Developing a Groundwater Classroom and Field Science Program for High School Students: The Montana Groundwater Academy (MGA)

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What is the Montana Groundwater Academy?

- A 3-day, place & research-based science program, part of which is enacted at a groundwater (GW) education field site in Missoula, MT
- Engages students in 1st-hand investigations
- Aligned w/ *Next Generation Science Standards*
- Led by scientists & educators
- Builds student capacity for informed decision-making about pressing water issues
- Involves many local supporting, education & school district partners

Program Learning Goals

Participating students develop the capacity to…

Explain

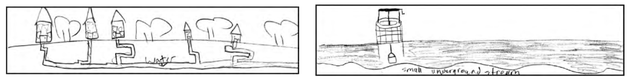
- Where GW is located
- How & why GW moves
- Seasonal & long term patterns & trends
- How GW & surface water connect & interact
- How GW becomes contaminated & how contamination can be remediated

Investigate GW issues in western Montana

Know how to protect, manage & sustain GW resources

Program Need

Public understanding of water science required for informed citizenship is poor, & current educational opportunities are limited.



Common conceptions of middle & high school students

Other common informal ideas include…

- GW is polluted by stuff falling down wells
- GW is a dead-end
- Contaminants seep through ground w/out need for water transport
- There is generally little awareness of driving forces (e.g., gravity, head) or of constraining factors (e.g., permeability, solubility)

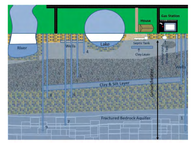
In response to this need, we developed the MGA program and a GW education field site in Greenough Park in Missoula. The field site comprises 12 monitoring wells & 4 staff gauges on Rattlesnake Creek.

Marked places show wells & staff gauge locations

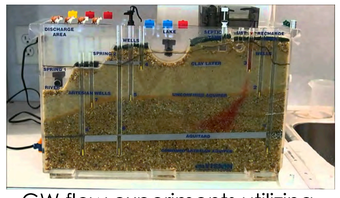
MGA utilizes an "Engage, Explore, Explain, Apply" instructional model

Day 1: Classroom GW Investigation

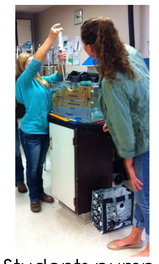
Students investigate GW w/a physical model.



Fold-over map



GW flow experiments utilizing sand tank model

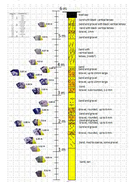


Students pump well to test effects

Day 2: Groundwater Field Investigation

Students investigate where GW is at the field site. Where is it coming from? Where is it going?

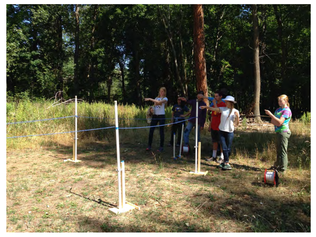
Well & creek monitoring network



Geology (video clear PVC well)

Grant supports field trip costs

Demo WL measurement



3D piezometer string flow model

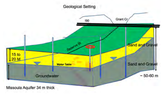
Students collect & share GW level data

Constructing a group GW flow map

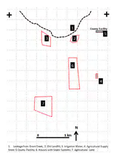
Day 3: Groundwater CSI Investigation

In this ***application lesson***, students work in teams to investigate the source of a reported well contamination & use evidence to predict which areas will be impacted. They also develop a plan for remediation.

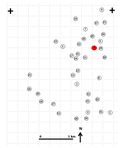
1985 N Reserve St herbicide discovered in a well



Geology



Possible contamination source overlay



Well overlay

Comparing analyses

GW elevation overlay

Project Partners

Supporting

City of Missoula Parks,
Mountain Water Company,
Missoula Valley Water Quality District,,
NewFields Companies, LLC

Education

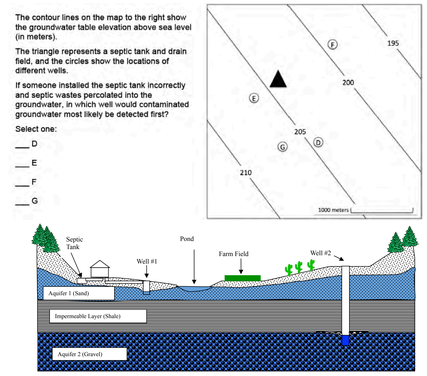
Watershed Education Network,
Bitter Root RC&D,
Clark Fork Coalition,
Salish Kootenai College

School Districts

Florence Carlton, Frenchtown, Lincoln, Missoula, Ronan, Stevensville

Program Evaluation

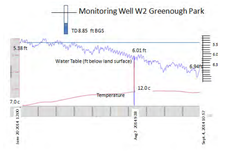
We are assessing effectiveness of program w/ data from students, teachers & education partners.



How does water get into the pond? Explain as many pathways as you can.
Could pumping from well #1 affect the water in the pond?
Could pumping from well #2 affect the water in the pond?
Explain your answers.

Future Directions

- Sustain & expand audiences: university, public, professional, etc.
- Expand emphases: computational reasoning (NSF STEM+C grant: *Comp Hydro*)
- Maintain & expand partnerships & funding
- Make use of site for applied research



Data compilation

Workshops

Field-site development

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