Objective

Student will be able to build a physical model of a local watershed and test a question regarding how water moves through it.

Purpose

- Novel way to teach kinematics
- Potential to be place-based, involves student experience, culturally relevant
- Science, sustainability, engineering, and design concepts

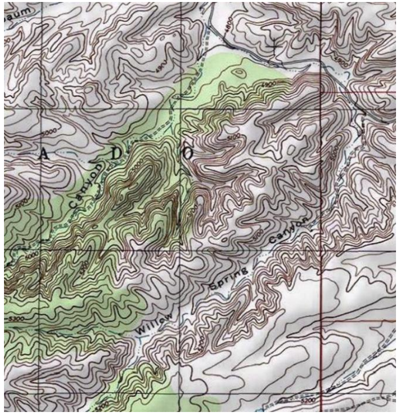
Standards Engaged

HS.P2U1.5: Construct an explanation for a field's strength and influence on an object (electric, gravitational, magnetic).

HS.P3U1.6: Collect, analyze, and interpret data regarding the change in motion of an object or system in one dimension, to construct an explanation using Newton's Laws.

HS.E1U1.12: Develop and use models of the Earth that explains the role of energy and matter in Earth's constantly changing internal and external systems (geosphere, hydrosphere, atmosphere, biosphere).

Planning (~1 week)			**Construction** (~1 week)		**Data Collection** (~1 week)			**Reflection**
Milestone 1	Milestone 2	Milestone 3	Milestone 4	Milestone 5	Milestone 6	Milestone 7	Milestone 8	Milestone 9
Identify watershed using google maps *Record topographic map*	*Conduct a discussion and make a written plan for group division of labor*	*Bring recycled cardboard for construction*	*"Skeleton" of model is complete.*	*Model is coated with water resistant material.* *No more work required on model construction.*	*Write 4 testable questions about the motion of water through your watershed.* *Collaborate with group to decide on 1 question you will answer.*	*Begin testing question.* *Method must be recorded in notebook.* *Data must be recorded in notebook.*	*Represent data graphically. (Dear Data used for inspiration)*	*Reflection*



Sample topo of Willow Spring Canyon in Coronado National Forest using Google Earth. It is very easy to get good quality topographic maps using Google Earth mobile app. Visit this site for guidance on how to do this: https://ngmdb.usgs.gov/topoview/

Reference photo of what a "skeleton" structure of watershed model should look like.

From CraftKnife.blogspot.com (2020)

Materials

Per group:

- Cardboard (on average students used ~ 24 in^2 cardboard)
- Hot glue gun x1
- Hot glue sticks x8
- Scissor x2
- Ruler x2
- Pipettes x4
- Aluminum pans

