

# Bio-MEMS and Nanotechnology

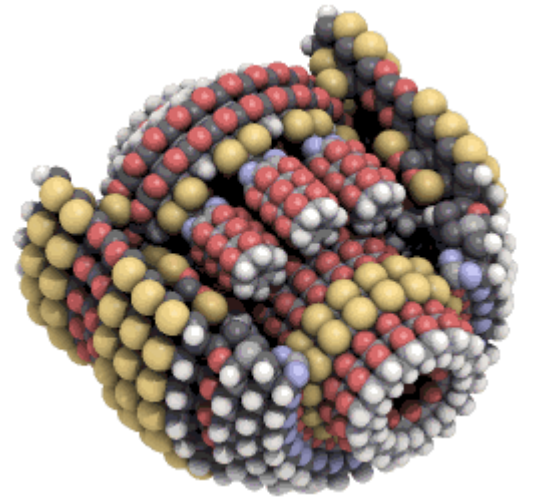
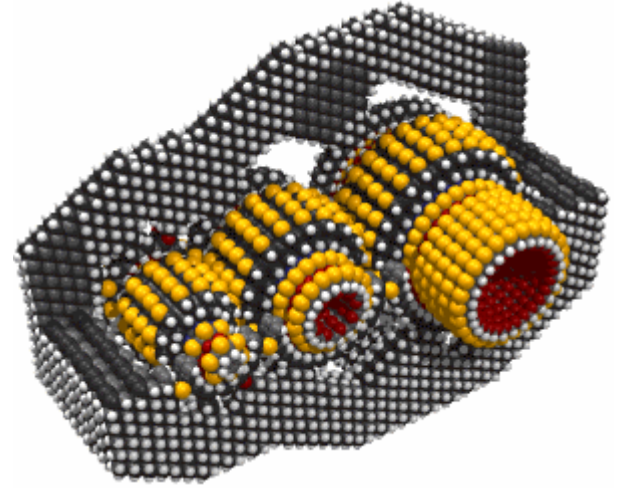
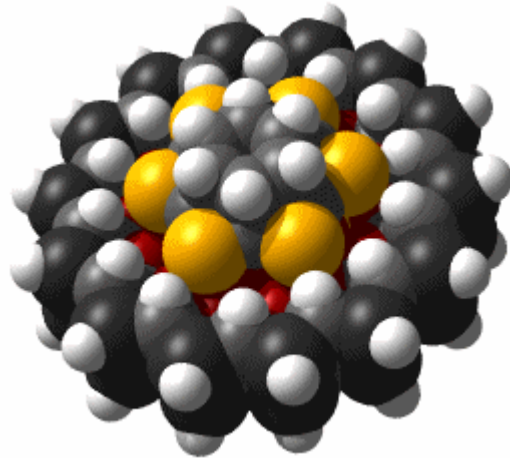
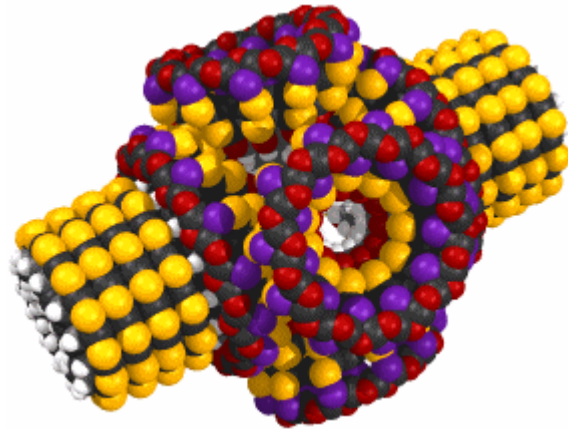
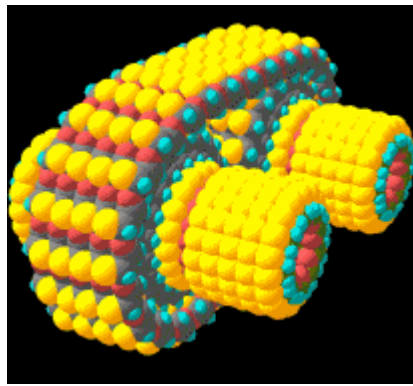
Course Code: BMED-6004



