Nanobiotechnology Workforce Training On A Shoe-string Budget

M V Pattarkine, PhD

Professor, Chair, Biotechnology, Nanobiotechnology Initiative

Director, Capital Area Biotechnology Partnership

HARRISBURG UNIVERSITY
OF SCIENCE AND TECHNOLOGY

This webinar is hosted by:

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The Micro Nano Technology Education Center (MNT-EC) is an NSF ATE center based out of Pasadena City College in California.

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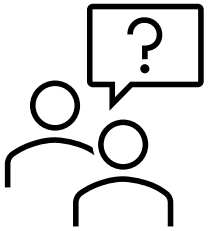
https://www.youtube.com/@nano4me

Please use the Q&A module for questions related to the webinar topic.



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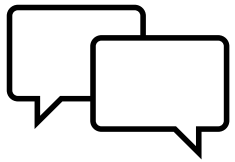

Host

Bob Ehrmann
Consultant
NACK Center / CNEU

Co-host

Vishal Saravade
Assistant Teaching Professor
CNEU

Presenter

Mrunalini Pattarkine
Professor & Chair, Biotechnology
Harrisburg University of Science and Technology

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Outline

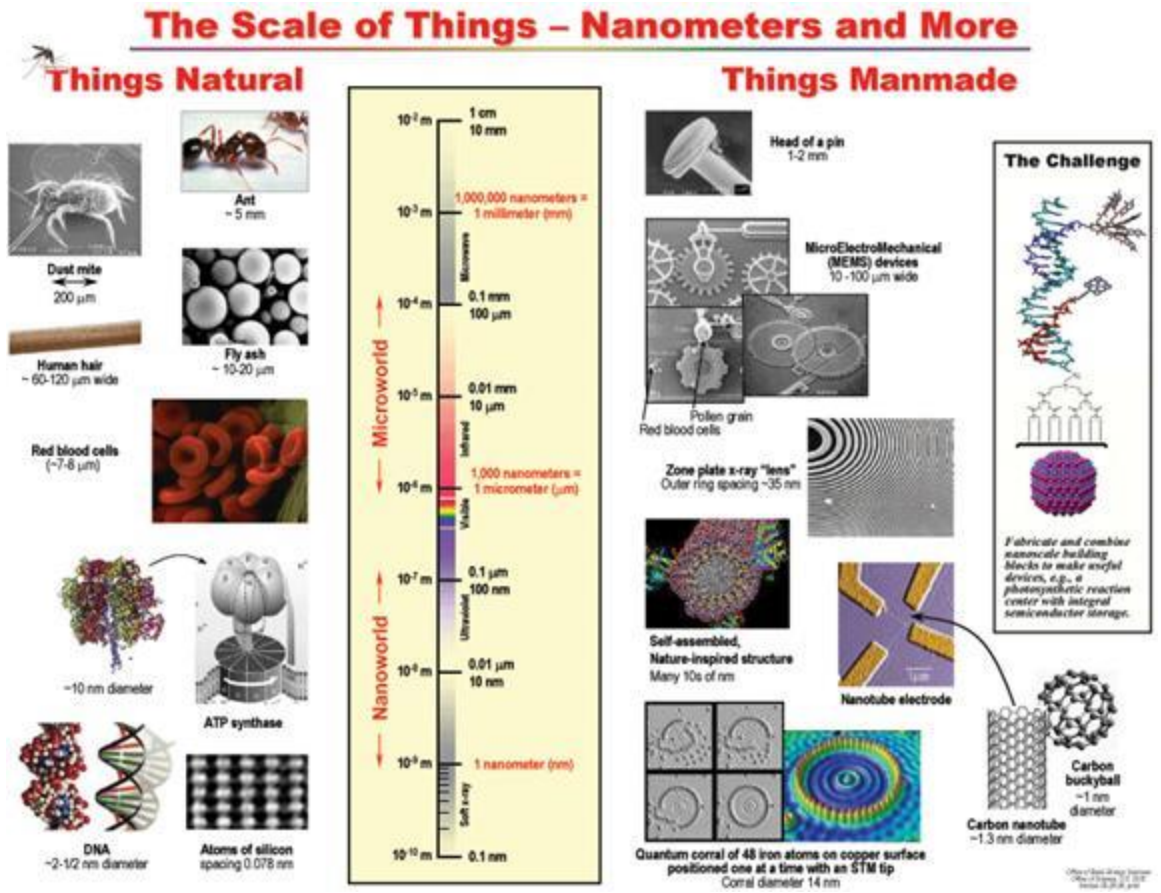
Nano(bio)technology- *The WHAT, WHY AND HOW??*

What- The concepts

Why study this? Applications, potential careers

How- workforce skills, training -ideas

Nanotechnology



http://www.science.doe.gov/bes/scale_of_things.html)

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Nanobiotechnology?

