

# Elasticity

10/29/12

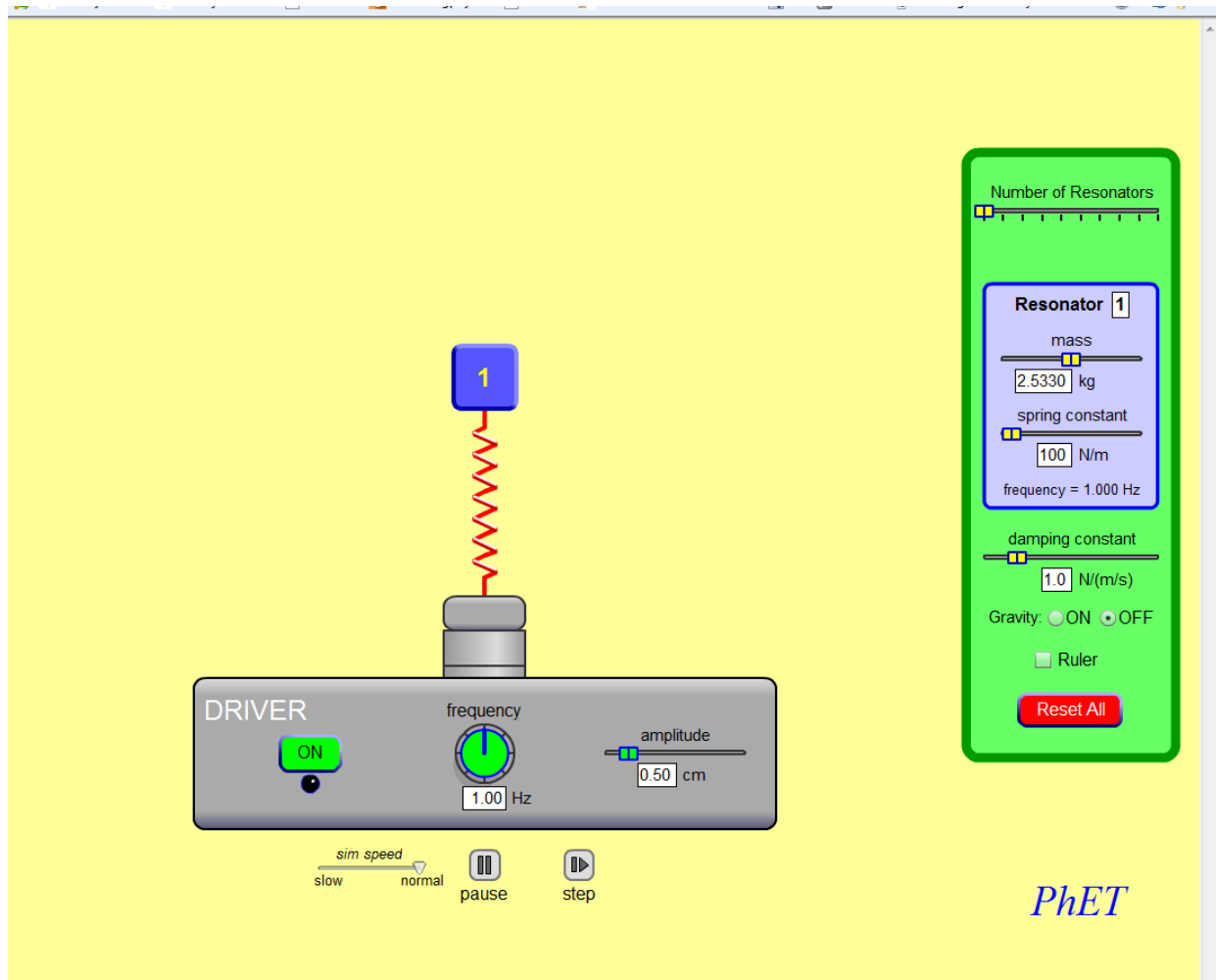
# *Springs and Masses*

The screenshot shows the PhET 'Springs and Masses' simulation interface. On the left, a vertical ruler is marked from 0 to 50 cm. In the center, three red springs are labeled 1, 2, and 3. A dashed horizontal line indicates the 30 cm mark. At the bottom center, a yellow box contains the text 'Hang Me!'. Below this, there are three mass blocks: a 100 gram block, a 250 gram block, and a 50 gram block. To the right of these blocks are three colored cylinders (green, red, and brown) representing different materials. On the right side of the interface, there is a control panel with the following elements:

- friction**: A slider ranging from 'none' to 'lots', currently set at the midpoint.
- softness spring 3**: A slider ranging from 'soft' to 'hard', currently set at the midpoint.
- Show Energy of**: Radio buttons for '1', '2', '3', and 'No show'. 'No show' is selected.
- Time Scale**: Radio buttons for 'real time', '1/4 time', '1/16 time', and 'pause'. 'real time' is selected.
- Gravity**: Radio buttons for 'Jupiter', 'Moon', 'Earth', 'Planet X', and 'g = 0'. 'Earth' is selected.
- Stopwatch**: A checkbox that is currently unchecked.
- Sound**: A checkbox that is currently checked.
- Show Help**: A button with a red border.

In the bottom right corner, the text 'PhET' is displayed. In the bottom left corner, there is a small button labeled 'About...'.

# Resonance sim



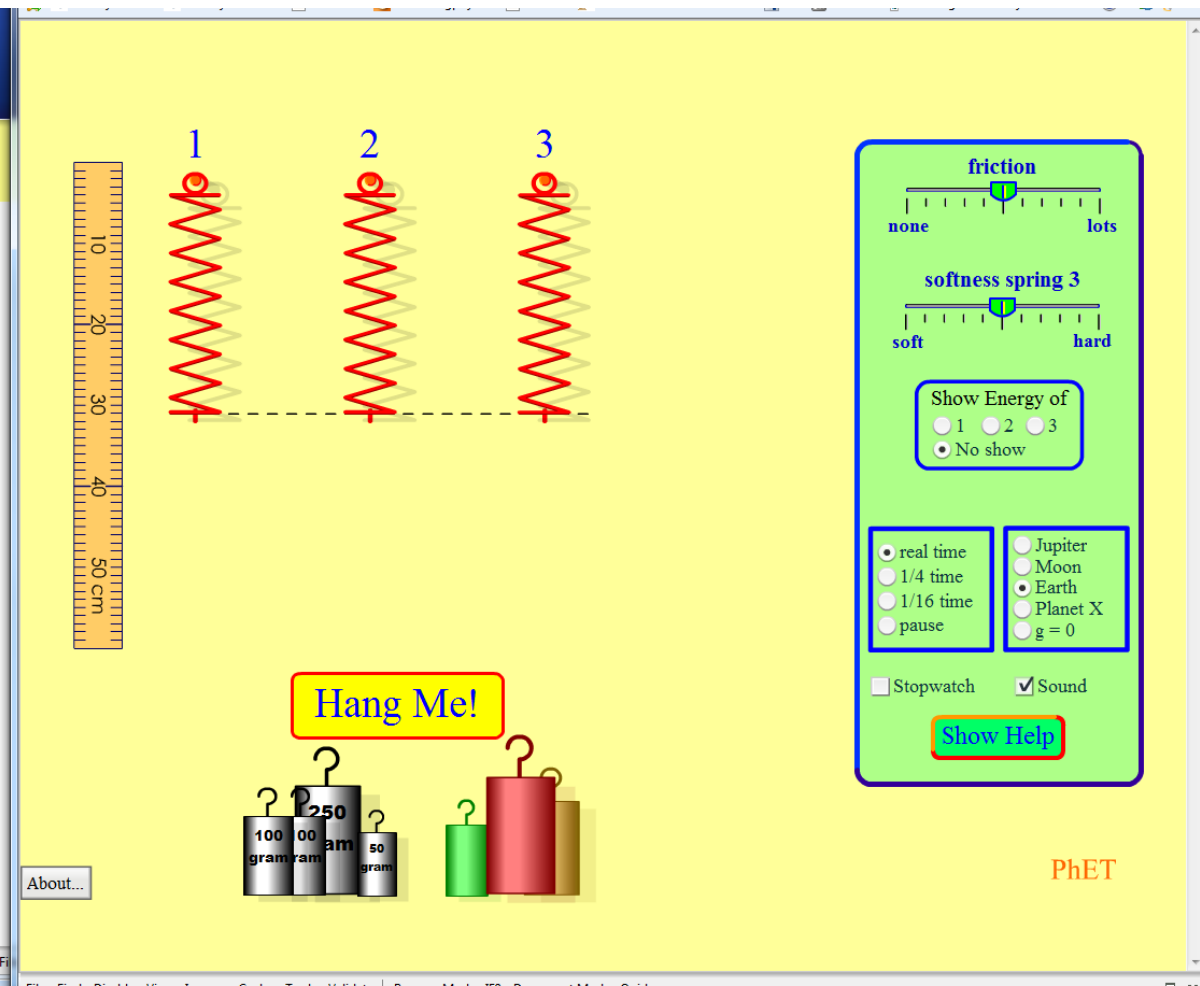
# Hooke's Law

$$F = - kx$$

# *Springs and Masses*

What is the spring constant of Spring 3?

What is the mass of the red weight?



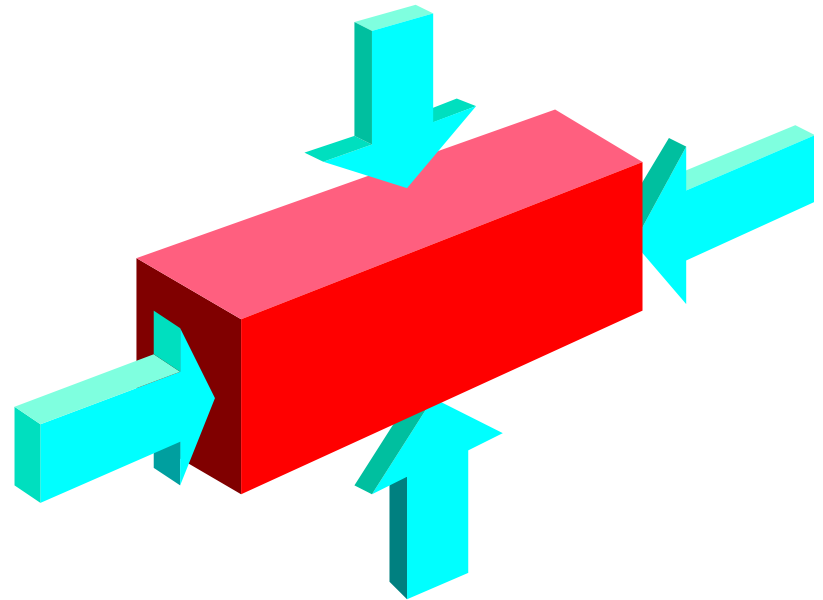
# Deformation

- Stress and Strain
- Faults
- Folds

# Stress and Strain

- **Compression**

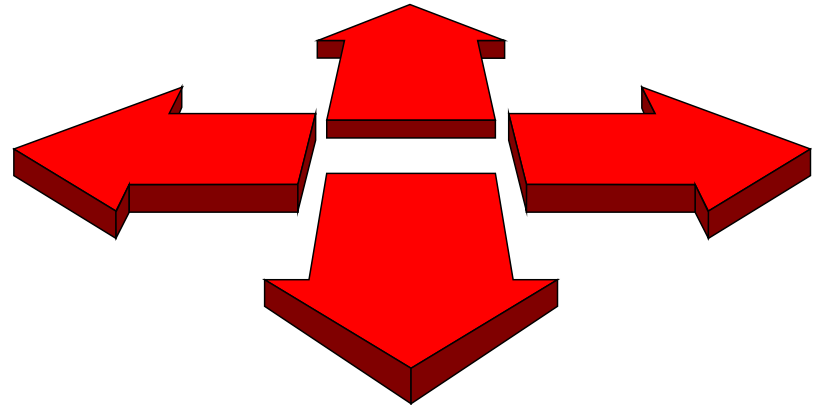
- Forces opposite
- Act towards each other