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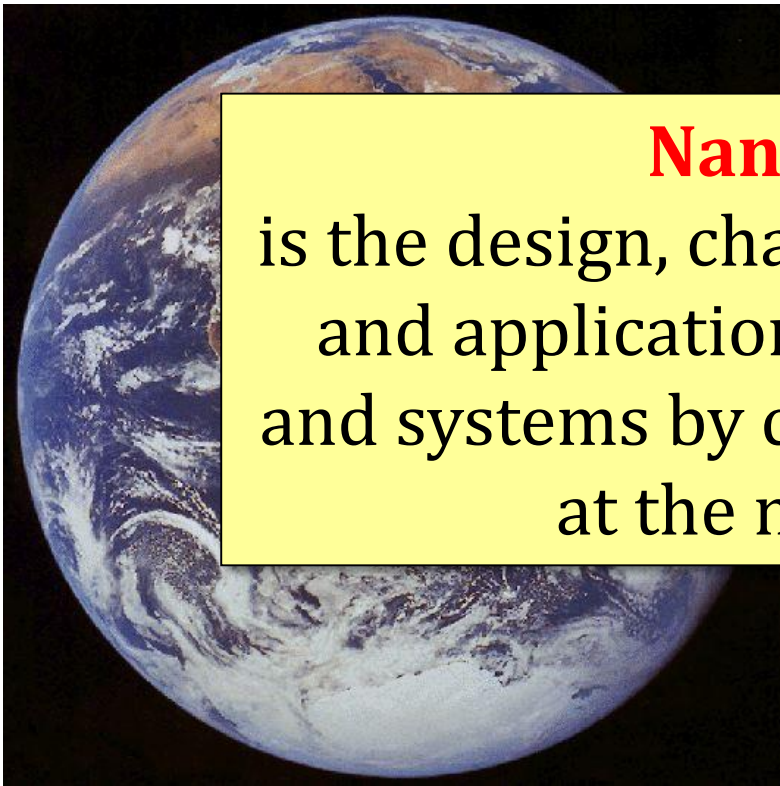


# What is Nanotechnology?

"Nanos" Greek: "Dwarf"

