Water Education That Makes Sense

Using Investigations, Modeling & Data to Support Student Sense-Making About Big Ideas

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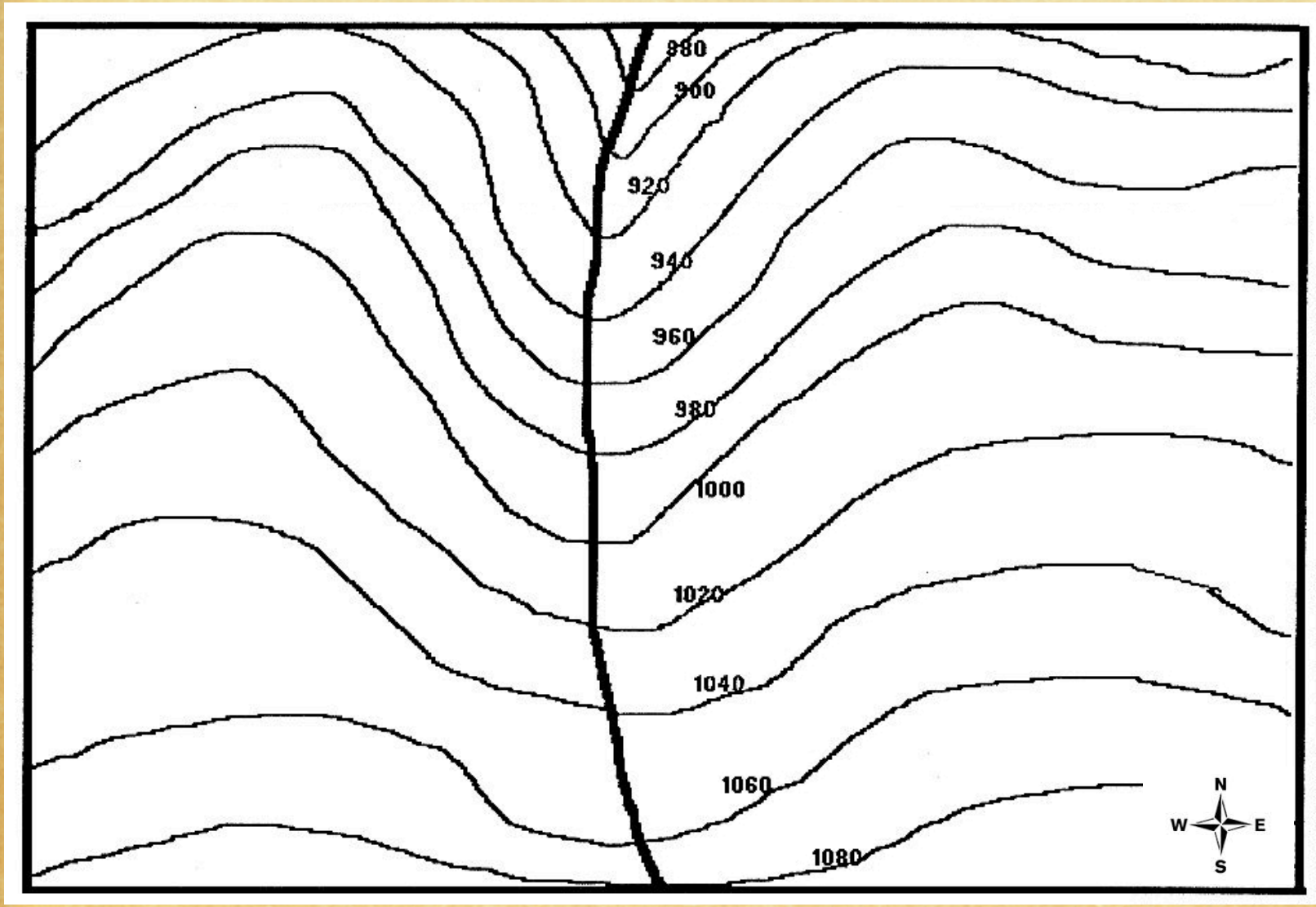
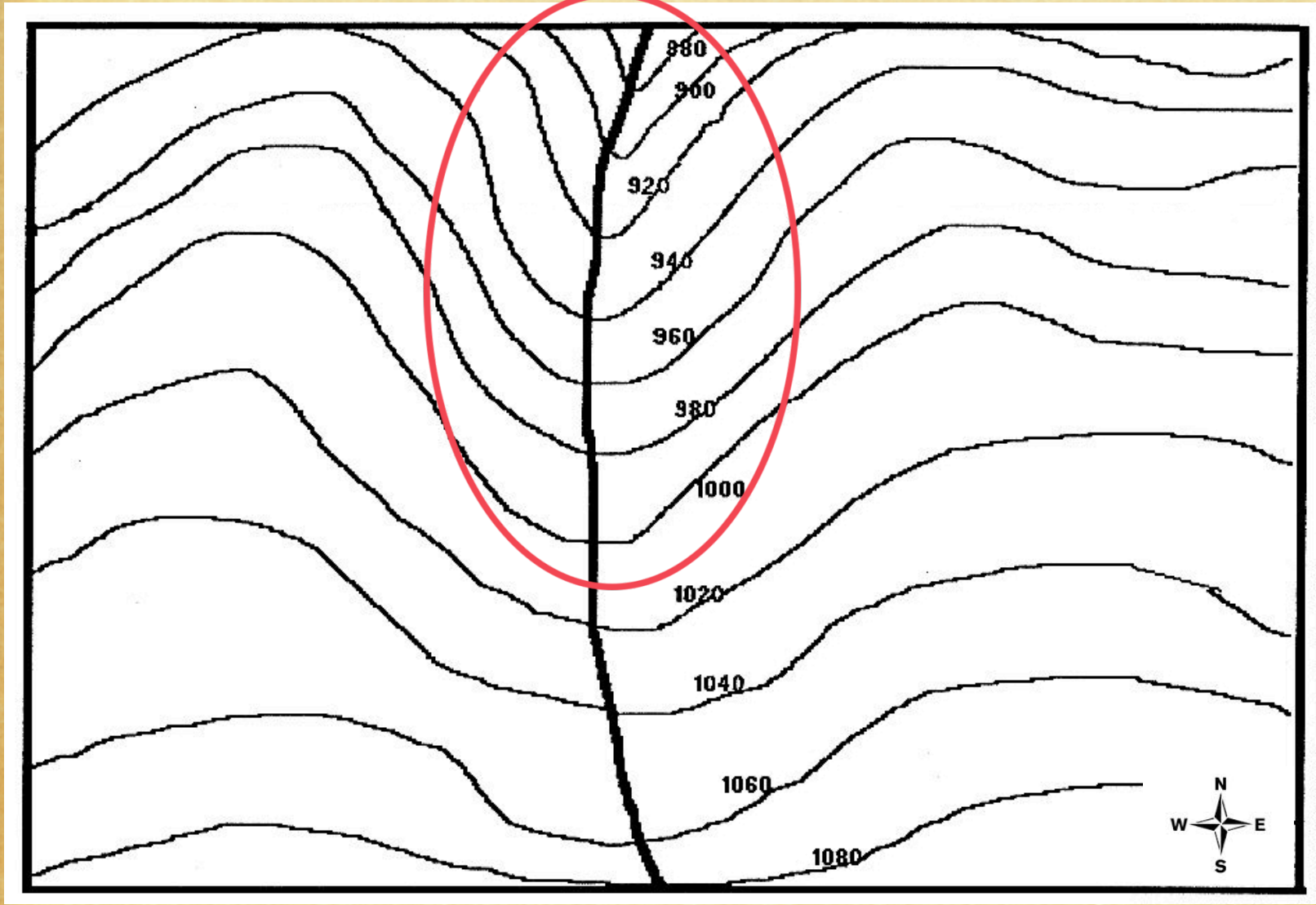
Overview

- What is learning like a scientist?
- Watershed Education Network Example
- Montana Groundwater Academy Example
- Montana Groundwater Academy Application Activity

In which direction is the stream flowing?



