Soft Solids

3 ECTS - 35h
Wednesday : 2 PM – 5:30 PM
ENS – Room L363

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Introduction to solid mechanics
Focus on *soft solids*

Traditional solid mechanics (Stiff)

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soft solids

large shape changes : functionalities, morphogenesis..

A) soft because slender

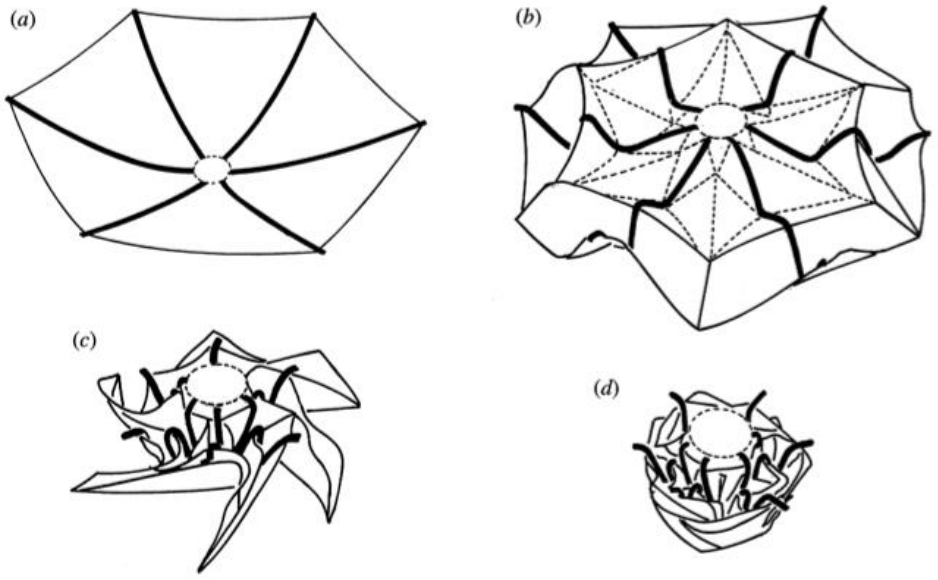

Figure 3. Folding of the CRTS reflector, with localized folds in each tape spring.

drag sail

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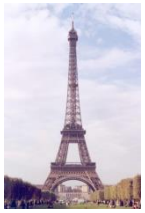

soft solids

large shape changes : functionalities, morphogenesis..

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Morphogenesis
In biology

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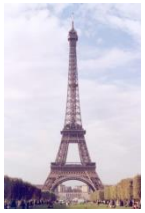


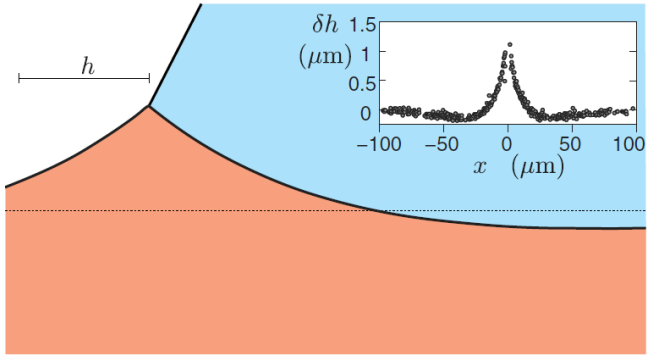
soft solids

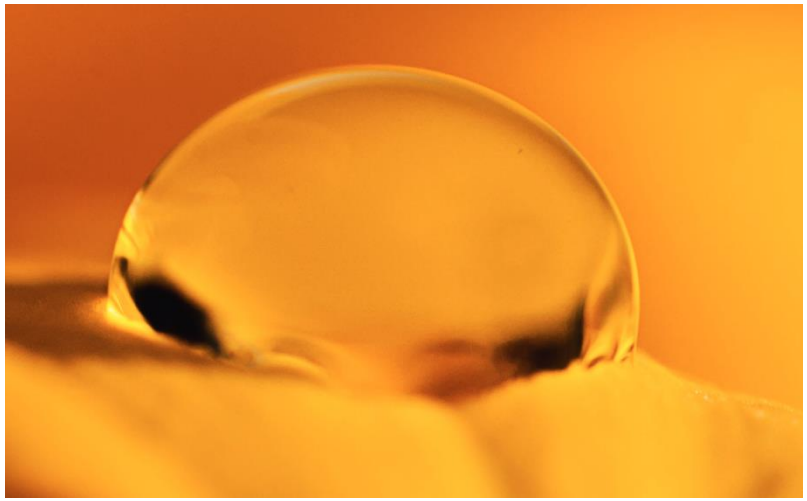
large shape changes : functionalities, morphogenesis..