1 nm =  $10^{-9}$  m

Earth



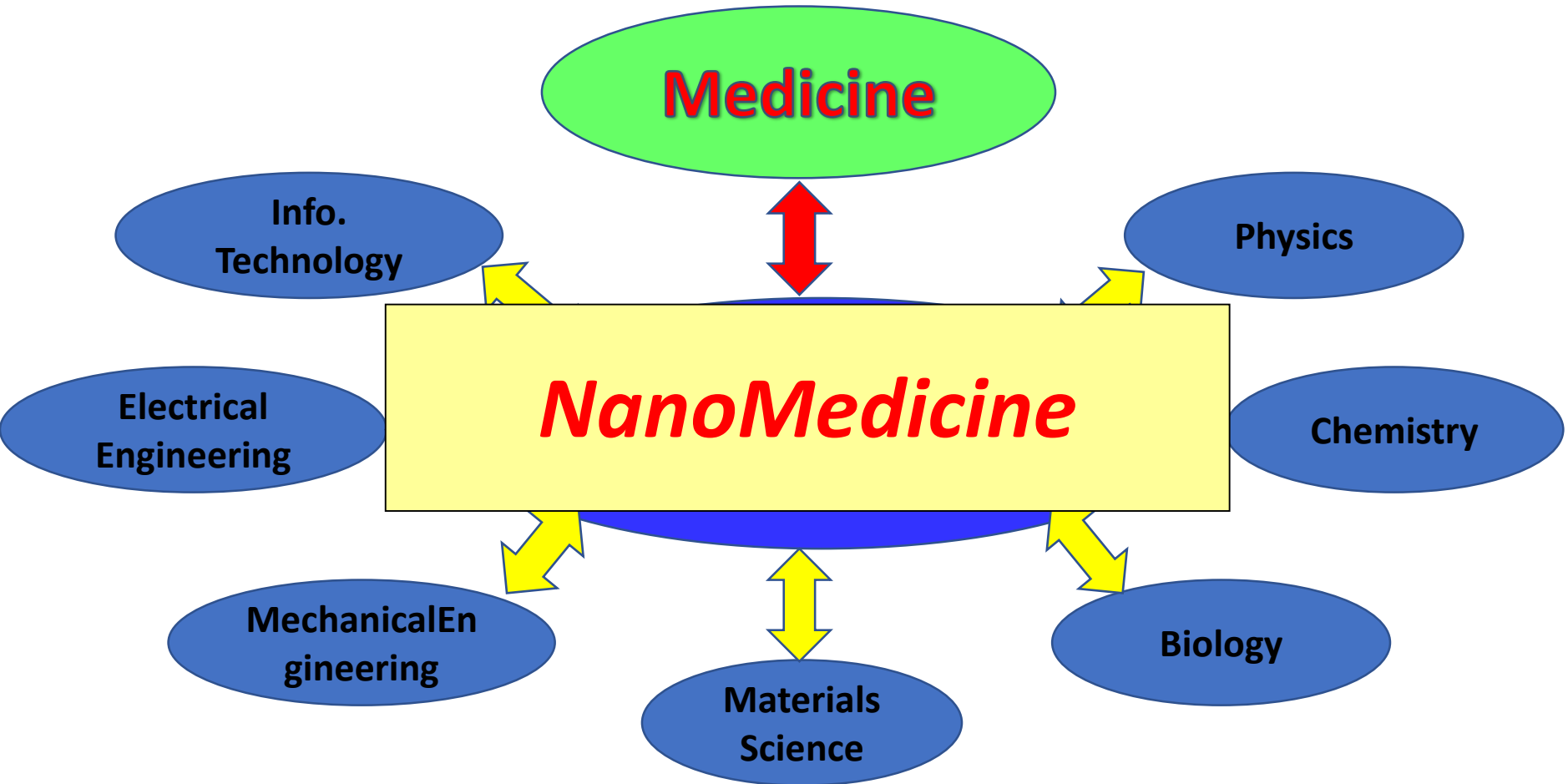
## Nanotechnology

is the design, characterization, production and applications of structures, devices and systems by controlling shape and size at the nanometer scale.

Difference:  $1,2 \times 10^{-9}$  !!

$\phi = 13000$  km

# Nanotechnology is “*Multidisciplinary*” !



# What is MEMS?

## Micro-Electro-Mechanical Systems

MEMS is a technology, consisted of microelectronic elements, actuators, sensors, and mechanical structures built onto a substrate, which is usually silicon.

They are developed using microfabrication techniques: deposition, patterning, and etching.

The benefits on this small scale integration brings the technology to a vast number and variety of devices.

# What is Bio-MEMS?

BioMEMS is biomedical or biological applications of MEMS.

# What is MEMS?

## MicroElectroMechanical System

- **Micro:** Small size, micro-fabricated structures
- **Electro:** Electrical signal control e.g., sense, computer, etc. (In / Out)
- **Mechanical:** functionality, e.g., actuate, etc. (In / Out)
- **System:** Structures, devices, system controls

↪ **MEMS** is the integration of *mechanical elements, sensors, actuators* and *electronics* on a common *silicon substrate* through *microfabrication technology*.