In the circled area, is groundwater flowing into or out of the stream?



Scientific Literacy

- Scientifically literate people can understand, judge and use science
- All citizens need to make sense of information relevant to personal & societal issues
- Science is always growing, so we can't teach students everything now – need to prepare them for future learning
- But how?

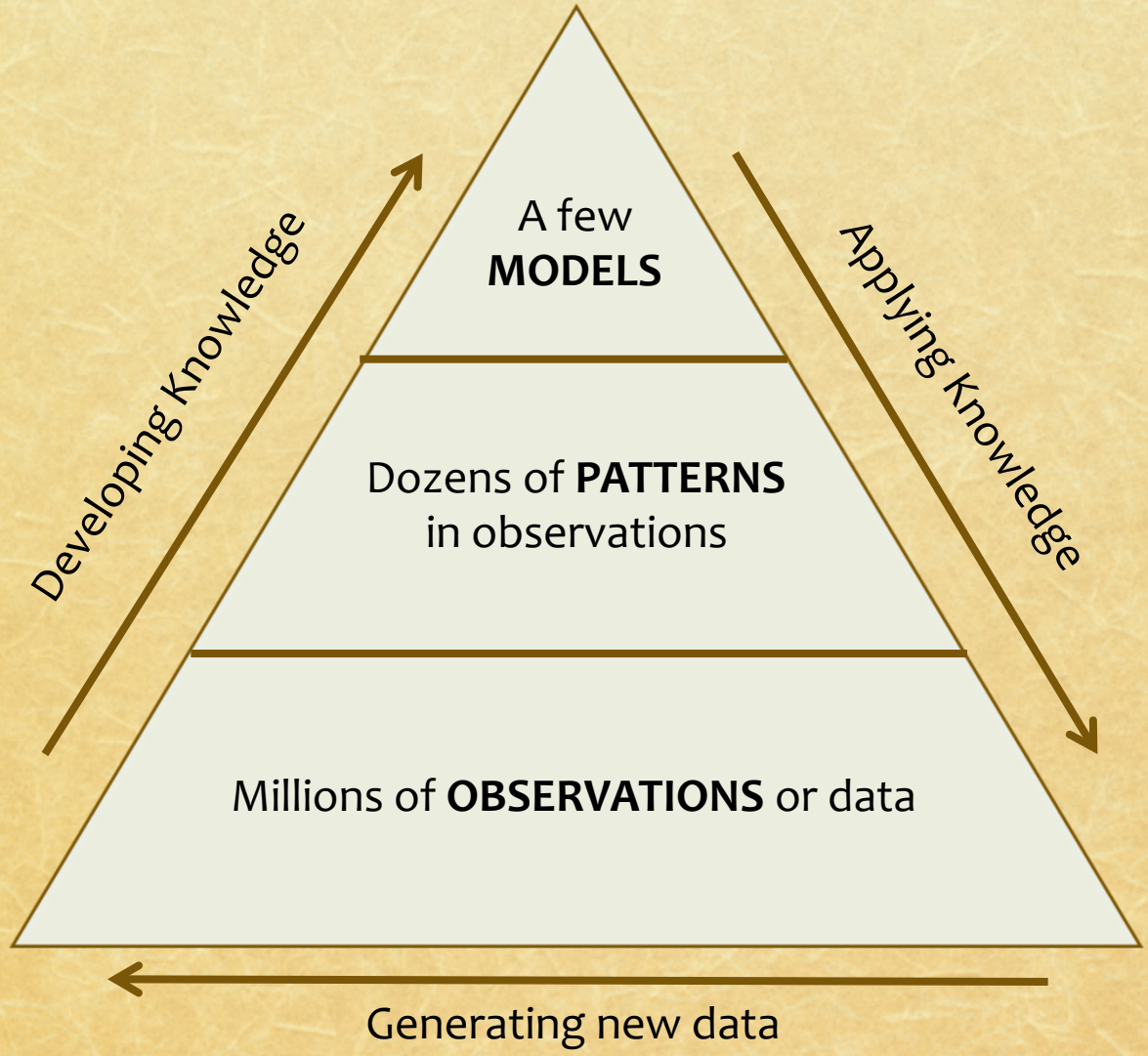
Practices for Future Learning

NGSS Scientific Practices are a good starting point…

1. Asking questions
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating and communicating information

But, how do these fit together into learning experiences?