Nano : One billionth of something

Technology: Systematic scientific and engineering knowledge, knowing how to make something and why it works

Nanotechnology : One dimension of measurement in nanoscale.

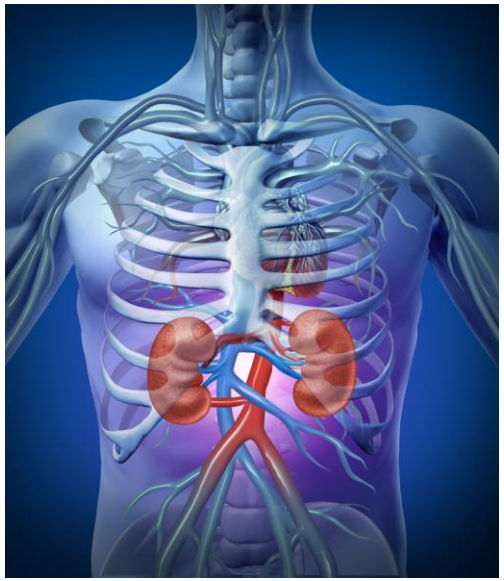
Nanobiotechnology : When nanotechnology is applied to processes related to living systems, it becomes Nanobiotechnology.

Nanotechnology –New?

Organ Level

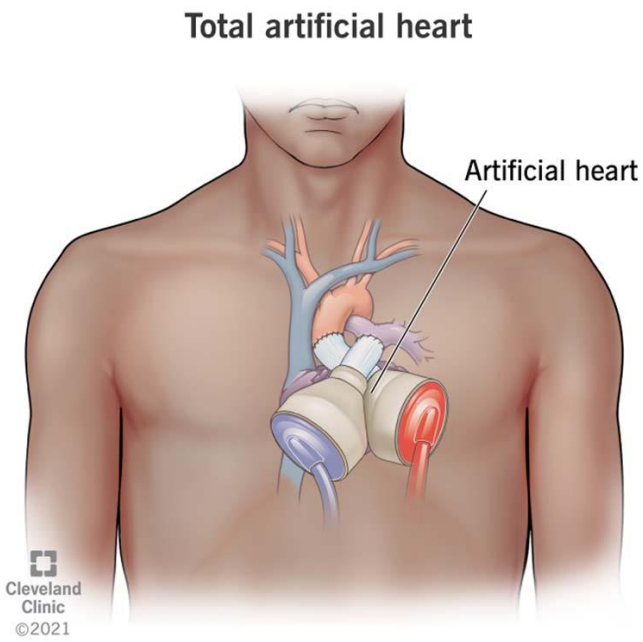
Heart

Kidneys



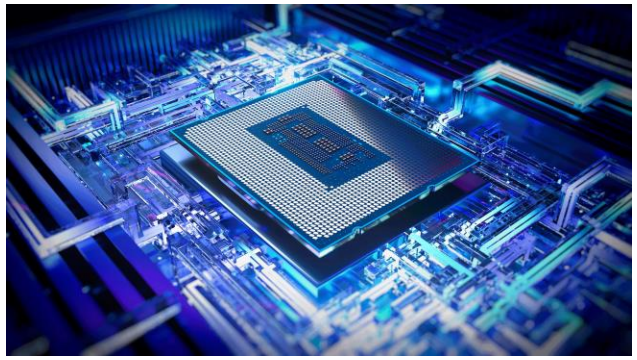
Brain

https://www.news-medical.net/health/Structure-and-Function-of-the-Heart.aspx



https://my.clevelandclinic.org/health/treatments/22173-total-artificial-heart

https://www.usatoday.com/story/tech/reviewedcom/2020/04/23/where-buy-water-filter-pitchers-brita-pur-and-more/3010775001/



https://www.businesswire.com/news/home/20220927005482/en/Intel-Launches-13th-Gen-Intel-Core-Processor-Family-Alongside-New-Intel-Unison-Solution

Biomolecular Level

Human/Living systems- Inherently nano-enabled- built using nanoscaled structures.

