Tracking Water

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Time Required: 1-2 one-hour class periods **Grade Level:** 5th grade

Background:
These lessons serve as an excellent anchor to the NGSS unit Earth's Systems that I'll be implementing in the fall. I found a fantastic lesson from the JPL website that tracks water across the globe using satellite data from space. This would be a great hands-on way for students to discover the trends and patterns of water distribution in different parts of the US. Students will interpret heat maps and create a line graph from the data they found. As a class, we examine overall trends of the data and discuss statistical patterns like clusters and outliers. The website for the lesson: https://www.jpl.nasa.gov/edu/teach/activity/tracking-water-using-nasa-satellite-data

Here is the data source link for the data integration lesson that I would use in my 5th grade classroom: GRACE Data Over the United States. NASA's GRACE satellites measured land water storage in the US from 2003-2013. The video shows patterns of water movement and trends in changes of water height in millimeters for the last 10 years.

Objectives:
- Students are able to interpret a heat map and collect data for one US city for one year.
- Students are able to create and present data in a line graph of land water storage data in one US city for one year.
- Students are able to describe trends in land water storage data over a 10-year period in the US.
- Students are able to work collaboratively with others.

Standards:
- CCSS.MATH.CONTENT.6.SP.B.5.B **Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.**
- CCSS.MATH.CONTENT.5.G.A.2 **Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.**
- CCSS.MATH.CONTENT.6.SP.B.5.C **Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.**
- **5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.**

Mathematical Practices:

- CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.
- CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.
- CCSS.MATH.PRACTICE.MP3 Construct viable arguments and critique the reasoning of others.
- CCSS.MATH.PRACTICE.MP4 Model with mathematics.
- CCSS.MATH.PRACTICE.MP5 Use appropriate tools strategically

Articles for extension:

- https://www.audubon.org/news/arizona-department-water-resources-and-audubon-agree-funding-plan-conserve
- https://www.denverpost.com/tag/colorado-water
- https://www.watereducation.org/colorado-river-project

Podcast:

- https://www.npr.org/2016/05/19/478643452/rain-barrels-are-now-legal-in-colorado

Engaging Context:

What makes this lesson an engaging context are the relevance and real-world issues about water rights and water restrictions in our community and state. Students are often surprised when I tell them that in the Midwest where I used to live many people owned rain barrels (illegal in CO until recently) and there were no water restrictions for homeowners. In Colorado, this is a different story.

As a way to engage, I want to share photos taken from a Boulder resident, Matt Nager, that captured the beauty of Colorado and all the ways people rely upon its water. Some of the pictures are breathtaking and serve as a way to connect how earth systems like the biosphere, geosphere, and hydrosphere interact. https://www.mattnager.com/STORIES/COLORADO-WATER/1
I would ask students a few engaging questions: *What kind of questions come to mind as you view the pictures? Why might a scientist or mathematician want to track water data?*

Data Collection:

Unfortunately we left school before I could do this lesson as a whole class, however, I did have a few students look at the heat graphs and create line graphs from the data to give me a sense if the data would help them understand the concepts better. One of the first questions that came up was how to read a heat map. The three students I interviewed had seen heat maps before but don't recall being asked to read one. I had to teach students the basics in reading a heat map. We looked at different US regions and noticed which ones seemed to have the most dramatic change in a 10-year period. I asked the students, *How can we use math to help support the claims we're making?*

The three students graphed Denver data from three different years. One student got hung up on the precision of the data. Each band of color covers 100 mm units of H2O. We agreed that the different hues of color within that band of color could be interpreted in 50 mm increments for better accuracy. Since we were looking at trends in the data over several years, this made the most sense to all of us. We decided that if anyone was in doubt about a measurement to use, we could get a consensus from other students. When I do this as a whole group next year, students will use their small groups to get consensus on measurements.

The data for Denver was interesting and the three students had a lot to say about it. One boy did all the other years so he could get a better picture of what was happening to water levels. We talked about the color intensities on both ends of the spectrum and the potential consequences. (droughts, floods, trouble growing crops) Finding a water balance was optimal. We talked about natural fluctuations in our area and what months were the snowiest/rainiest in the Denver area. It turns out the data supports the phenomena we experience -March and May really are wet and snowy! It's not that unusual to have a snow day in spring. As a formative assessment, I would use the class discussion of trends to check for understanding of concepts.

A simple rubric from the JPL website I would use for the final line graphs is shown below.

0	1	2
Students are unable to articulate what a heat map communicates and did not graph data.	Students produced a graph but are unable to articulate what data the heat map provides.	Students are able to articulate the data presented in their heat maps and how the data translate to their graph.

To extend, I want to tie in recent water management legislation since water rights and conservation is a hot topic. Colorado is the only state where 8,000 miles of river flow out of the state, no water flows in. I included articles on water legislation and the Colorado River Project I would use as discussion. One of the social studies standards for 5th graders is to know the geographic locations and regions of the western hemisphere. I would include a mapping exercise for students. In addition, I would ask probing questions like, How has water distribution changed over time across the US and what new information does that give us? What trends or patterns do you notice across the country? I would explore the perspectives of different people and their interest and interactions with the data. What would a scientist do with this data? What would a city planner do with this data? A politician? A farmer? A business owner?

References:

Tracking Water Using NASA Satellite Data Activity | NASA/JPL Edu. (2018, May 18). Retrieved from https://www.jpl.nasa.gov/edu/teach/activity/tracking-water-using-nasa-satellite-data/