Ways to Engage Students: Place-based Learning and Service Learning

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Place-based Learning of Surface and Groundwater Processes

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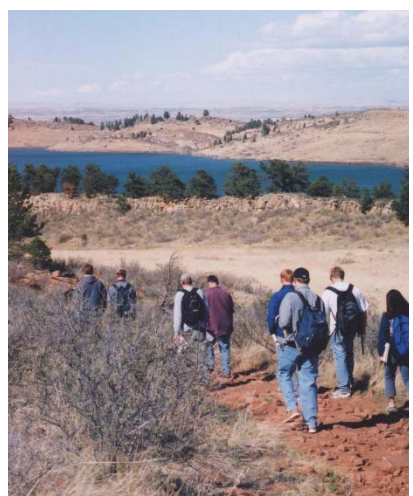
Place-based Learning

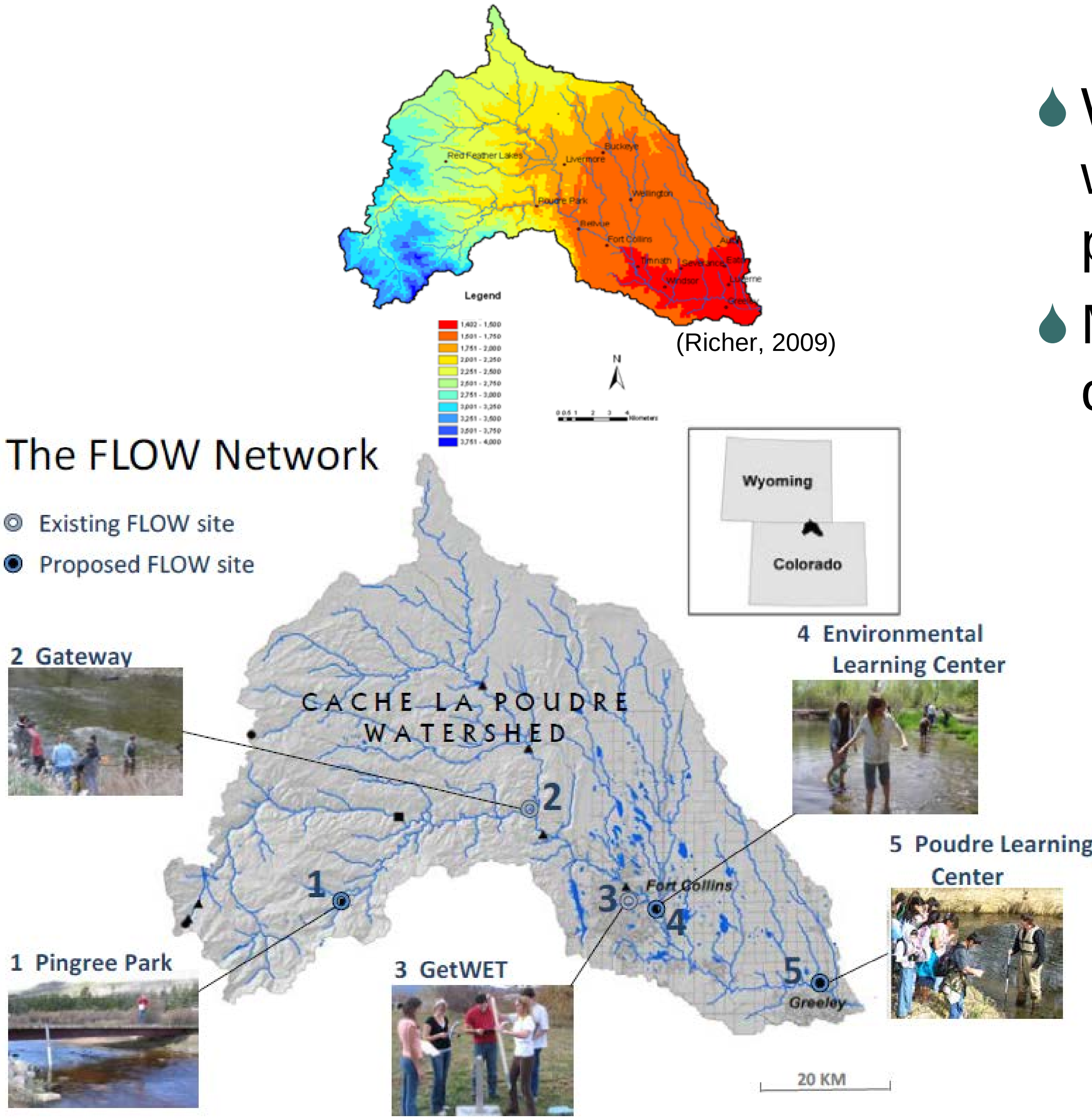
Use local environment as primary source for learning