# Stress and Strain

- **Tension**

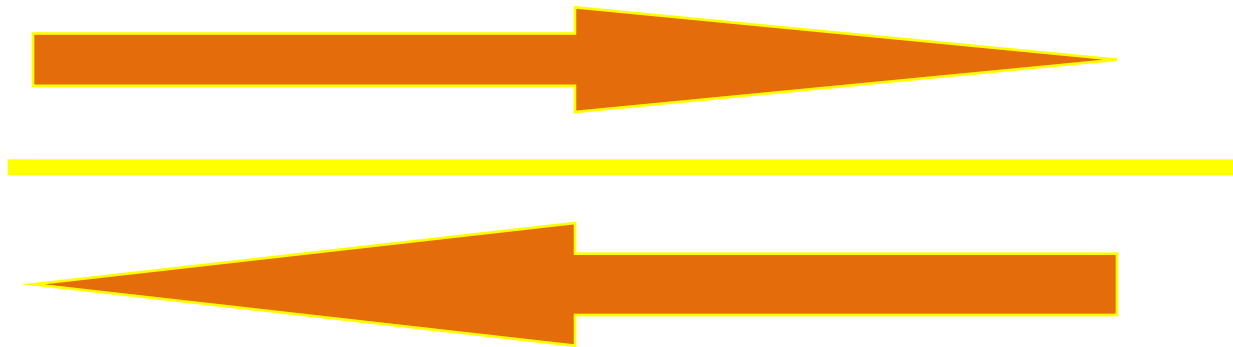
- Forces opposite
- Act away from each other





# Stress and Strain

- **Shear**
  - Forces opposite
  - Act parallel
  - But across a plane



# Stress and Strain

- **Strain (Deformation)**
  - Change in shape or size ( $\Delta L/L$ )
  - Response to stress (Force/Area  $F/A$ )

$$F/A = Y \Delta L/L$$

$Y$  = Young's Modulus

Characterizes how the material **strains** in response to **stress**



**Strain** can be measured by how much the shape changed.

# Elasticity of Rock



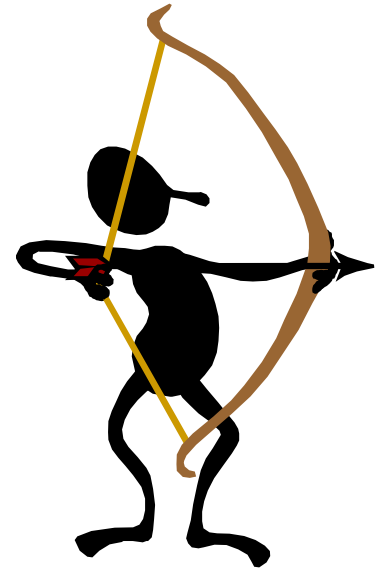


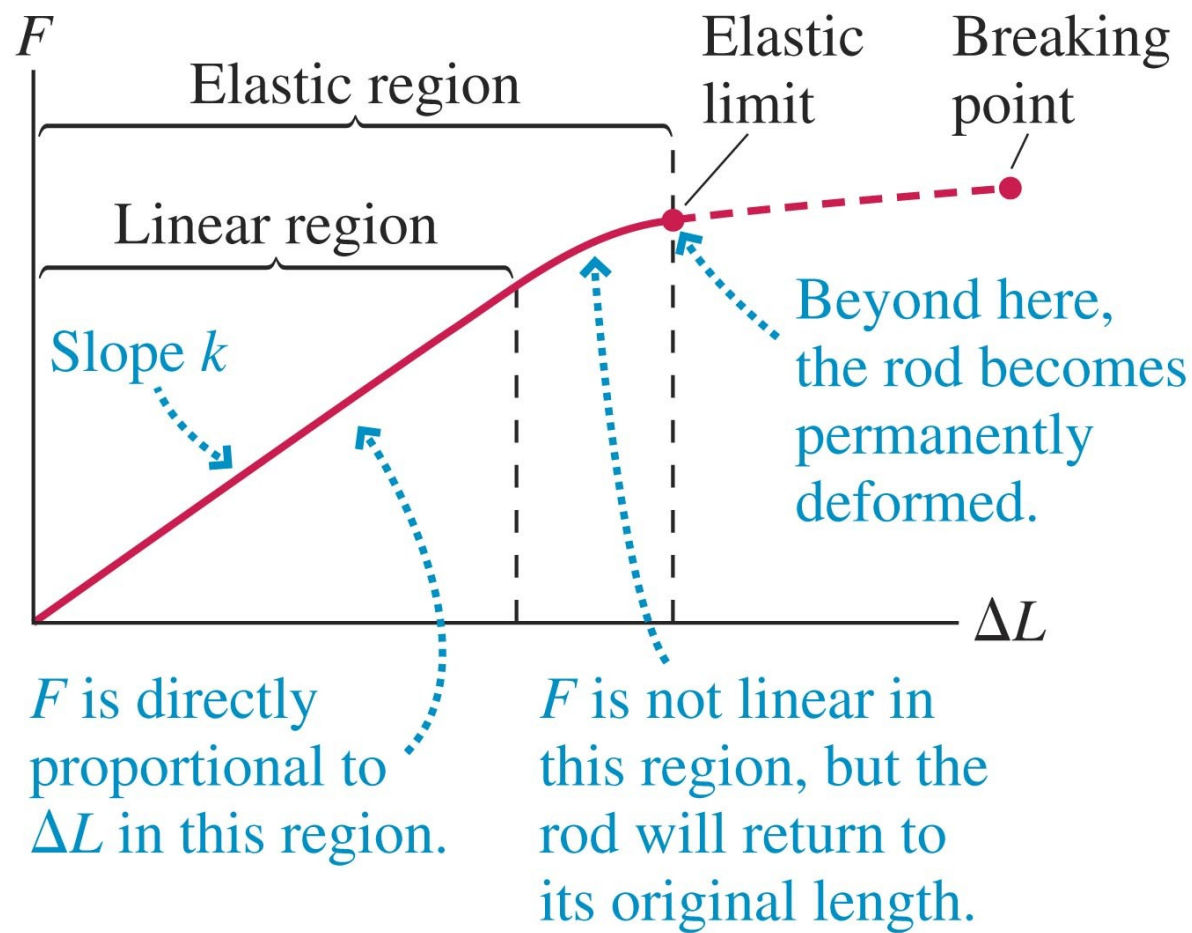
**Strain** can be measured by how much the shape changed.

# Stress and Strain

- 1) Elastic deformation
  - *Temporary* change in shape or size
  - Recovers when stress is removed

$$F = - kx$$



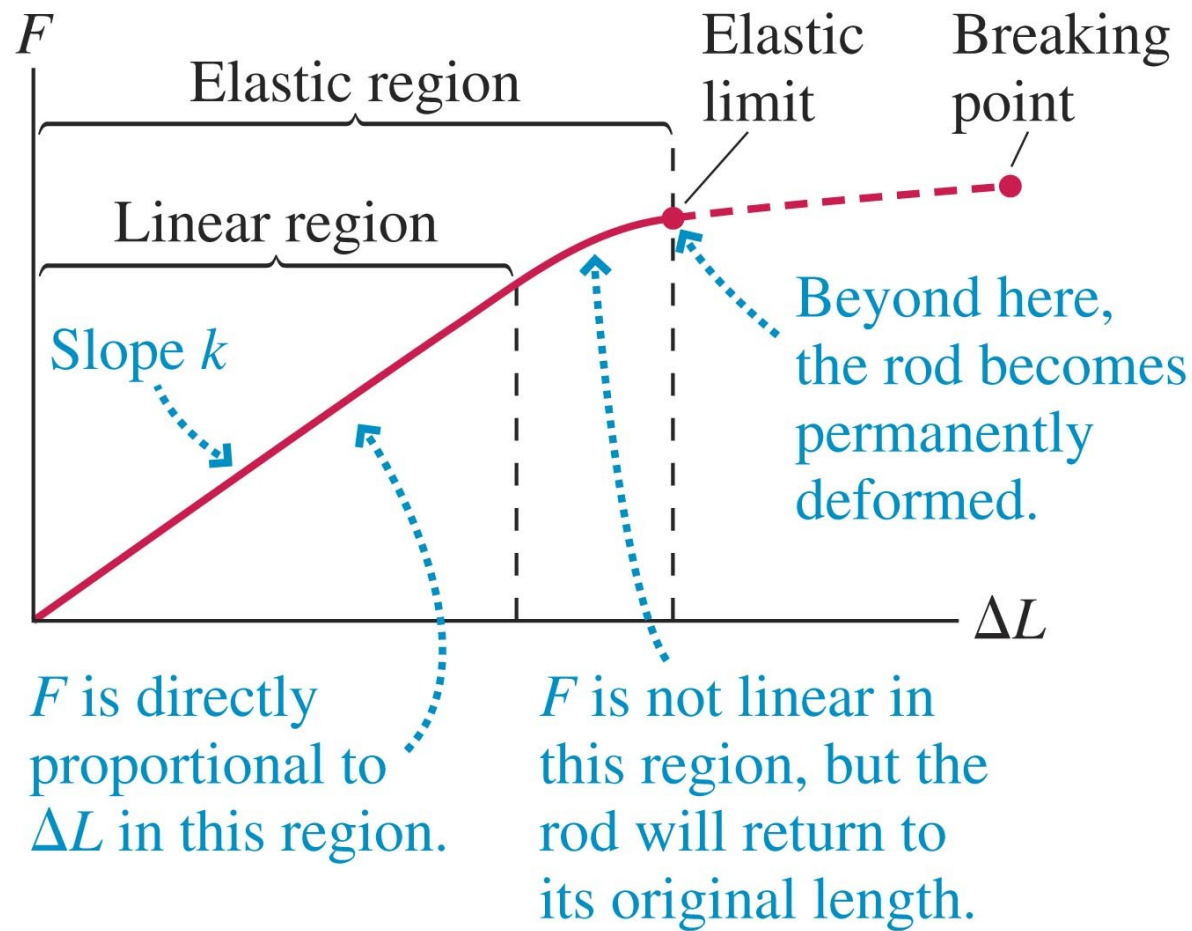


# Stress and Strain

- **2) Ductile (plastic) deformation**
  - Permanent change in shape or size
  - Not recovered when the stress is re
  - (Folding)
  - Playdough, clay







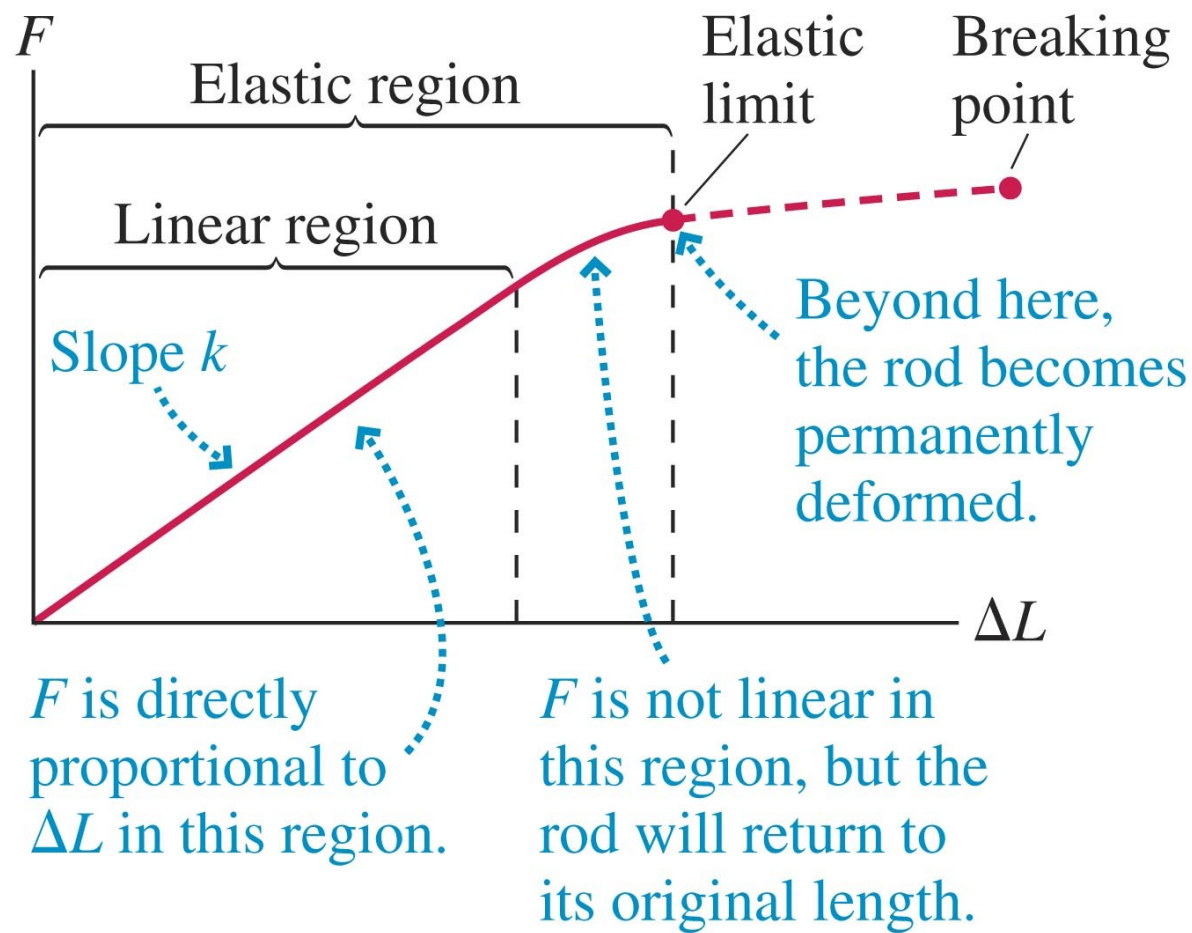


Stretched beyond  
the ***elastic limit***  
Permanently  
deformed

# Stress and Strain

- 3) Brittle deformation (rupture)
  - (Faulting)
  - Past *Tensile* Strength







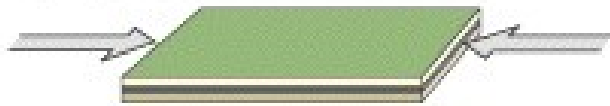
Past ***Tensile  
Strength***

# Stress and Strain

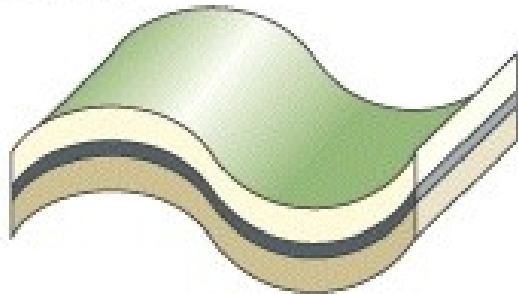
- Factors that affect deformation
  - Temperature (**Young's modulus**)
  - Pressure (**Stress**)
  - Strain rate (not considered in this chapter)
  - Rock Type (**Young's Modulus**)

# Tectonic Forces and Resulting Deformation

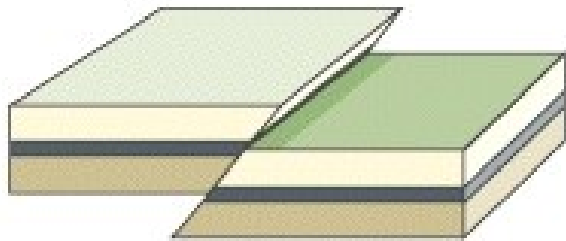
COMPRESSIVE  
FORCES



Folding



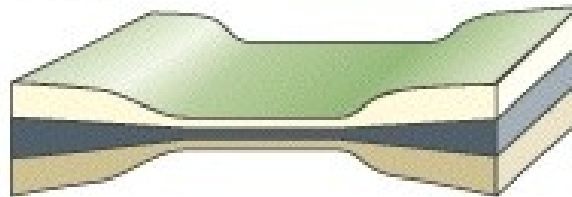
Faulting



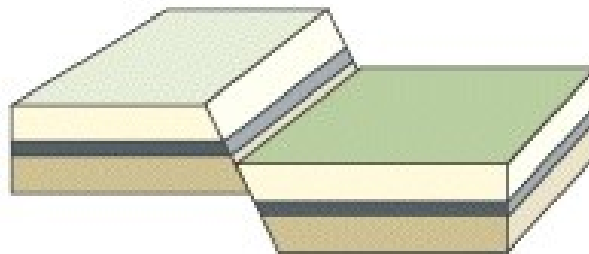
TENSIONAL  
FORCES



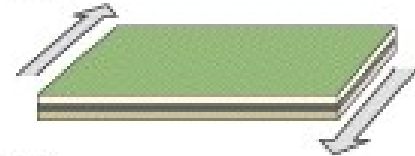
Stretching and  
thinning



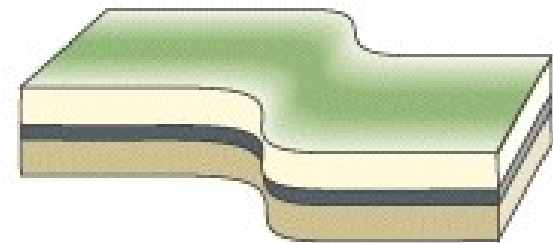
Faulting



SHEARING  
FORCES



Shearing



Faulting

