**Unit 5-Mother Functions**

State Standards and Benchmarks:

**9-12.A.2.1** Distinguish between the concept of a relation and a function.

**9-12.A.2.2** Determine whether a relation defined by a graph, a set of ordered pairs, a table of values, an equation, or a rule is a function.

**9-12.A.2.5** Explain and use function notation in both abstract and contextual situations and evaluate a function at a specific point in its domain.

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

**9-12.A.1.17** Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.

**9-12.G.3.1** Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent in a coordinate plane.

**9-12.G.2.1** Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

**Day 1**

Benchmark:

**9-12.A.2.1** Distinguish between the concept of a relation and a function.

**9-12.A.2.2** Determine whether a relation defined by a graph, a set of ordered pairs, a table of values, an equation, or a rule is a function.

Learning Objective:

Given various representations, the students will determine whether they represent a function or relation and be able to explain the difference with 80% accuracy as determined by teacher observation.

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

Index cards

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 | Write a RAFT, You are a function, write a letter to a relation explaining how you are compatible (similar) or dissimilar. |
| Review | 10 | Read some of the letters. Discuss similarities and differences between functions and relations. |
| Cooperative Learning | 10 | In pairs, have students work together to create an example of a function that has a graph, set of ordered pair, and an equation. Make sure the equation is in function notation. |
| Cooperative Learning | 15 | Have pairs exchange sets of function cards with another pair. Do NOT look at the new set you received. Then have the pairs pair up so you have groups of four. They cannot pair with someone they switched cards with. You should have groups of four that have two sets of function cards that they did not create themselves. Have them shuffle the cards and then work together to sort them. Repeat if time allows. |
| Closure | 5 | Summarize the days review lesson. On a scale of 1 to 4, how comfortable are you with functions vs. relations? Show of hands.   1. no idea 2. need some help 3. got it on my own 4. can help others |

Reflection:

**Day 2**

Benchmark:

**9-12.A.2.5** Explain and use function notation in both abstract and contextual situations and evaluate a function at a specific point in its domain.

Learning Objective:

Given a function, the student will evaluate the function at a specific x-value correctly in 4 out of 5 problems.

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

notecards or post-it notes

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 | Brainstorm what you remember about function notation, evaluating functions and using domain to find range and graphing the function. |
| Engage | 10 | Play the function machine game online with the class: <http://hotmath.com/util/hm_flash_movie.html?movie=/learning_activities/interactivities/guess_the_function.swf&return_to=Algebra%20I%20Activities&title=Guess%20the%20Function>  Have all students record the input and output and only put in the rule when the class agrees on it. |
| Cooperative Learning | 15 | Have students pair up. One student is the “function machine” and the other must provide inputs until they can guess the rule. After the rule is guessed, switch places. The students are practicing EVALUATING FUNCTIONS.  (For advanced students, they can visit the website <http://www.quia.com/cb/69212.html> and play jeopardy with a partner) |
| Independent Practice | 10 | Complete review page for evaluating functions, teacher created.  **Evaluate the following functions at the given domain:**   1. **f(x)=x+4 for x=3 Answer: (3, \_\_\_\_\_\_\_\_)** 2. **f(x)=2x for x=6 Answer: (6, \_\_\_\_\_\_\_\_)** 3. **f(x)=3x+5 for x=2 Answer: (2, \_\_\_\_\_\_\_\_)** 4. **f(x)=x – 3 for x=16 Answer: (16, \_\_\_\_\_\_\_)** 5. **f(x)=2x-1 for x=0 Answer: (0, \_\_\_\_\_\_\_\_) \*\*** 6. **On the graph from #5, what is this point called? (HINT: the graph would be crossing an axis right there)** |
| Closure | 5 | Review the process and the “function machine”. Discuss why the answer was written as an ordered pair. Two points can make a line. For other function families, we may need more points. We’ll learn about the other families tomorrow. |

Reflection:

**Day 3**

Benchmark:

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

Learning Objective:

Given different parent function equations, the student will be able to identify the corresponding graph and describe how a transformation changes a graph of a given function with proficiency as determined by correctly completing the exit pass at the end of class.