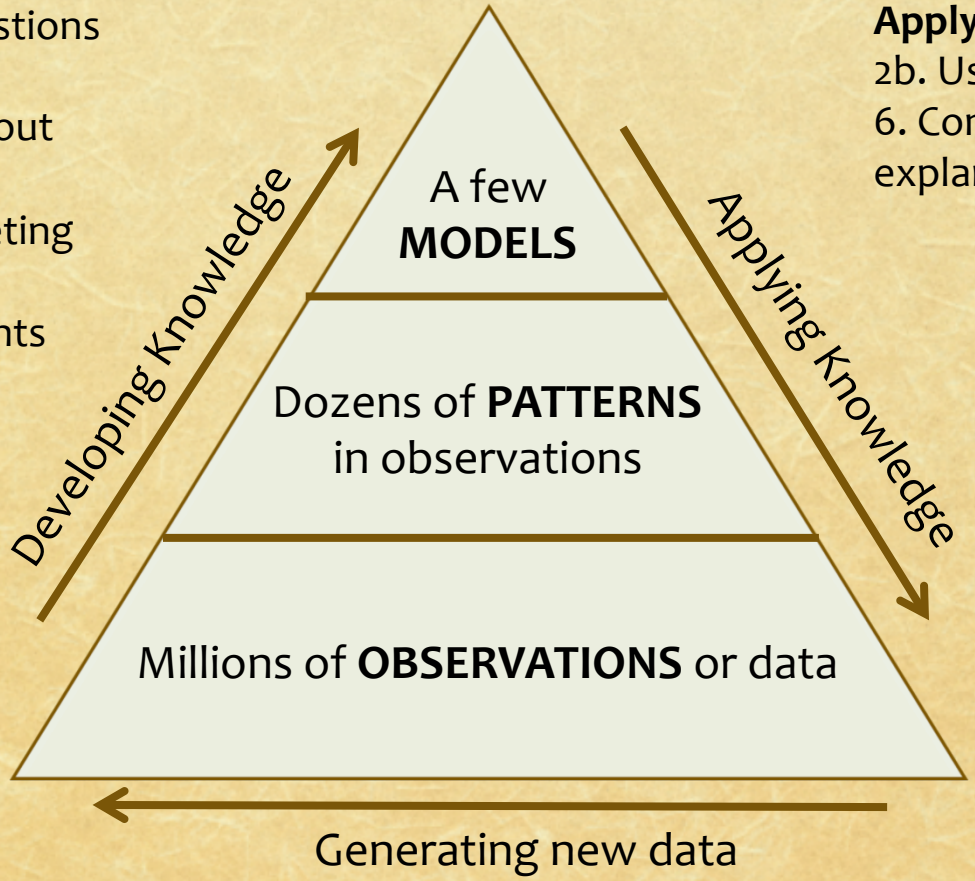
Learning Like a Scientist



Scientific Practices

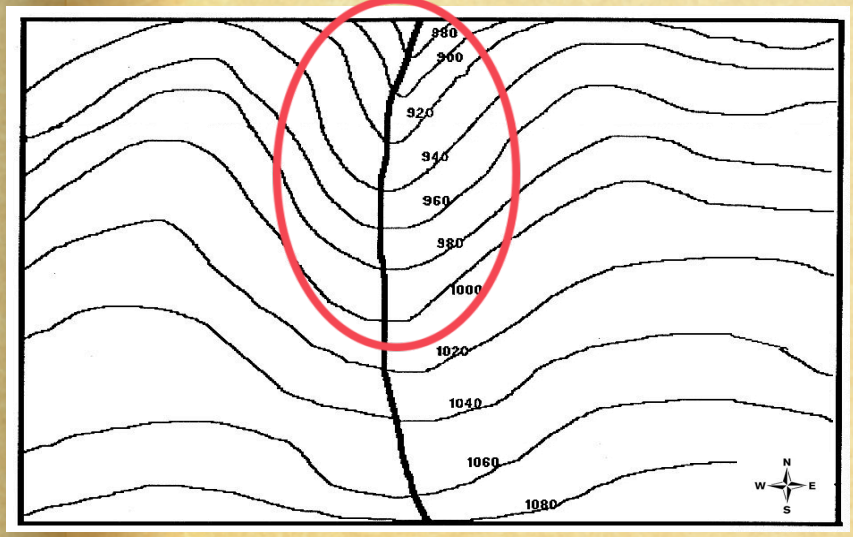
Developing Knowledge
1. Asking scientific questions
2a. Developing models
