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# K-12 Partnership Lesson Plan

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# *Predicting Earth’s Future: Building Your Own Climate Model*

## Overview

As Earth’s climate continues to change as the result of human activity, it is becoming increasingly important to be able to predict what climates will be like in the coming decades. In this exercise, students will use real data collected since 1750 to develop their own climate model that will predict changes in the Earth’s average temperature in the year 2050. They will then use their model to test how their predictions will change under different carbon emission policies.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Generate graphs in Microsoft Excel
* Evaluate relationships in scatterplots
* Explain how climate models work including their limitations
* Explain what a model is and the basic components that go into constructing a model

**Length of Lesson**

90 minutes (10 min for background presentation, 60 min for exercise, 20 min for discussion)

**Grade Levels**

Grades 9-12

**Materials**

* Presentation PowerPoint slides
* Computers with internet access to use Google Spreadsheets
* Data for climate exercise ([www.tinyurl.com/BuildClimateModel-1](http://www.tinyurl.com/BuildClimateModel-1))
* Worksheets for students to work through

**Background**

There are many factors that influence Earth’s climate: energy output from the sun; concentrations of greenhouse gases like carbon dioxide (CO2), nitrous oxide (N2O), and methane (CH4); volcanic eruptions that emit aerosol particles; absorption of CO2 by the oceans; even the amount of sunlight reflected into space by glaciers and ice caps (known as the albedo effect). Climate scientists use data about each of these factors and many more, to build models that predict how Earth’s climate will change. Some of these factors are variable (like the concentration of CH4 worldwide) while others (like the energy output of the sun) don’t really change even over the course of decades. Scientists must decide which factors to include in their models and how much weight to give to each of them in order to construct a model that can make accurate and precise predictions. In this exercise, students will focus on the two major drivers of Earth’s climate: the amount of carbon dioxide and the amount of aerosols (small particles found in dust and smoke) in the atmosphere. They will then see how their models will change under different policy scenarios aimed at reducing CO2 emissions.

### Activities of the session

1. Introduce models as simplified versions of some part of the world that we use to understand how the world works (see accompanying PowerPoint). Explain that before scientists can build a model, they have to make many decisions about what kinds of data to include in their model.
2. Introduce the activity to students.
3. Have students work on the activity.
4. Have students write their estimates up on the board.
5. Compare answers and discuss their predictions.

**Resources**

* Data sources
* NASA climate website: climate.nasa.gov
* General climate info: www.climate.gov

**Extensions and Modifications**

1. Have students work in groups of five to develop a climate model instead of each person doing it individually. Each person could pick one variable and make the graphs and do interpretations for that variable and then report that back to the group.
2. In Step 3, when students build their model, they can extrapolate the trends from Step 1 just by eyeballing where the trend is going but if you have covered some statistics, students could plot a linear regression to get the equation and then exactly calculate what the values will be in the year 2050.
3. Have students research specific carbon emissions policies or proposals and test how effective they will be using their model.

**Assessment**

Students will be assessed through producing and interpreting graphs based on data and by answering questions at the end of the activity.