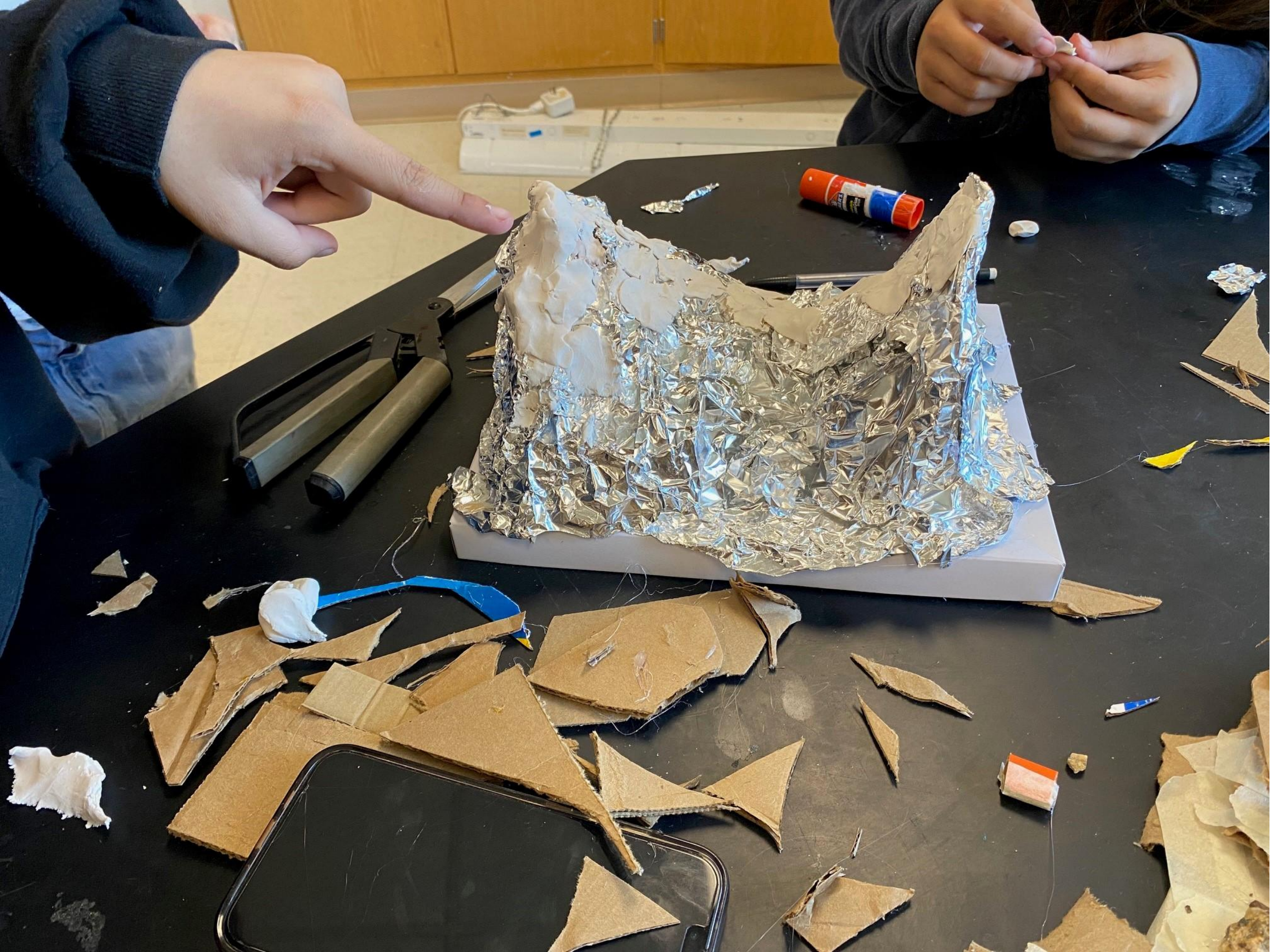
Per classroom:

- Aluminum foil roll x2

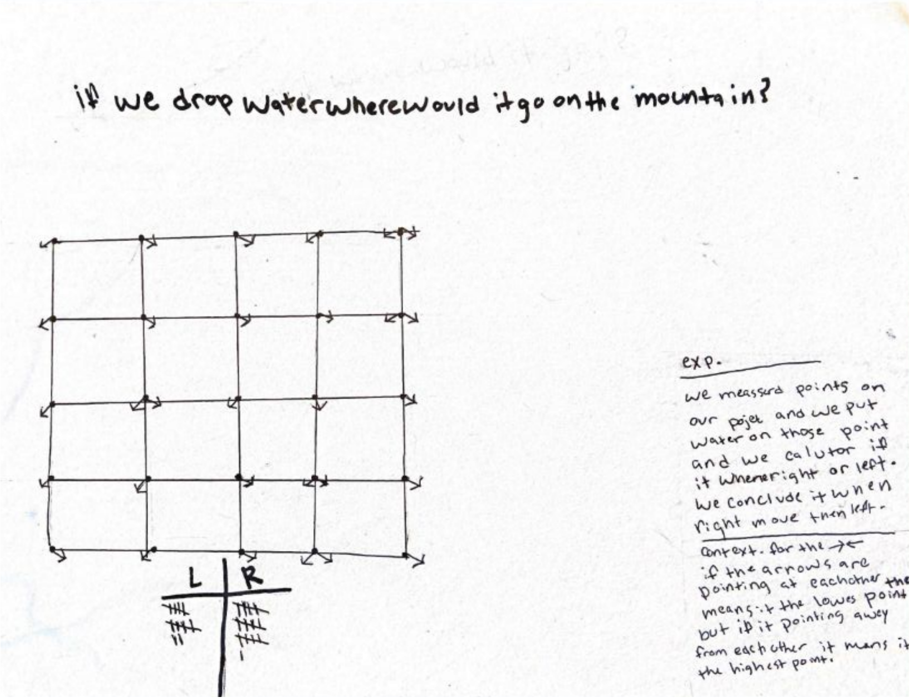
Optional:

