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Data Source: [Compact Reconnaissance Imaging Spectrometer for Mars \(CRISM\)](http://crism.jhuapl.edu/data/mica/)
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At the beginning of the school year, in the Geology on Mars unit, students take on the role of planetary geologist to uncover the secrets of the habitable possibilities that may have supported life on Mars. Students engage in trying to answer the anchoring unit question “How can we search for evidence that other planets were once habitable?” Through satellite imaging and other data collected via NASA’s Curiosity Rover, students observe geological evidence and compare them to the structures of Earth. Then, they explore the investigative question “What geologic process could have formed the channel on Mars? There are two claims: flowing lava formed the channel on Mars; flowing water form the channel on Mars. Students model how flowing water can create channels using a sand-filled stream table where they observe patterns from the movement of sediments. The unit culminates discussing their claim in a science seminar and writing a scientific argument. Although the evidence students observe is acceptable, there are many avenues students can explore that can answer the unit question. Since they explore other Earth systems such as the atmosphere, hydrosphere, and biosphere, students can collect other relevant data that can be used to compare Mars’s system with Earth. Why not have students dive deeper and discover other evidence that the planet was once sustained life?

Mars Reconnaissance Orbiter—launched in 2005—is another of NASA’s exploratory spacecraft equipped with a compact reconnaissance imaging spectrometer (CRISM) that traces chemicals and other water-related minerals on the surface of Mars. It can also monitor the weather, record atmospheric profiles, probe the internal structure of the terrain, and locate sites of high interest to collect samples and export it back to Earth (NASA, 2014). If students are interested in chemistry, they can explore the molecular composition of Mars’s landscape, which can support or reject the presence of water on the planet. For example, CRISM analysis reveals minerals like hydrated silica, which terrains

enriched with the mineral takes appearance of sediments instead of bedrock. This is critical piece of evidence because sediments are the result of weathering—one of which could be water. This leads to the next enhancement of the lesson looking at the minerals or rock types on Mars. Although students do not learn about rock formation until after the plate motion unit, students who choose this route are already exposed to a topic that is not covered, expanding on their current work. Enhancing the lesson using CRISM data transforms the objective but still focused on the unit question. Students will be able to collect geochemical data to determine if Mars was once habitable. In their final writing piece, students will be able to use the data collected to provide a unique personalized perspective to their findings.

Data is information. Information brings solution. Solutions drive society. Society changes the world. Data in the classroom is a powerful learning tool for students, so they can see in real time, or the most they could, to explain and understand scientific phenomena. Using this data, they are able to justify the events that occur in the world around them. Simply providing a textbook full of “facts”—which is not always accurate or antiquated—convince students of scientific understanding. Data collected from other sources offers a different learning experience. It can either support or reject their findings in class. Retrieving data from reliable sources is a learning opportunity itself.

The rationale behind using data is having the authenticity factor in a classroom environment and a sense of being part of a broader scientific learning community. As educators, we must promote the true Nature of STEM (NOSTEM) within the classroom. Dr. Peters-Burton states that inquiry “leads to the development of valid and productive ideas” (2014). One of the characteristics of Nature of Math (NOM) is that data validates the “quality of solutions and models by understanding the differences between mistakes and reasonable choices that did not turn out to be successful.” Engineers rely on mathematical figures and statistics to solve problems. Whether it fails or succeeds, the data drives decision-making to reach a solution, a common principle across content areas. This adds to the authentic experience of learning inside and outside of the classroom. With programs like NASA Citizen Science initiatives, students and other volunteers can

collaborate with scientists to provide real data that can be utilized. A popular one like Globe Observer, help NASA collect environmental data from clouds, trees, and mapping land. Another one, iNaturalist, community scientists can participate in recording the flora of a location, which can provide information of invasive species in different places and perhaps identify rare species in part of a broader conservation project.

Data come in different forms. Qualitative and quantitative data provides meaning for solving problems. If the data are expressed numerically, I always tell my students what do the numbers mean? Use your numbers. They have meaning. Science and engineering incorporates math once it uses those numbers because one you record the raw data, what are you going to do with it? Analyze. Interpret. Discuss. Another way data can be used is by having discussions on figures that may seem inaccurate. Students fixate on always getting the right answer. In NASA's Intro to Engineering for kids, the video mentions that during experimentation engineers discover what works and what does not. When things go wrong during testing, scientists and engineers will learn more in order to revise it. These conversations are part of the elements that makes STEM engaging to individuals. Content areas in STEM are not separate entities, but framed as a pulley-rope model where each discipline relies on the other to work having the engineering approach as the catalytic bridge to bring all four areas together (Nadelson & Seifert, 2016). Data-integrated lessons are power tools to enhance instructions, connect across multiple content areas, and offer an authentic experience to STEM in the classroom. A world without data is a world without solutions.

References:

- 1 National Aeronautics and Space Administration (2014). *Mars Reconnaissance Orbiter* [Fact sheet]. Retrieved from <https://mars.nasa.gov/mro/>
2. Peters-Burton, E. E. (2014). Is There a “Nature of STEM”? *School Science and Mathematics*, 114(3), 99–101. doi: 10.1111/ssm.12063
3. Nadelson, L. S., & Seifert, A. L. (2017). Integrated STEM defined: Contexts, challenges, and the future. *The Journal of Educational Research*, 110(3), 221-223. doi:10.1080/00220671.2017.1289775