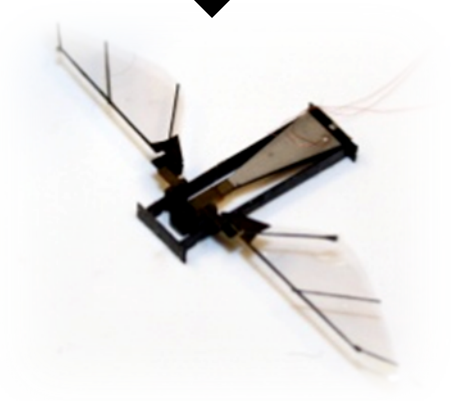
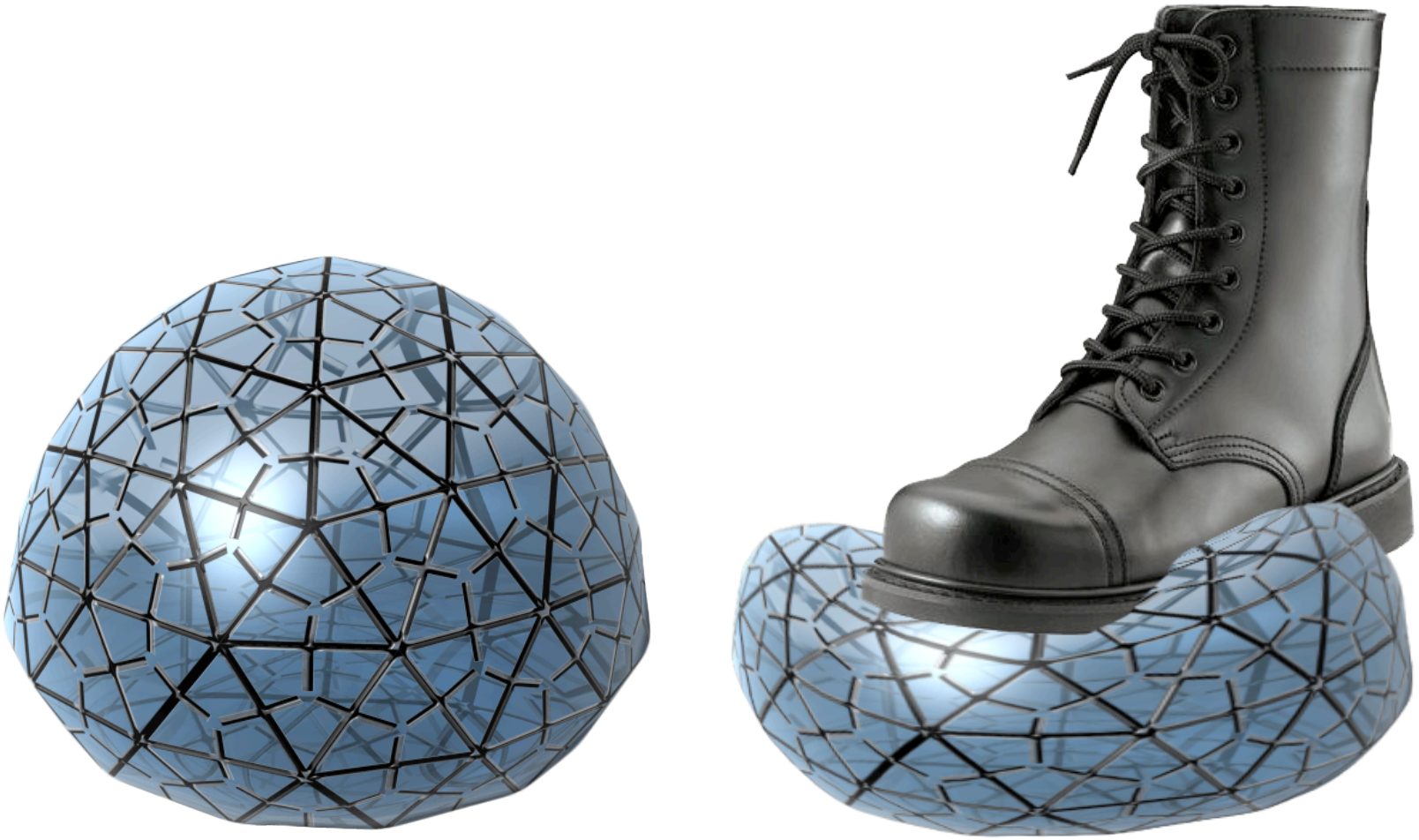
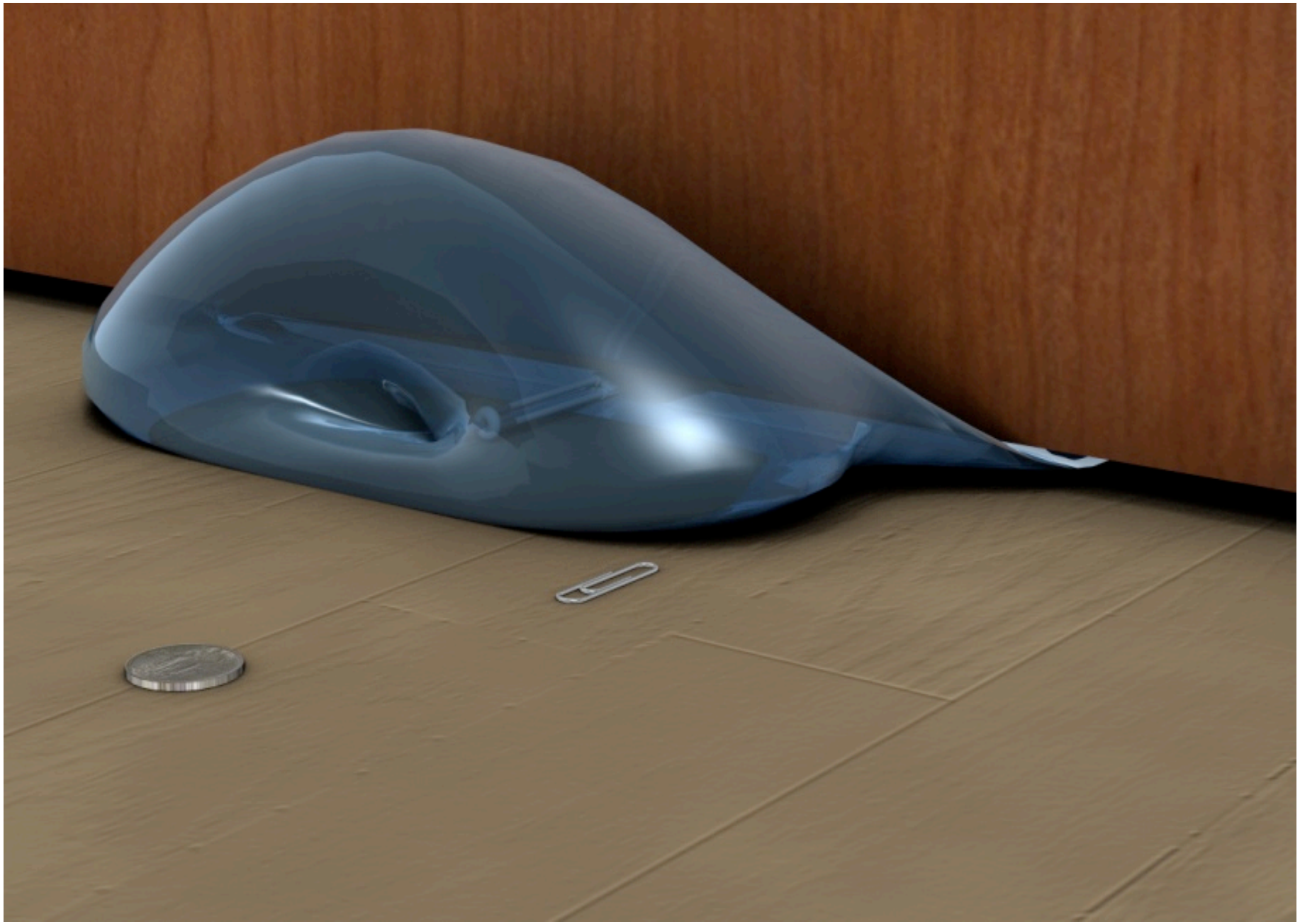
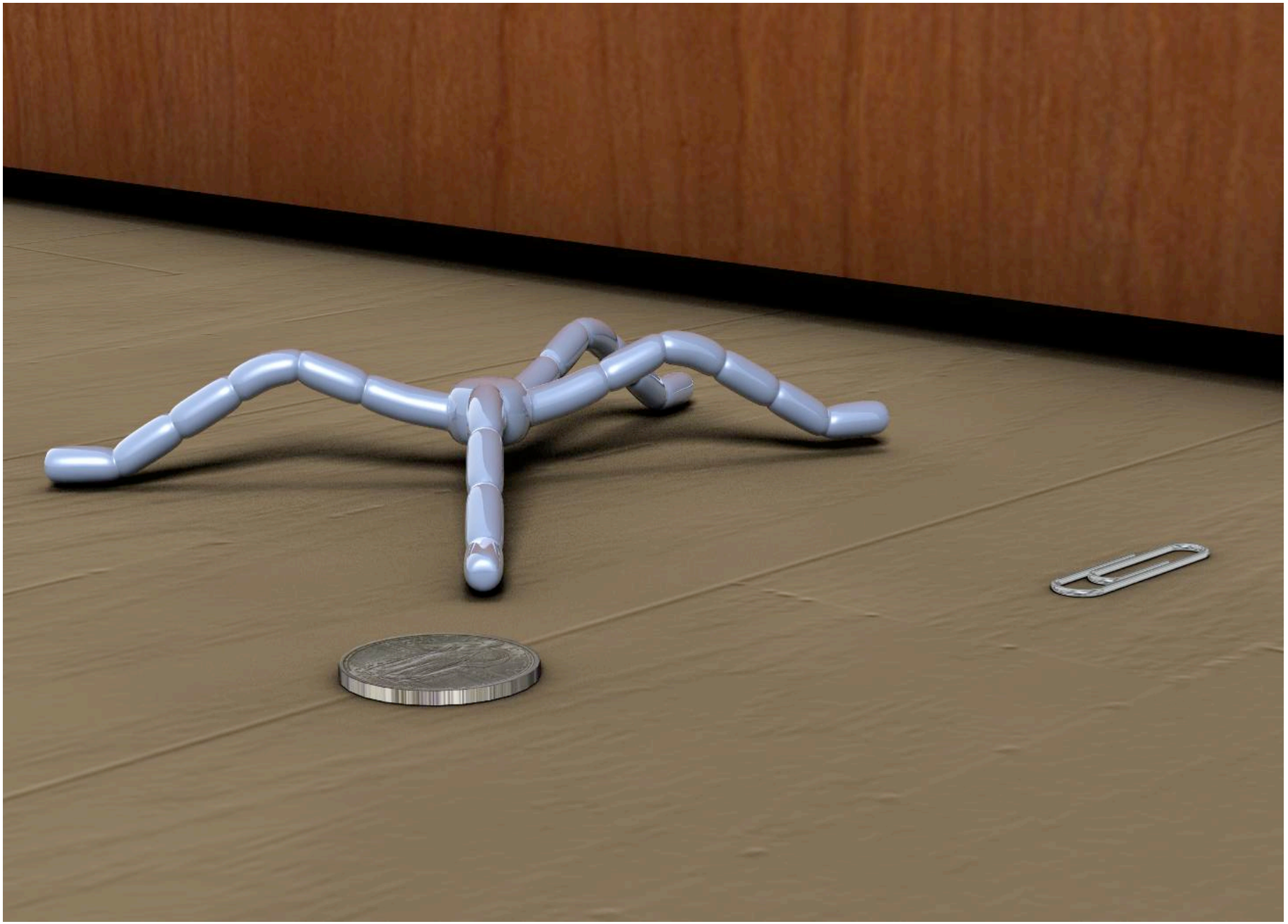
What happens if you step on one?

