

**Lecture** (1hr. 20 min)

5 min	<p>Explain objective and outcome of this module.          Describe format of lecture/exercises (specifically, mention that there is something due at the end of the period).          Show and explain final exam question.</p>
20 min	<p>Short lecture about calculus and derivatives          * Concept (infinitesimals, derivative vs finite differential).          * Origin (map on slide w/ arrows to locations of known          - Moscow Mathematical Papyrus (c 1850 BCE) volume and area          - Eudoxus (c 408-355 BCE, method of exhaustion), then Archimedes          - Liu Hui (~300 CE, independently developed method of exhaustion)          - Hasan Ibn al-Haytham (Alhazen) (c 965 – 1040 CE, integration of parabolas)          - Madhava of Sangmagrama (c 1340 – 1425, derivatives, Taylor series)          - Renaissance: Bonaventura Cavalieri (infinitesimals), Pierre de Fermat (finite differences), Isaac Newton, Gottfried Wilhelm Leibniz, Maria Gaetana Agnesi.          * Discuss “stereotype threat” regarding math, mainly with respect to gender.</p>
5 min	<p>Think-Pair-Share          * What is an example of a derivative in everyday life?</p>
<p>~20 min           (scales to available time)</p>	<p>Second lecture: with examples of calculus in geology.          “Spot the derivative” – Solicit examples of derivatives in each of the slides.</p> <ul style="list-style-type: none"> <li>* Glaciology (what we should have been discussing today): glacier flow, thermodynamics, ocean coupling dynamics.</li> <li>* Hydrology: permeable flow, diffusion.</li> <li>* mass wasting: potential and kinetic energy, flow physics, hazard analysis.</li> <li>* fluvial systems: erosion, deposition, fluid mechanics</li> <li>* Climate science: atmospheric convection, carbon cycling</li> <li>* Volcanology: eruption rate, volume, hazards, magma dynamics</li> <li>* Geochemistry: radioactive decay, diffusion, thermodynamics...</li> <li>* Seismology: wave propagation, fault dynamics</li> <li>* Tectonics: solid mechanics, deformation, fluid flow...</li> </ul>
25 min	<p>Group activity          Takes ~20-30 min.          Work in groups of 3-4. Questions in worksheet.</p>
5 min	<p>“One minute essay”   <i>When did you last interact with a derivative in real life? What was it?</i></p>