
TEACHING FOR QUANTITATIVE LITERACY IN UNDERGRADUATE GEOSCIENCE COURSES

Earth Educators' Rendezvous, 2018, Morning Workshop,
8 am - 11:30 pm, M-W
Jennifer Wenner, facilitator

MY WORK IN QUANTITATIVE LITERACY FOR GEOSCIENCE

The Math You Need, When You Need It
math tutorials for students in introductory geoscience

Math You Need > Unit Conversions > Instructor

Math You Need

The Project

Guiding students through unit conversions

An instructor's guide to [Unit Conversions](#)

Jump down to: [Objectives](#) | [Student Difficulties](#) | [What we left out](#) | [Resources](#) | [The Authors](#)

What should the student get out of this page?

This page is designed to address the universal feeling of geoscience faculty that we shouldn't have to spend so much time addressing the mathematics of unit conversions. By the end of this module, students should:

1. have a handle on the "rules" (or steps) for doing unit conversions;
2. be able to perform unit conversions for most units used in an introductory geoscience course.

Why is it hard for students?

Many of us feel that the "simple arithmetic" involved in doing unit conversions should have been taught to our students during their elementary school days. And, to be quite honest, they probably were. However, many students still struggle with the arithmetic involved; here are some possible reasons why:

1. It's math!
 - Many students are math phobic and as soon as arithmetic is mentioned, they shut down.
2. It's math WITH FRACTIONS!
 - For whatever reason, students struggle with fractions. It may be because they can't remember the rules for the arithmetic manipulation of functions, or because the math of fractions IS complicated.
 - On the student page, we have included a review of how to multiply fractions since that is the arithmetic manipulation that is used in unit conversions.
 - You can direct them to the [review of Math with Fractions](#), if they need more help
3. Students are not familiar with the units (particularly the "dreaded metric system")
 - Many students have no intuition about the metric system and, as a result, feel like they are floundering when asked to evaluate their answers
4. Instead of being an equation into which they plug numbers, the process of unit conversions is

Teaching Quantitative Literacy

Secure | <https://serc.carleton.edu/quantskills/methods/quantlit/index.html>

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Search the Site Go

Teaching Quantitative Skills in the Geosciences

resources for undergraduate students and faculty

Teaching Methods > Teaching Quantitative Literacy

Teaching Quantitative Literacy

created by Jennifer Wenner, Geology Department, University of Wisconsin Oshkosh

Related Links

[Quantitative Skills, Thinking and Reasoning Site Guide](#)

[Quantitative Literacy Project](#)

"The world of the twenty-first century is a world awash in numbers."

- Lynn Arthur Steen (*Mathematics and Democracy: The Case For Quantitative Literacy*, 2001)

What is Quantitative Literacy?

Do your entry-level students understand the graphs printed on the front page of *USA Today*? Can they evaluate the meaning of indicators of global warming? Quantitative literacy addresses students' ability to evaluate numerical and graphical data on a daily basis.

Why is Quantitative Literacy important?

Students are bombarded with numbers every day -- in the newspaper, on television, even when deciding which cell phone company has the best deal. Entry-level geoscience classes may be the only instance in which students are asked to develop intuition about numbers...

How can we best prepare quantitatively literate students?

When teaching quantitative skills to entry-level students, here are five good ideas:

1. Place concepts in context
2. Use multiple representations
3. Work in groups
4. Use appropriate technology
5. Do in-depth problems that last more than one day