1. DNA
2. Proteins
3. Cell membranes

Nanoscale and Life Science Applications

Nanobiotechnology – We are learning from Nature....

Apply that knowledge to solve problems.

Nanobiotechnology has lot of applications – health, medicine, biopharma, food, agriculture, environment, energy… the list is unending.

Nanoscale and Life Science Applications

- At nanoscale, properties change drastically
- As seen, biological systems are composed of nanoscale structures
- Due to this biocompatibility of nanoscale materials, nanobiotechnology has lot of applications-health, medicine, pharma, food, environment, energy… the list is unending.

Teaching Nanobiotechnology

Need to teach the concepts- properties unique for nanoscale materials and their connection with biological systems.

Need to teach skills that enable studying the properties and explore their applications.

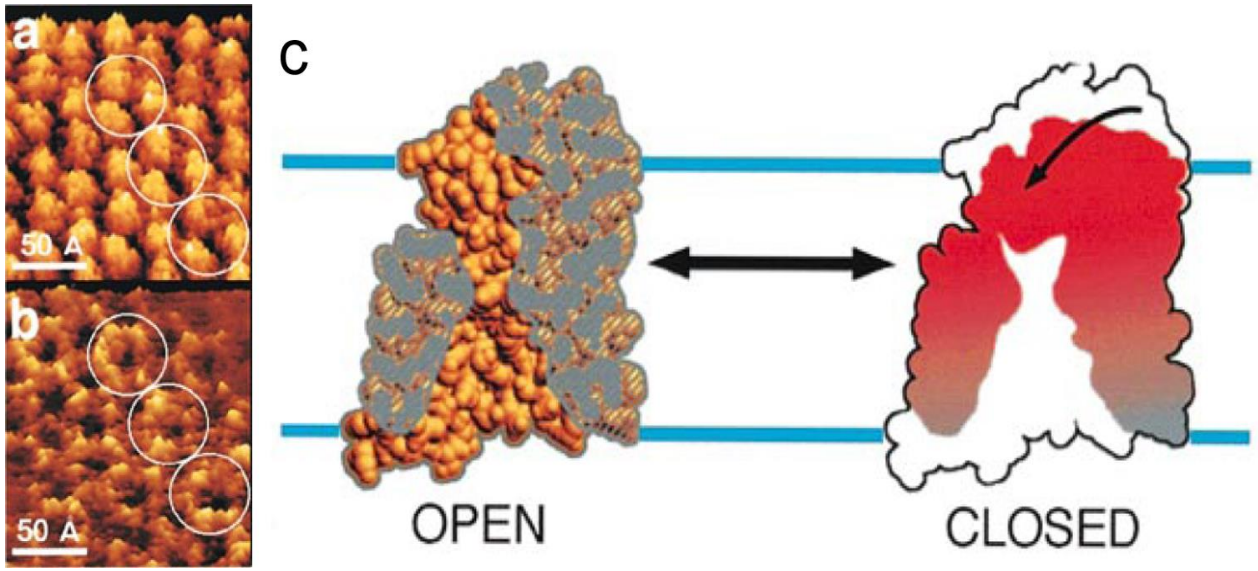
Protein-Based Nanobiotechnology

- Proteins play vital roles
  - Support
  - Movement
  - Transport
  - Buffering
  - Regulation
  - Defense

Voltage Gated Channel Proteins

Living cells exchange materials by means of channels proteins, are chemically selective and function under the control of signaling mechanisms.

The switch from open to closed conformation is driven by the potential gradient across the cell membrane.

