

*7<sup>th</sup> International Conference on Global Health Challenges*  
*GLOBAL HEALTH 2018*

# **Proteomics: From Nano-Structures to Mega Functions**

Prof. Dr. Hassan M. Khachfe

Lebanese Institute for Biomedical Research and Application (LIBRA)

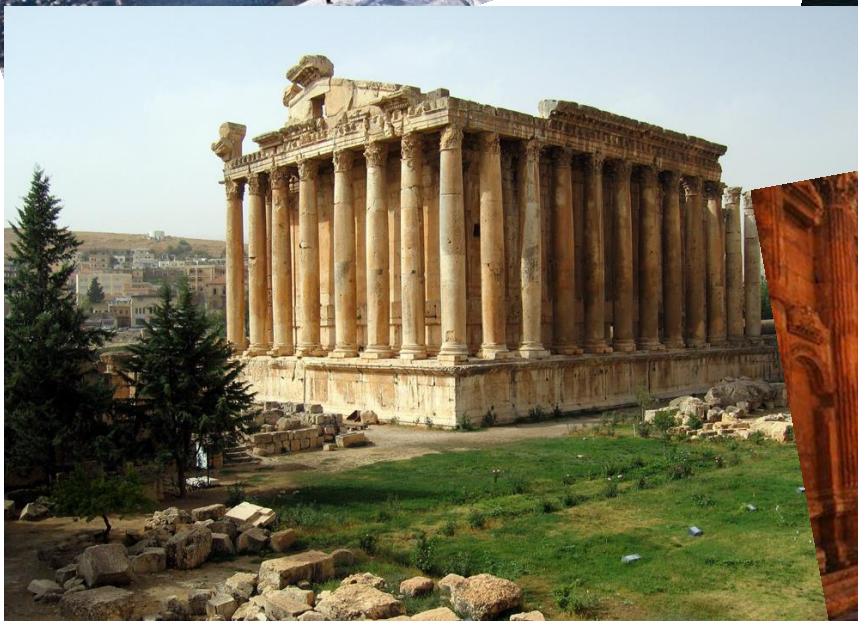
International University of Beirut (BIU)

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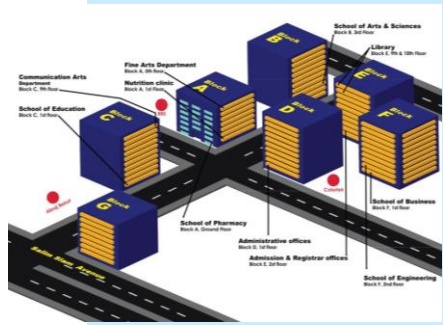
Lebanese International University (LIU)

NexTech / ICGHC 2018, 18-23/11/2018, Athens, Greece







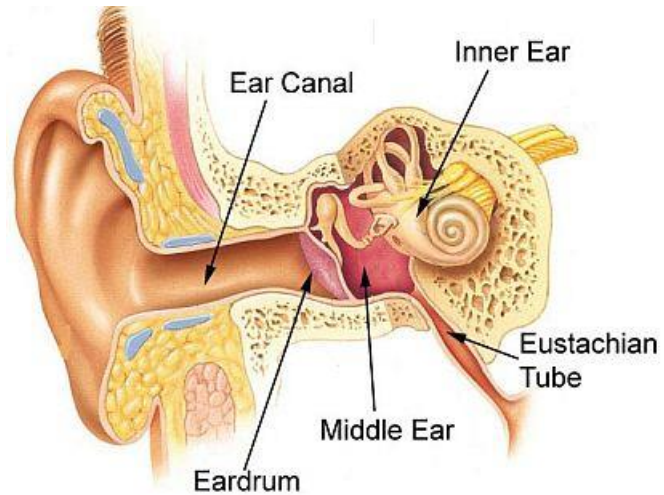
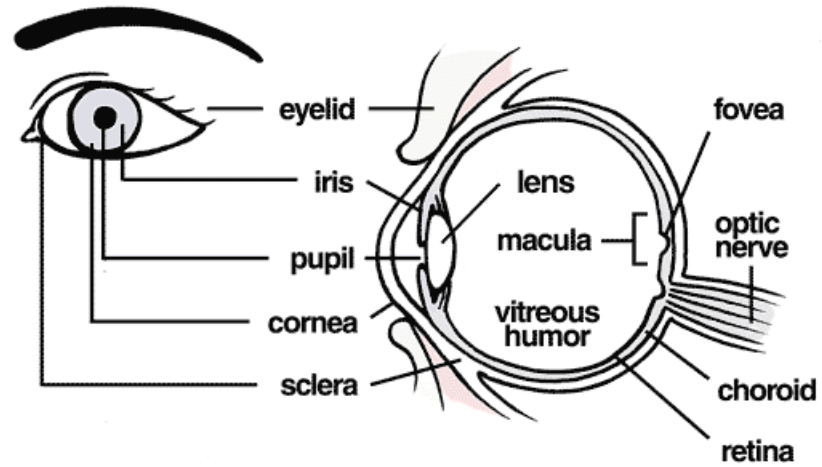


