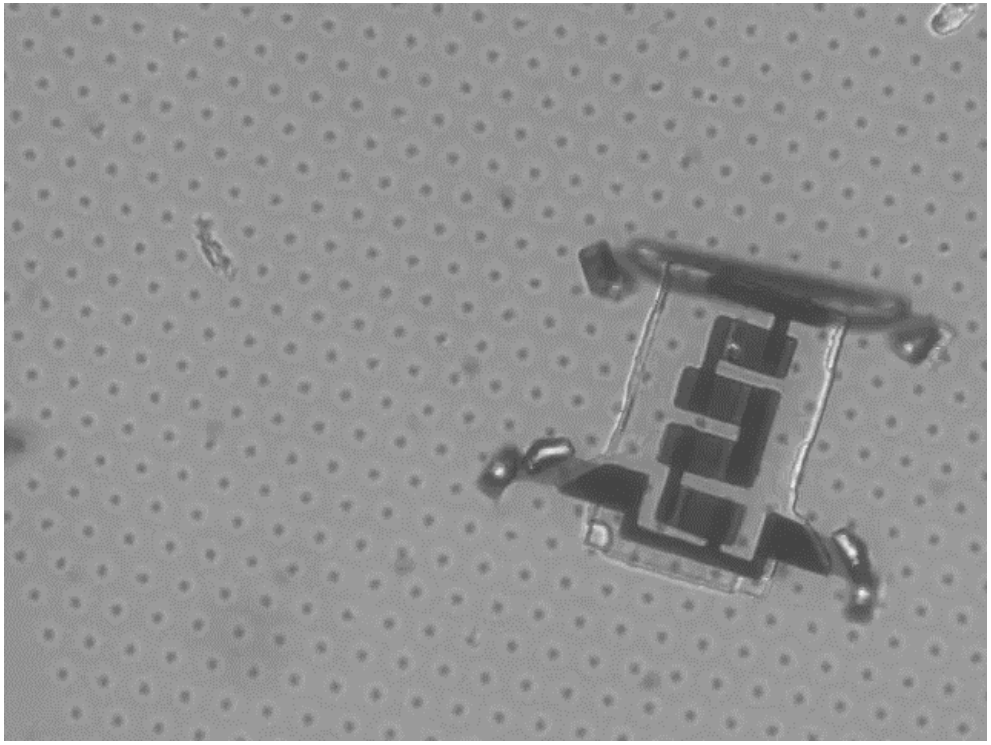
Nano-notes

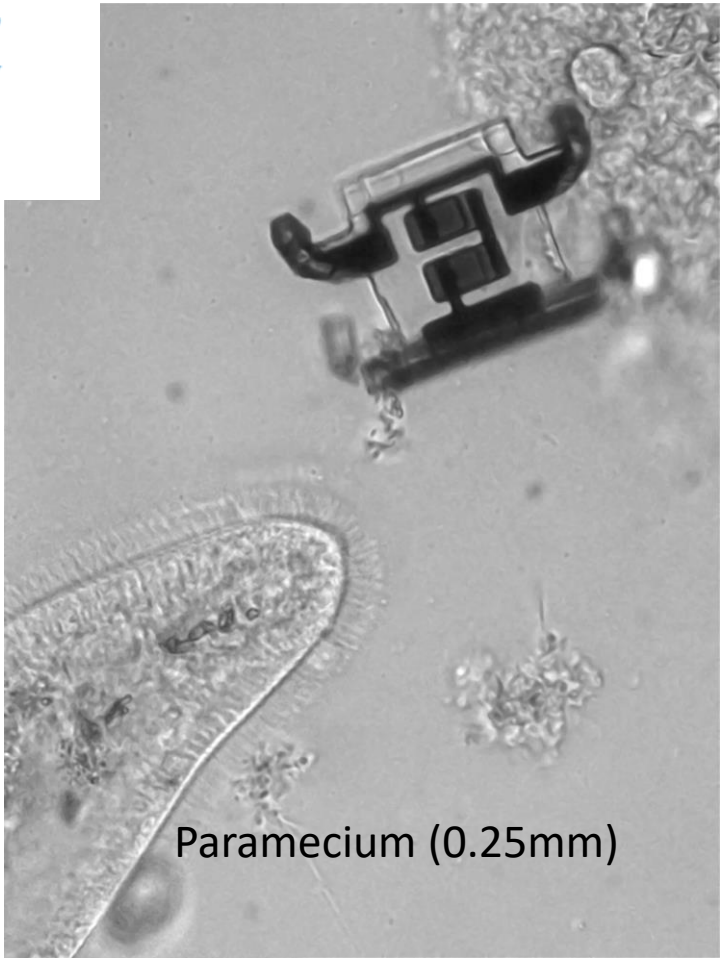
January 2020

TRILOBITES

The Microbots Are on Their Way

Tiny sensors with tinier legs, stamped out of silicon wafers, could one day soon help fix your cellphone battery or study your brain.