3. Planning & carrying out investigations
4. Analyzing & interpreting data
7. Engaging in arguments from evidence

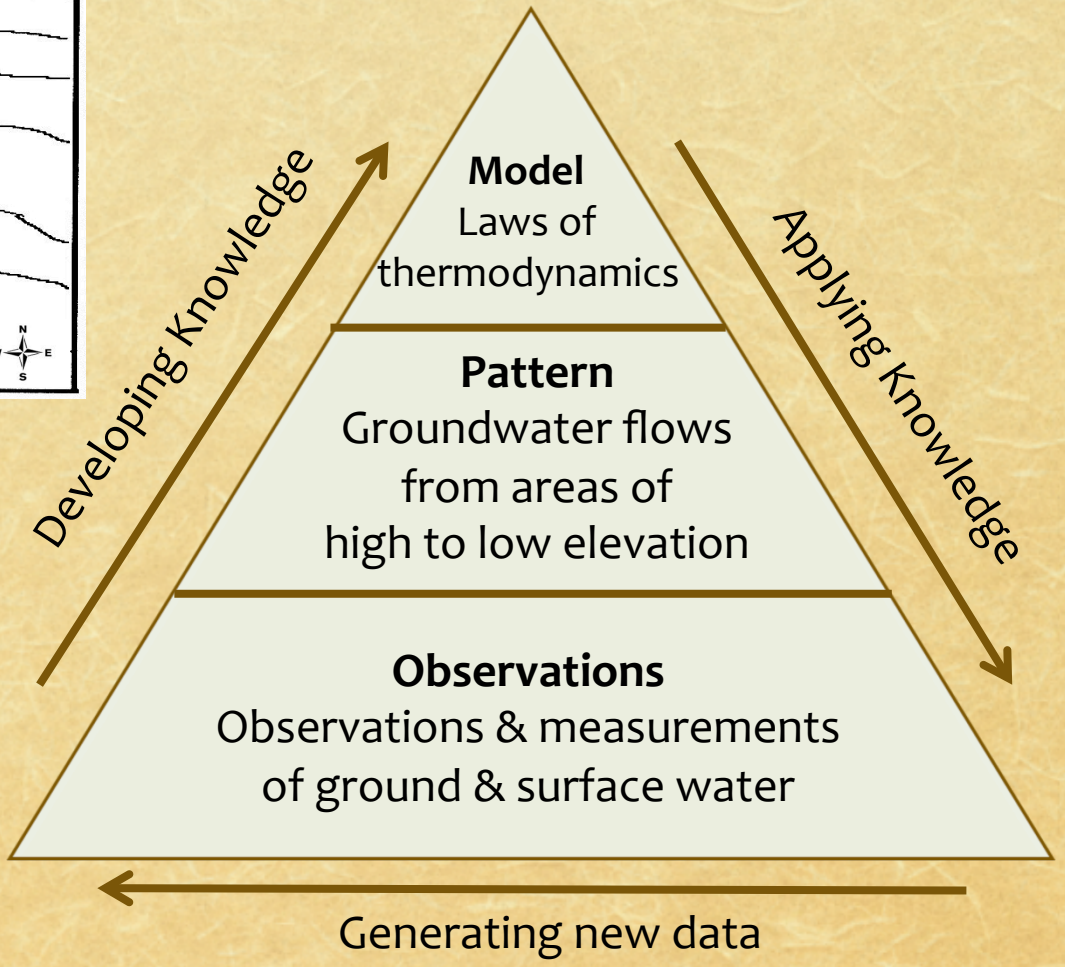
Applying Knowledge
2b. Using models
6. Constructing explanations