- Soil sample (may be collected outside)
- Polymer clay

Student Work

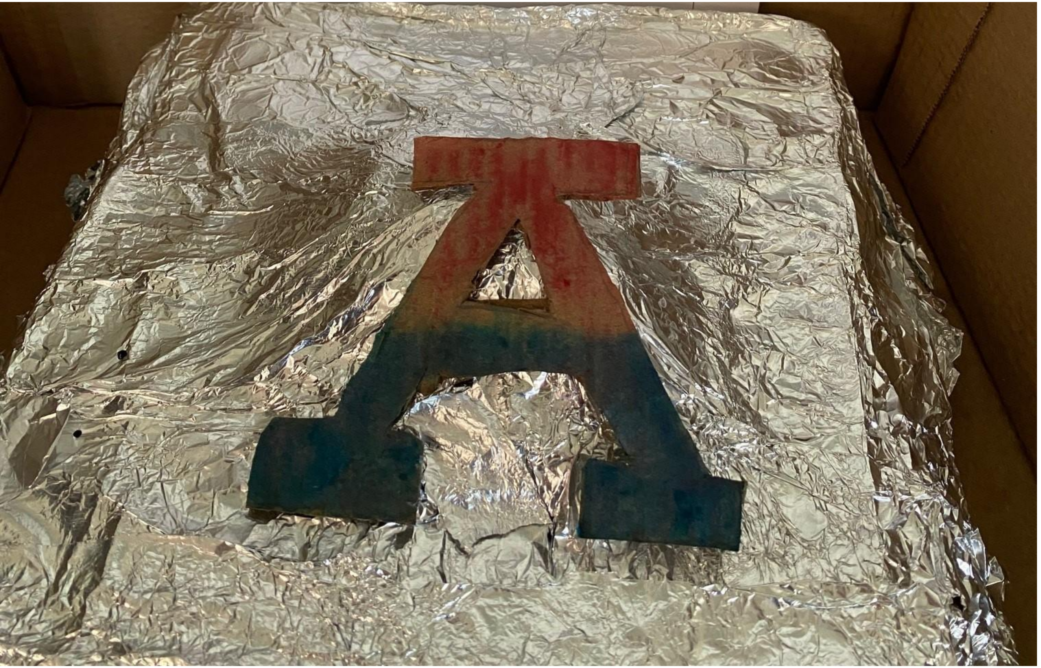


"Reddington Pass"