- Anchors learning to familiar landscape (Butler et al., 2000)
- Increases relevance of lessons (Dunnivant et al., 1999)
- Captures cultural traditions; human-ecological bonds; place-consciousness (Gruenewald, 2003)

- At CSU, improved water literacy clearly needed
- Based on 240-student survey in GEOL120 and 122 (Spring 2012)
  - 50% knew source of drinking water in Fort Collins
  - 15% illustrated where groundwater occurs



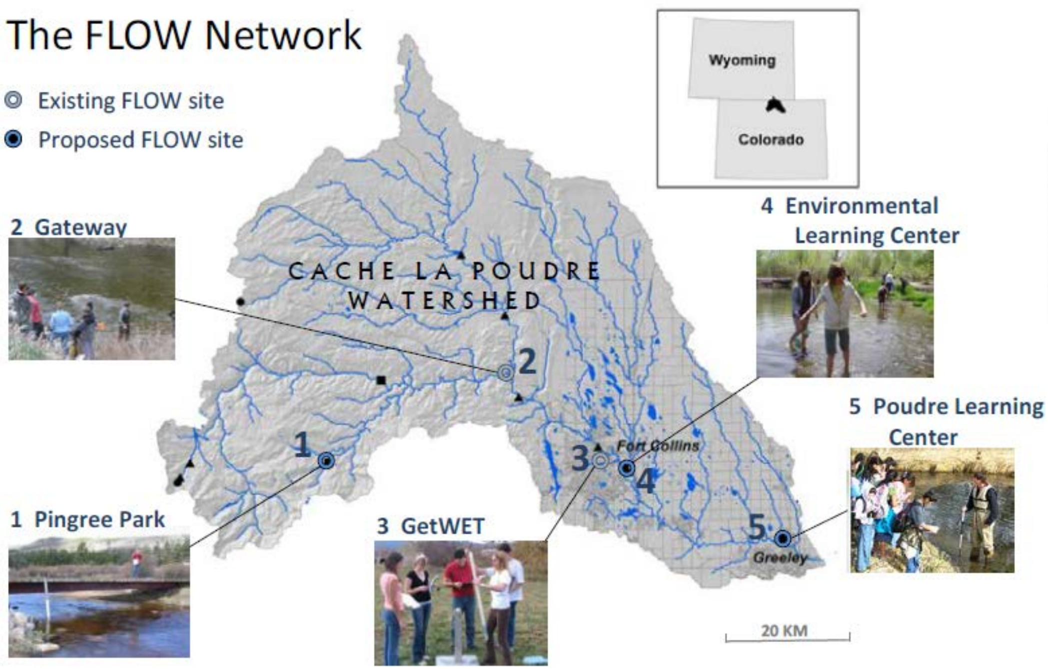
Cache la Poudre Watershed

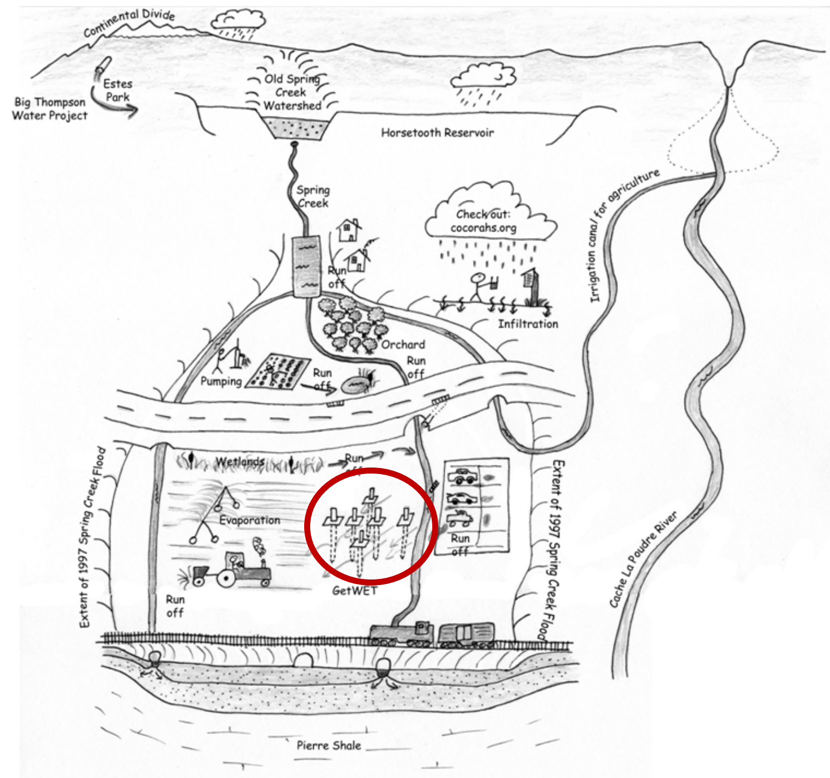


(Richer, 2009)

- Watershed interest requires watershed-scale participation
- Myriad learning opportunities due to:
  - spatial variability of surface and groundwater processes related to diverse geologic, climatic, biologic, and land use characteristics
