Math Connections in the STEM Classroom — Carla Butler
Data & Math Are Everywhere — June 2022

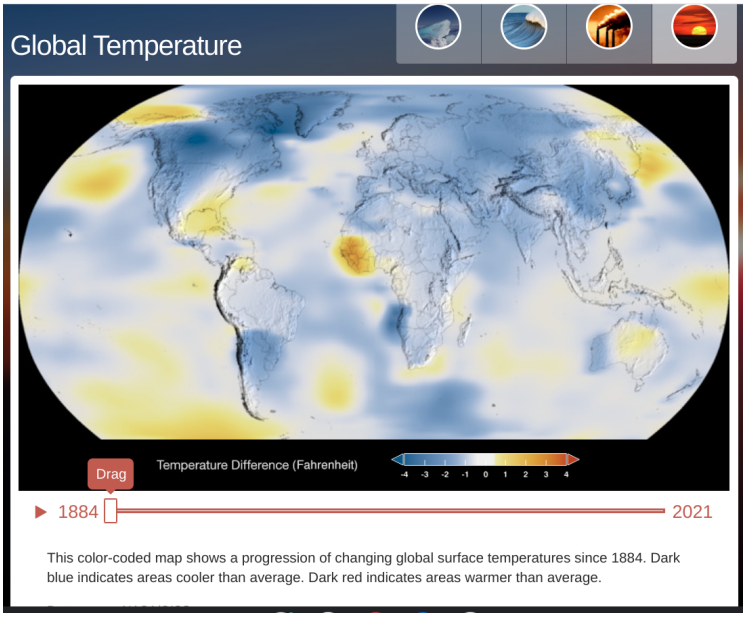
Global Temperature Change

Over the past 2,000+ years, the Earth's surface has continued to warm significantly due to global warming. NASA has provided an interactive data resource to support this statement on their NASA Global Climate Change website. https://climate.nasa.gov/vital-signs/global-temperature/.

Data & Engaging Concept

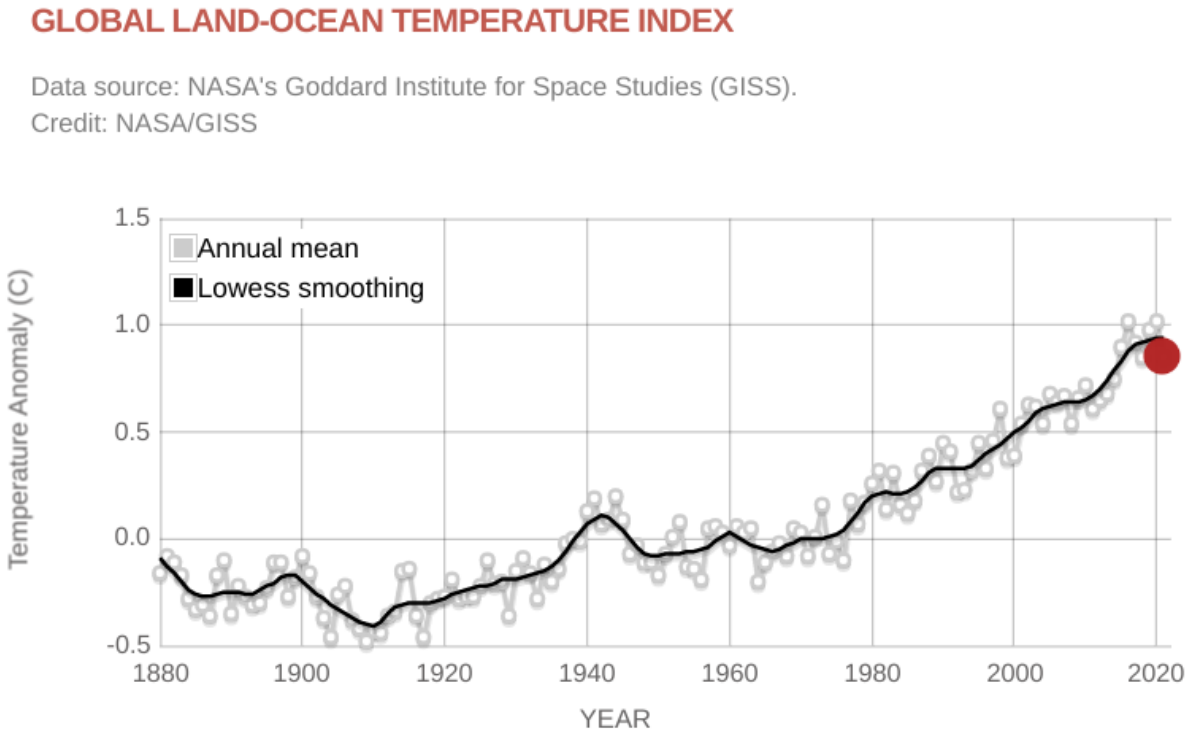
1. I would first have students independently think about their thoughts about global temperature. Do you think global temperatures have decreased, increased, or stayed the same over the last several hundred years? I would ask them to support their thinking with any reasonings they may contribute to the change in global temperatures or the lack of change.

2. After giving students time to gather any prior knowledge about this topic and share their thinking with a partner and gather class ideas, we would visit NASA's Climate Change Time Machine which provides a visualization of how Earth's Global Temperatures are changing over time. While observing the progression of changing surface temperatures on the time machine, I would ask students to make notes about their overall noticings and any particular observations that interest them. Students would then be asked to share their observations and provide supporting evidence at any particular year or time periods.

