

ATMO/GG/OCN 150: Introduction to Quantitative Earth and Environmental Science

Quantitative Reasoning (FQ) Foundations Requirement

Instructed by Prof. Garrett Apuzen-Ito, POST 810, gito@hawaii.edu

This course provides an introduction to pre-calculus mathematics and physics as applied to problems in Earth and Environmental Science. Students will work on real-world problems and learn through a combination of independent study and participatory class activities. This course fulfills credits in the Quantitative Reasoning (FQ) Foundations requirement.

By taking this course you will:

- Will meet all the learning objectives required of FQ courses
- Will be prepared to take the Department of Mathematics' placement exam and place into calculus.
- Gain appreciation and quantitative understanding of the basic laws of physics governing the natural world, as well as the ability to solve problems using them.
- Will be able to recognize connections between the basic behavior of physical laws, mathematical functions, and processes in Earth and Environmental Science.

Class format and activities: Two class meetings per week will involve a combination of lectures, peer discussion, and exercises. One recitation section is also offered. In-class exercises and weekly problem sets, supported by peer discussions, will provide you with regular practice and skill-building, and supply frequent two-way feedback between you and the instructor. Weekly assignments will consist of concept-based questions that request qualitative answers, as well as problems in which the math tools are used to quantitatively address issues in Earth and Environmental Science.

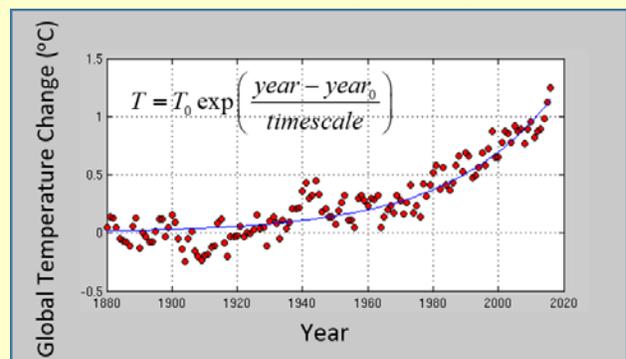
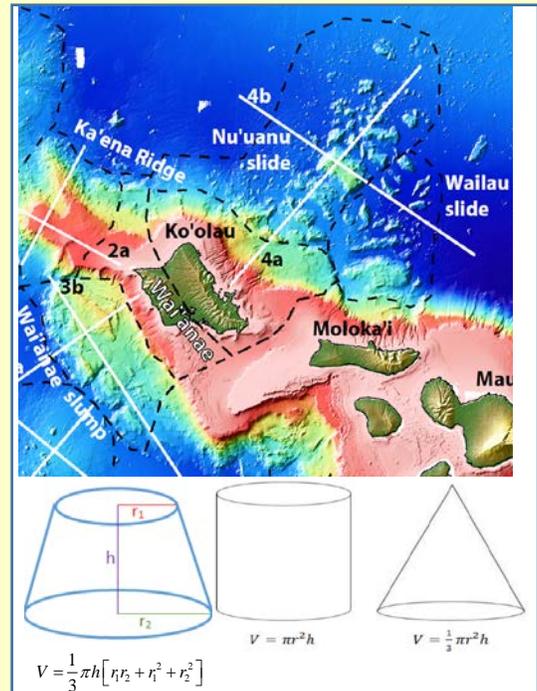
Weekly Problem Sets are due at the end of the week at the beginning of class. Assignments not turned in on time will be assessed 30% credit charge for each day it is late.

Grading: 15% class activities, 35% problem sets, 15% exam I, 15% exam II, 20% final

Two Required, Free Textbooks:

College Physics, P. Urone, R. Hinrichs, Openstax, <https://openstax.org/details/books/college-physics>
Precalculus, J. Abramson, Openstax, <https://openstax.org/details/books/prec calculus>

Honor Code and Class Culture: The class culture will be built upon mutually respectful, supportive, and honest interaction. You are encouraged to work together on your problem sets and class activities, but all work turned in for grading must be yours, and yours alone. Unless specifically designated, there will be no collaborations during exams. Cheating will not be tolerated, and everyone is responsible for upholding our honor code.