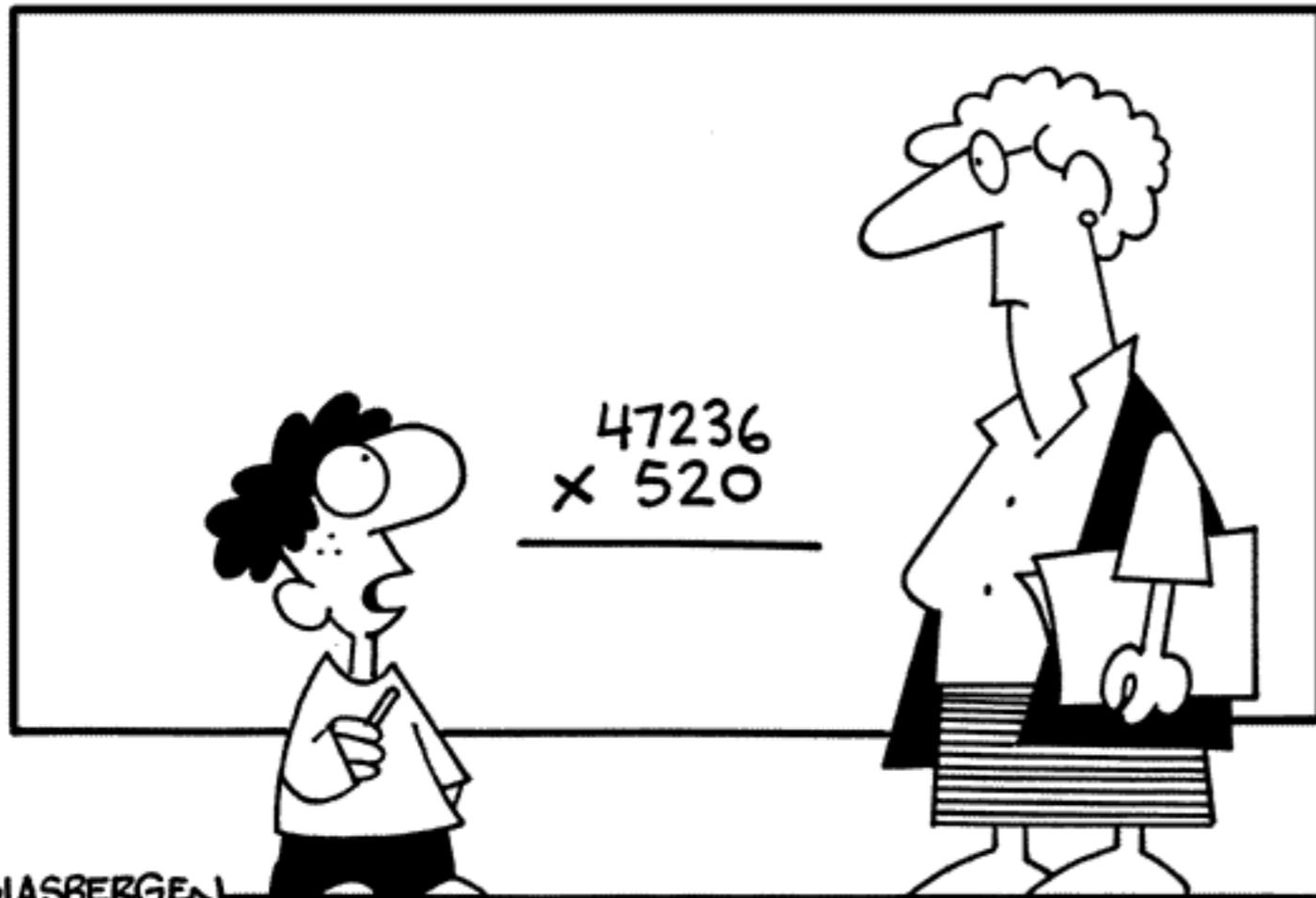
(compiled by participants of "Teaching Quantitative Skills in the Geosciences", July 2002)

Mathematical concepts often covered in introductory geology courses

Many of the topics covered in introductory geology courses have important underlying mathematical concepts. Below is a list of some of the mathematical concepts that may be contained in an entry-level course. Each concept is linked to a page that gives some mathematical background on these concepts and links to geology context for those concepts:

WHAT IS QUANTITATIVE LITERACY?