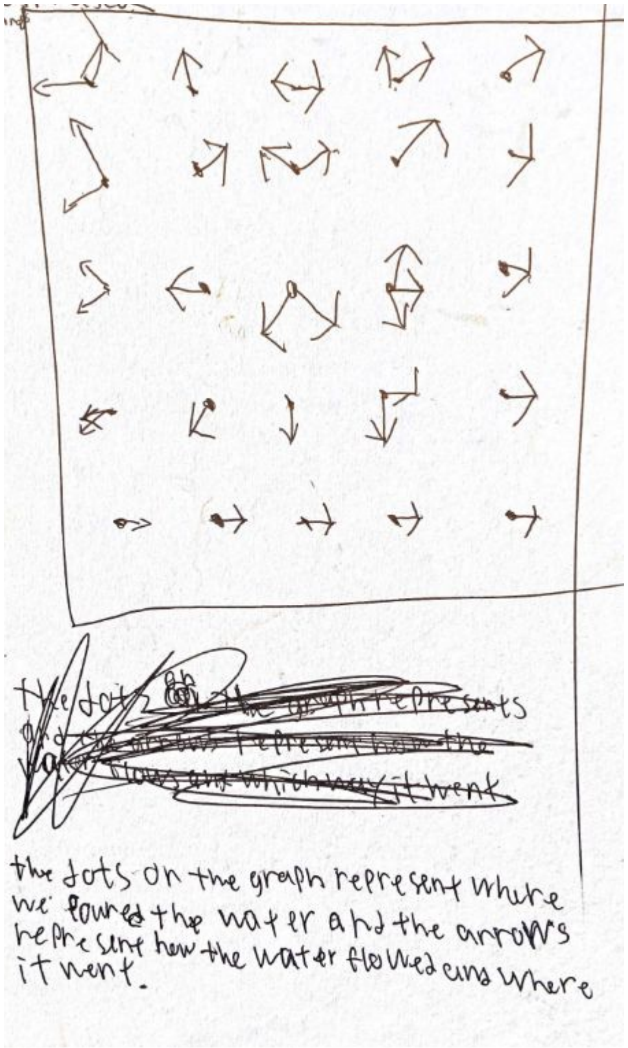


“Sabino Creek”

“Mississippi River Delta”



“Sentinel Peak”

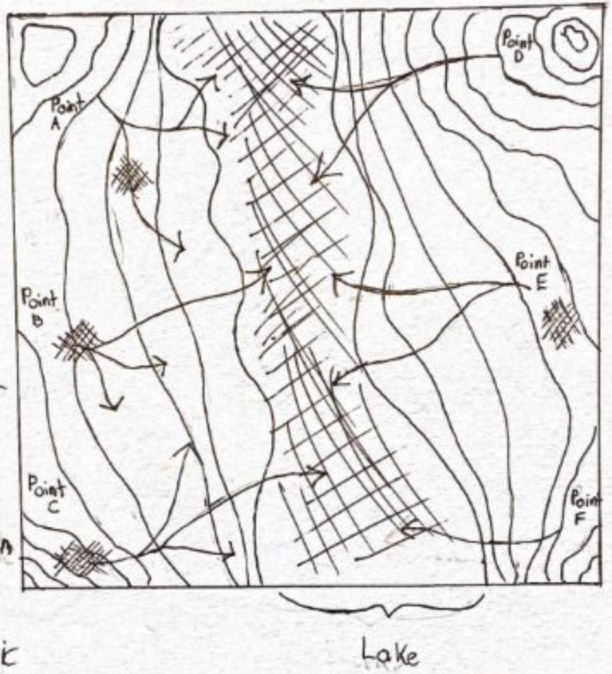


“Sahuarita Lake”