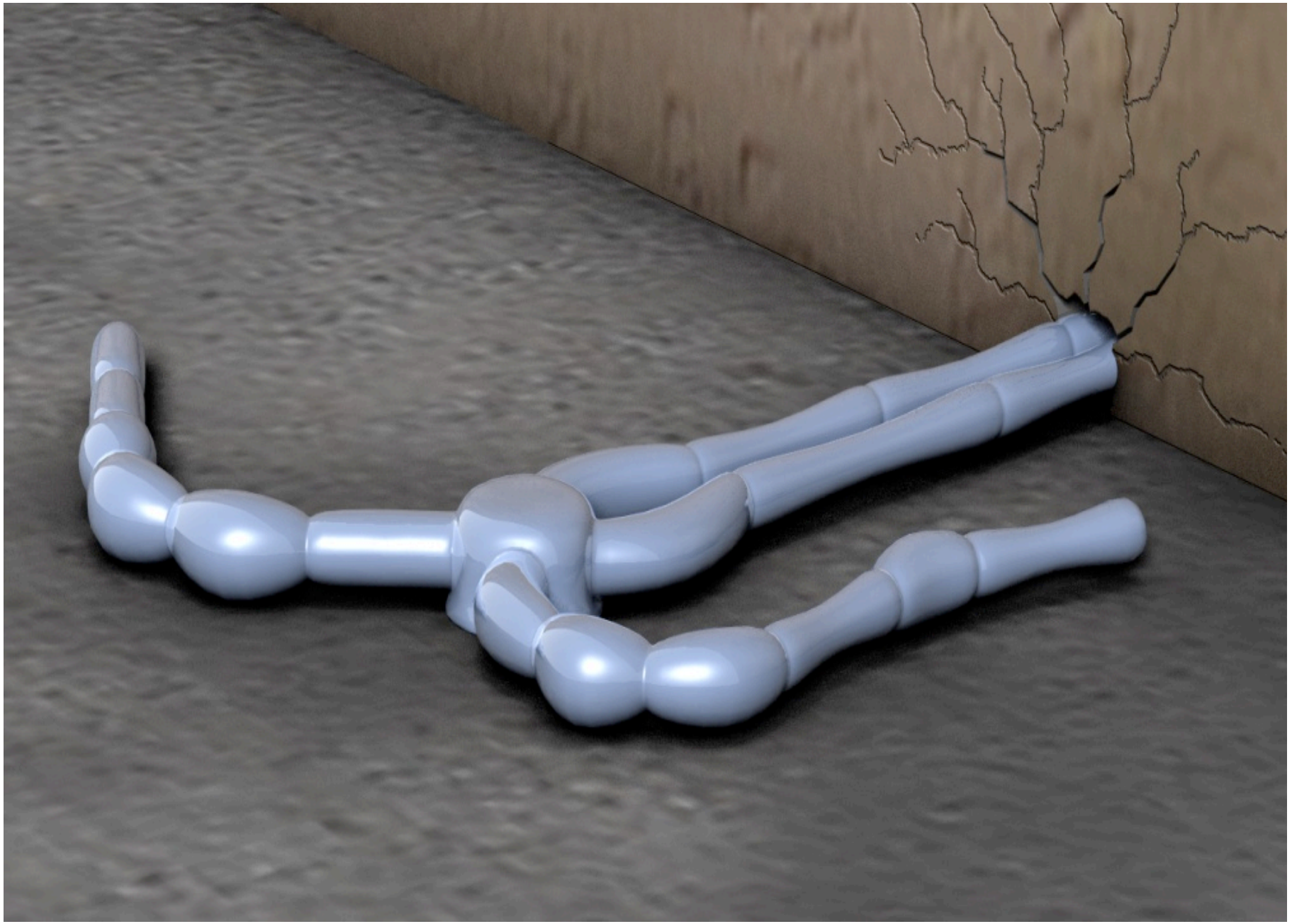


?







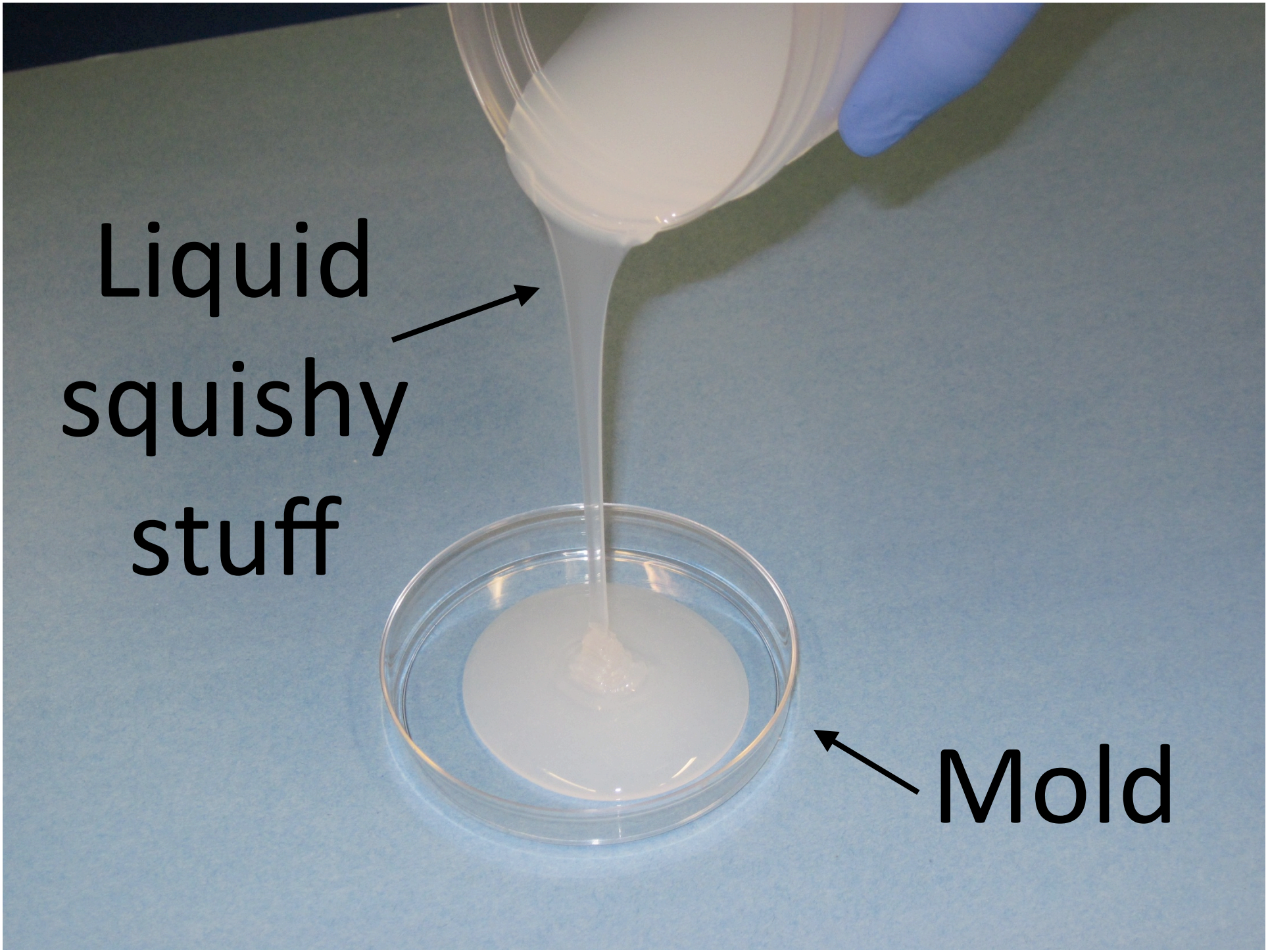


How do you make them squirm, squish, twist and bend?