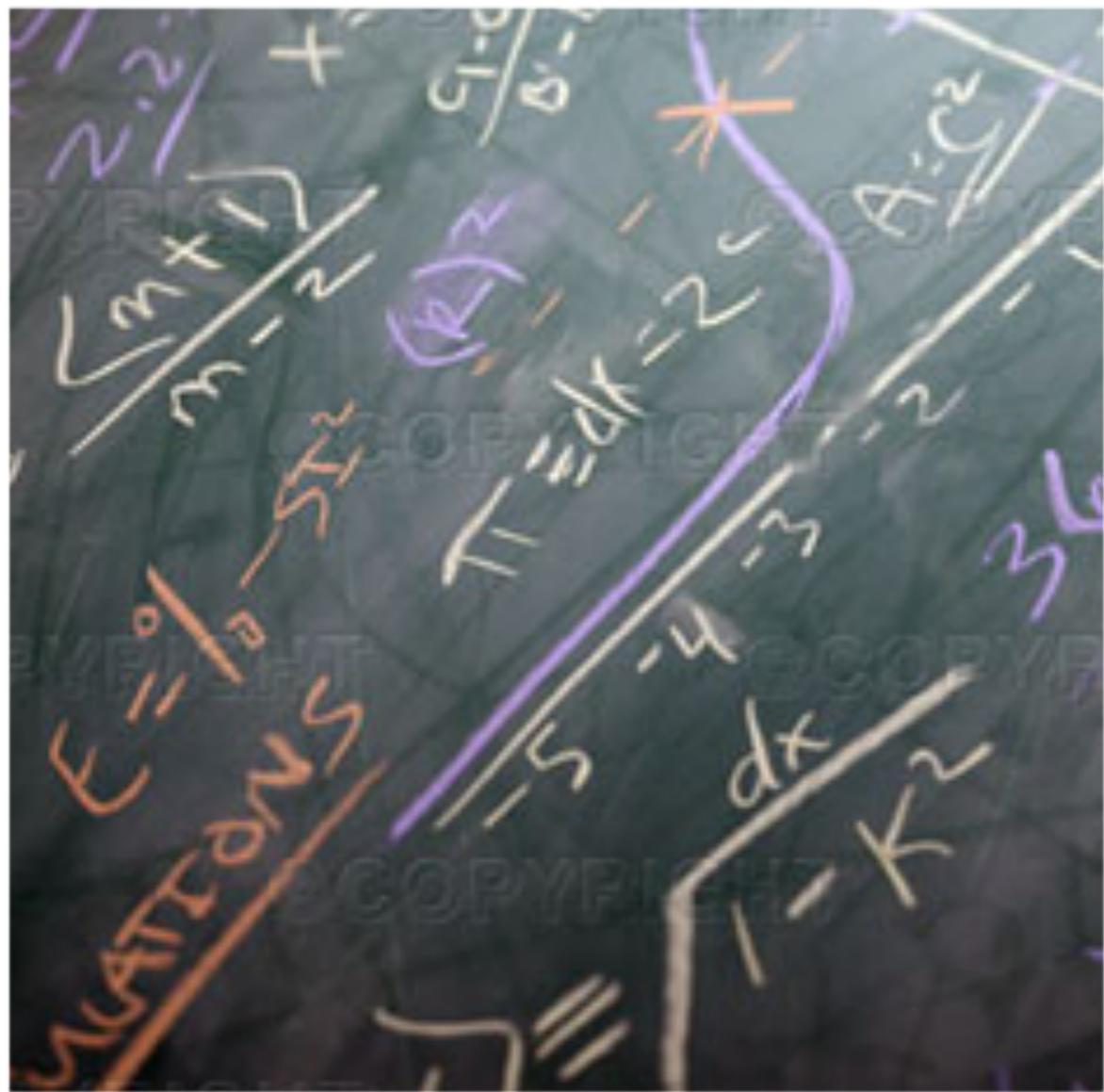
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“Aren’t there enough problems in the world already?”