https://www.nytimes.com/2019/04/30/science/microbots-robots-silicon-wafer.html

Science News *from research organizations*

Deadly 'superbugs' destroyed by molecular drills

Date: December 12, 2019

Source: Rice University

Summary: Motorized molecules activated by light target and drill through highly antibiotic resistant bacteria and kill them within minutes. The molecules can open bacteria to attack by drugs they previously resisted. The strategy could be applied to bacterial infections or

JANUARY 6, 2020

Making computers and smartphones more energy efficient with novel tiny structures

by CORDIS

from research organizations

Brain-like functions emerging in a metallic nanowire network

Emerging fluctuation-based functionalities are expected to open a way to novel memory device technology

Date: December 26, 2019

Source: National Institute for Materials Science, Japan

Summary: An international joint research team succeeded in fabricating a neuromorphic network composed of numerous metallic nanowires. Using this network, the team was able to generate electrical characteristics similar to those associated with higher order brain

Alert over the march of the 'grey goo' in nanotechnology Frankenfoods

{2}A breed of Frankenfood is being introduced into human diet and cosmetics with potentially disastrous consequences, experts said last night.

Academics, consumer groups and Government officials are warning that the arrival of

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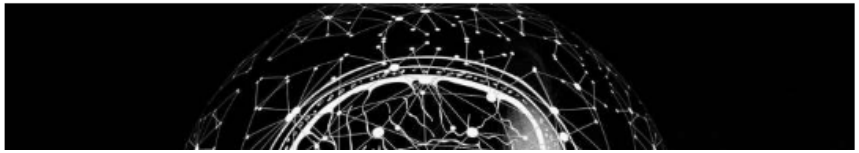
DECEMBER 31, 2019

How nanoparticles from the environment enter the brain

by Elena Fritz, Tomsk State University



http://www.telegraph.co.uk/news/picturegalleries/earth/10744432/Animal-photos-of-the-week.html?frame=2868115


Why do lotus leaves never get wet?
http://www.easywildflowers.com/quality/ner.lute.htm

How does the gecko stay on the ceiling above your head?

http://www.cites.org/eng/gallery/species/reptile/madagascar_day_gecko.html

A Changing World

- Nanotechnology is going to rapidly change the world that we know
  - Atomically precise manufacturing
  - Make what you want at a lower cost
  - No waste
  - Large scale
  - A world where solar cells cost no more than paper
- Nanotechnology will be the driving force behind the next industrial revolution