General Practices Associated with All 3 Arrows
5. Using mathematics & computational thinking
8. Obtaining, evaluating & communicating information

Learning Like a Scientist





The Triangle In Action

- Stream Monitoring Program Overview
- Montana Groundwater Academy (MGA) Overview
- MGA Application Activity – Solve a Groundwater CSI!

WEN and Stream Monitoring

- The Watershed Education Network and partner, Lolo Watershed Group(LWG) developed a 3-day experience for Lolo School 6th graders

Lolo Creek Study with Lolo School

Program overview:

3 day study:

Day 1-class visit: questions and discussion

Day 2- 1/2 day field trip: observations through biological, physical, and chemical data collection

Day 3- Analysis and application to answer questions

Lolo Creek Study Day 1 (Questions)

- What makes a healthy river/creek?
- Is Lolo Creek a healthy creek?
  - What do you know about Lolo Creek?
  - What can we measure at the Lolo Creek site?

Lolo Creek Study Day 2 (Observations)

Three Stations for data collection:

- Physical: cross-section, grid toss and pebble count
- Chemical: pH, temp, dissolved oxygen, riparian area
- Biological: aquatic insect collection, ID and count

Macroinvertebrate collection

Pebble count

Cross section and water depth

Lolo Creek Study Day 3 Patterns & Models

- Students analyze data and make initial judgments about creek health
- Students are provided with model of what makes healthy creek (criteria/rubric)
- Apply criteria to gauge health of Lolo Creek
- Students enter data into spreadsheets, make graphs
- Share data on Lolo Watershed Group website:

http://lolowatershed.org/learn/creek-data-2016/

Pollution Tolerance Index

Macroinvertebrate Pollution Tolerance Index

Project ID:	DATES: / / TIMES:
Site ID:	Surveyors:
Stream/River:	GPS Coordinates:
Organization/School:	Station Description:

See page 59 in the VWM Guidebook

Pollution Tolerance Index

Put a check next to each taxa which is present in your macroinvertebrate sample. Complete the remainder of the chart. Fill out one of these for each sample.

GROUP 1 TAXA *Intolerant*		GROUP 2 TAXA *Moderately Intolerant*		GROUP 3 TAXA *Fairly Intolerant*		GROUP 4 TAXA *Very Tolerant*	
	Stonefly Nymph		Dameselfly Nymph		Black fly Larva		Segmented worms (aquatic)
	Caddisfly Larva		Dragonfly Larva		Midge Larva (excluding blood midges)		Rat-tailed Maggot
	Mayfly Nymph		Sowbug		Planaria		Left-handed snail
	Dobsonfly Larva		Scud		Leech		Blood midge (red)
	Riffle beetle		Crayfish				
	Water Penny		Cranefly Larva				
	Right-handed Snail		Clam/Mussel				
			Gilled snail				
# of taxa =		# of taxa =		# of taxa =		# of taxa =	
	x 4		x 3		x 2		x 1
Group Score =		Group Score =		Group Score =		Group Score =	

Total of all group scores = _____

Your Stream Quality Assessment:

Assessment:

