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Endeavor: STEM Methods

## Engaging Contexts Data Integration Proposal

### Mapping with NASA for context and constraints

#### Guiding Questions:

What types of constraints would an actual Mars rover face in moving across the surface of Mars?

What constraints do you need to consider when programming your Sphero to move across the surface of this challenge?

**Goal:** Students will use data gathered from the HiRISE Operations Center at the University of Arizona showing HiRISE DTMs (Digital Terrain Models) of Mars. They will analyze different data points for the constraints they would present to a typical Mars rover. Students will use the tools available from NASA on the Mars Trek site to map a journey for a rover. They will make predictions about the effects of the surface features on the travel of a rover.

Many of NASA's missions are conducted by robots. While some robots can make decisions based on data received from sensors, humans still must program the robots - we tell robots what to do and how to execute their missions. In order to program a SPHERO on a robotic mission through a set course representing Mars in one autonomous program students must understand the constraints of the course. Constraints are a critical component of the design process and a fact of life. By posing the question, "How do surface features affect the variables of speed and time when programming a SPHERO robot to travel across a course?" Putting this constraint in context with the actual constraints found on Mars builds authenticity for students and thereby increases student interest.

#### Procedure for data collection:

Students in STEM class will use computers and the DTM Map of Mars from the Digital Terrain Models on <https://www.uahirise.org/hiwish/maps/dtms.jsp> to collect data from at least three student selected points on the map.

Students will use the digital tools on <https://trek.nasa.gov/mars/> to plan a path across Mars which includes:

- Three topographical features
- location (longitude and latitude)

- distance in KM between features
- Description of constraints

### **INTERDISCIPLINARY CONTEXT:**

The STEM Connection class I teach is designed to provide opportunities for students to learn computer science concepts and basic coding while reinforcing the Georgia Standards of Excellence for Engineering, Technical Literacy, and relative academic standards. By focusing on the Georgia Standards for Technical literacy, “Standard 10 – Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving,” and “Standard 11 – Students will develop the abilities to apply the design process” students will become more aware of how constraints play a role in the Design Engineering Process especially when writing executable code for a robot or machine that must interact with variable surfaces and environments. In addition, students will be able to reinforce their understanding of the Georgia Standards of Excellence in science “S7CS4 – Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities,” and “S7CS5 – Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters”. The students will be using real data collected by NASA to create an accurate map much like the map they create when developing the pseudocode for their Spheros in the challenge activity of this unit. It is my intention to provide time to compare their maps to the course they will be using in their challenge activity and to discuss the constraints collaboratively

### **RESOURCES:**

Department of Education, GA - <https://www.georgiastandards.org/Georgia-Standards/Pages/default.aspx>

NASA - <https://trek.nasa.gov/mars/>

University of Arizona's Lunar - <https://www.uahirise.org/hiwish/maps/dtms.jsp>