Geology and Geophysics 303
Structural Geology
Recap

Active Geologic Structures:
Kilauea Dikes

http://volcanoes.usgs.gov/ims/jpg/Photoglossary/fissure4_large.JPG
Fossil Geologic Structures:
Ship Rock Dikes

Large Fold
King Oscar Fjord, East Greenland
Active Fold and Faults in Hawaii
Hilina Pali

Large Geologic Structures:
Plate Boundaries

volcanoes.usgs.gov/images/glossary/fault.php

Small Geologic Structures
Dislocation in a Crystal

http://www.geol.ucsb.edu/faculty/hacker/geo102c/lectures/dislocation2.jpg

31. RECAP

I Main Topics
   A Course philosophy
   B An approach to practicing structural geology
   C Mathematical and physical fundamentals
   D Fieldwork, theory, and experiment
   E Practice good habits
31. RECAP

III Course philosophy
   A Geology can be treated as a scientific discipline
   B Course is intended to challenge students
   C Course emphases
      1 Concepts (not vocabulary)
      2 Critical thinking (not “cookbooks”)
      3 Fundamentals (not fashion)
      4 Quantitative predictions (Where? When? How big?)
### 31. RECAP

#### III AN APPROACH TO PRACTICING STRUCTURAL GEOLOGY

<table>
<thead>
<tr>
<th>Topic</th>
<th>Subtopics</th>
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<tbody>
<tr>
<td>Geometry</td>
<td>Orthographic &amp; stereographic projections</td>
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<tr>
<td></td>
<td>Maps and cross sections</td>
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<td></td>
<td>Coordinate transformations</td>
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<td>Differential geometry</td>
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<tr>
<td>Kinematics</td>
<td>Strain</td>
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<tr>
<td>Mechanics</td>
<td>Rheology</td>
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<td></td>
<td>Stress</td>
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<td>Introduction to boundary value problems</td>
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<td>Stresses around a hole</td>
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<td>Stresses around a screw dislocation</td>
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<td>Application to Geologic Structures</td>
<td>Opening-mode cracks</td>
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<td>Faults</td>
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<td>Folds</td>
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</tbody>
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### 31. INTRODUCTION AND COURSE PHILOSOPHY

#### IV Mathematical and Physical fundamentals

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>Vectors</td>
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<tr>
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<td>Tensors</td>
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<tr>
<td></td>
<td>Linear Algebra</td>
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<td>Solution of simultaneous linear equations</td>
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<td>Eigenvectors and eigenvalues</td>
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<td></td>
<td>Differential Equations</td>
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<td></td>
<td>Introduction to dimensional analysis</td>
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<td></td>
<td>Differential geometry</td>
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<tr>
<td>Physics</td>
<td>Fundamentals of Continuum Mechanics</td>
</tr>
</tbody>
</table>
31. INTRODUCTION AND COURSE PHILOSOPHY

IV Mathematical and Physical Fundamentals

Fish Net Analogy

http://upload.wikimedia.org/wikipedia/commons/1/1c/PayallarFishing.jpg

http://upload.wikimedia.org/wikipedia/commons/b/b7/36-pesca%2C_Taccuino_Sanitatis%2C_Casanatense_4182.jpg

31. RECAP

V **Fieldwork**, Theory, and Experiment

http://www.rci.rutgers.edu/~schlisch/structureslides/shiprock_LJM.jpg
31. Recap

V Fieldwork, Theory, and Experiment

- Governing Equation
  \[ 0 = \frac{d^2 u_r}{dr^2} + \frac{1}{r} \frac{du_r}{dr} - \frac{u_r}{r^2} \]

- Boundary Conditions
  \[ u_r(r = a) = u_0 \]
  \[ u_r \to \infty = 0 \]

- Solution
  \[ u_r = u_0 \left( \frac{a}{r} \right), \quad u_o = 0 \]
  \[ \sigma_n = \frac{E}{(1 + v)} \left[ \frac{-u_0 a}{r^2} \right] \]
  \[ \sigma_{\theta\theta} = -\sigma_n, \quad \sigma_{\theta r} = 0 \]

31. RECAP

V Fieldwork, Theory, and Experiment

http://medesign.seas.upenn.edu/index.php/Main/HomeHistory

http://www.spacegrant.hawaii.edu/classActs/GelVolTe.html

Hawai'i Space Grant Consortium
31. RECAP

VI  Practice good habits
    A  Seek the essence of phenomena (in their clearest expression)
    B  Start with simple, well-defined problems
    C  Draw neatly labeled diagrams
    D  Check your work as you go
    E  Seek different perspectives
    F  Strive for high standards
    G  Help others