K. Eric Drexler

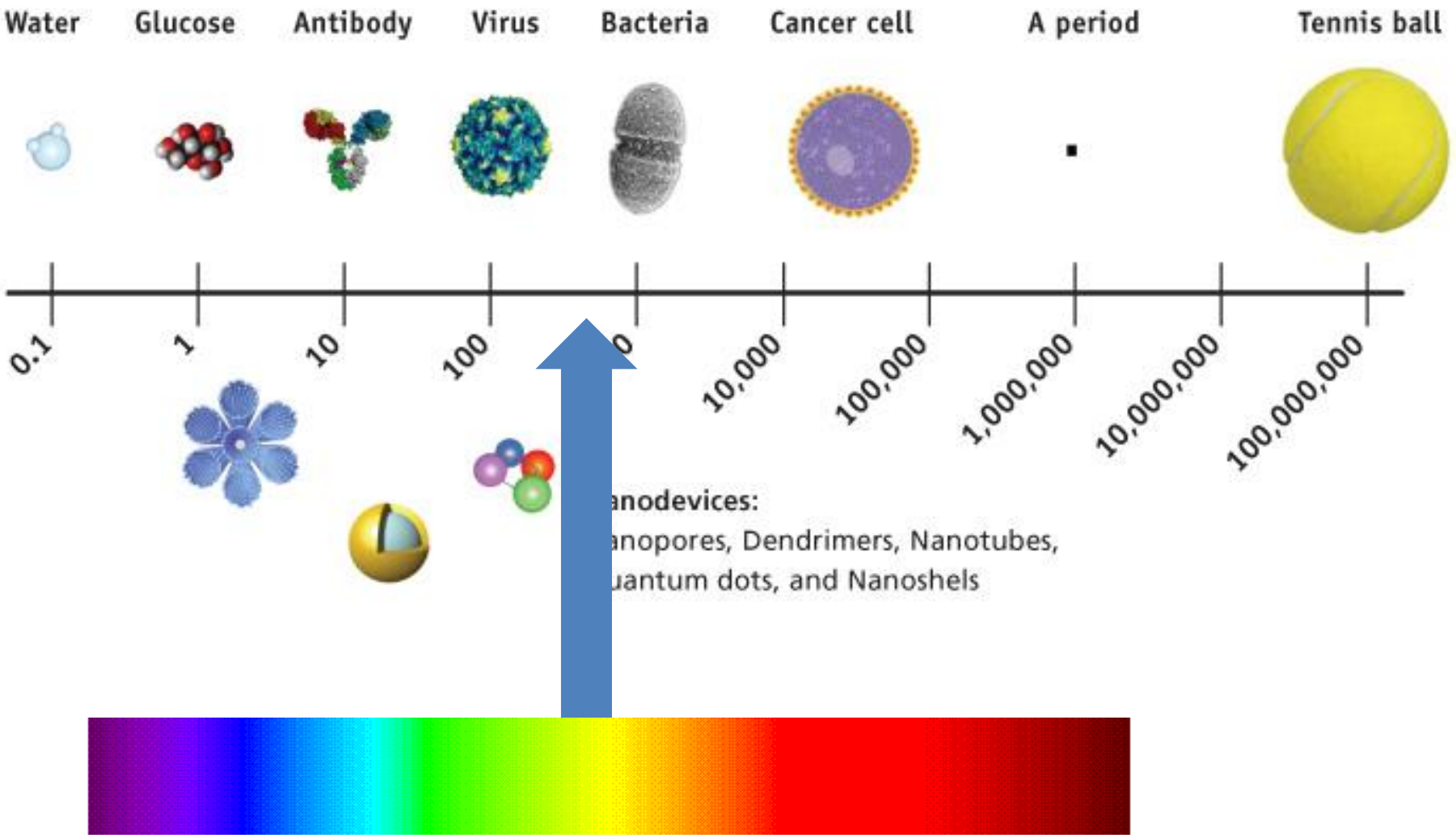
What is nanotechnology?

- Definitions
  - "nanotechnology is the understanding and control of matter at dimensions between 1 and 10 nanometres where unique phenomena enable novel applications"
    - US National Nanotech Institute
  - "nanoscience is the study of phenomena and manipulation of materials at atomic, molecular and macromolecular scales where properties differ significantly from those at larger scale"
    - The Royal Society (UK)

Appreciating scales

- Exercise in comparing sizes of objects in the world
- What would you say about the nano-part of the scale?

Appreciating scales



Why is nanotechnology so *sexy*?

- The properties of materials change dramatically at this scale because of the size of the materials involved.
- New materials hold promise in all walks of life
  - New textiles
  - Medical treatments and diagnosis
  - Improved energy efficiency
  - A greener world – against pollution

