**Physics of the Solid Earth**

Instructor: Ethan Williams

We often consider the Earth as a solid rock floating in space. Yet, natural processes like volcanoes and earthquakes show us just how dynamic the interior of the Earth must be. This class uses the principles of Newtonian mechanics and basic calculus to explore the physics (and basic chemistry) behind our planet Earth. We will look at the structure and composition of the Earth, processes of melting and magma generation in the mantle, the formation and evolution of the continents, and the physics of crustal deformation. If you’ve ever wondered why earthquakes happen, this is the class for you! No background in geology is assumed.

**Syllabus**

Introductions (5 mins)

Earth structure and composition: (20 mins)

1. Overall structure (5 mins)
   1. Crust/mantle/core
   2. Lithosphere/Asthenosphere
2. Plate tectonics (10 mins)
   1. Oceanic vs. continental crust
   2. Types of margins
   3. Earthquakes and volcanoes
3. Earth materials (5 mins)
   1. Rocks vs. minerals
   2. Fundamentals of mineralogy
   3. Fundamentals of petrology

Fundamentals of continuum mechanics (20 mins)

1. Conservation of mass (10 mins)
2. Conservation of momentum (10 mins)

Continental deformation: (30 mins)

1. Earthquakes (15 mins)
   1. Earthquakes in strike-slip environments
   2. Earthquakes in subduction environments
2. Describing brittle deformation (15 mins)
   1. Stress and strain
   2. Strength and failure
   3. Mechanics of earthquakes

Tectonics and volcanism: (30 mins)

1. Divergent margins (10 mins)
   1. Mantle flow
   2. Decompression melting
2. Convergent margins (10 mins)
   1. Melting in the mantle wedge
   2. Arc volcanism
3. Describing viscous flow (10 mins)
4. Fundamentals of fluid mechanics
5. Mechanics of volcanism