  - relevance of local water issues

Spring Creek





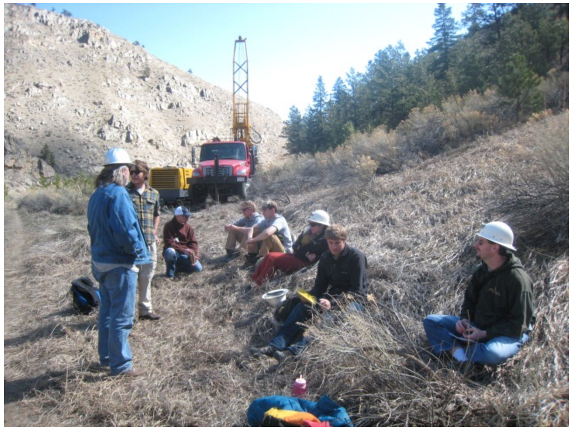
(Rathburn and Weinberg, 2011)

- On-campus hydrologic field station
- Emphasize groundwater-surface water interactions

Current Research

Objectives:

- Improve undergraduate teaching and learning of water concepts at CSU, FRCC, and UNC
  - **Hydrologic Field Stations** = access to reliable water quantity and quality data for authentic field, laboratory, and web-based learning opportunities



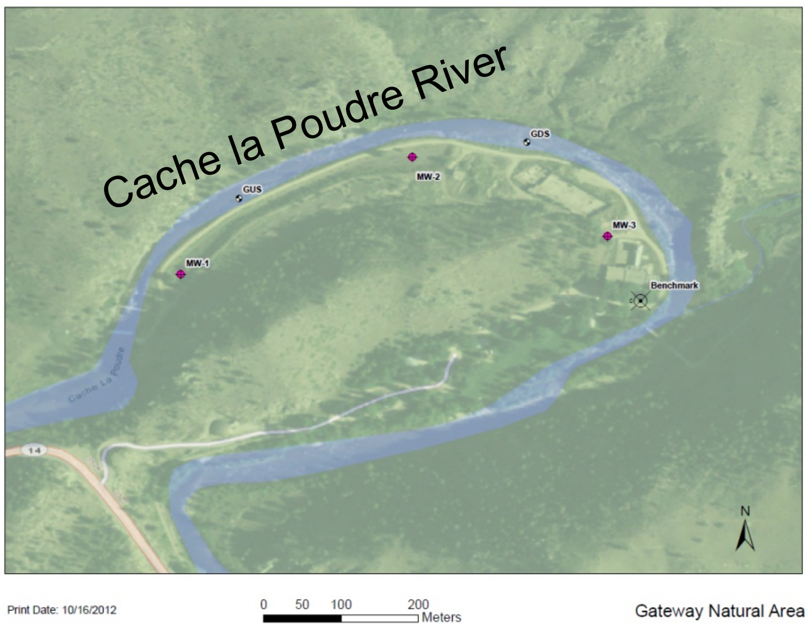
- Hypothesize that knowledge outcomes will increase due to contextual association of CSU, FRCC, and UNC students to the Poudre watershed
  - Select control courses without place-based linkages
  - Test within 2-year and 4-year institutions