YouTube – “Elephant Trunk Up”

YouTube – “Octopus escaping through a one inch hole”

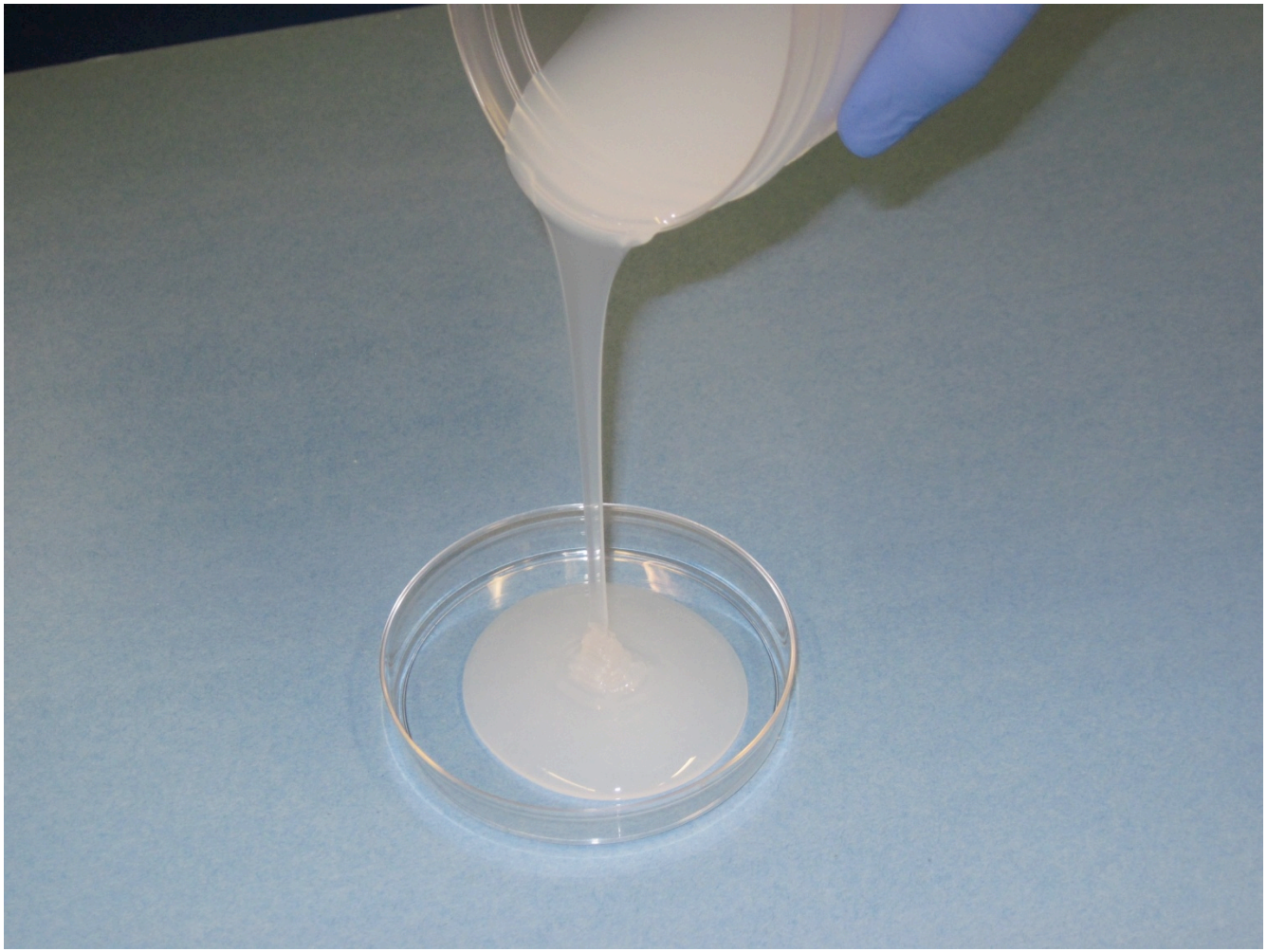
How do you make a robot squishy?


Liquid
squishy
stuff
Mold

What is liquid squishy stuff?

- PDMS (**Polydimethylsiloxane**)
- EcoFlex ®

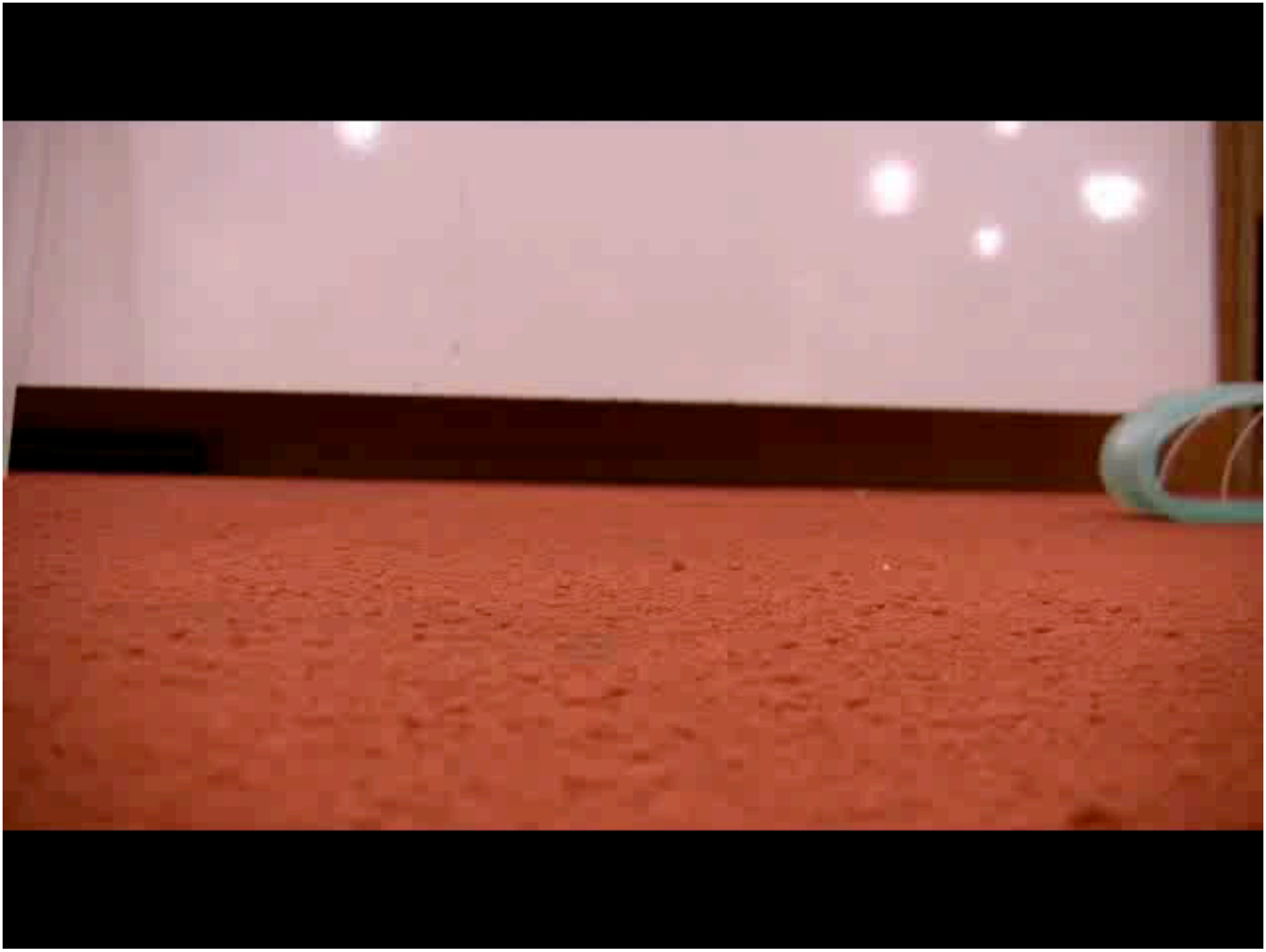
} Silicon Rubber



What is liquid squishy stuff?

EcoFlex ®

Images of EcoFlex® molds from www.smooth-on.com



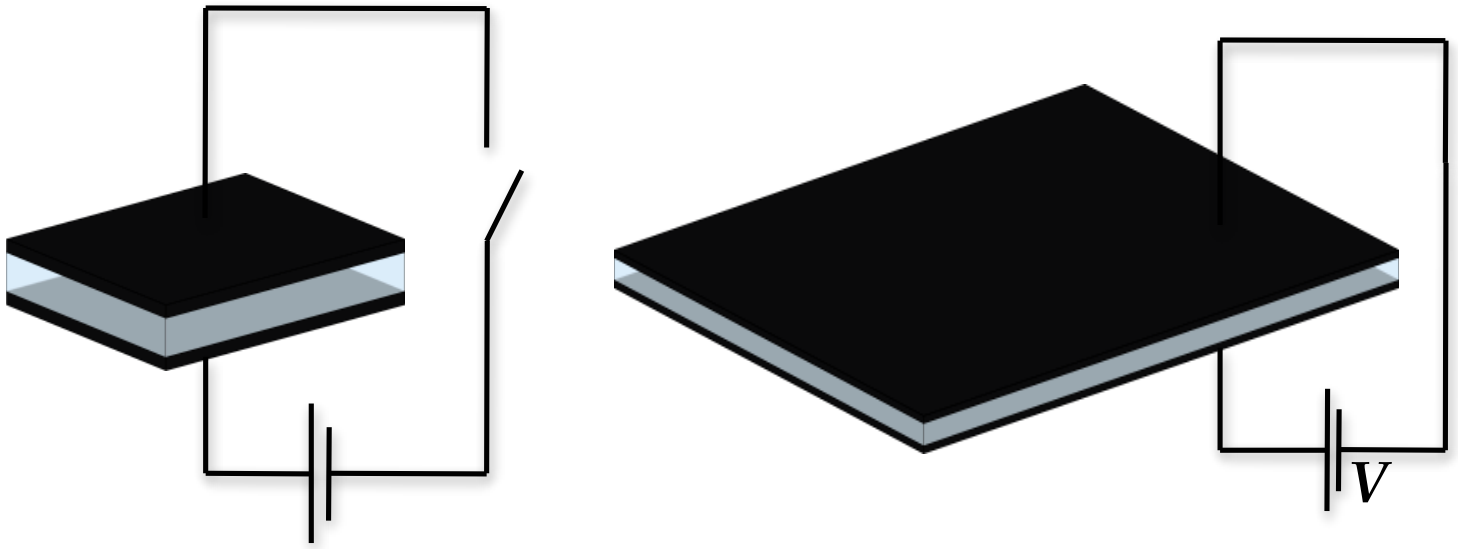
A different kind of soft robot….