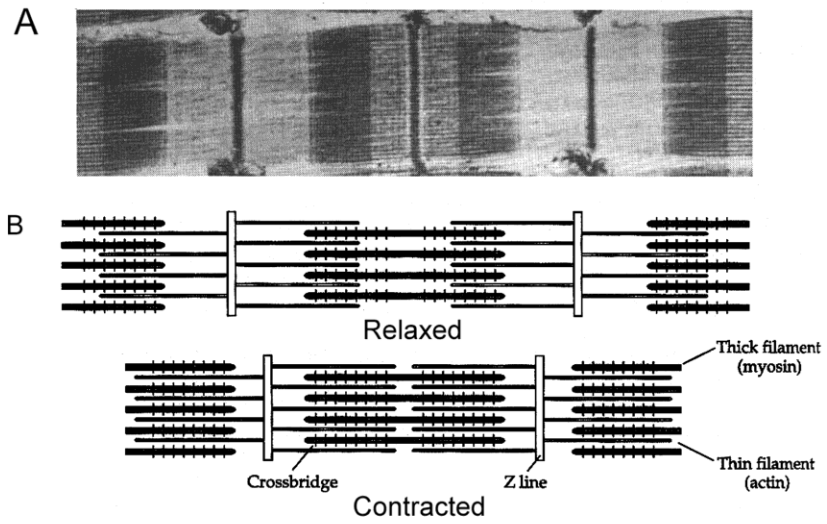


AFM images of a monolayer of voltage-gated Porin OmpF on a graphite surface in an electrolyte solution.

Molecular Motors In Muscle Cells

Motor function in muscle cells is carried out by an actin-myosin complex.

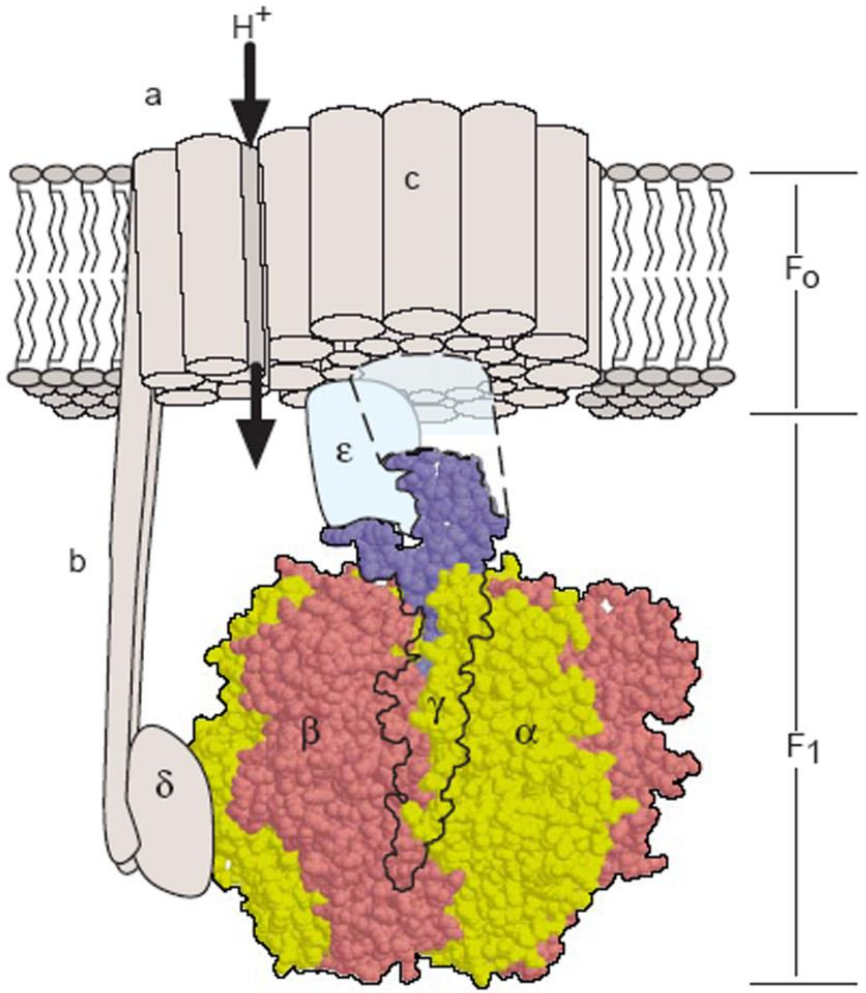
The active components of muscle tissues are the ***sarcomers***, thick filaments to which are attached many myosin molecules.



- ***Sarcomeres*** appear as ca. 100,000 bands in cardiac muscle (TEM image)

Muscle tissues can contract by more than 20% in length on a period of tens of milliseconds.