A) soft because slender

B) soft because of weak material

Soft contact line
Liquid drop on a gel





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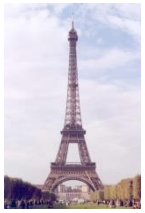


soft solids

large shape changes : functionalities, morphogenesis..

A) soft because slender

B) soft because of weak material

Soft shock
Splat ball

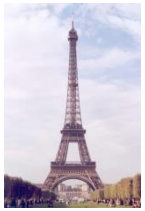
https://www.youtube.com/watch?v=FH7aSxn-nEQ

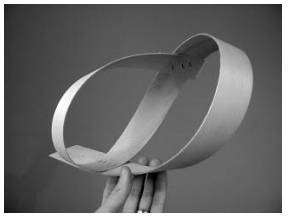
Introduction to solid mechanics
Focus on *soft solids*

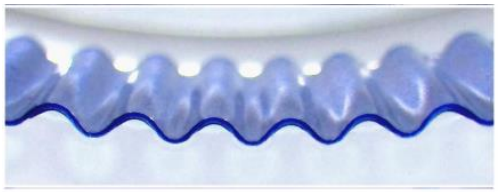
- Physicist point of view: order of magnitude, dimensional analysis, interpretation
- Mini research projets

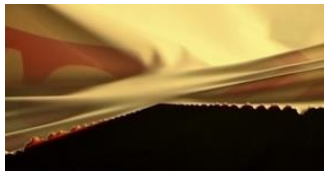
Program:

08/01	MC	1D Continuum mechanics
15/01	BR	Slender media
22/01	MC	3D Continuum mechanics
29/01	BR	Slender structures
05/02	MC	3D Structures
12/02	BR	Instabilities
26/02	MC	Fracture
04/03	BR	Peeling, tearing and delamination
11/03	MC	Soft materials
18/03	BR	Plates and shells
01/03		Exam









Mini projects

OBJECTIVE : to help you think/discuss about the class material and use it in a real problem

- By group (recommended : 2 persons)
- Interaction with us
- Experiments are possible (contact us)

- A short presentation (10mn) during class

1/3 of the final mark

New mini projects

- What are the conditions for whip cracking ?
- What is the dynamics (speed) of a safety band wrapping ?
- How to cut a well shaped roasbeef slice ?
- How fast can you strike a golf ball?
- Sticky climber man competition
- What are the condition for a paper popper to make noise?
- What is the height of a solid siphon
- Can we explain why a grooved flat strip folds into a cylinder when under traction?
- Why does Kamifusen (Japanese ball) inflate when bouncing?
- How do animals/plants stick to walls?
- What is the sticking diameter of a splat ball ?
- Why do we get sauce everywhere when eating spaghetti?

https://blog.espci.fr/softsolids/mini-projects/

Older mini projects

- What is the wind speed over which an umbrella accident can occur?
- What is the landing dynamics of a snake?
- The mowing of wheat: cutting or bedding?
- Is it good to have a flexible fishing rod ?
- How long does it take for a inverted cap before jumping ?
- What is the jumping height of water beads?
- What is the highest pile of cubes?
- How to make collapsible rubber cups stable?
- How should captain Haddock shake his finger to debond the band aid?
- Should a diving bird be concerned with buckling?
- Oak or reed : which one breaks first in a storm?
- What is the maximum height an M&M can fall ?
- How do spider webs stick to walls?

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What is the wind speed over which an umbrella accident can occur?

What is the landing dynamics of a snake?

What is the height of a solid siphon?

https://youtu.be/_dQJBBklpQQ

The mowing of wheat: cutting or bedding?