# Structures & Mechanisms

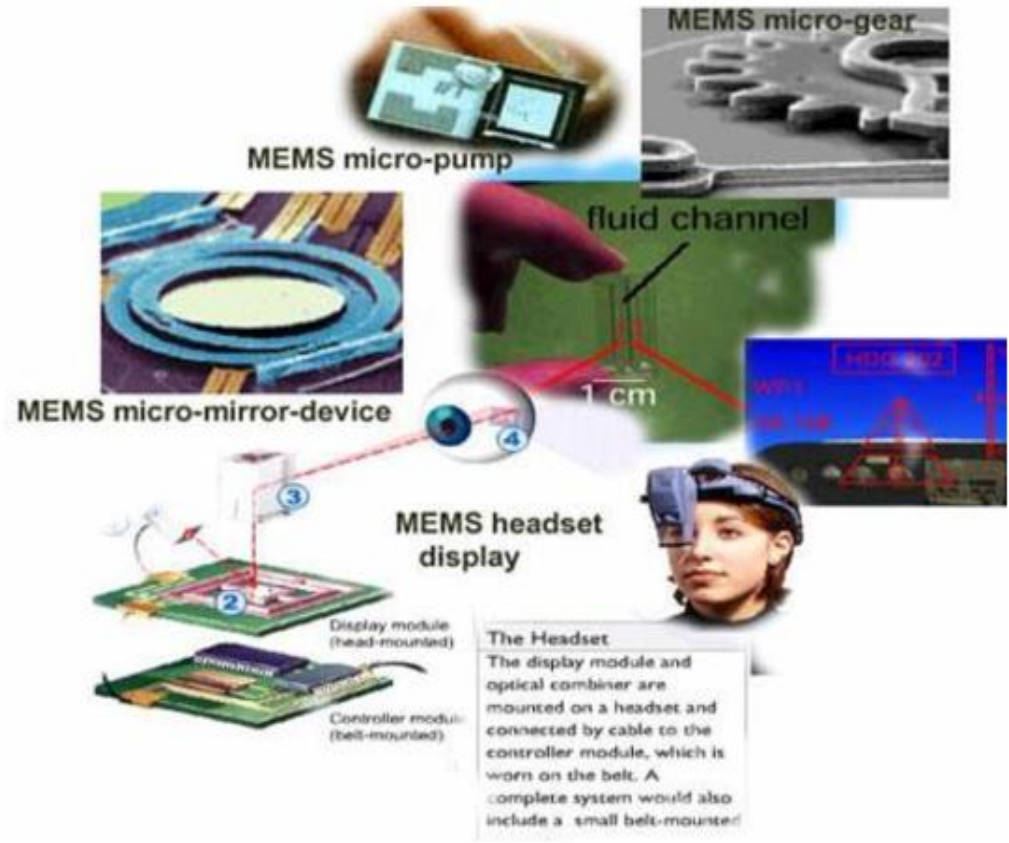
- **Structures** support and transmit **loads**.
- **Mechanisms** transfer/transform **motion** AND support and transmit **loads**.
- Another view: both transfer and transform **energy** (**load\*motion**)

## MEMS

- Most MEMS are *sensors and actuators*, i.e., they are transducers.
- Transducers are energy transformers and transmitters.

# What is MEMS?

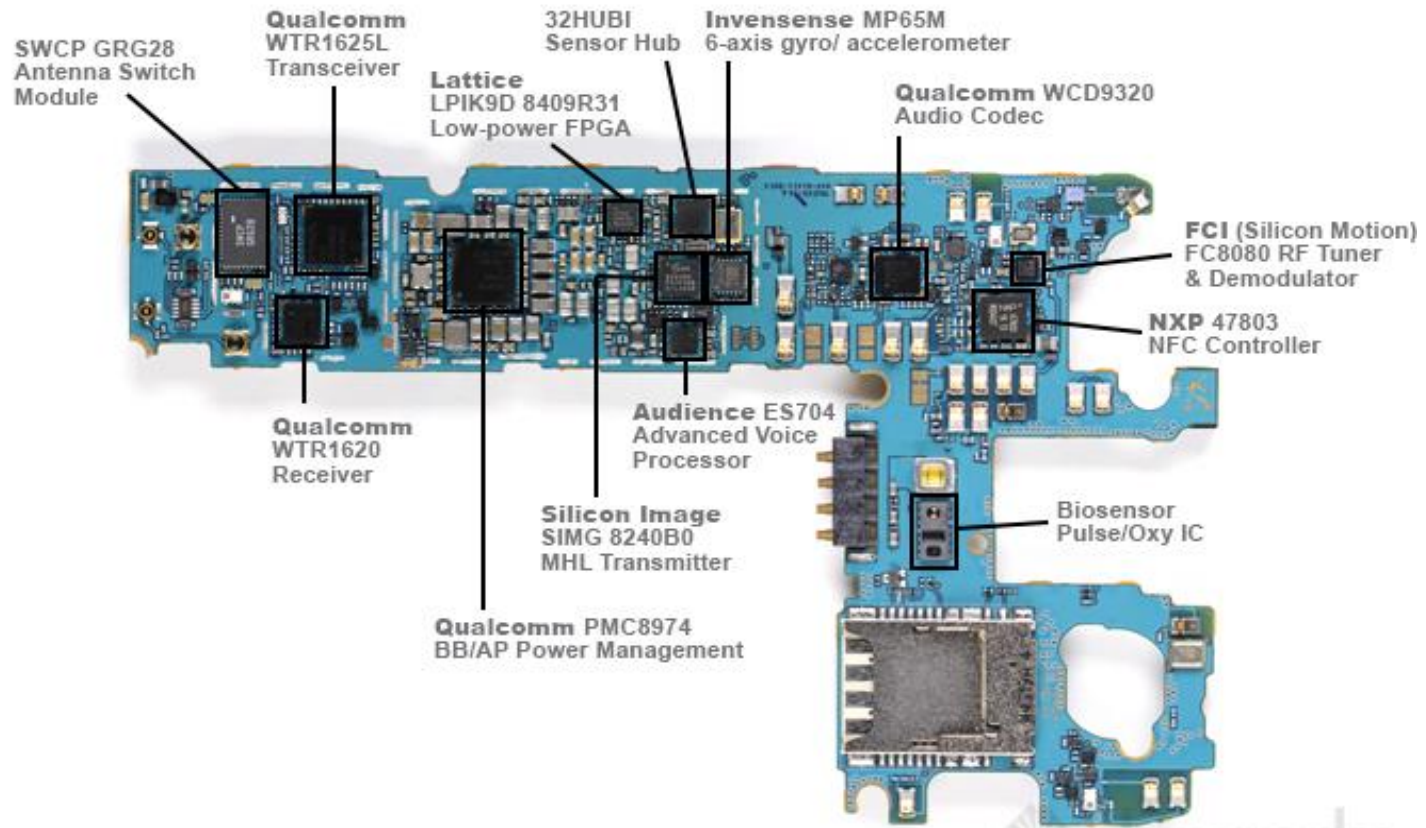
➤ MEMS technology is the integration of mechanical elements, sensors, actuators and electronics on a common silicon substrate through microfabrication technology.





