**Subject area/course**: Mathematics/Algebra I

**Grade level/band**: 9-12

**Task source**: Colorado Department of Education; Colorado Content Collaborative in Mathematics

**Power to the Variable**

**STUDENT INSTRUCTIONS**

1. **Task context**:

You are a scientist who works at Mauna Loa observatory in Hawaii who measures CO2 concentration in the atmosphere. You have data from the last 50 years (<http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo_full>). You are presenting to the governor about your data, including a prediction about what the CO2 level will be in Hawaii in the year 2050. In order to create your prediction you will need to determine if it should be modeled by a linear or exponential function based on the rate of growth.

1. **Final product**:

You will be expected to show evidence of each step of the modeling process:

* Problem – Show an understanding of what is being asked and what the data are modeling.
* Formulate – Create a linear and exponential function for the data showing each model in an equation, graph and table.
* Compute – Calculate the CO2 levels for 2050 and the date at which the CO2 will be above 500 parts per million with each model.
* Interpret – Interpret the parameters of the functions in the context of CO2 concentration over time.
* Validate – Check the model for accuracy by predicting the CO2 concentration for intermediate years to assess the reasonableness of each model.

You must include the following products in your report:

* Provide a **written report** of each part of the modeling process described above and a statement of final conclusions including the limitations of each model.
* Create a 2 to 3 minute **digital story** (video) that the governor would be able to watch and understand the prediction and the limitations of the prediction.

**Additional Information**

1. **Knowledge and skills you will need to demonstrate on this task:**

* Linear and exponential functions provide the means to model constant additive rates of change and constant multiplicative rates of growth, respectively.
* Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
* Create equations and inequalities in one variable and use them to solve problems; include equations arising from linear, quadratic, and exponential function with integer exponents.
* Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
* Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
* Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs.
* Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
* Interpret the parameters in a linear or exponential (domain of integers) function in terms of a real world context and prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.

1. **Materials needed:**

* You will need access to the Internet for data, specifically: <http://www.esrl.noaa.gov/gmd/ccgg/trends/#mlo_full>
* You will also need a graphing program such as Excel or a graphing calculator that can fit linear and exponential models to data.

1. **Time requirements:**

This task will take approximately 2-3 class sessions to complete. Your teacher will provide additional details regarding timelines and due dates.

1. **Scoring:**

Your work will be scored using the Power to the Variable Rubric. You should make sure you are familiar with the language that describes the expectations for proficient performance.