This learning progression is for an Algebra I class; the vast majority of the class contains freshman but there are representations of all grade levels The class uses the Holt McDougal, Common Core Edition from 2012 every now and then throughout their lessons but usually create their lesson plans with math tasks and activities to help engage the students. For this learning progression the class will be learning how to graph relationships and how to evaluate values using x-y tables and graphs. The standards that are applied to this lesson are the following:

CCSS.MATH.CONTENT.HSF.IF.A.1

Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of corresponding to the input x. The graph of f is the graph of the equation y = f(x).

CCSS.MATH.CONTENT.HSF.IF.A.2

Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

 CCSS.MATH.CONTENT.HSF.IF.B.5

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.

CCSS.MATH.CONTENT.HSF.BF.A.1.A

Determine an explicit expression, a recursive process, or steps for calculation from a context.

CCSS.MATH.CONTENT.HSF.LE.B.5

Interpret the parameters in a linear or exponential function in terms of a context.

The CCSS Mathematical Practices that are applied to this lesson are the following:

CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others.

CCSS.MATH.PRACTICE.MP4 Model with mathematics.

CCSS.MATH.PRACTICE.MP6 Attend to precision.

CCSS.MATH.PRACTICE.MP7 Look for and make use of structure.

A teaching strategy that will be used during this learning progression is group work and collaboration. Students will be able to work in groups in order to work in groups of no more than four. In a classroom set up such as this, the teacher will be able to facilitate to more students throughout the class period and guide the lesson rather than direct instruction. Every 5-10 minutes the teacher will bring the class together for a brief fist-to-five on the students understanding and go over any misconceptions that the teacher had noticed or seen while monitoring the students. The only things that the students will be doing separately on a standard day-to-day basis will be the formative assessments during class: the warm-up problems in the beginning of class, hinge questions in the middle of class, and the exit slips at the end of class.

**Lesson 1:**

In Lesson 1, the class period will start out with a warm up problem that will take the first 5-7 minutes. This warm up problem will apply their knowledge of inequality graphing on line graphs to the graphing lesson of graphing relationships of two different elements. The first part of the warm up problem that the students will start out with will be: Graph the inequality$ 3\leq x\leq 6$. Each student will be given a notecard that they will provide their line graph. The next part of the warm up problem will be: Write a scenario for which your inequality could represent. This will allow the students to relate their knowledge of inequalities to something that they might be experience on a daily or weekly basis. An example of a scenario would be “Jennifer is taking 6 classes and has a

HSF.IF.A.1, HSF.IF.B.5

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MP1 Make sense of problems and persevere in solving them

minimum of 3 classes every day. The amount of books that she could be carrying in her backpack on any given school day would be $3\leq x\leq 6.$ With this particular scenario, students will be able to see the soft connection between their inequality lessons and the introduction to graphing relationships. The first thing that we will go over will be the concepts of *range* and *domain*. Domain will be described as all possible x-values; the range will be described as all possible y-values. It is important for the students to understand this first concept as it will be extremely important as they move forward in the class and in mathematics during their academic career.

 The next thing that the teacher will go over will be the definition of a function or an equation and how a picture on a graph represents those equations. Students will create graphs while watching a graphing story. These stories show a relationship between time and one other element (quantity, height, distance, etc.). Students will watch the graphing story and then depict what the graph should look like. As an example, with one graphing story showing the relationship between time and the height of a girl on a swing the students will have to try and show a graph that represents the girls

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height (on the x-axis) at what time (on the y-axis) within the video.

The students will be given a sheet that has four different graphs on it. These will be the graphs that the students need to draw the representation of time and the other element that will be depicted in each video. The students will also need to correctly label their axes and state what the domain and range is. Going off of the previous example, the domain (time) would be $0\leq x\leq 55$ and the range would be $0\leq y\leq 15$. This is because the swing goes all the way to bottom of the forest that the girl is swinging to a maximum of 55 feet (the domain) and the video is 15 seconds long (the range).