Learning Objectives
Introductory Geology Course - Majors

Apply scientific method to understand:

1) **Watershed Attributes:** identify and describe the geologic, topographic, climatic, soils, and land cover features of a watershed
2) **Water Data:** familiarity with the types of measurements collected in a watershed, understand uses of the data, and interpret graphs of data
3) **Water Balance:** identify and describe the major inputs and outputs of a water balance, complete a simple water balance

Gateway Natural Area



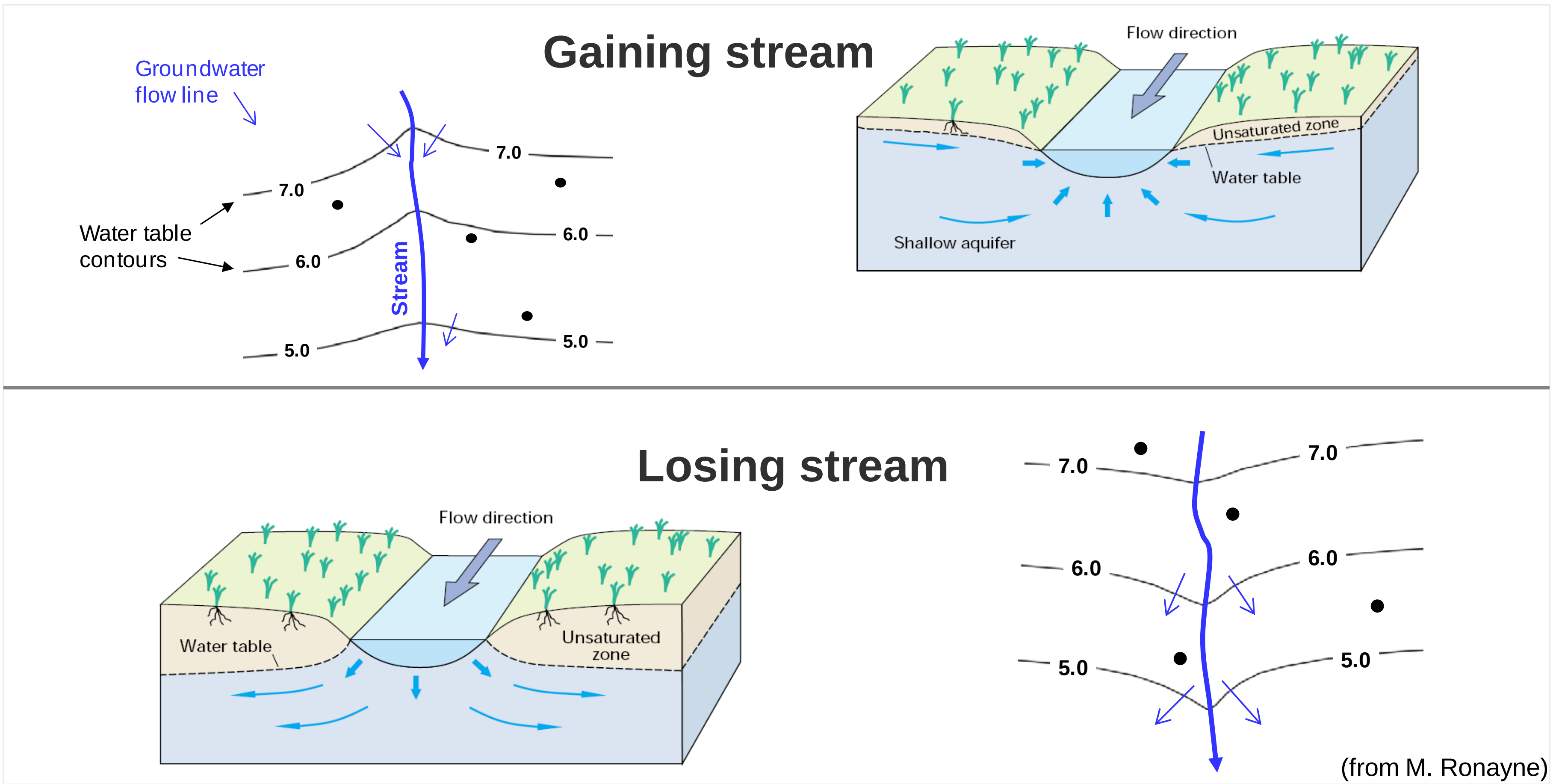
- Groundwater wells
- Surface water gauges and piezometer nests
- Students involved during all phases