Dielectric elastomer actuator

Rubber

Fancy word for “muscle”, or something that moves

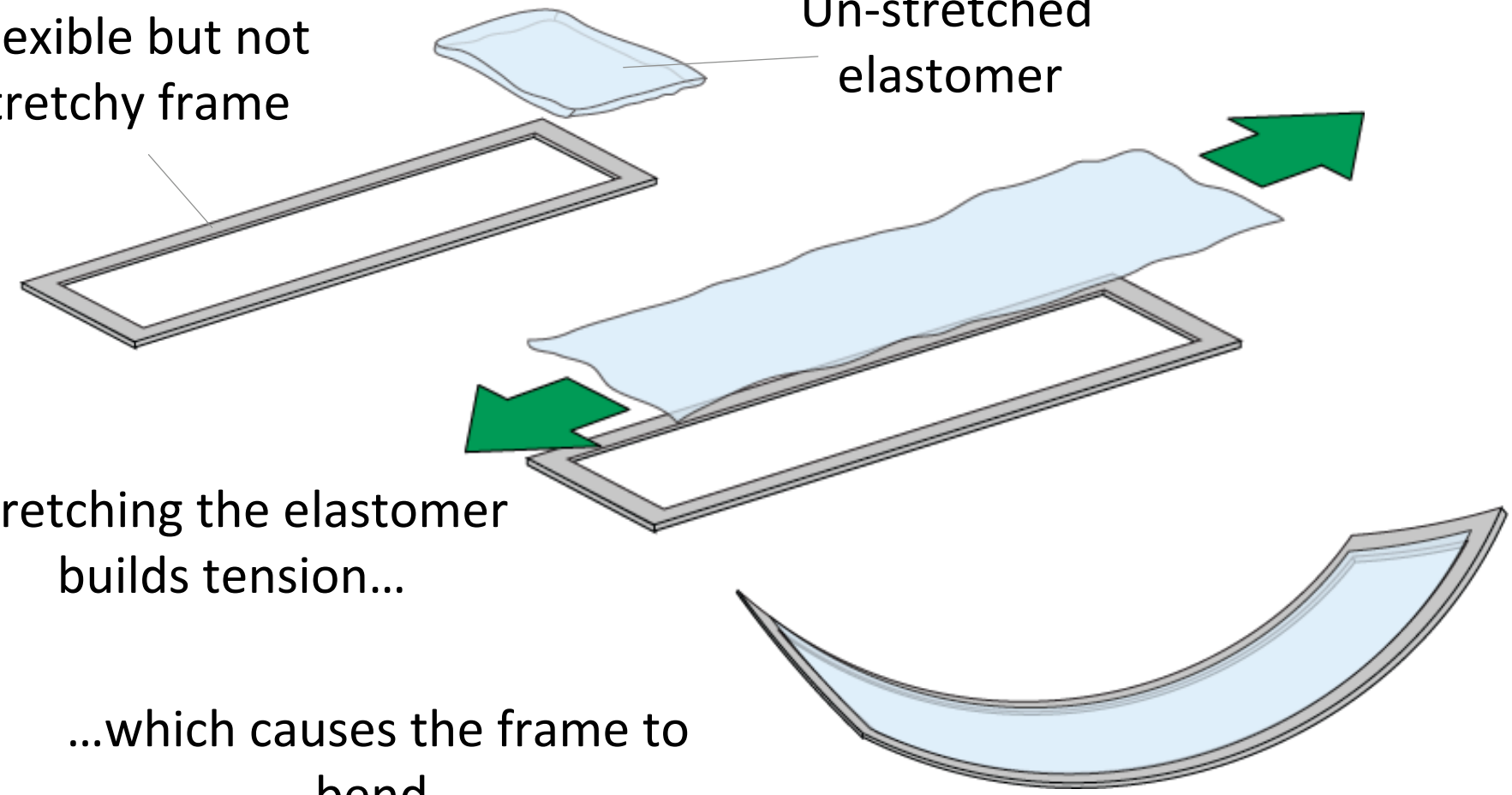
Something that does not conduct



Can we make 3D shapes from something 2D?

Flexible but not stretchy frame

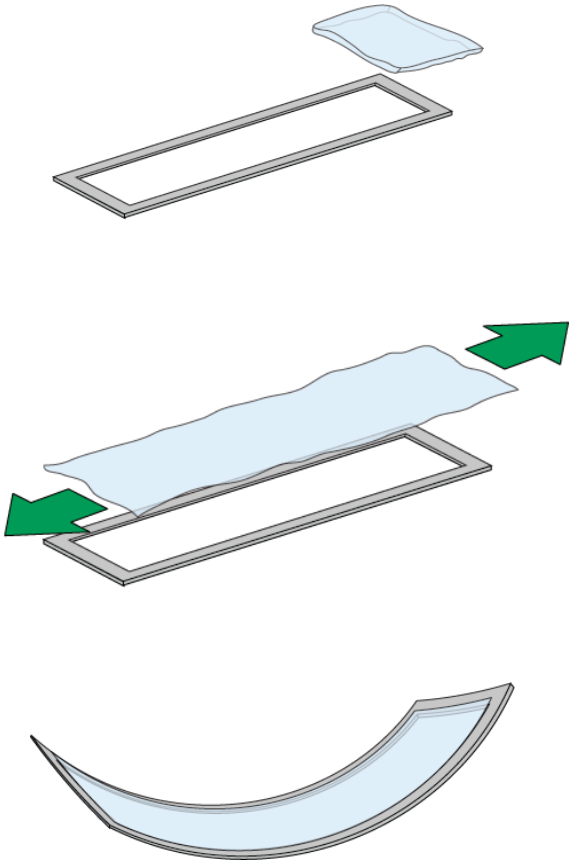
Un-stretched elastomer



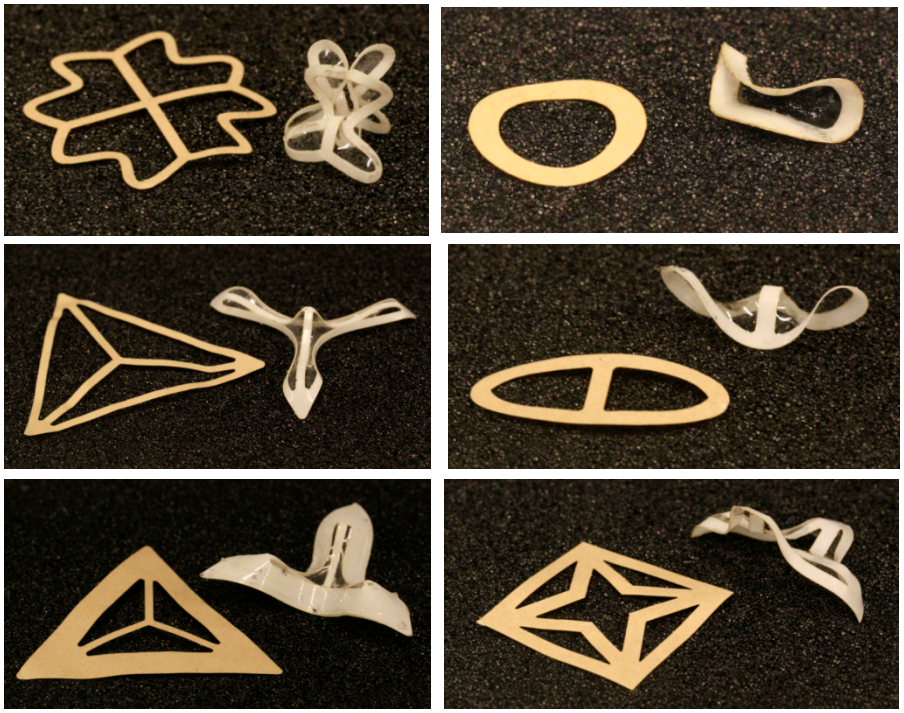
Stretching the elastomer builds tension…

…which causes the frame to bend.