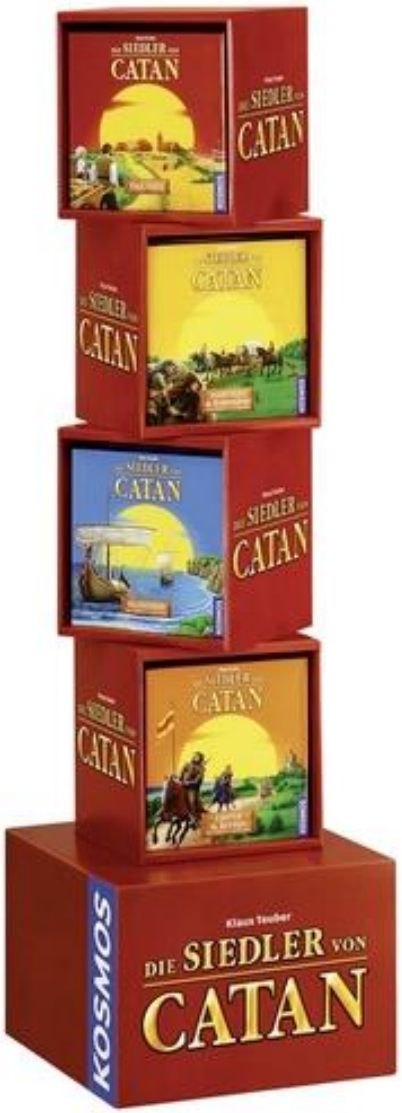
Is it good to have a flexible fishing rod ?

What is the jumping height of a jumping cap ?

What is the bouncing height for water beads?

https://youtu.be/OfcCsP-T1pc

What is the highest pile of cubes?



Why does Kamifusen (Japanese ball) inflate when bouncing?

https://youtu.be/dqXZ3bxVBcs

How to make collapsible rubber cups stable?

Why is it so hard to peel an old carrot?

How should captain Haddock shake his finger
to debond the band aid?

Should a diving bird be concerned with buckling?

Why do we get sauce everywhere when sucking spaghetti?

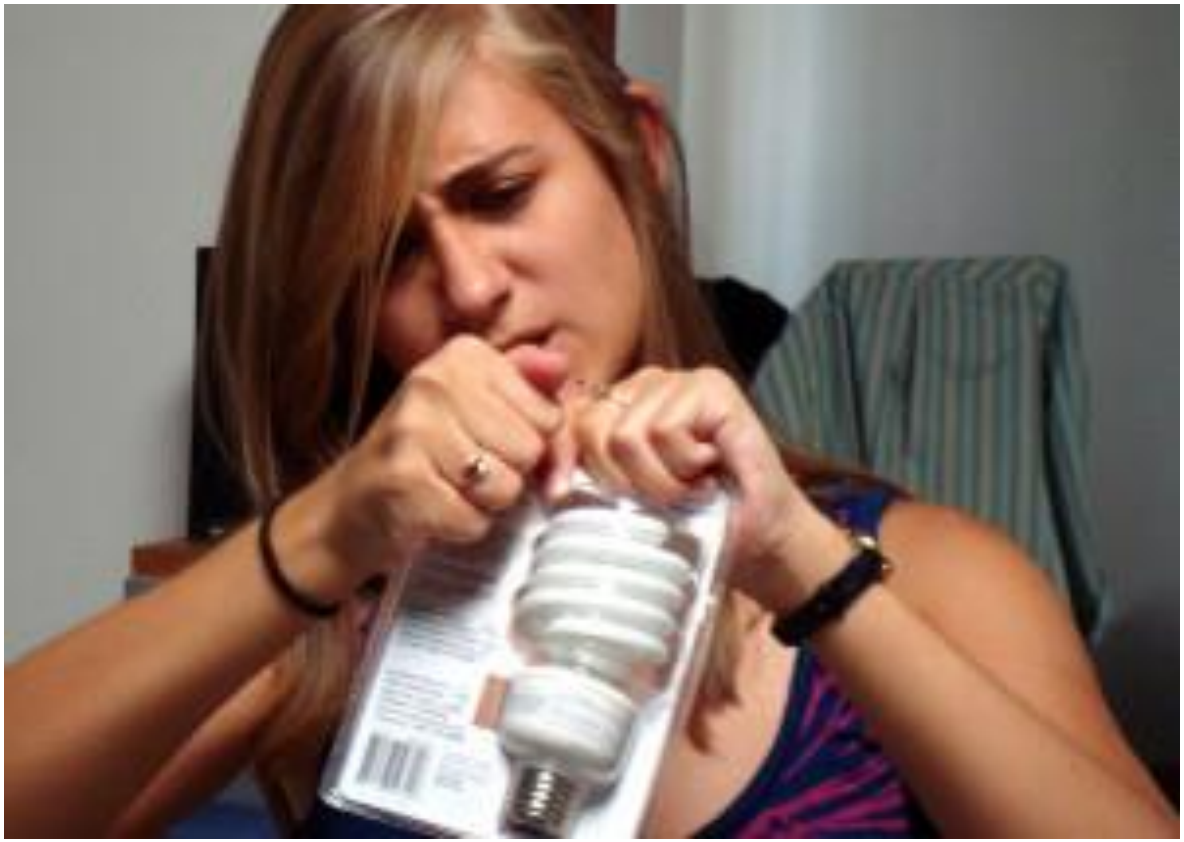
What is sticking diameter of a splat ball ?