Unglaciated confined, 1640 m, recently burned

Key Learning Concepts

Integrated groundwater-surface water analysis

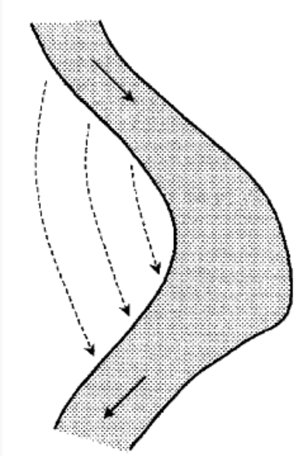
- Measurement of groundwater levels and river stage.
- Assessment of groundwater-surface water interaction.

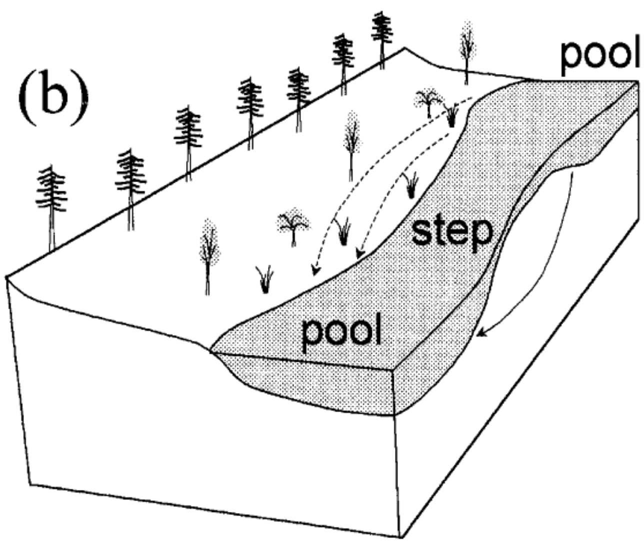


(from M. Ronayne)

Key Learning Concepts

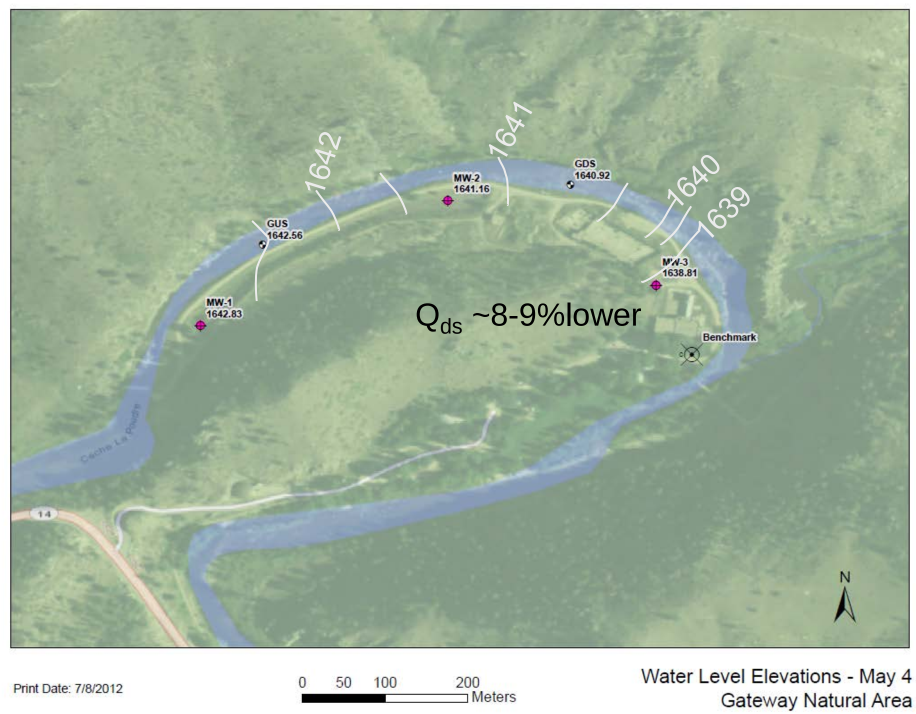
Channel sinuosity enhances the groundwater-surface water exchange





(Hayashi and Rosenberry, 2002)

- Students collect, plot and analyze discharge data for the Poudre River at two gaging stations. Measure water table elevations.
- Evaluate how and why discharge changes over time and space.