23 and above	Potentially Excellent Water Quality
17 to 22	Potentially Good Water Quality
11 to 16	Potentially Fair Water Quality
10 or less	Potentially Poor Water Quality

Comments:

Montana Groundwater Academy (MGA)

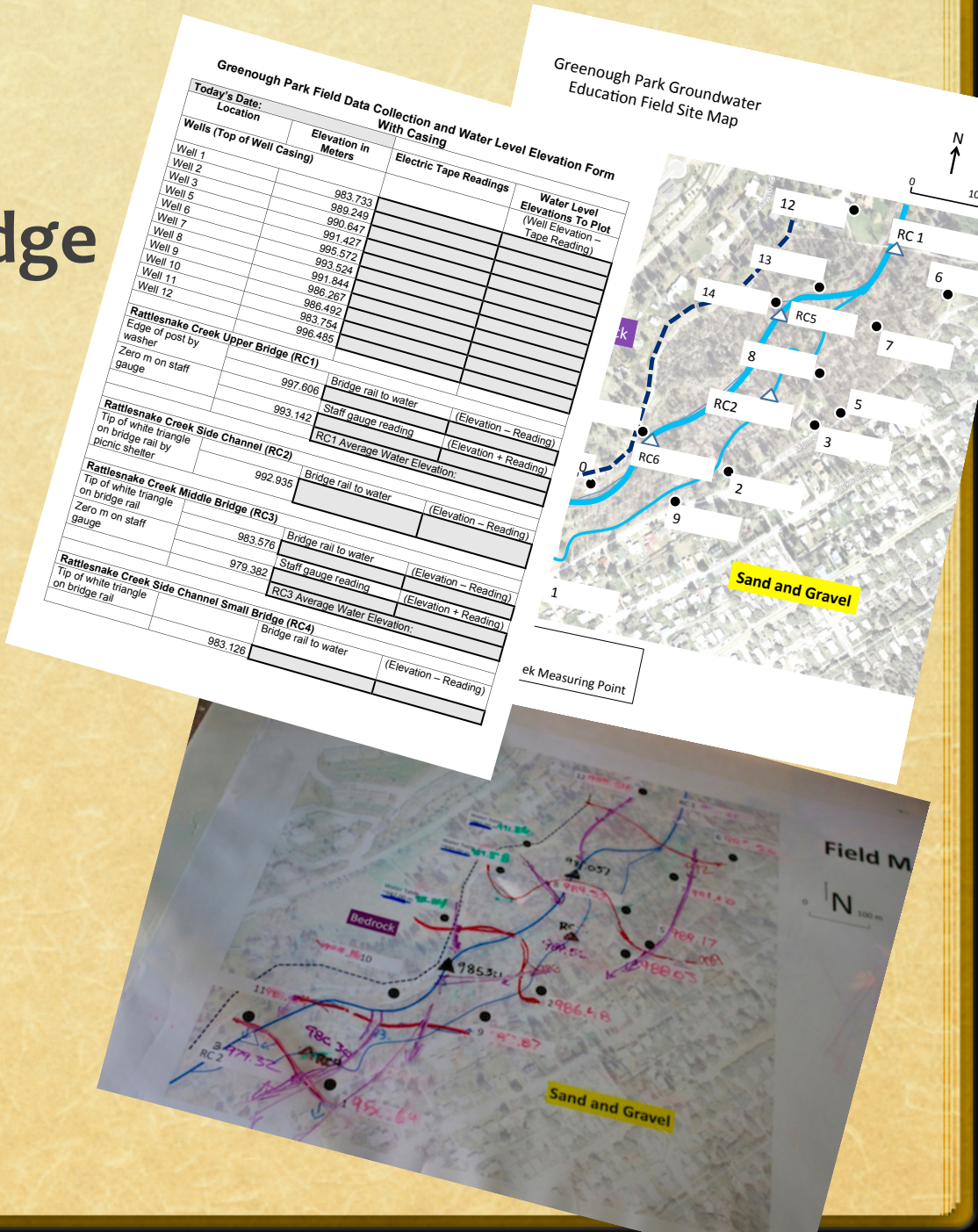
- **3-day program with classroom & field experience**
- **Learning Goals - Students develop capacity to…**
  - Describe structure of groundwater (GW) system
  - Explain why GW moves in different directions & with differing levels of ease depending on site conditions
  - Explain how GW & surface water connect & affect each other
  - Explain how GW becomes contaminated & how contamination can be prevented / remediated