A Rotary Motor – ATP Synthase

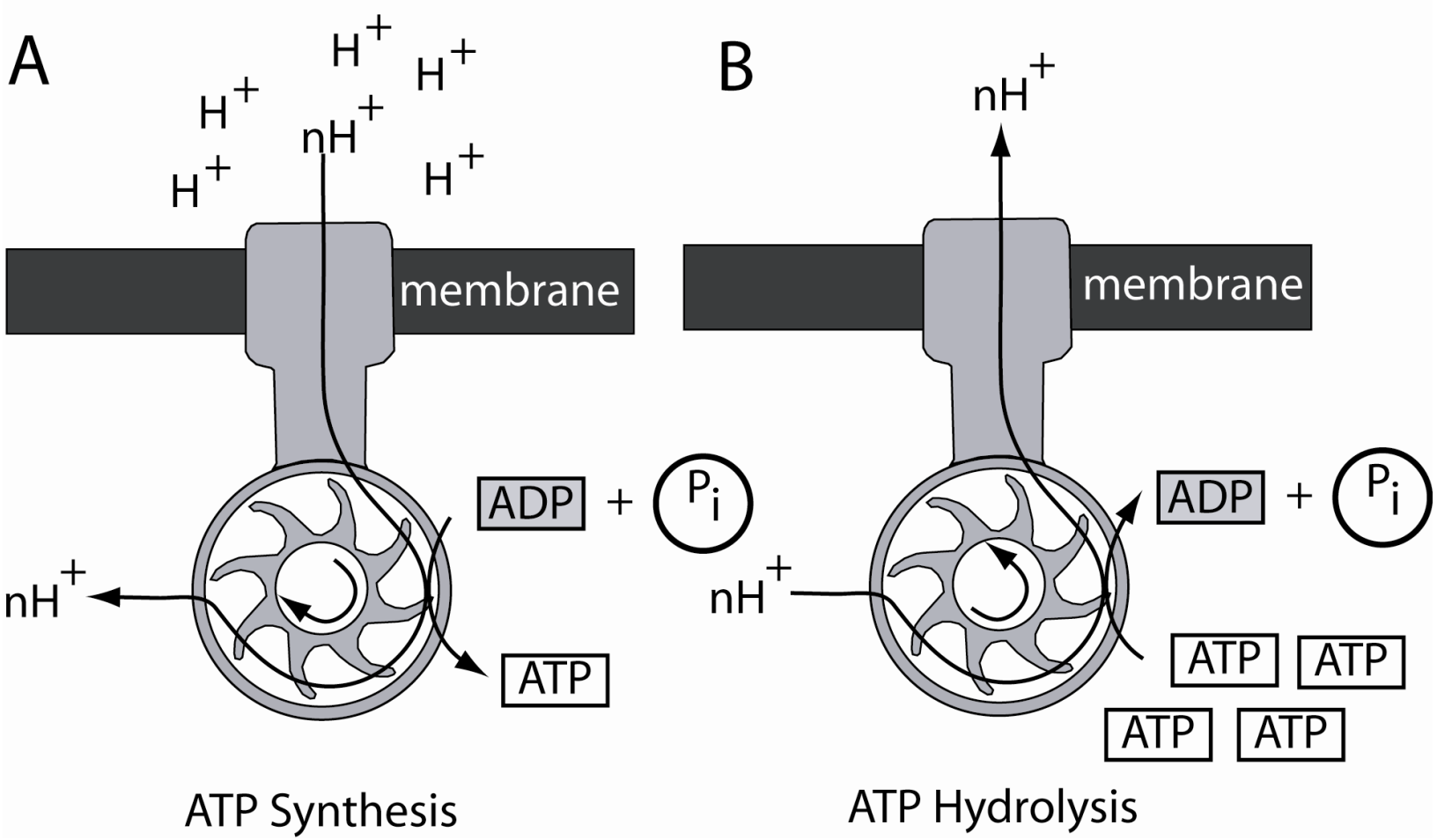


A reversible motor:

Proton gradient drives F1 rotation accompanied by ATP synthesis from ADP.

High ATP concentration drives rotation in opposite direction with ATP hydrolysis which pumps protons.

clockwise rotation ***counter-clockwise rotation***



Protein Based Nanostructures

Where do we use it?