Assessment:

Exit Pass

Accommodations:

Tier 2:

Tier 3:

Materials:

Function Family resource: <http://www.acoe.org/acoe/files/edservices/math/FamilyOfFunctionsLesson.pdf>

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 | “We are Family” as the students enter the room:  <http://www.youtube.com/watch?v=jrs66XInXXo> |
| Brainstorm | 5 | Have students brainstorm different types of non-linear functions. |
| Discussion | 20 | Discuss what a parent function is and have students create a foldable that has the 5 parent functions and their graphs.  f(x)=x  f(x)=|x|  f(x)=√x  f(x)=x2  f(x)=x3  Next page provided for accommodations and differentiation of instruction. |
| Introduction | 10 | Transformations video: <http://www.youtube.com/watch?v=OZkd0G_SZLk&feature=related>  Discuss what a transformer “does” (i.e. it changes size or location or parts of it are moved around, but it’s essentially still the same) A transformation is a change, therefore, when we “transform” functions, we change the parent function. There are 4 types of transformations: translation, rotation, reflection and dilation.  Translation: a movement  rotation: similar to the hands on a clock; turning about a point  reflection: like a mirror, equal distance to a line of reflection  dilation: larger or smaller; like what your pupils do when you go from dark to light. |
| Close | 5 | Exit pass written on notecard:  3 parent functions and their graphs  2 ways to transform them and what the transformation does  1 thing you liked about the lesson or 1 thing you don’t understand |

Reflection:

**Non-Linear Functions**

**Absolute Value function**

**f(x) = |x|**

|  |  |
| --- | --- |
| *x \_\_\_ y*  0 0  1 1  2 2  3 3  4 4  5 5  6 6 | [image] |

**Quadratic Function**

**f(x) = x2**

|  |  |
| --- | --- |
| [image] | *x \_\_ y*  0 0  1 1  2 4  3 9  4 16  5 25  6 36 |

|  |  |
| --- | --- |
| [image] | *x \_\_\_ y*  0 0  1 1  2 8  3 27  4 64  5 125  6 216 |

**Cubic Function**

**f(x) = x3**

**Day 4**

**(Absolute Value)**

Benchmark:

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

**9-12.G.2.1** Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

Learning Objective:

Given the absolute value parent function, the student will experiment with different coefficients to identify transformations of the graph and be able to evaluate the transformations for a given domain with proficiency as determined by completion of the closing summary.

Assessment:

Summary at the close of class

Accommodations:

Tier 2:

Tier 3:

Materials:

Notecards with different transformations of a parent function written

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 |  |
| Introduction/Engage | 5 | The graph of the absolute value of any domain is a function. The parent function is f(x)=|x|  Have a volunteer draw the graph on the board |
| Cooperative Learning | 15 | TRANSFORMATION STATIONS: Divide the class into four groups. Each group goes to a station that has five different functions to graph, based on a single transformation (one station has dilation, one has vertical translation, one has horizontal translation, one has reflection) |
| Discussion | 10 | Have the groups report out what they think each station did. Derive a general formula that uses variable to indicate what position does what transformation. Use colored pencils to make the graphs. |
| Modeled/Guided instruction | 5 | Evaluating transformed functions. Just like evaluating parent functions, evaluate at a given domain to find the range. Verify the point is on the graph. |
| Closure | 5 | Summarize the lesson: What was the parent function? What were the transformations we did to the parent function? How do you evaluate a function? |

Reflection:

**Day 5**

**(Square Root)**

Benchmark:

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

**9-12.G.2.1** Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

Learning Objective:

Given the square root parent function, the student will experiment with different coefficients to identify transformations of the graph and be able to evaluate the transformations for a given domain with proficiency as determined by completion of the closing summary.

Assessment:

Summary at the close of class

Accommodations:

Tier 2:

Tier 3:

Materials:

Notecards with different transformations of a parent function written

Materials:

Notecards with different transformations of a parent function written

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 | Use your calculator to find the square root of the first 10 whole numbers, rounded to the hundreds place. |
| Introduction/Engage | 5 | The graph of the square root of any domain is a function. The parent function is f(x)=  Have a volunteer draw the graph on the board |
| Cooperative Learning | 15 | TRANSFORMATION STATIONS: Divide the class into four groups. Each group goes to a station that has five different functions to graph, based on a single transformation (one station has dilation, one has vertical translation, one has horizontal translation, one has reflection) |
| Discussion | 10 | Have the groups report out what they think each station did. Derive a general formula that uses variable to indicate what position does what transformation. Use colored pencils to make the graphs. |
| Modeled/Guided instruction | 5 | Evaluating transformed functions. Just like evaluating parent functions, evaluate at a given domain to find the range. Verify the point is on the graph. |
| Closure | 5 | Summarize the lesson: What was the parent function? What were the transformations we did to the parent function? How do you evaluate a function? |

Reflection:

**Day 6**

**(Quadratic)**

Benchmark:

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

**9-12.G.2.1** Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

Learning Objective:

Given the quadratic parent function, the student will experiment with different coefficients to identify transformations of the graph and be able to evaluate the transformations for a given domain with proficiency as determined by completion of the closing summary.