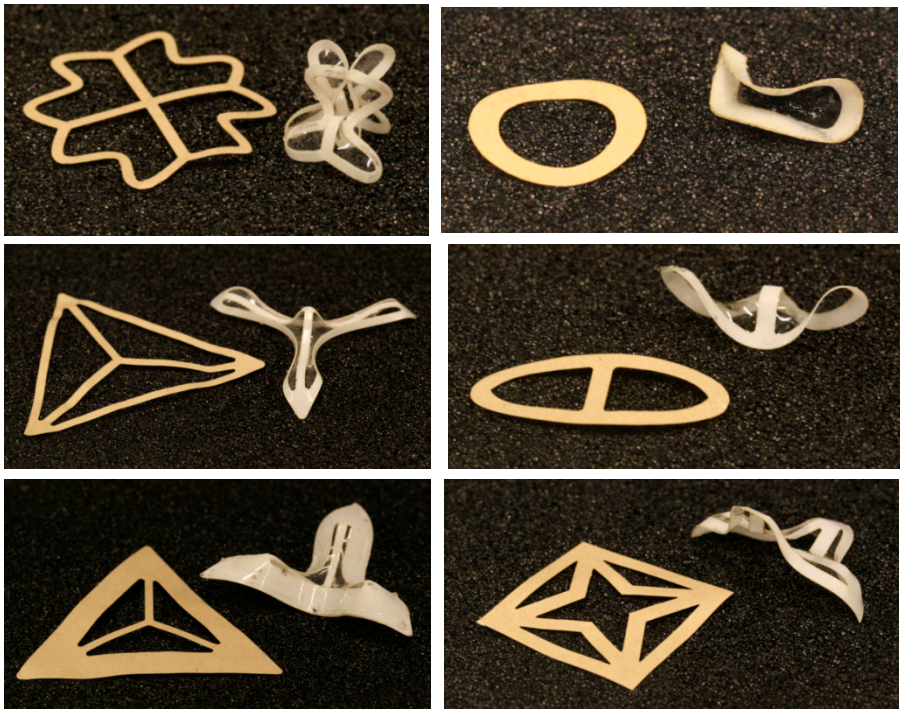
Can we make 3D shapes from something 2D?



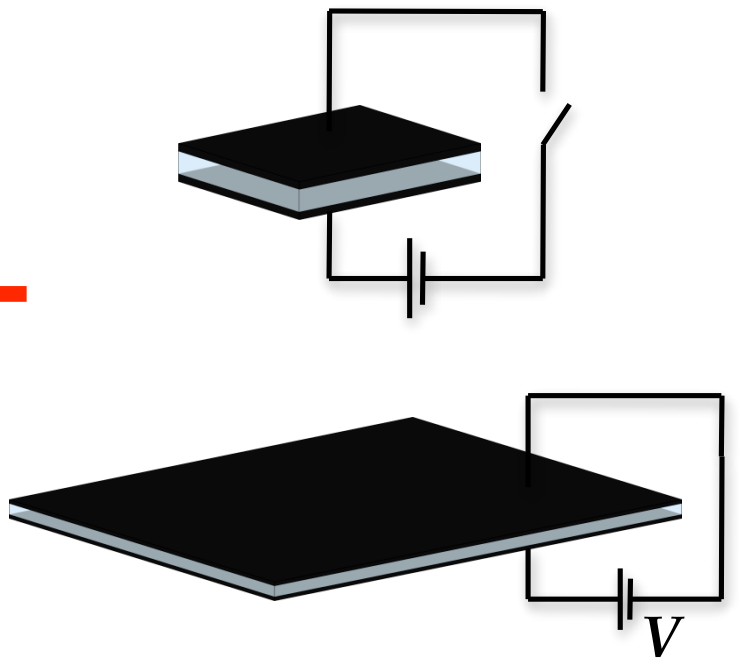
http://commons.wikimedia.org/wiki/File:Archery_competition.jpg