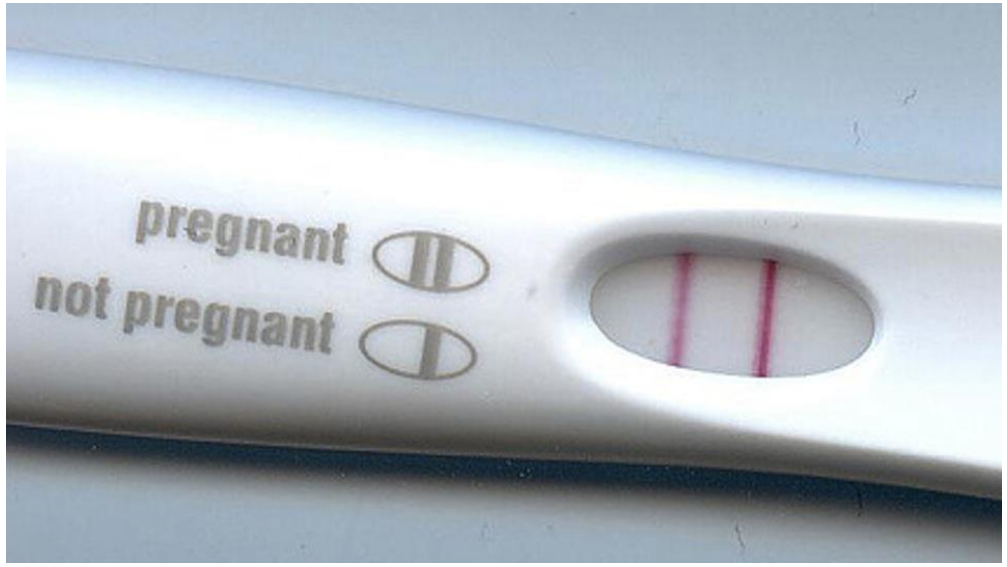
1. Biosensors- glucose meter, pregnancy testing kit

2. DNA-Protein conjugates- for diagnostics, medical imaging, drug delivery for treatment.

3. Fuctionalization of nanomaterials with proteins
   Drug Delivery
   Imaging
   Diagnostics

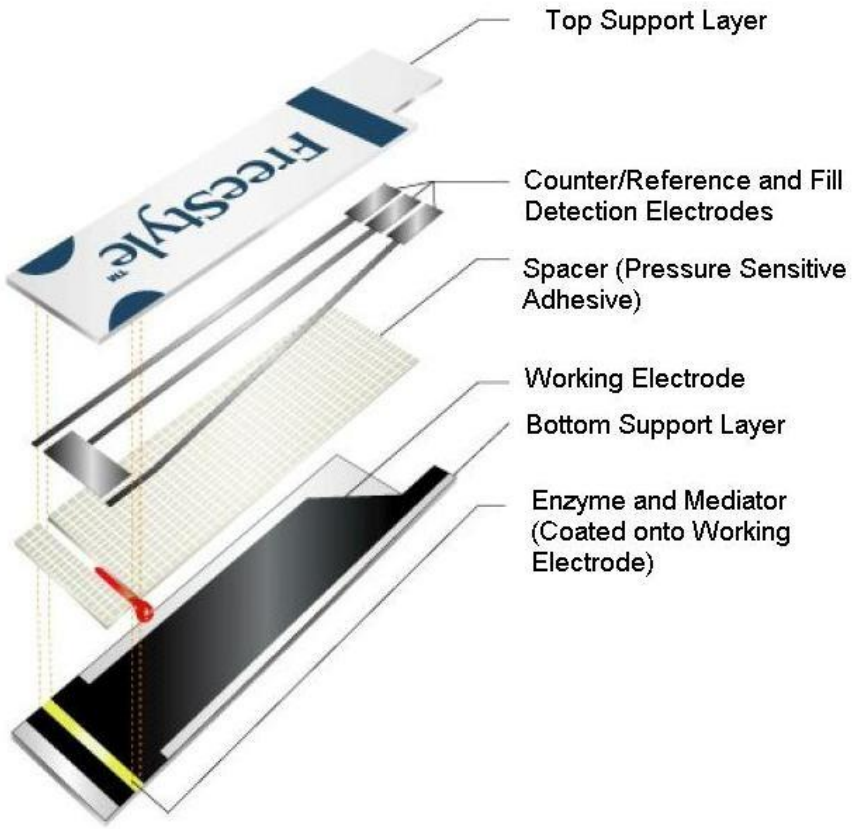
Pregnancy Test Kits

Optical Biosensor: Immobilized Protein



The **pregnancy test kits** rely on the presence of the glycoprotein hormone, human chorionic gonadotropin (hCG) that is secreted by the placenta in the urine shortly after fertilization. The placenta begins developing after the fertilized egg implants in a woman's uterus, which happens about six days after conception.