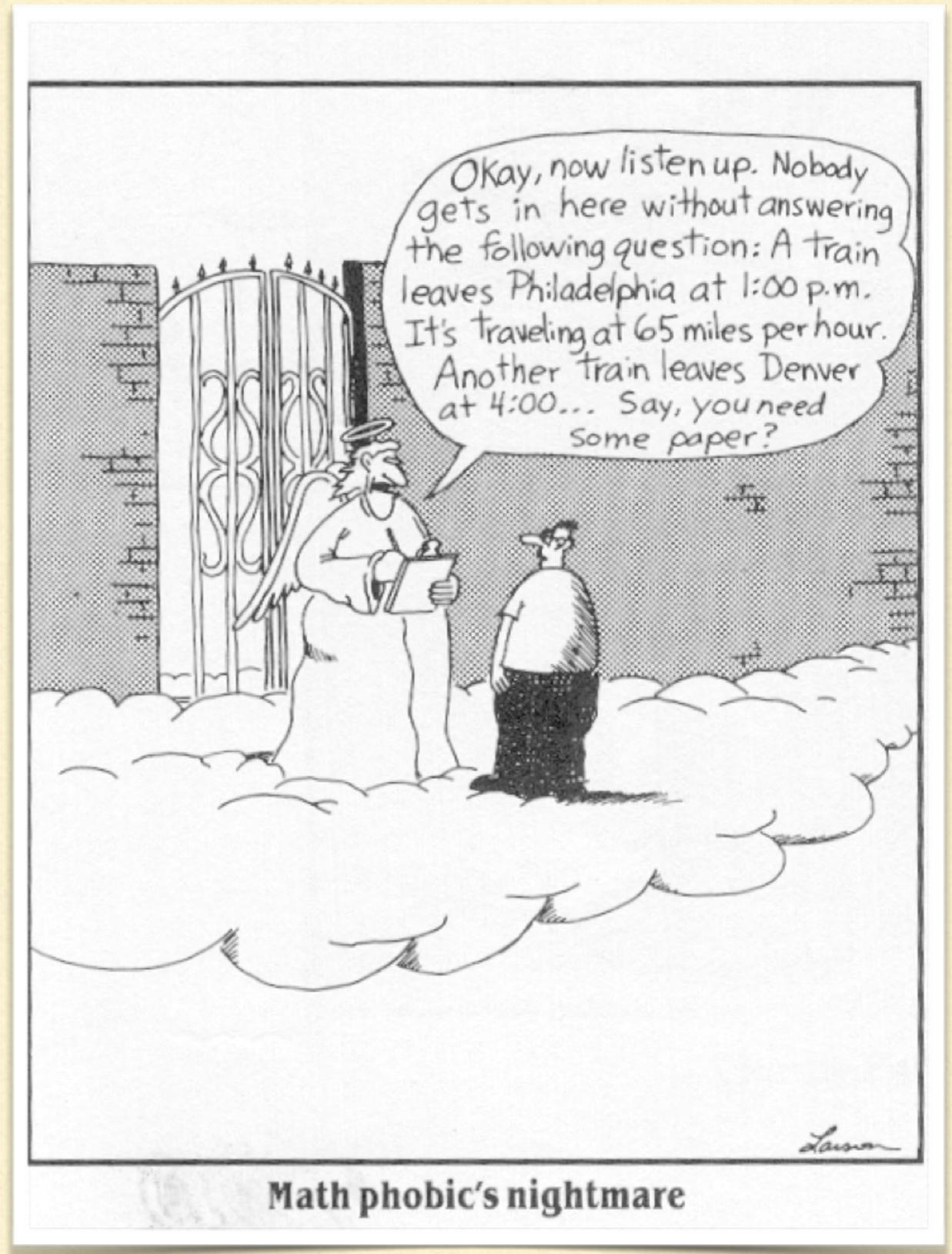
“Quantitative literacy is...a habit of mind...that employs and enhances both statistics and mathematics. Unlike statistics which is primarily about uncertainty, [it] is often about the logic of certainty. Unlike mathematics which is primarily about ... abstract structures, [QL] is often anchored in data derived from and attached to the empirical world...[T]his inextricable link to reality makes [QL] every bit as challenging and rigorous as mathematical reasoning. -L. Steen, *The Case for QL*, 2000

WHAT IS QUANTITATIVE LITERACY?