An *enabling* technology

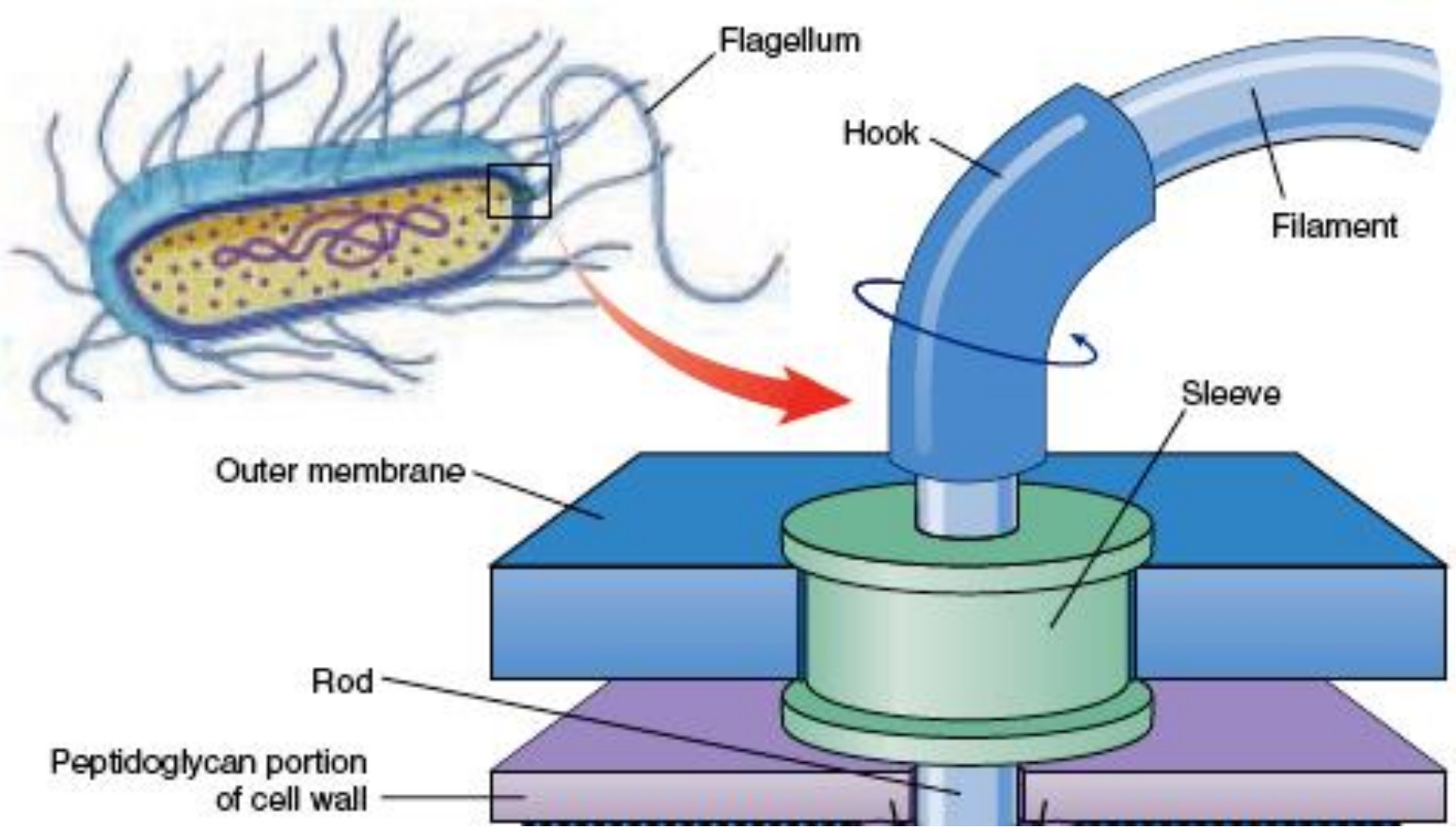
- The techniques and approaches of nanotechnology as a field are considered “enablers”
- They can be the tools and methods that can be applied across many different sectors of the economy
    - Aerospace
    - Construction
    - Textiles
    - Transportation
    - Healthcare
    - Energy
    - Chemical
    - Computing…….

When did it all start?

- 1959 Richard Feynman
- “There’s plenty of room at the bottom”
- Envisaged technologies that would enable the exploration and exploitation of the world at the atomic scale

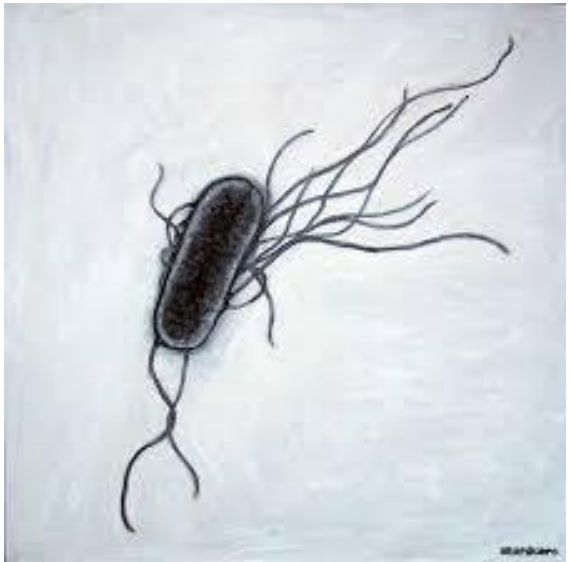
but Mother Nature got there first!