http://humantouchofchemistry.com/how-do-pregnancy-tests-work.htm



Glucose Monitoring Device

https://www.google.com/search?q=glucose+strip+structure&biw=1366&bih=651&source=lnms&tbm=isch&sa=X&ved=0ahUKEwiup53brqzNAhVIVD4KHTHsAS8Q_AUIBigB#imgrc=JkPYCREIlyrNRM%3A

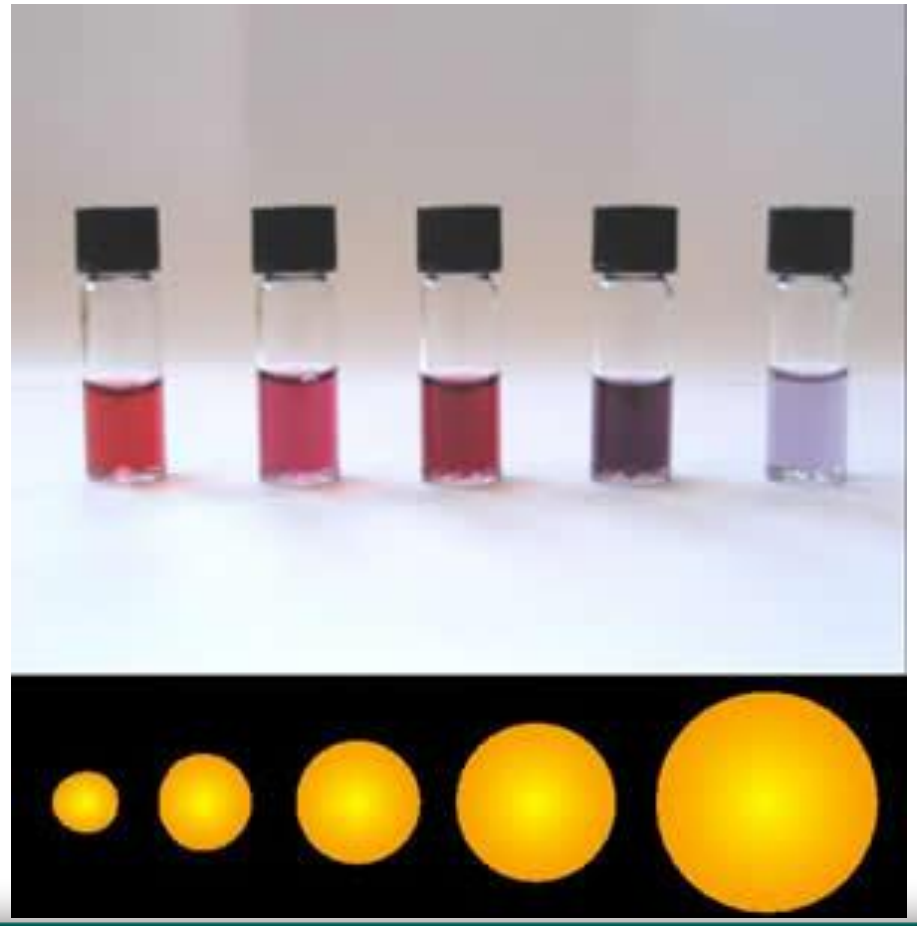
Gold Nanoparticles

Applications for drug delivery
Cancer research
Genetic modifications of Plant and biological systems
Biosensors for various applications: diagnostics

Optical Biosensors
Bradford Assay

Gold?

