Using Polar-ICE Data Stories to Drive Small Group Student Research Projects

BY JULIE WOOD

INTRODUCTION

For students living and learning in an urban environment, the ocean is an abstract concept. Students from The Young Women's Leadership School of Brooklyn, an all-girls 6-12th grade public school in Bushwick, Brooklyn, comprises a population of whom 82% qualify for a free or reduced-price lunch. For various reasons, these students rarely spend time outside. When they do, it is in concrete playgrounds, not at the beach or even in a park. However, the Polar-ICE Data Stories make the ocean accessible and engaging.

Data Stories and Small Group Work

This past school year, my Earth Science students chose to use the Polar-ICE Data Stories (https://polar-ice.org/focus-areas/polar-data-stories/) as the framework for their STEMposium projects. The STEMposium is an annual event featuring projects from math, science, and computer science classes that showcases content the students are mastering. Students present at the school level and then the top projects from each school go to a larger STEMposium hosted by Cornell Weill Medical School. For 7 weeks last year, a small group of 12 students met during lunch to explore the Antarctic and Arctic environments.

Students self-selected research groups of two to four members and then spent two sessions reading through the eight Data Story sets on the Polar-ICE website. Each group was asked to rank their top three stories in order of interest. I then conferenced with each group to discuss the underlying science content that they would need to research in order to fully engage with the stories and present them at the STEMposium. For example, the group that ranked "What drives patterns in ocean change?" as their top choice needed to understand tides, surface ocean currents, CODAR (coastal ocean dynamics application radar), eddies, convergent and divergent fronts, and convergence zones and density. While some of these topics are covered in our standard curriculum, others necessitated supplemental research. Identifying the additional research topics and scaffolding them for each group by providing source materials, gave them the foundation they needed to explore the data with confidence. The Polar-ICE Data Stories also had accessible links to

Students presenting at the Weill Cornell STEMposium. Courtesy of Dash Anderson

supplemental and background research that helped the students further build their knowledge.

Students did much of the supplemental research outside of our group time. Our school does not have a systematic process to teach research skills and methods so I gave the students checklists and templates to identify key facts and ideas. I also wanted to make sure that students were able to connect the research to the Data Stories in meaningful ways. I created a Google Classroom for our research teams where students were able to use the templates and checklists that I created to organize their research and then post their research for me to review and provide feedback.

STEMposium Projects

Each group was responsible for creating a research poster and interactive presentation for the STEMposium. The required components included: title, testable question, hypothesis based on background research, procedure for conducting secondary research, presentation of the data, data analysis, conclusions, and next steps for further research. Students initially focused on the testable question using an introductory lesson on what makes a question

testable, and then a sheet of practice questions students revised to make testable. Once the questions were set, students used the Data Stories and research materials to complete the other sections.

Lastly, they chose their interactive presentation component. The interactive component could be incorporated into any of the sections of the project. For example, the surface currents research group mentioned earlier used a Project Converge lesson on convergence zones involving blowing confetti in a pie pan to mimic how surface currents concentrate phytoplankton. This activity was referenced in the Data Story (http://coseenow.net/converge/classroom-program/in-class-lessons/#oceanconv). Students incorporated this into their background research section. The microplastics group encouraged students to download the app, "My Little Plastic Footprint" (https://www.plasticsoupfoundation.org/en/psf-in-action/plastic-footprint-2/) and take the quiz about plastics in the ocean and students' own plastic footprints. Each group also compiled a glossary of terms for their project board.

When the students presented at the STEMposium, they received overwhelmingly positive feedback on their use of authentic data, ability to connect current research to future research ideas, and their clear explanation of complex data sets. The experience built their confidence and facility with data. Two students went on to competitive summer research programs—inspired by their success with the Polar-ICE Data Stories.

CONCLUSION

The Data Stories were an excellent resource for developing these projects for several reasons. First, they pose questions but do not provide defined answers. Instead of showing science as a mechanism for "getting the right answer," they demonstrate how science is an ongoing process of questioning, researching, evaluating, and then starting again at questioning. It is far more empowering for students to explore places where their voice can contribute to a conversation scientists are having, rather than to view science as a set of established answers that have already been answered. The Data Stories provide an access point to authentic science content, data, and process.

Secondly, the Data Stories have differentiated levels of difficulty. While the students self-selected their groups and projects, I conferenced with each group and was able to steer lower-level students toward the Icefish story, which is presented in more of a conversational tone, provides highly engaging subject matter, and easily readable graphs. I directed higher-level students toward the Data Story on ocean currents and convergence, which is written in more academic language and involves reading complex current diagrams and tidal graphs. Students who respond better to data visualizations can use the Arctic sea ice Data Story, which has more interaction with the data itself through animations of the graphing and a compelling representation of the area of sea ice as the area of different U.S. states. One group that wanted to focus on something they thought was more relatable for their peers chose the microplastics Data Story, which they plan to share with our school's Environmental Action Club to raise awareness of plastics use. All of these groups of students are using real data and connecting with authentic scientific research at a level they find comfortable and with an approach to content and data analysis that resonates for them.

Finally, the Data Stories are well-designed to be used as a short-term exploration in a unit or, in my case, as a short-term research project. In a school using the 5E framework, they can operate as an Engage, Explore, and Explain for a unit. The Stories have a narrow scope and small scale which makes them usable in any curriculum and at any content level.

The Data Stories align with the NGSS Cross-Cutting Concepts of Patterns, Cause and Effect and Systems and System Models, all 8 NGSS Science and Engineering Practices, and with Common Core Literacy and Math Standards. They also introduce the Polar Literacy Principles which can serve as a new framework for making science education more comprehensive.

In my own experience in the classroom and working with other science teachers for the past 10 years, finding usable data sets for high school aged students at multiple skill levels is a common struggle. The Polar-ICE Data Stories are easily adapted to English as a New Language student, special education, general education, and advanced student use. They are aligned to the standards that guide classroom teaching, short enough in length to be easily incorporated but detailed enough to give a solid foundation in content, and engaging in subject matter. They are an excellent addition to current curricular offerings and a fantastic resource for teachers looking to strengthen their students' data literacy.

REFERENCES

Additional articles, and references and abstracts for all contributions are available on Polar-ICE (https://polar-ice.org/nmea_current/) and NMEA (https://www.marine-ed.org/s/Polar-Ice-Resources-Current.pdf) sites.

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