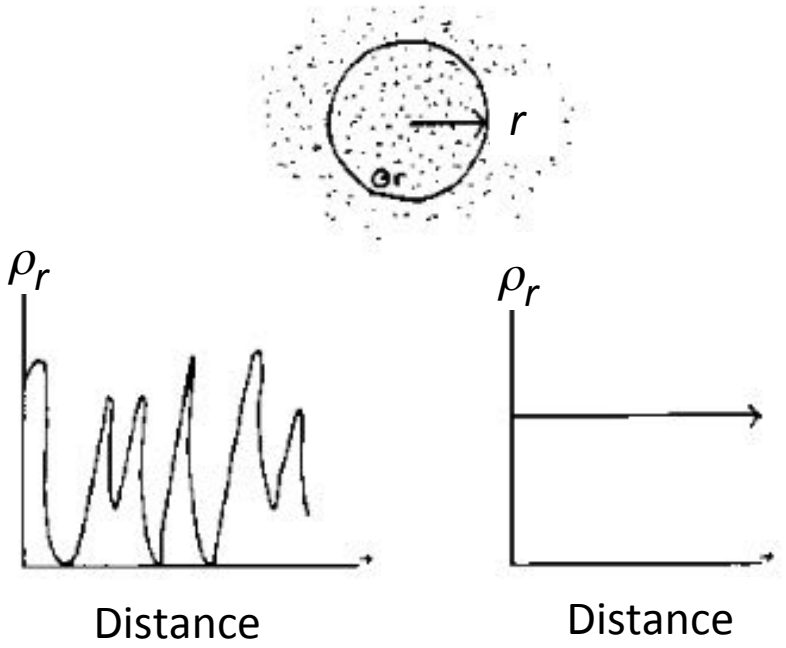
What is a Continuum?

- Smoothly varying intrinsic physical properties of the material should be definable. Examples of commonly relevant properties are mass density, specific heat capacity, thermal conductivity, permeability to water flow, elasticity and viscosity.
- For example, total mass density ρ_r. Define $\bar{\rho}_r = \frac{mass\ in\ V_r}{V_r}$

  where V_r is a volume with characteristic dimension r, which is the averaging scale.

- If r is very small, say of the order of molecular dimensions, then clearly ρ_r will show dramatic variations with position (left).
- If the averaging-length r is large relative to the scale of material variations, then ρ_r is smooth (right), and we can treat the material as a continuum.
- (This is clearly an idealization).



ESS 411/511 Geophysical Continuum Mechanics Class #1

Classical Mechanics

- Point particles
- $\boldsymbol{F} = m\boldsymbol{a}$

or

- $\Sigma_j \boldsymbol{F}_j = 0$

Continuum Mechanics

- Length scales
- $\boldsymbol{F}$ is expressed through stress
- Field properties
- Material properties
- Constitutive relations

ESS 411/511 Geophysical Continuum Mechanics Class #1

Some averaging length scales to consider

Water flow
- Molecular
- Eddies
- Bed forms
- Channel dimensions

Sand Dunes
- Molecular
- Grains
- Dune size
  height, width, length
- Dune field

Rock Mountain
- Molecular
- Crystal
- Stratigraphy
  layers, blobs
- Joints

ESS 411/511 Geophysical Continuum Mechanics Class #1

Let's look at some rocks …

- Suggest 2 continuum questions about each rock
- Suggest a value for *r* for each question.

ESS 411/511 Geophysical Continuum Mechanics Class #1

Let's look at some rocks …

- Suggest 2 continuum questions about this rock
- Suggest a value for *r* for each question.

ESS 411/511 Geophysical Continuum Mechanics Class #1

Let's look at some rocks …

- Suggest 2 continuum questions about this rock
- Suggest a value for *r* for each question.

Thera-putty


Thera-putty
t = 1 min


Thera-putty
t = 2 min


Thera-putty
t = 3 min


Thera-putty
t = 4 min


Thera-putty
t = 5 min


Thera-putty
t = 6 min


Thera-putty
t = 7 min


Thera-putty
t = 8 min


Thera-putty
t = 9 min


Thera-putty
t = 10 min


Thera-putty
t = 11 min


Thera-putty
Tazmin –
Lab Assistant

ESS 411/511 Geophysical Continuum Mechanics Class #1

Problems Lab tomorrow (Thursday)

- We will experiment with Zoom discussion technology and how to share notes.
- Then discuss springs, dash-pots, and silly putty.

ESS 411/511 Geophysical Continuum Mechanics Class #1

For Friday class

- Read Raymond Notes Ch 1 (class web site),
- Read Mase, Smelser and Mase, Ch 1
- Read Raymond Notes Ch 2, (2.1 and 2.2).

I am also preparing a short CR/NC writing assignment (1 point) in Canvas (Assignment Group - Pre-class prep).

- It will be due in Canvas at the start of class.
- I anticipate the whole thing will be around ~half a page.
- The goal to help us get into the topic, and the points from this and similar exercises will contribute to class participation grades.
- The writing assignment should help you to be prepared to discuss what you see as the key feature of a spring, and of a dashpot, and to be prepared to discuss stress, strain, and elastic behavior.

- I will send another message when it is posted in Canvas.