Sahuarita Lake

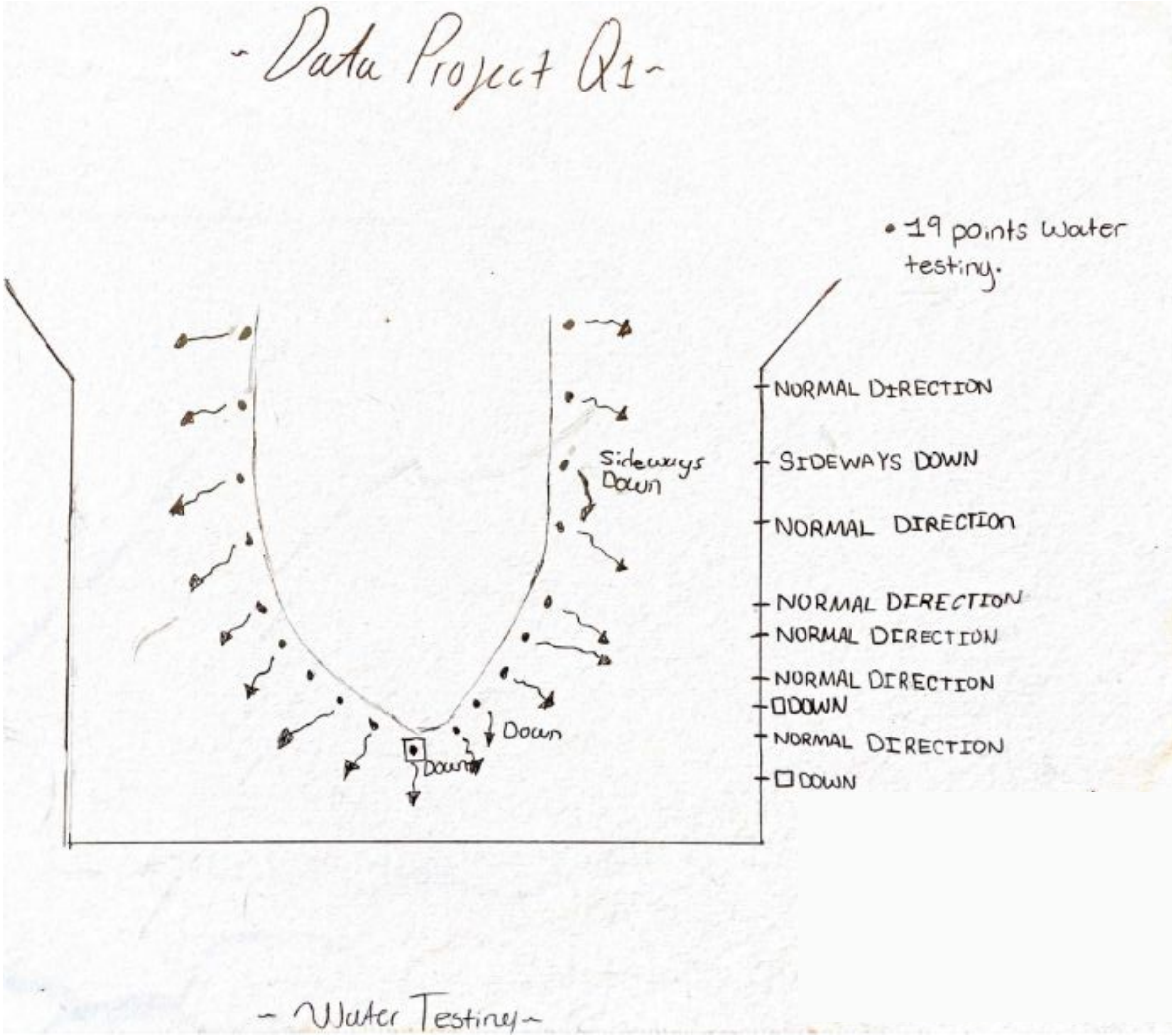
= Puddles

→ = Stream



The data in this picture represents where the water goes (the arrows), when Poured in certain spots, or Stayed (The puddle Figures), when Poured. The shape of the model is in a topographic form.

“Catalina Mountain Range”



Reflection

I teach two classes: plant science and STEM– which is essentially a semester of physics and a semester of chemistry. Although my experience in BIORETS more consistently aligned with the learning goals of plant science, I was able to think about how to teach concepts in STEM in a more creative manner. After some discussion with one of my fellow teachers, we came up with this idea to teach motion with water instead of rolling carts or balls. To me, teaching kinematics (motion, Newton's laws, etc.) is a bore. When I think of my time on the Santa Cruz river, I think of how I could watch the river flow for hours. Clearly, there is an aspect of moving water that inspires wonder far more than rolling carts down hills. Anecdotally, I think the students agree.

This project was a huge undertaking for quarter 1. Some reflection for how I would repeat this in following years:

- I would practice building models with cardboard prior to this. Some students took off with building while others were overwhelmed by the steps.
- I would mentally prepare to have my classroom be a disaster. During this project there was lots of cardboard, and even more scraps in various corners of my room. Though I think this mess can be managed, messiness is realistic when one is engaging ~100 learners in a construction project.
- Having students build models of their choice *and* identify a question relating to motion to experimentally answer is overwhelming. This was a quarter 1 project for me after all, and many students had varying exposure to/practice with the scientific method. In the future, I would provide the question for the students. For example, "How fast does water move at different points in my model". For students in need of extensions, I would give more choice.

Overall, I really enjoyed doing this project early in the year. One because I think it really sells the idea that science can be used as a lens to view your local world to students. Secondly, because it starts the year off with a concrete example of what a scientific model is that can be used to support students when we begin discussing more abstract conceptual models throughout the year.

Supplemental Resources/Suggestions

https://river-runner.samlearner.com/ (Potential manipulative for anticipatory set)

https://www.kickstarter.com/projects/inventable/inventable-a-kid-safe-power-tool-for-cutting-cardboard (In case you find yourself with some extra funds. This could make constructing topographic slices easier)

- Spend some time instructing how to read topographic maps
- Spend some time teaching unit analysis to assist students with scale