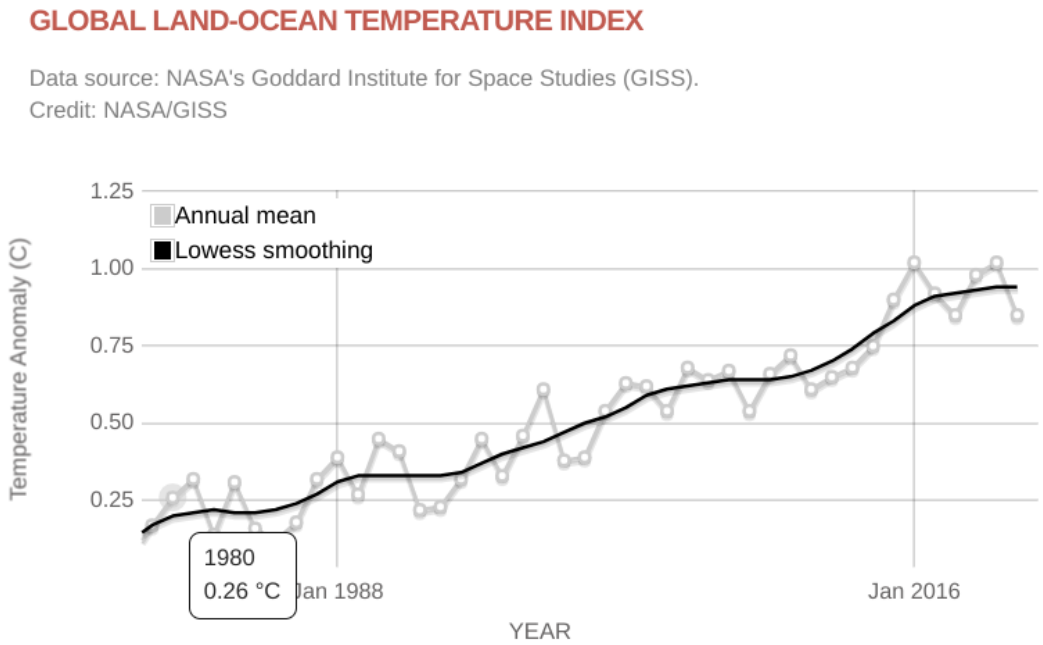


3. After sharing our observations, ask students what we would need to mathematically quantitatively support our observations. Ask them what kind of data we would need to know to support to properly analyze what we observed about Global Temperature Change. (years and temperature)

4. We would then take a look at the same data displayed on an interactive line graph at NASA's Global Climate Change Website - https://climate.nasa.gov/vital-signs/global-temperature/. I would ask students to make connections between their observations and noticings from the time machine to the data on the line graph. This will help students to visualize and see how the same data is represented on different data displays.



5. This particular line graph resource will allow users to zoom in and crop any particular portion of the data. For instance, you can zoom in and crop the data to just look at the data from 1980-2020 as seen below. Users can also hover over any data point for more detailed information.



The CCSS Math Connections /Practices / Standards Addressed:

- **CCSS.MATH.PRACTICE.MP2** - Reason abstractly and quantitatively.
- **CCSS.MATH.PRACTICE.MP4** - Model with mathematics.
- **CCSS.MATH.PRACTICE.MP5** - Use appropriate tools strategically.
- **CCSS.MATH.CONTENT.8.SP.A.1** - Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
- **CCSS.MATH.CONTENT.8.SP.A.2** - Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line.
- **CCSS.MATH.CONTENT.8.SP.A.3** - Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept. *For example, in a linear model for a biology experiment, interpret a slope of 1.5 cm/hr as meaning that an additional hour of sunlight each day is associated with an additional 1.5 cm in mature plant height*.

6. From here, we can really dig deeper into some mathematical analysis of the data. Students could use this interactive graph for data analysis or even pull data from the graph to create their own graph for a particular time period choosing intervals for axes they wish or to make the data easier to read. The following analysis could be performed with the data set independently, collaboratively, and discussed as a group:
    a. What year between 1980 - 2020 was the coolest? Warmest? What was the difference in average temperature between these years?
    b. What is the average temperature for each decade? What do you notice when comparing the averages for each decade?
    c. What is the overall trend of this data set?
    d. Draw a line of best fit through the data points and calculate the slope of the data set?
    e. Describe what the slope represents in terms of temperature over time.
    f. What is the initial value of the data set? What does the initial value represent in terms of this data set?
    g. Write an equation to represent the overall changes in the average temperatures from 1980-2020.
    h. Based on your equations, what would you predict the average global temperature to be in the year 2035?

7. For an assessment of individual understanding, students could be assigned a different time frame of the same data set to analyze using the same mathematical tasks above. For example: the years 1940-1980.

Extensions:

- Prompt students to think further about what they are still wondering about global temperature changes. Encourage students to follow-up with a short independent study and report back about their findings.

- Examples:
    - Students could look further into what may be contributing factors of global warming.
    - Students could look into any particular time period they observed as interesting from the time machine or graph and research what may have been occuring during that time period which may have affected the data set.
    - Students could research how global warming is affecting the planet.
    - Students could research and create a list of ways kids can take small steps to reduce their impact on the environment.

Resources:

- NASA Global Climate Change Global Land-Ocean Temperature Index - https://climate.nasa.gov/vital-signs/global-temperature/
- NASA Global Climate Change TIme Machine - https://climate.nasa.gov/interactives/climate-time-machine