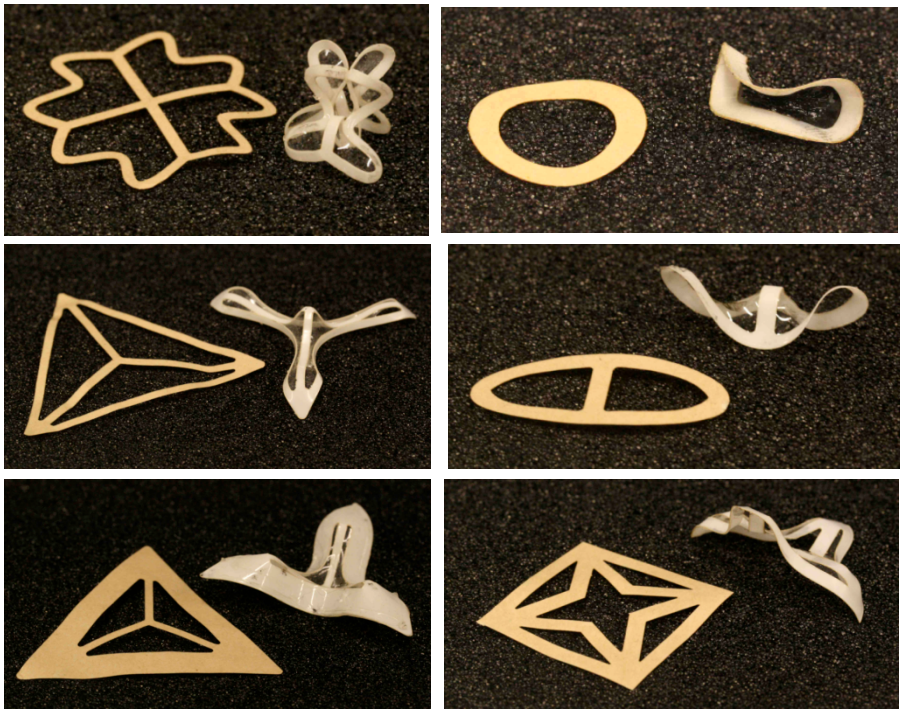


Complex 3D shapes
from
simple 2D frames

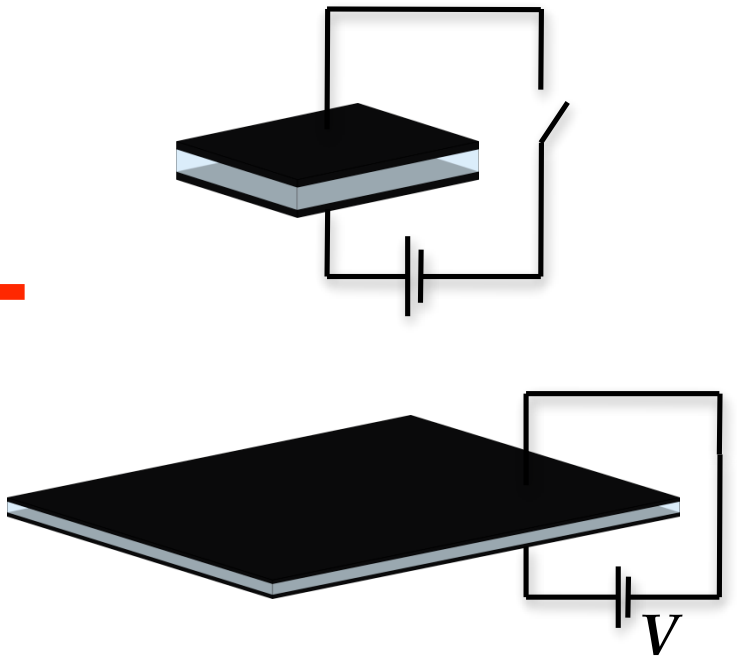


+

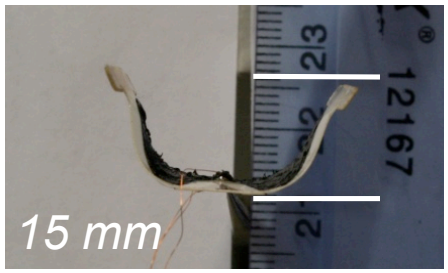

V



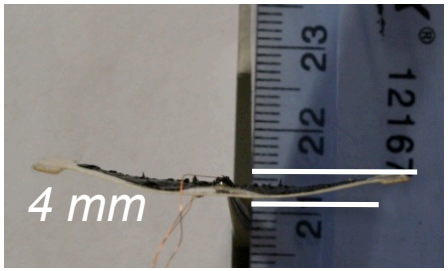
+



=

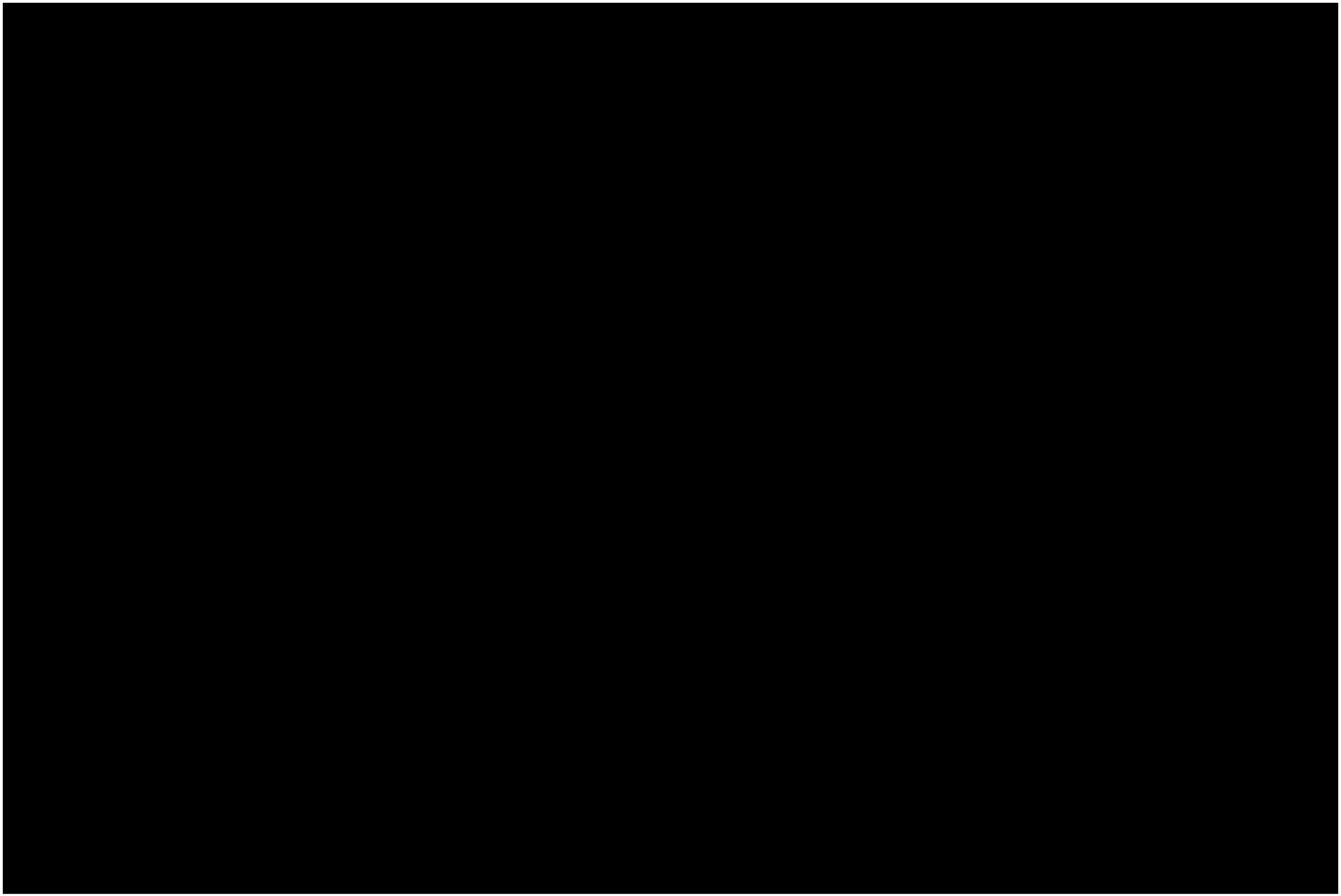


← Rest state
i.e. no voltage

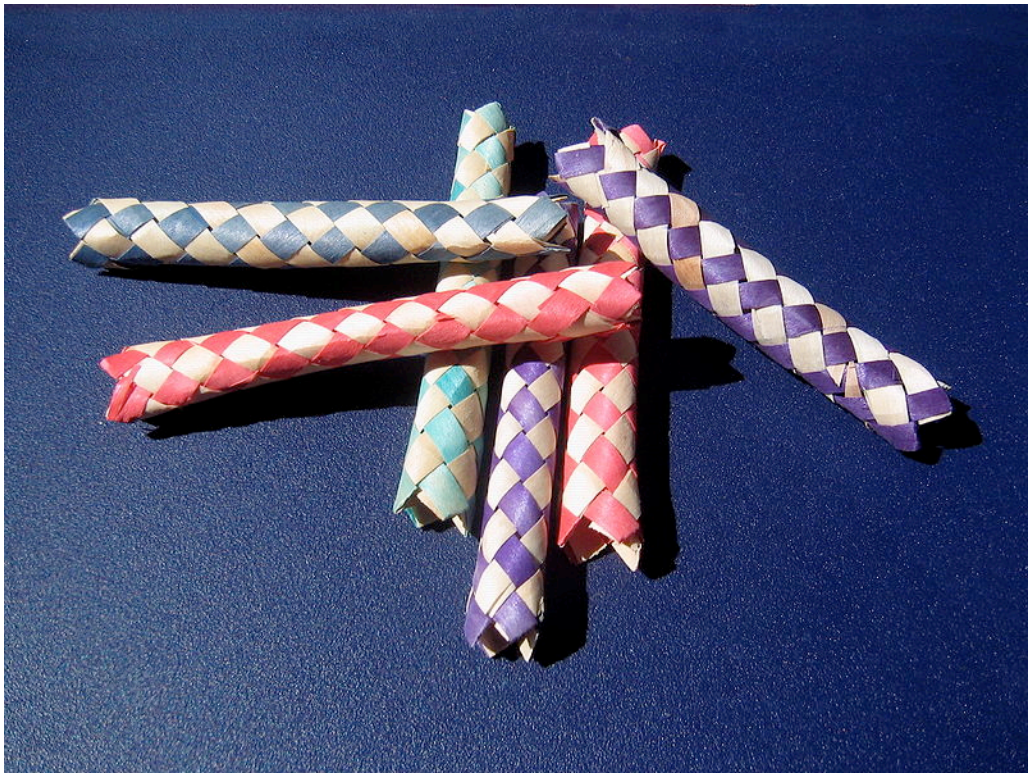


← Voltage
applied

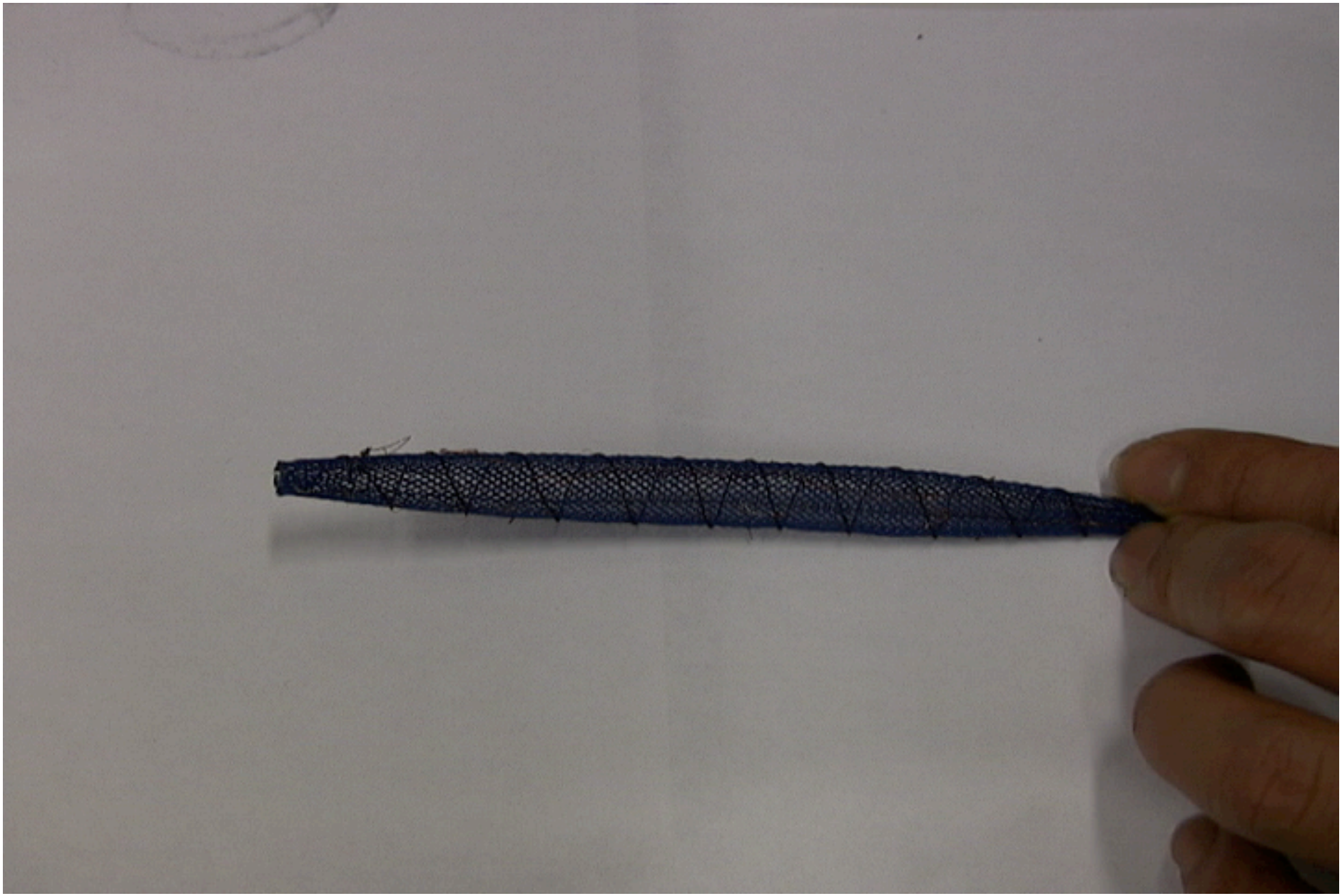
Electrodes are made from conductive carbon grease



What else is stretchy?