# What is MEMS?

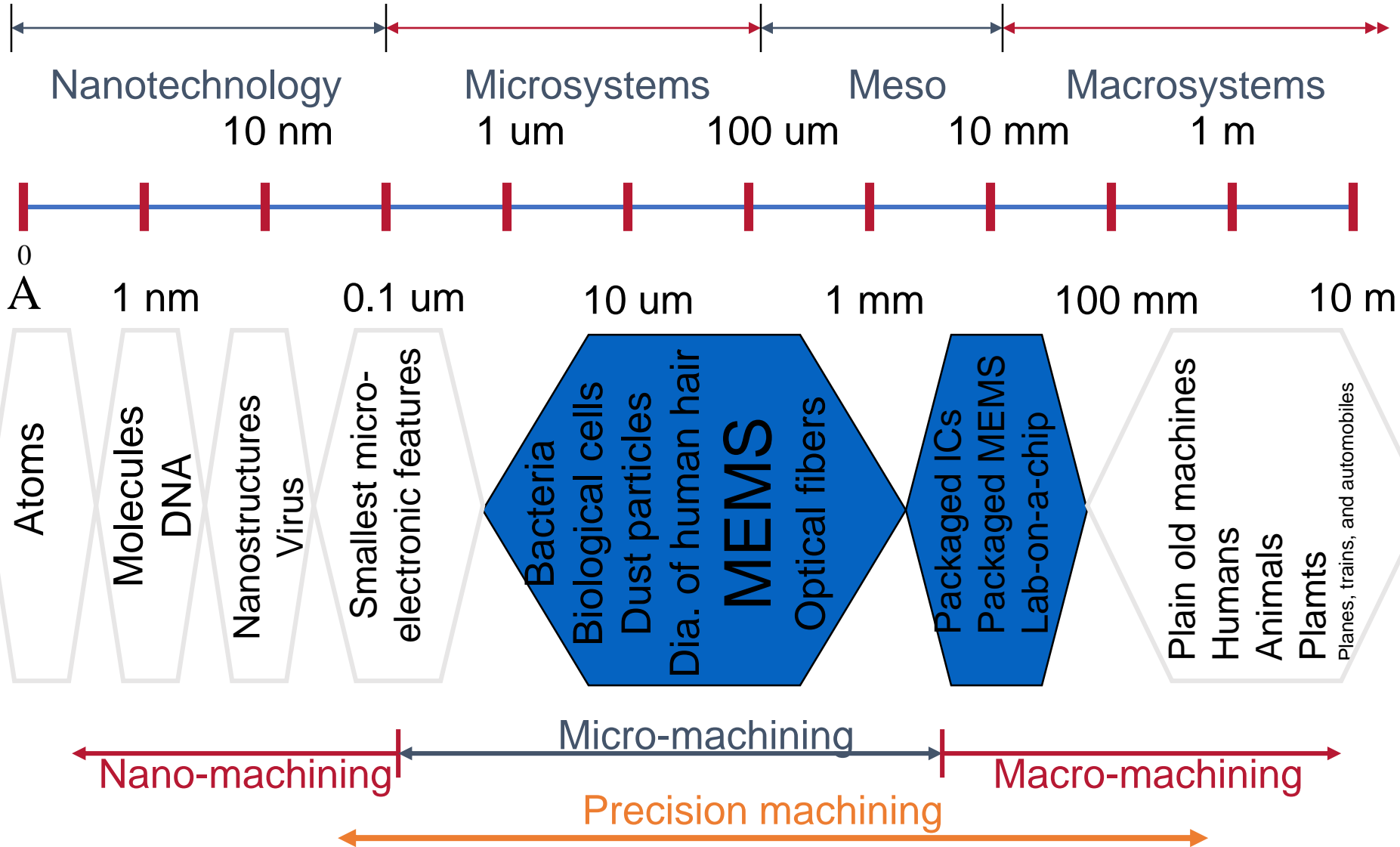
Smartphones, tablets, cameras, gaming devices, and many other electronics have MEMS technology inside of them