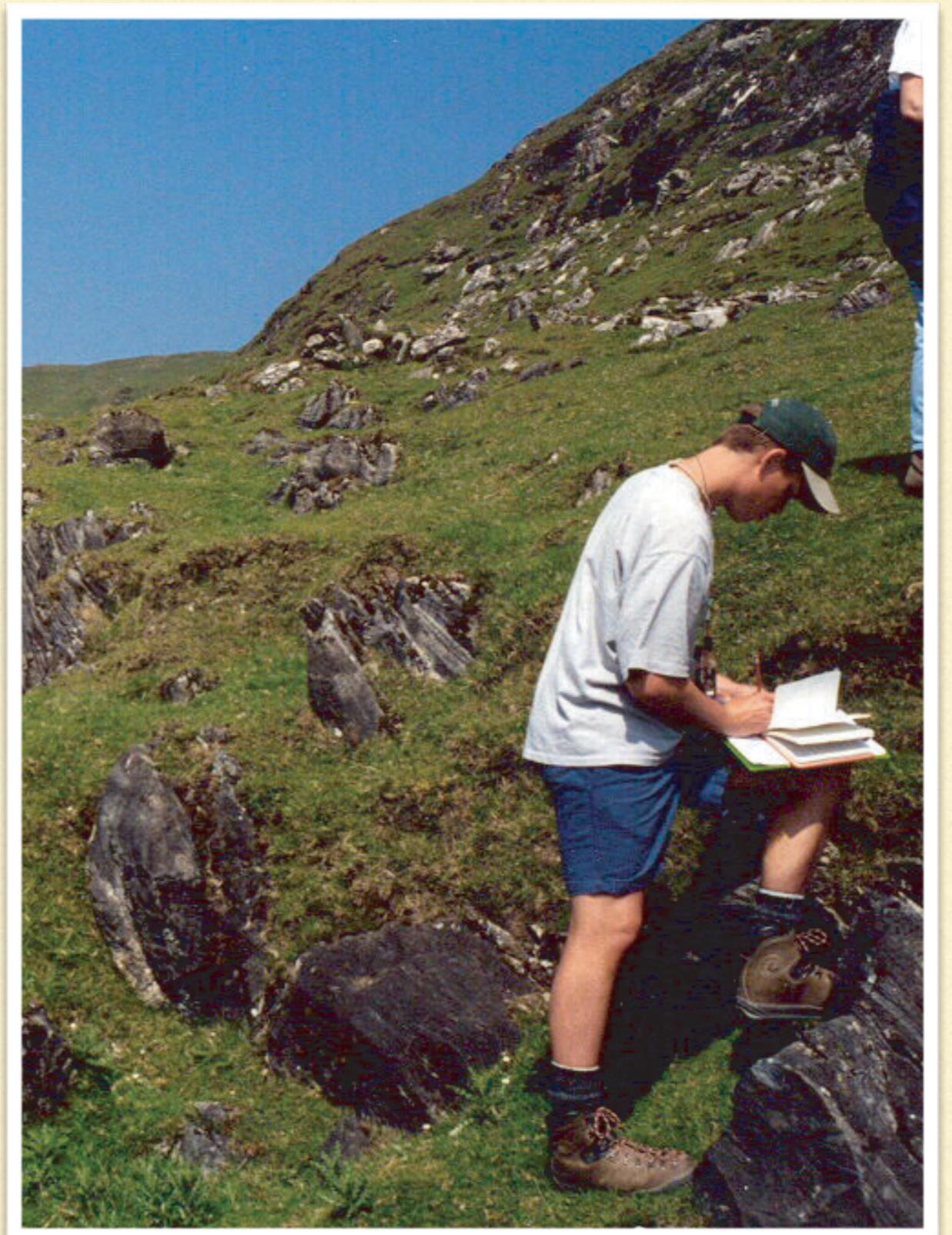
- Reasoning with quantitative concepts
- not just performing calculations
- **MATH IN CONTEXT** - an important skill for an informed citizenry

WHY IS IT IMPORTANT?



WHAT IS THIS WORKSHOP ABOUT?

How do we efficiently and effectively prepare our undergraduate students for a number-rich geologic world?



WHAT WILL YOU ACCOMPLISH THIS WEEK?

- Monday

- Discuss why QL is hard for our students (and how to help)
- Talk with each other about important quantitative skills for your courses
- Explore and discover topics in your course(s) where QL or support for QL is needed

- Tuesday

- Incorporate best practices for supporting students in learning QL into your course(s)
- Develop resources and/or problem sets that use best practices for your students (may be a team effort)

- Wednesday

- Build resources, problems and best practices into your syllabus
-

WHAT MATH CONCEPTS ARE ESSENTIAL?

THINK GENERALLY ABOUT

- Why are QS hard for students?
 - What might you do to aid/support students?
 - What geoscience topics are associated with the skills you've brainstormed?
 - What mathematical concepts are used in multiple contexts?
-

MATH CONCEPTS IN THE GEOSCIENCES

- Arithmetic/Computation
 - Fractions and Ratios
 - Units and Unit Conversions
 - Scientific Notation
 - Estimation
 - Algebra
 - Logarithms/Exponential Functions
 - Exponential Growth and Decay
 - Logarithms
 - Geometry and Trigonometry
 - Graphs
 - Vectors and Matrices
 - Probability and Statistics
 - Probability
 - Error Analysis
 - Correlation
 - Describing Data Distribution
 - Significance (Signal vs Noise, Uncertainty)
 - Data Trends/ Curve Fitting/ Regression
 - Problem Solving/Equations
 - Models and Modeling
 - Differential Equations and Integrals
 - Fourier Series, Spectral Analysis
 - Inversions
-

USE YOUR SYLLABUS TO THINK ABOUT

- What topics in your course are ripe for quantitative problems/activities?
 - Are there topics that utilize the same mathematical concepts?
 - Do you already have some quantitative problems?
 - What kinds of support (outside of class, online, in class) do you need to be able to integrate more QL into your classes?
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