MGA Day 1 – Developing Knowledge

- **Question** – Which well would you use for your house?
- **Observations** – Experiment with flow model to investigate
- **Patterns** –
  - GW flows from high to low elevation
  - GW flows at different rates depending on permeability
- **Model/Explanation** – GW flow in a system is governed by differences in potential energy

MGA Day 2 – Developing Knowledge

- **Question** – Where is GW located, coming from & going to at site?
- **Observations** – Collect elevation data from wells & stream
- **Patterns** – Create & interpret GW contour map
- **Model/Explanation** – GW flow is governed by potential energy

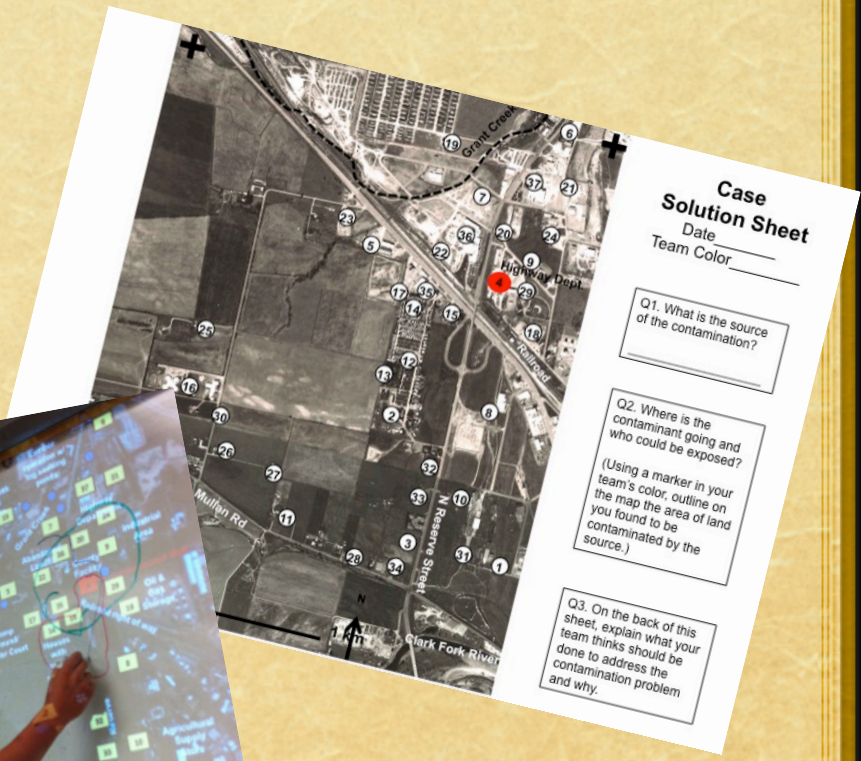


MGA Day 3 - Application

- Students solve a real world groundwater CSI case

Case Briefing - How it Works

- Each team needs to answer 3 questions to solve the case
- 4 info packets to help solve the case. Team need to decide in which order to receive packets:
  - Drinking water quality standards
  - Geological & groundwater elevation data
  - Info about potential sources of contamination
  - Water quality data for 15 wells
- Timing
  - 5 minutes: Review info & choose initial order for packets
  - Then, each 5 minutes teams choose: 1st 2nd, 3rd, & 4th packets
  - 5 minutes: Teams finalize their case solutions
  - 10 minutes: Class reviews case & each team's so



Questions & Contact

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