# What is MEMS Technology?

- MEMS technology is based on a number of tools and methodologies, which are used to form small structures with dimensions in the micrometer scale.
- MEMS fabrication approach that conveys the advantages of miniaturization, multiple components, and microelectronics to the design and construction of integrated electromechanical systems.
- Made up of components between 1-100  $\mu\text{m}$  in size.
- Devices vary from below one  $\mu\text{m}$  up to several mm.

# Accepted Size Range for MEMS



# Components

## Microelectronics:

- “brain” that receives, processes, and makes decisions
- data comes from microsensors

## Microsensors:

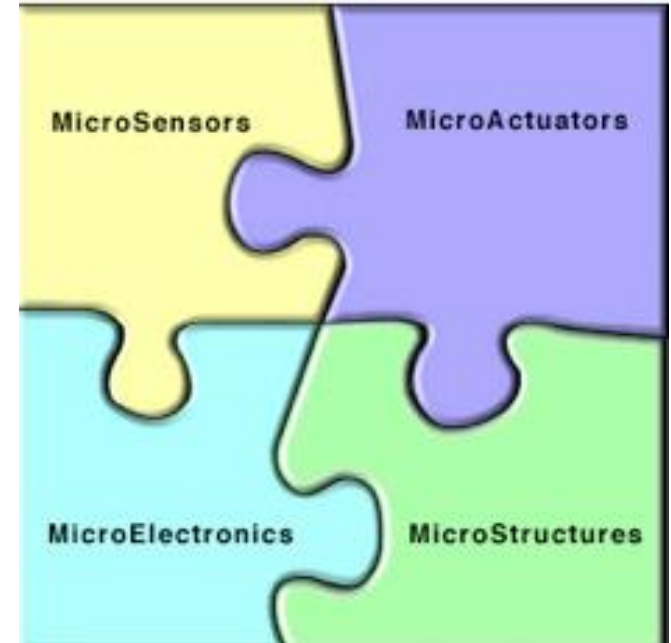
- constantly gather data from environment
- pass data to microelectronics for processing
- can monitor mechanical, thermal, biological, chemical agnetic readings

## Microactuator:

- acts as trigger to activate external device
- microelectronics will tell microactuator to activate device

## Microstructures:

- extremely small structures built onto surface of chip
- built right into silicon of MEMS



<https://www.mems-exchange.org/MEMS/what-is.html>

# MEMS Fabrication Process