Bacterial motors



Viscocity

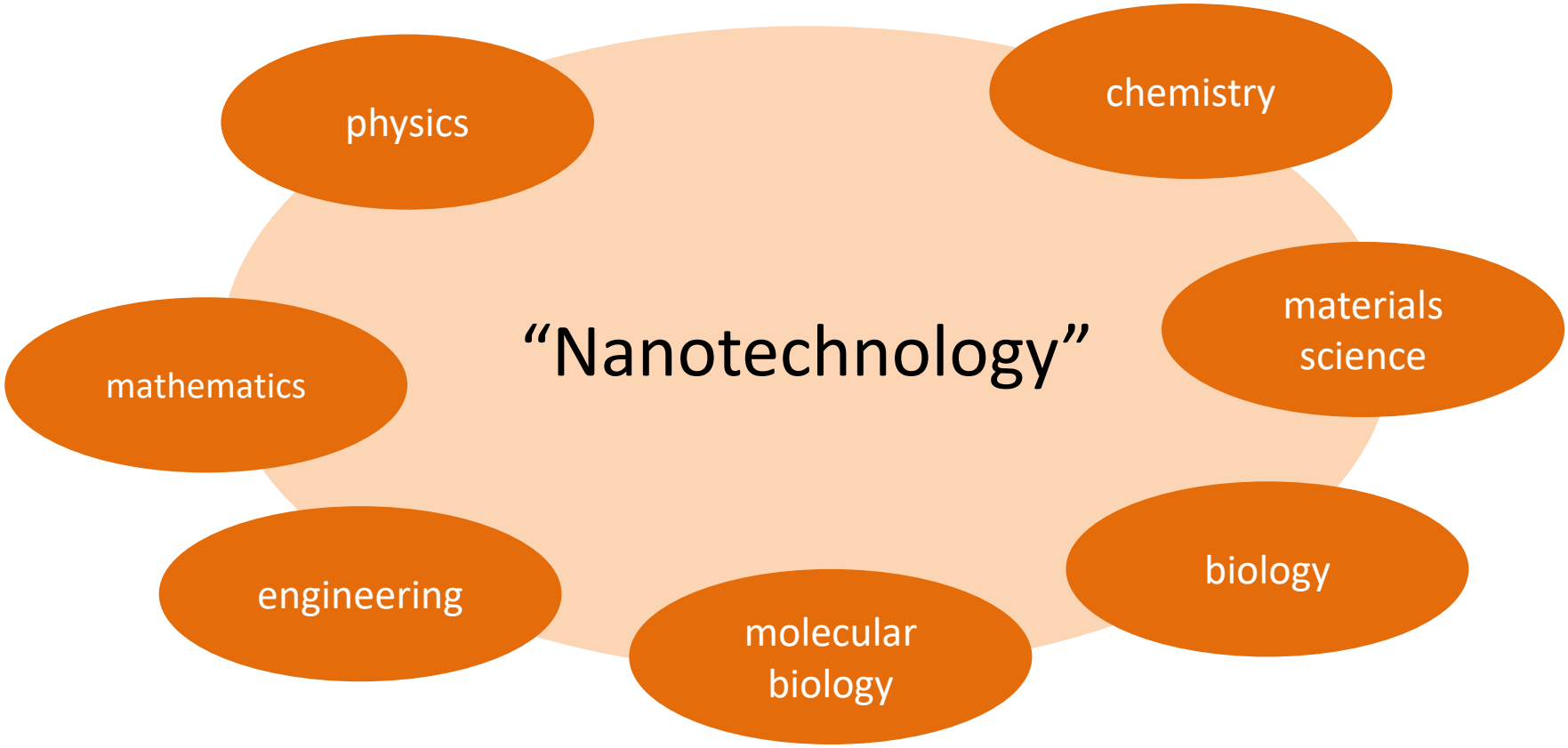
- *E.coli* has *molecule-sized motors* which turn *corkscrew-shaped flagellae* that allow it to propel itself through water
- But the forces involved are very different at this scale
- *It is like swimming through molasses*



The Big Ideas behind nanotechnology

- Size and scale
- Small is (very) different
- Structure of matter
- Forces at nanoscale
- Applications
- Ethical questions

Nanotechnology is a multidisciplinary field



Where is nano?

- Just because we can't see it, doesn't mean that it doesn't have an effect.
- Nano is all around us but because it is small, we need special methods to study and understand it.
- It is only now with the advent of the digital computer and techniques that allow us to see things on the atomic scale that we can begin to make sense of this nano-world

Summary

- In these sessions we are going to explore together different aspects of nanotechnology
  - Main principles of nano: how the physical and chemical properties of materials change at the nanoscale
  - How nature got there first
  - How nanotechnology can be used in everyday life