**Multiple Representations of Functions**

*Description*: In this activity, we investigate functions under different representations, and ask students to convert between representations. Students are also asked to interpret and make sense of data and information presented in different representations.

**Possible Learning Objectives**

* MA 203.1: Identify quantities and changes in quantities in mathematical representations, and distinguish constants from variables.
* MA 203.3: Create models for real-world situations through appropriate mathematical strategies.
* MA 203.4: Interpret functions and convert between their representations, including symbols, tables, graphs, and words.

**Activity Objectives**

The students working on this activity will work towards understanding:

* The procedures involved in translating between representations of functions
* How to determine the optimal representation for the given context

**Prior Knowledge**

Before completing this activity, students should have encountered:

* The definition of a function, including function notation
* Linear functions: slope, different forms of a line, characteristics
* Quadratic functions: general form and characteristics

Other options for this activity could require knowledge of:

* Logarithmic, exponential, or trigonometric functions

**Learning Outcomes**

* *Measurable Outcomes*
  + Convert between graphical, algebraic, numerical, and verbal descriptions of various functions.
  + Analyze a given representation and justify why an alternate representation might be useful.
* *Extensions*
  + Identify a real-world situation which is given by one of the four descriptions, and convert to any of the other three.

**Elements of Mathematical Inquiry**

* *Active Learning*

These activities are built so that students need to reflect on properties and characteristics of specific function types in order to develop multiple representations of that function. The problems are from a variety of non-standard contexts, which may force students to become more involved in the problem.

* *Meaningful Applications*

The functions in the activities are drawn from a variety of non-standard contexts, with which students are forced to engage. This encourages students to draw connections between unfamiliar contexts and familiar ones, which could provide the framework for more versatile thinking in future endeavors. Additionally, students must identify mathematical relationships within an activity in order to successfully convert between representations.

* *Academic Success Skills*

This activity addresses several academic success skills. It addresses problem solving and critical thinking by requiring students to think carefully about the function given, and then translating that information to different representations. Since it is written to be collaborative, the nature of collaboration encourages the development of classroom communities. The problems require use of different strategies, which helps to encourage productive struggle, persistence, and perseverance. Additionally, the variety of non-standard contexts could improve student motivation and interest in mathematics, and facilitate a change in belief about mathematics itself.

**Recommended Technologies**

The follow are not necessary to complete this activity, but may be used to aid student understanding:

* Calculator: graphing or scientific
* Computer graphing systems such as GeoGebra, Desmos, etc.