Assessment:

Summary at the close of class

Accommodations:

Tier 2:

Tier 3:

Materials:

Notecards with different transformations of a parent function written

Materials:

Notecards with different transformations of a parent function written

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 |  |
| Introduction/Engage | 5 | The graph of the square of any domain is a function. The parent function is f(x)=x2  Have a volunteer draw the graph on the board |
| Cooperative Learning | 15 | TRANSFORMATION STATIONS: Divide the class into four groups. Each group goes to a station that has five different functions to graph, based on a single transformation (one station has dilation, one has vertical translation, one has horizontal translation, one has reflection) |
| Discussion | 10 | Have the groups report out what they think each station did. Derive a general formula that uses variable to indicate what position does what transformation. Use colored pencils to make the graphs. |
| Modeled/Guided instruction | 5 | Evaluating transformed functions. Just like evaluating parent functions, evaluate at a given domain to find the range. Verify the point is on the graph. |
| Closure | 5 | Summarize the lesson: What was the parent function? What were the transformations we did to the parent function? How do you evaluate a function? |

Reflection:

**Day 7**

**(Cubic)**

Benchmark:

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

**9-12.G.2.1** Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

Learning Objective:

Given the cubic parent function, the student will experiment with different coefficients to identify transformations of the graph and be able to evaluate the transformations for a given domain with proficiency as determined by completion of the closing summary.

Assessment:

Summary at the close of class

Accommodations:

Tier 2:

Tier 3:

Materials:

Notecards with different transformations of a parent function written

Materials:

Notecards with different transformations of a parent function written

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 |  |
| Introduction/Engage | 5 | The graph of the cube of any domain is a function. The parent function is f(x)=x3  Have a volunteer draw the graph on the board |
| Cooperative Learning | 15 | TRANSFORMATION STATIONS: Divide the class into four groups. Each group goes to a station that has five different functions to graph, based on a single transformation (one station has dilation, one has vertical translation, one has horizontal translation, one has reflection) |
| Discussion | 10 | Have the groups report out what they think each station did. Derive a general formula that uses variable to indicate what position does what transformation. Use colored pencils to make the graphs. |
| Modeled/Guided instruction | 5 | Evaluating transformed functions. Just like evaluating parent functions, evaluate at a given domain to find the range. Verify the point is on the graph. |
| Closure | 5 | Summarize the lesson: What was the parent function? What were the transformations we did to the parent function? How do you evaluate a function? |

Reflection:

**Day 8**

**(Family Feud review)**

Benchmark:

**9-12.A.2.1** Distinguish between the concept of a relation and a function.

**9-12.A.2.2** Determine whether a relation defined by a graph, a set of ordered pairs, a table of values, an equation, or a rule is a function.

**9-12.A.2.5** Explain and use function notation in both abstract and contextual situations and evaluate a function at a specific point in its domain.

**9-12.A.1.14** Evaluate polynomial, rational, radical, and absolute value expressions for one or more variables.

**9-12.A.1.17** Solve linear equations and inequalities in one variable including those involving the absolute value of a linear function.

**9-12.G.3.1** Use rigid motions (compositions of reflections, translations and rotations) to determine whether two geometric figures are congruent in a coordinate plane.

**9-12.G.2.1** Identify the origin, coordinate axes, and four quadrants on the Cartesian coordinate plane, and draw and label them correctly.

Learning Objective:

The student will participate in the classroom activity for Family Feud in order to review for the assessment tomorrow.

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

Family Feud template

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 |  |
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| Closure | 5 |  |

Reflection:

**Day 9**

**(Assessment)**

Benchmark:

Learning Objective:

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

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| **Strategy** | **Time** | **Activity** |
| Bell work | 5 |  |
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| Closure | 5 |  |

Reflection: