

ESS 411/511
Geophysical Continuum Mechanics

Instructors:

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We will use Canvas and a course web site at:
<https://courses.washington.edu/ess511/>

Today

- COVID-19 and ESS 411/511
- Introductions
- Syllabus
- Concept of a continuum

COVID-19 POLICY

- Everyone should be vaccinated.
- We should wear masks when in a group activity
- In case of classroom exposure, quarantining is not necessary for students and faculty who are vaccinated and not experiencing COVID-19 symptoms.
- If UW goes back into lock-down, we can continue the class thru Zoom.
- If instructors test positive or need to isolate, we can move onto Zoom.
- If you need to isolate, the lecture slides will be available so you can follow asynchronously. We hope that you will be able to connect with classmates and instructors with questions through Canvas or Slack.

COVID-19 POLICY

Major Changes *from last (version 3 - 31 August) version:*

- Instructors may teach unmasked, if they are more than 6 feet from all individuals in the room (i.e., in the front of the class).
- Request for students to self-isolate only if they begin showing symptoms after close contact (6 feet or less, at least 15 min) with a person during the infections period (48 hours before first symptoms) or are unvaccinated.
- Vaccine records are being verified by 1:1 meetings with authorized HR personnel
- College-purchased N95 masks and voice amplifiers have arrived for distribution by units.

Introductions

(We want this to be an interactive class)

1. Pair up with a classmate who you don't know (yet). One of you will take 2 or 3 minutes to interview the other.
You want to learn a few things such as, for example,
 - Their name
 - Where they are from
 - Their interests in Earth Science, and in this class
 - One thing about them that might be unusual, special, or surprising.
2. Then switch interviewer/interviewee roles.
3. Then introduce your interview partner to your other classmates in a plenary session.

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Class-prep assignments

There will be a short CR/NC writing assignment before each class (1 point) in Canvas (Assignment Group - Pre-class prep).

- It will be due in Canvas by the start of class.
- I anticipate they will typically be around ~half a page.
- These assignments should go “live” around the time of the previous class (so that there is only one Class-prep active at any one time)
- The goal to help us get into the topic, and the points from this and similar exercises will contribute to class participation grades.

Class-prep for Friday

Canvas > Assignments > Pre-class prep > Class _02

Read Raymond Notes Ch 1 (class web site,
<https://courses.washington.edu/ess511/NOTES/notes.shtml> (
[Links to an external site.](#))),

Read Mase, Smelser and Mase, Ch 1

Read Raymond Notes Ch 2, (2.1 and 2.2, also on class web site).

Then

In a prose sentence for each, discuss what you see as the key feature of a spring, and of a dash pot.

and

In a prose sentence for each, discuss what you consider to be the essential nature of each of stress, strain, and elastic behavior.

I anticipate the whole thing will be ~half a page.

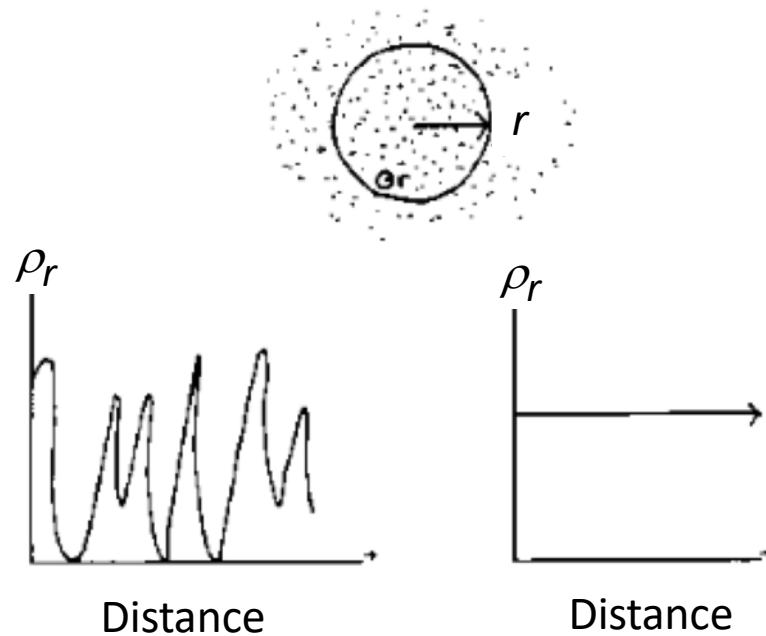
What is a Continuum?

- 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 $\bar{\rho}_r = \frac{\text{mass in } V_r}{V_r}$

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

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- 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).



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Classical Mechanics

- Point particles

- $\mathbf{F} = m\mathbf{a}$

or

- $\sum_j \mathbf{F}_j = 0$

Continuum Mechanics

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

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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

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Let's look at some rocks ...

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



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Let's look at some rocks ...

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



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Let's look at some rocks ...

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



Thera-putty

$t = 0$ min



Thera-putty

$t = 1 \text{ min}$



Thera-putty

$t = 2 \text{ min}$



Thera-putty

$t = 3 \text{ min}$



Thera-putty

$t = 4 \text{ min}$



Thera-putty

$t = 5 \text{ min}$



Thera-putty

$t = 6 \text{ min}$



Thera-putty

$t = 7 \text{ min}$



Thera-putty

$t = 8 \text{ min}$



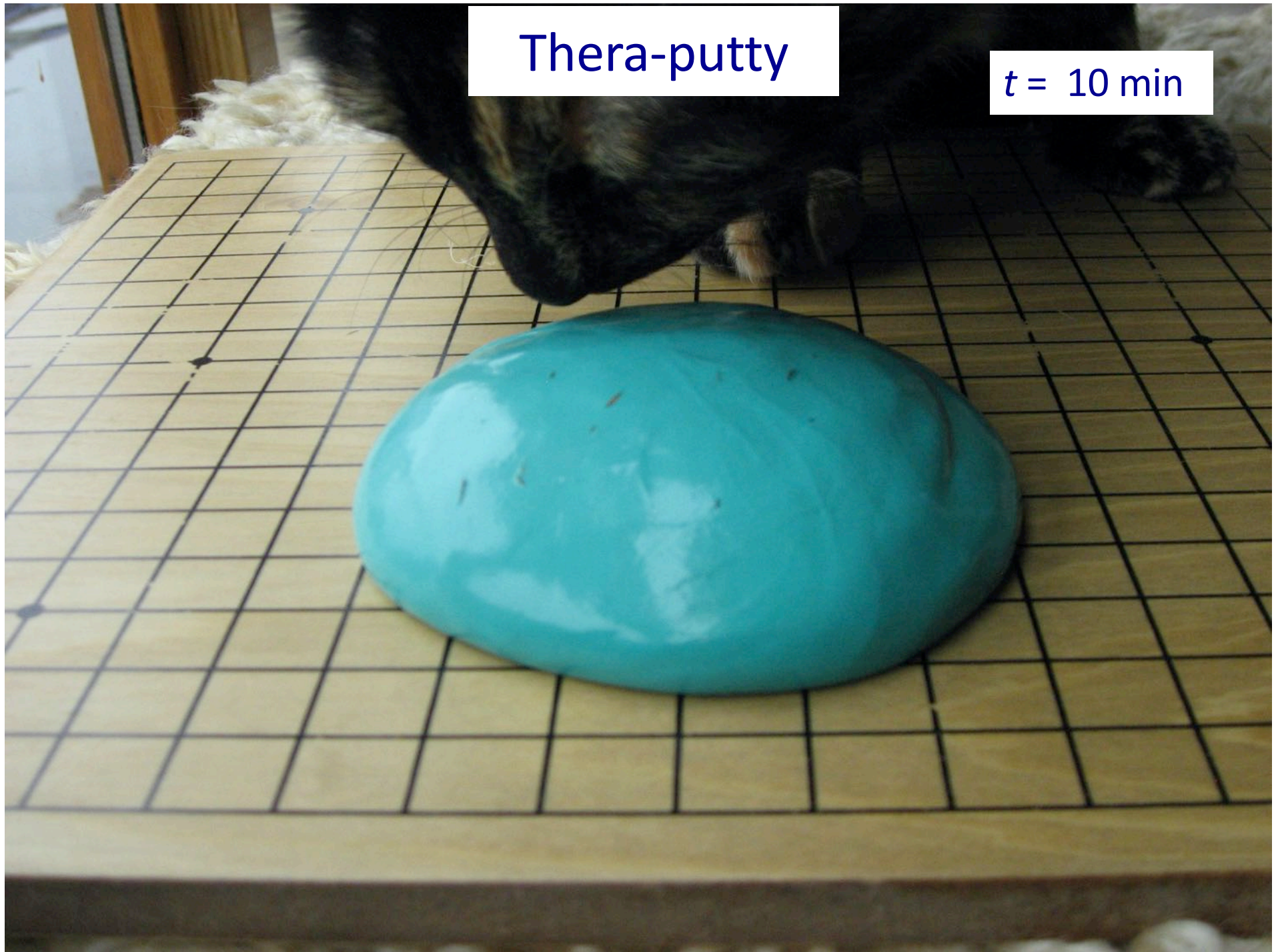
Thera-putty

$t = 9 \text{ min}$



Thera-putty

$t = 10 \text{ min}$



Thera-putty

$t = 11 \text{ min}$



Thera-putty

Tazmin –
Lab Assistant



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Problems Lab tomorrow (Thursday)

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