YES!!! Nano-Gold

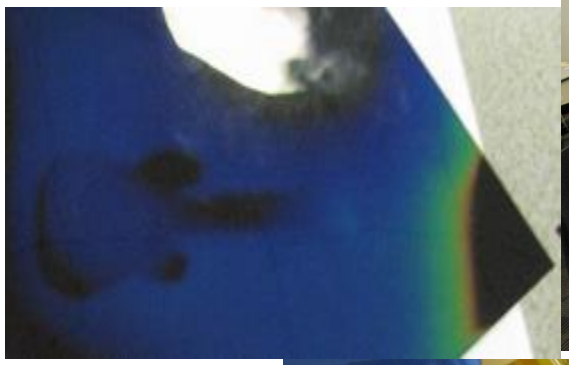


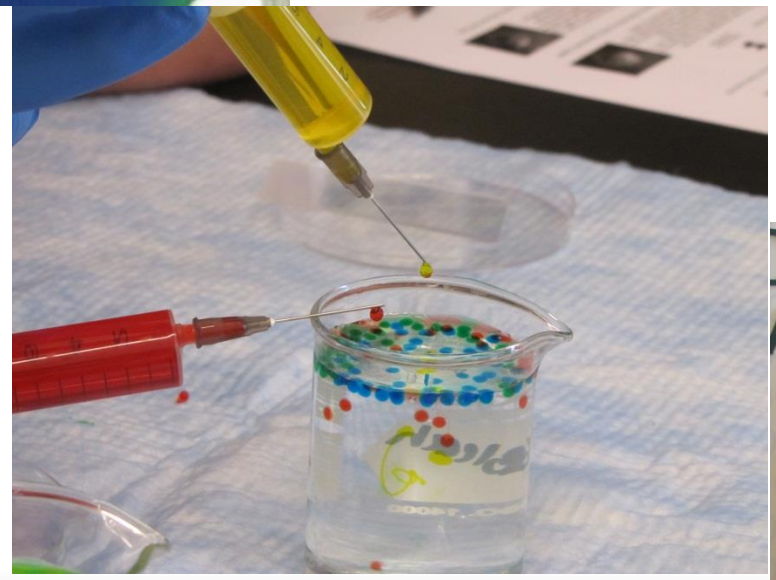
Quantum Dots (QDs) For Biological Labeling

Oobleck Tub Walk

http://www.youtube.com/watch?v=3tIdifGYWVw&feature=youtu.be

Liquid Body Armor
Non-Newtonian Fluids






MORE CURIOUS
ABOUT IDEAS.
HOLLISTER

Student Workshops

Engaging the students and /or parents?

- Hands-on activities
- Panel discussions
- HU student presentations
- Poster competitions

Poster Competitions

Students enter their science projects in a poster competition

Trophies and cash awards for first three ranks

Skills

Protein Immobilization, estimation.

DNA-Nanoparticle conjugates. Gold Nanoparticles

Surface Functionalization of nanoparticles

Characterization of nanoparticles- Absorption and Emission spectroscopy

Upcoming Professional Development Opportunities

Micro/Nanotechnology Health and Safety Course, June 5-8, in person at University of Minnesota Minneapolis Campus. To register, visit https://bit.ly/3xvUZ8x?MNT-Calendar

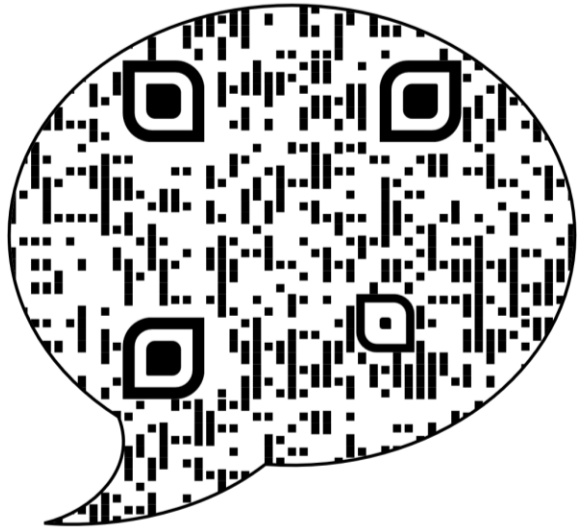
NACK Hands-on-Site Workshops, May 8-10 and Aug 7-9, register at www.cneu.psu.edu/workshops

HI-TEC 2023, July 24-27 in Atlanta, GA. www.highimpact-tec.org/

MNT-EC Journal Writing Workshop, Sept 12-14, 10am-noon PST, online. To register, visit https://micronanoeducation.org/calendar/

Thank you for attending!

We would love your feedback



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Questions?