https://youtu.be/bOm_wvtcWm0

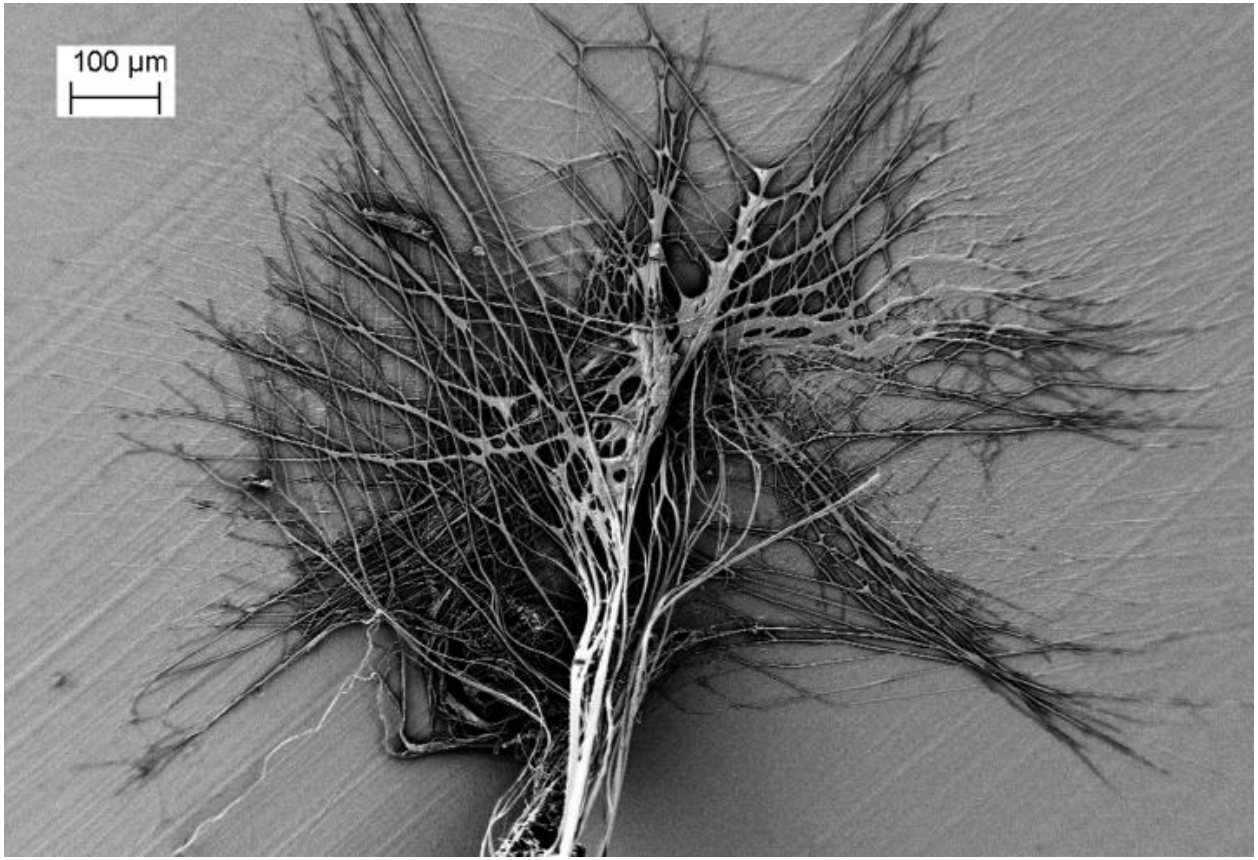
Oak or reed ? which one breaks first in a storm?

What is the maximum height an M&M can fall ?

Why is that so hard to open a packaging ?



How do spider webs stick to walls?



TODAY'S MENU
1D STRETCHABLE SOLIDS

- From springs to Hooke's law
- Strain and stress fields
- Fundamental principle of dynamics
- Static equilirium of an elastic rod
- Dynamics of en elastic rod
- Towards soft rods

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