 The hinge question in the middle of the class period, in order to assess how students are getting along with the concept of graphing will ask the students to create a scenario of their own that they could graph and what the domain and range could be. This will allow the teacher to see if the students truly understand the concept of graphing and the domain and range values. The students will be given a notecard that they will write their answer on and the teacher will collect them to review. While the teacher reviews the hinge question the students will carry on with their graphing.

MP3 Construct viable arguments and critique the reasoning of others.

HSF.IF.B.5

The teacher will pick their favorite wrong answer with the hinge question and will go over with the class and ask the students what is correct about it, what is wrong about it and what could have been done in order to make it correct. This will allow students to see their mistakes in real time instead of reaching a summative assessment and realize that they didn’t know what to do the whole time.

 The students will continue with the graphing stories until about 10 minutes left of class. After all of the materials are put away the students will be given a question on the board at the front of the room as their exit slip. The question will be: Please provide a graph to represent the following graphing story. Since the students worked in groups and created the graphs of the graphing stories, students will create a graphing story on their own so that the teacher can fully assess which students might not fully understand the concept.

**Lesson 2:**

The second lesson will help students learn how to evaluate a function given an input or solving the equation when given an output. The students will learn how to do this with a graph, table, and we will also start to tackle on solving for variables using an equation. During this lesson we will use the Function Machine from mathplayground.com to help the students see

HSF.IF.A.2, HSF.LE.B.5

patterns. The teacher will use this method instead of a worksheet in order to create a more interactive environment within the classroom. For every table we create using the function machine we will create the equation that goes along with the table. Afterwards, the students will receive a sheet that has six graphs, each with their own table with the x-values filled in. The students will then have to use the graph to figure out what the y-values are. Then they will have to try to find out what the function, or equation is as a group. Each group will present what they think the equation is and we will discuss it as a class. After each equation has been created we will then try to create a story problem to go along with each graph and equation so that the students will be able to put it into context and see where an equation might come from. After all the groups are finished with their group sheet we will go over the different ways one can find out the equation of a graph. It will go in this order so that the students understand the specific aspects of the graph that they are looking. At the end of class there will be an exit slip asking the students to fill out a table from the graph that will be posted at the front of the classroom and to also provide the equation that goes along with it.

**Lesson 3:**

This third, and final, lesson will be on understanding what the domain and the function is. The class will begin with a warm up problem: Create a table that satisfies the equation y=3x-4. This will be a brief review of the previous lesson. If students still have further questions on it then some time will be carved out of the day in order to help the students grasp the concept better. Students will understand that the domain is all possible x values and the range is all possible y values. Here we will take a look a different graphs as a class and talk about what the x values and y values are. Using the Geogebra program I will be able to zoom in and out so that the students will be able to see the graph as it continues on.

We will also take a brief look at piecewise functions and the cosine and sine function so that students can see what they look like and see how the domain and range might differ from, say, a linear function. Students will collaborate and create two of their own functions to be presented to the class so that the rest of their colleagues can try to guess what the domain and range is. At the end of class there will be an exit slip that will prompt the students to provide the definitions of domain and range and state what the domain and range of the graph at the front of the room is.

HSF.IF.A.1.

MP7 Look for and make use of structure.

MP3 Construct viable arguments and critique the reasoning of others.

**Warm Up Problems:**

Lesson 1:

 Graph the inequality$ 3\leq x\leq 6$ and write a scenario for which your inequality could represent.

Lesson 2:

 What is the definition of domain and range?

Lesson 3:

 Create a table that satisfies the equation y=3x-4

**Hinge Questions:**

(Taken part of the “Favorite Know” activity)

Lesson 1:

 Create a scenario of your own that you could graph and state what the domain and range could be.

Lesson 2:

 From the following graph, please create a table that depicts the function.

Lesson 3:

 (No hinge question, as students will be working on their mini-presentations)

**Exit Slip Questions**

Lesson 1:

 Please provide a graph to represent the following graphing story. (A graphing story will be played at the front of the classroom for the students to model).

Lesson 2:

 From the given table, create the equation that satisfies the coordinate points.

Lesson 3:

 Provide the definition of domain and range and state what the domain and range of the following graph is.