent Practice (25 min):

Guided Practice (10 min):

Continue teacher-lead demonstration of next the translation in problem #2. Circulate questions around the room for response to developing the table and using function notation. See additional questions and strategies in the teacher appendix of "Monster Graphs."

Ask scaffolding questions, similar to the ones used with #1, to prompt students at each step.

Independent Practice (15 min):

Allow students to complete the next transformation in the monster graph. Independent and guided practice may need to be blended as the teacher circulates and determine if there are class misconceptions or individual misconceptions. The vertical stretches of the monster graph will be more difficult for students to understand and may need a whole-class discussion or a student-lead discussion by a student that is showing proficiency in the monster graphs and the transformation. Students may need to be paired through this activity.

Circulate – debrief within pairs or as whole class. Have students "teach" the class when other class members are hesitant. This will check the students' ability to explain the content.

4 Close the Lesson and Assess Mastery (10 min):

Have students summarize what transformations occurred and what algebraic clues signal those transformations. Ask, *"Why do the functions shift? Stretch? Or Compress?"* Discuss with students terminology to describe transformations.

Function Dance – students stand and use body and arm movement to demonstrate the transformation of functions if told the operation that changes the function. Create a summary frame for students.

DIFFERENTIATION (I-3)

How will I scaffold and/or accelerate learning? For whom? How will I group my students?

SCAFFOLD:

ACCELERATE:

GROUP:

LOGISTICS (I-6, I-10)

What materials, resources, and technology will I need to prepare and arrange?

- "Monster Graph" activity page
- Document camera
- Graphing calculator for engagement activity
- Access to patty paper
- Clear transparencies to overlay graphs
- Colored pencils (Vis-à-vis pens for transparencies)