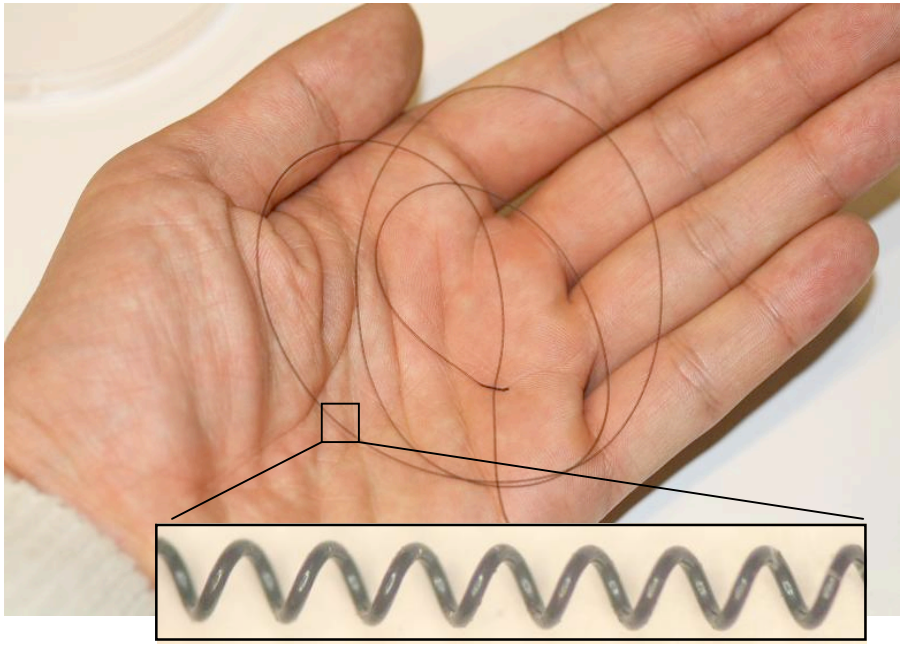


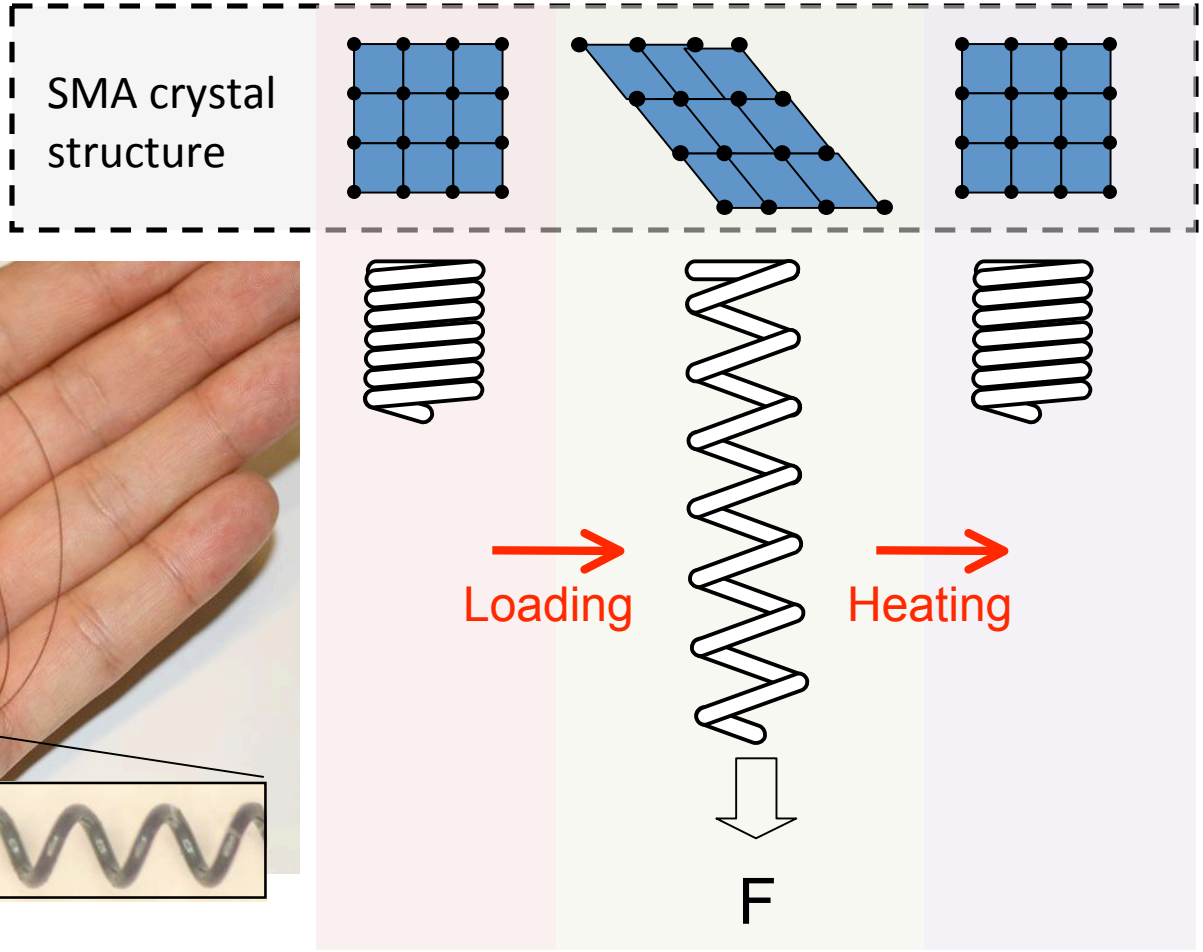
http://commons.wikimedia.org/wiki/File:Finger_trap_toys.jpg



Meshworm robot

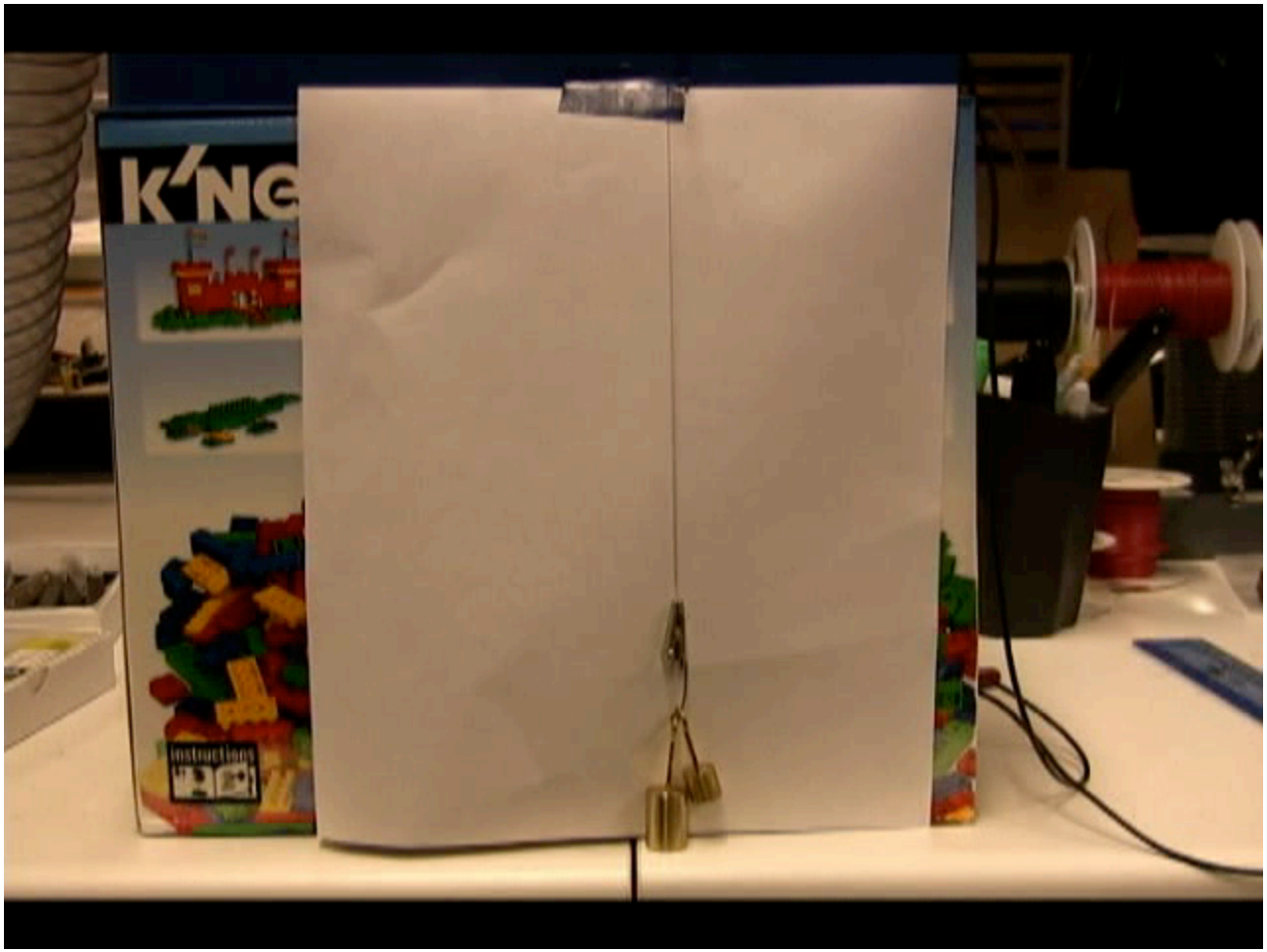
Shape memory alloy (SMA): a metal that “remembers” a certain shape when heat is applied

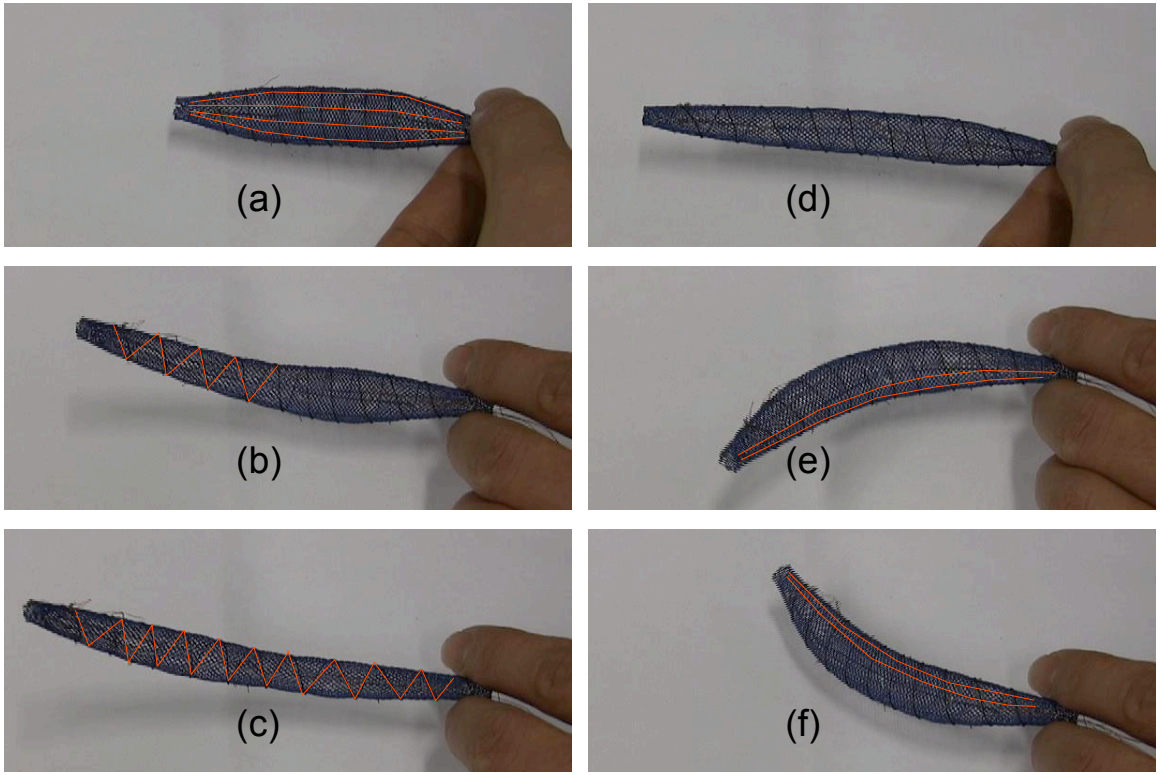




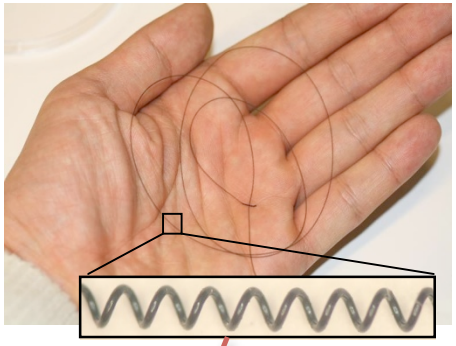
Meshworm robot

Shape memory alloy (SMA): a metal that “remembers” a certain shape when heat is applied