Weekly Schedule of Topics

Week 1: The Measure of Things and Functions

Phys 1.1 Physical Quantities & Units

Phys 1.3 Accuracy, Precision, and Significant Figures

PCal 1.1 Functions and Function Notation

Week 2: Functions: Basic Toolkit

PCal 1.2 Domain & Range

PCal 1.6 Absolute Value Functions

PCal 1.7 Inverse Functions

Week 3: Kinematics: Displacement, Velocity, and Acceleration

Week 4: Linear functions and Quadratic Functions

Week 5: Forces and Vectors and Two Dimensional Motion

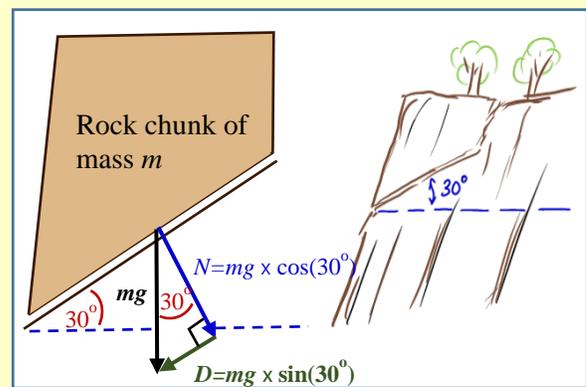
Sine, cosine, tangent, the unit circle, and the right triangle
Vector addition and subtraction

Relative motion of tectonic plates, and motion in two dimensions

Week 6: Forces and Force Balance

Newton's 1st, 2nd, and 3rd Laws

Friction, faulting, and slope stability



Week 7: On and In a Spherical Earth

Polar coordinates and arc lengths

Geographic coordinates and distances on the Earth

Earth's core, mantle, lithosphere, hydrosphere, and atmosphere:
areas, volumes, and masses of spheres and spherical shells

Week 8: Gravity and Earth's Figure

Newton's law of gravity

Circular motion and centripetal acceleration

Earth's figure and tides

Week 9: Work and Energy

Work and energy

Chemical energy and fossil fuels

Climate and Earth's energy budget

Week 10: The Powers of Earth and Exponential Functions

Radio-activity and the age of things

Population growth on a finite Earth

Week 11: The Powers of Earth and Logarithmic Functions

The inverse function of an exponent

Distinguishing the very big from the very small, the very fast from the very slow

Earthquake magnitudes

Week 12: Slopes and Gradients I: Things Move Downhill Not Uphill

Temperature gradient and heat flow

Concentration gradient and chemical transport

Week 13: Slopes and Gradients II: Things Move Downhill Not Uphill

Pressure, density, and the hydrostatic equation

Fluid flow and pressure gradients

Groundwater flow and hydrostatic head

Week 14: Waves in Space and Time

Wavelengths, frequency, and wavenumber

Seismic waves

Ocean waves

Week 15: Earth's Periodicity

Modeling ocean tides with trigonometric functions

Milankovich cycles and climate

PREPARATION OR DIRECT SUPPORT OF THE FOLLOWING PROGRAMMATIC STUDENT LEARNING OBJECTIVES:

ATM student learning objectives:

1. Apply physical principles to explain the thermal structure of the atmosphere.
5. Be able to explain ideas and results through written, numerical, graphical, oral and computer-based forms of communication.

GG student learning objectives:

2. Students can apply technical knowledge of relevant computer applications, laboratory methods, field methods, and the supporting disciplines (math, physics, chemistry, biology) to solve real-world problems in geology and geophysics.
3. Students use the scientific method to define, critically analyze, and solve a problem in earth science.

GES student learning outcomes:

1. Define and explain the basic principles and concepts of chemistry, physics, biology, calculus, geology, geophysics, meteorology, and oceanography.
2. Apply their understanding of the fundamentals of science and mathematics to the description and quantification of the interactions of the atmosphere, hydrosphere, lithosphere, and biosphere, including humans.
3. Employ the scientific approach to problem solving, and hypothesis formation and testing.

Title IX:

The University of Hawai'i is committed to providing a learning, working and living environment that promotes personal integrity, civility, and mutual respect and is free of all forms of sex discrimination and gender-based violence, including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence, and stalking. If you or someone you know is experiencing any of these, the University has staff and resources on your campus to support and assist you. Staff can also direct you to resources that are in the community. Here are some of your options:

As members of the University faculty, your instructors are required to immediately report any incident of potential sex discrimination or gender-based violence to the campus Title IX Coordinator. Although the Title IX Coordinator and your instructors cannot guarantee confidentiality, you will still have options about how your case will be handled. Our goal is to make sure you are aware of the range of options available to you and have access to the resources and support you need.

If you wish to remain ANONYMOUS, speak with someone CONFIDENTIALLY, or would like to receive information and support in a CONFIDENTIAL setting, use the **confidential resources available here:** <http://www.manoa.hawaii.edu/titleix/resources.html#confidential>

If you wish to directly REPORT an incident of sex discrimination or gender-based violence including sexual assault, sexual harassment, gender-based harassment, domestic violence, dating violence or stalking as well as receive information and support, contact: Dee Uwono Title IX Coordinator (808) 956-2299 t9uhm@hawaii.edu.