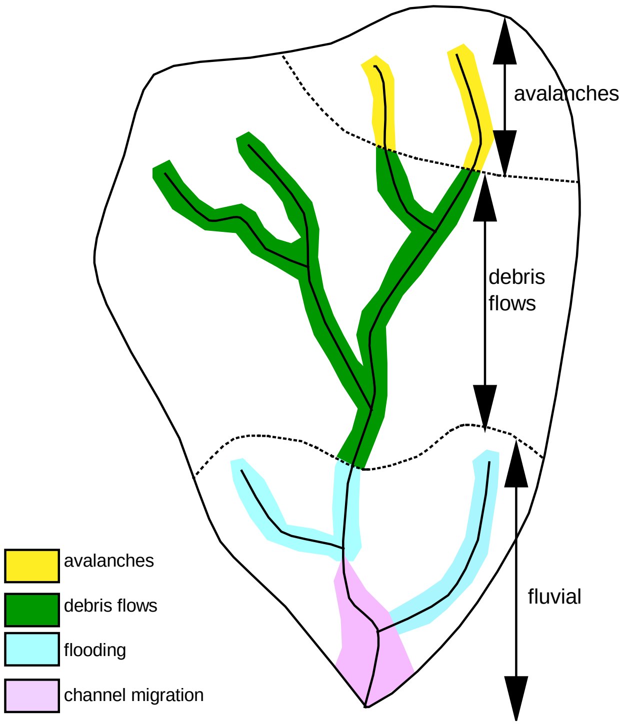
Key Learning Concepts

$$Q_i + P \pm Q_{gw} = Q_o + ET$$

Budget equation for river channel

- Q_i = river inflow
- P = direct precipitation (and hillslope runoff)
- Q_{gw} = gain or loss to groundwater
- Q_o = river outflow
- ET = evapotranspiration

Key Learning Concepts



(modified from Montgomery, 2012)

- Understand process domains (Montgomery, 1999)
- Disturbance regimes (fire and/or wind, avalanches, debris flows, flooding, channel migration)
- Current water storage, transfers, and demands

GEOL150 Lab Exercise

GEOL150 Rathburn   **Poudre River Surface Water/Groundwater Interactions**   **Fall 2012**
Name:____________________

Assignment will be due at the start of lab on Nov 15 and Nov. 16.

We will visit the Cache la Poudre River at Gateway Natural Area to learn about fluvial forms and processes, and surface water/groundwater interactions. You will learn how to make measurements to calculate discharge, channel flow resistance, bed material grain size, and groundwater levels. These data will then be useful in assessing the connections between surface and groundwater at the site. You will summarize all your findings in a short, scientific-style report, complete with Introduction, Methods, Results, and Discussion and Conclusions.
You will work in groups of 4-5 people for the fieldwork phase of the project:

1) Measure the flow velocity and channel cross sectional geometry for the wetted (presently active) channel at the Gateway Upstream (GUS) and Gateway Downstream (GDS) cross sections (see map). Start on the left bank (looking downstream), measure total channel width, then divide the channel into 20 stations. Record your data.

Distance along tape from LB (m)	Bed Elevation (measure from tape using wading rod; m)	Water Depth (m)	Velocity, at 0.6*depth (Take 5 readings; m/s)	Notes

Water depth at gage GUS (cm) ____________________ Water depth at gage GDS (cm) _______________________

GUS Elevation = 1642.68 m (elevation of staff gage at 50 cm mark)
GDS Elevation = 1640.98 m (elevation of staff gage at 50 cm mark)

Developed detailed rubric for students and grading (handout)

Develop a Place-based Lesson/Idea (5 min)

Share your Lesson/Idea with Colleague (10 min)

Place-based Learning Summary

- Effective, interdisciplinary, contextual, watershed approach to learning
- Positive feedback on student evaluations
- Imbues a sense of caring in students
- Natural segue into undergraduate research
- Build collaborations amongst faculty in different departments, within city/county, citizens groups

Acknowledgements and References

Mike Ronayne - Geosciences
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Sunset during High Park Fire, Fort Collins, CO Summer 2012
(photo by E. Wohl)

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