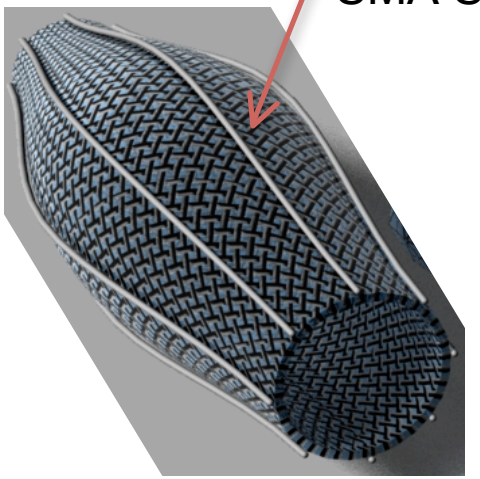




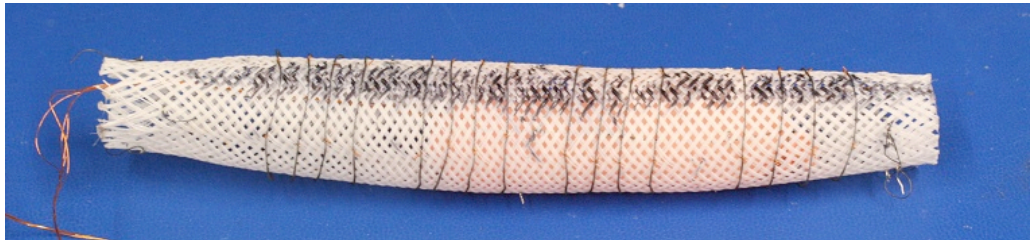
Red means that heat is being applied to that spring

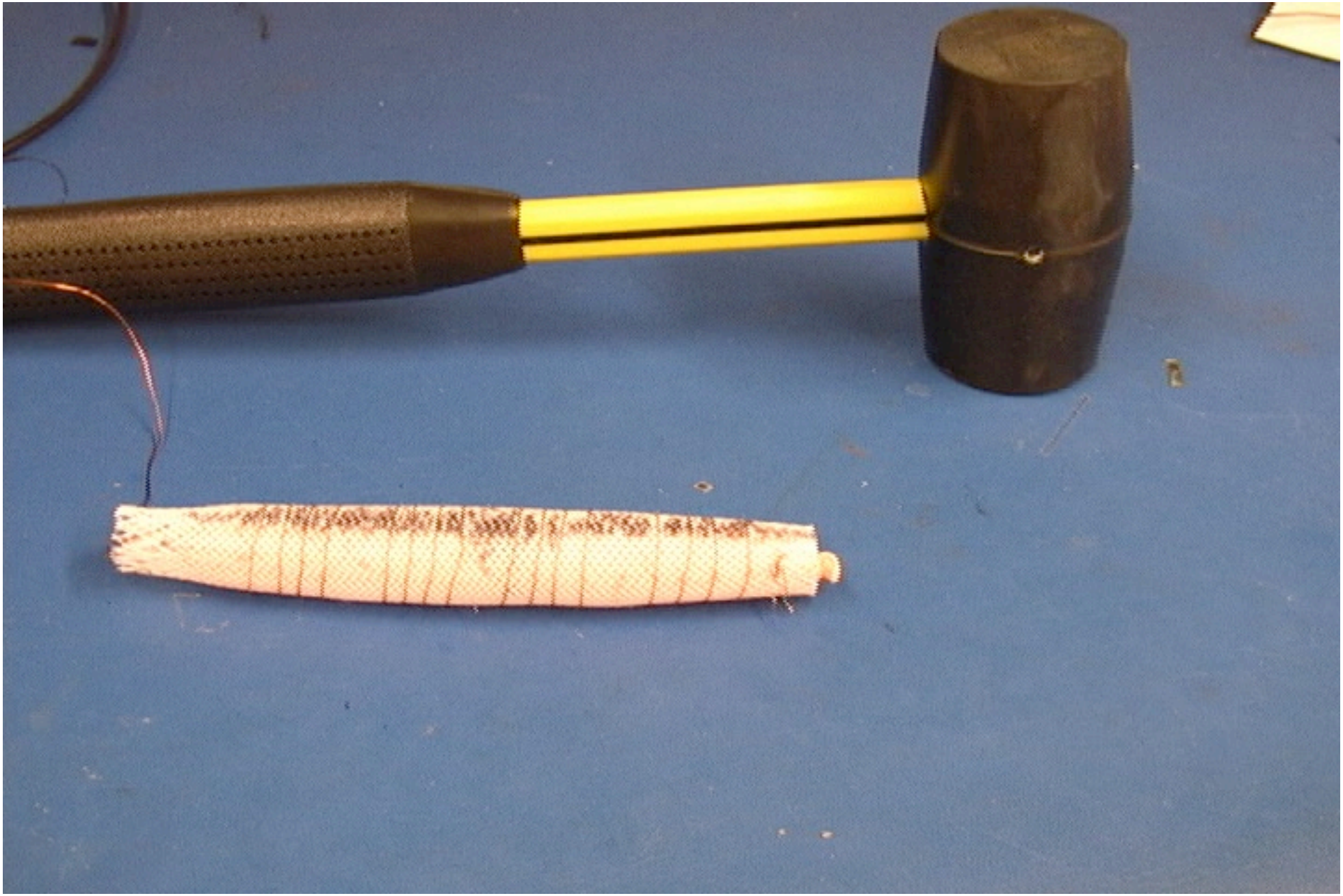


SMA Spring



Locomotion speed : 0.8cm/sec = 0.48m/min





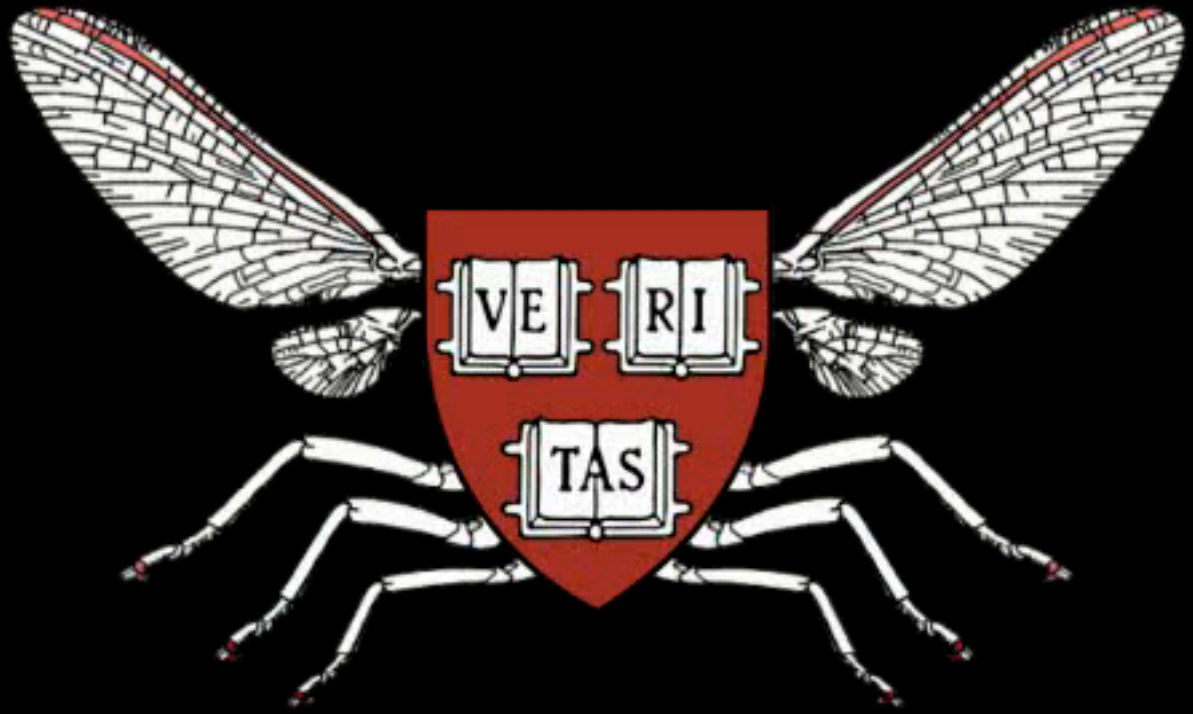
Another robot that isn't so squishy....

Can we maintain **stiffness** and still **change shape**?

http://commons.wikimedia.org/wiki/File:Rana_Gustavo.jpg

http://commons.wikimedia.org/wiki/File:Hipocampo.jpg

Programmable Matter by Folding



multiple shapes, compound folds