# The Lebanese International University

- ▶ School of Agriculture and Food Sciences
- ▶ School of Arts & Sciences
- ▶ School of Business
- ▶ School of Education
- ▶ School of Engineering
- ▶ School of Pharmacy



# Proteins in action

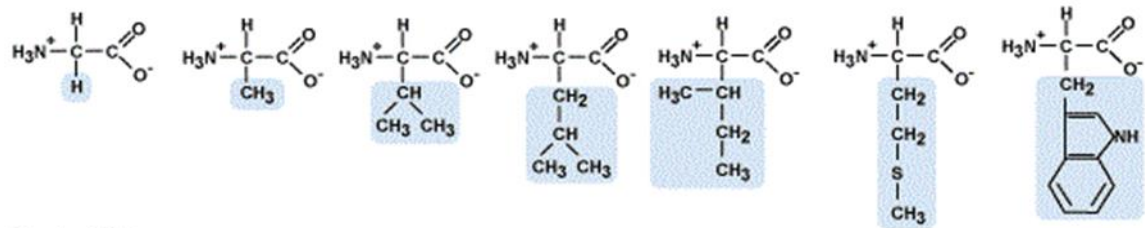
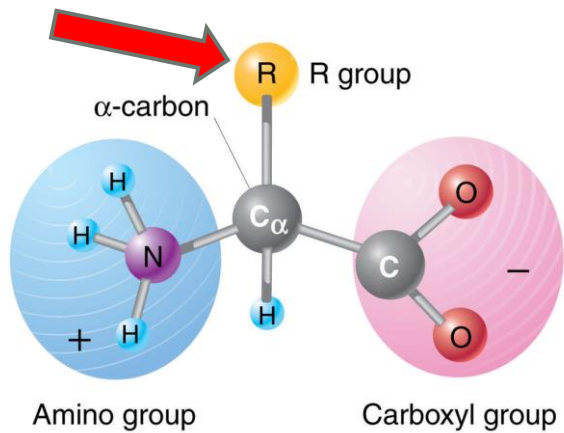


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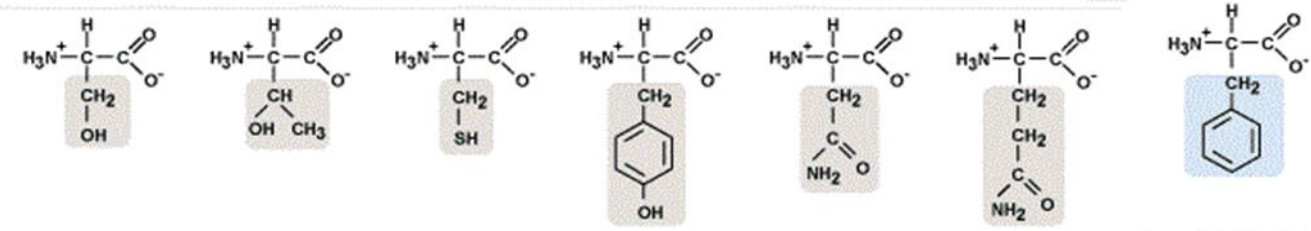


# Proteins...BIOC001 - Biochemistry for Pedestrians

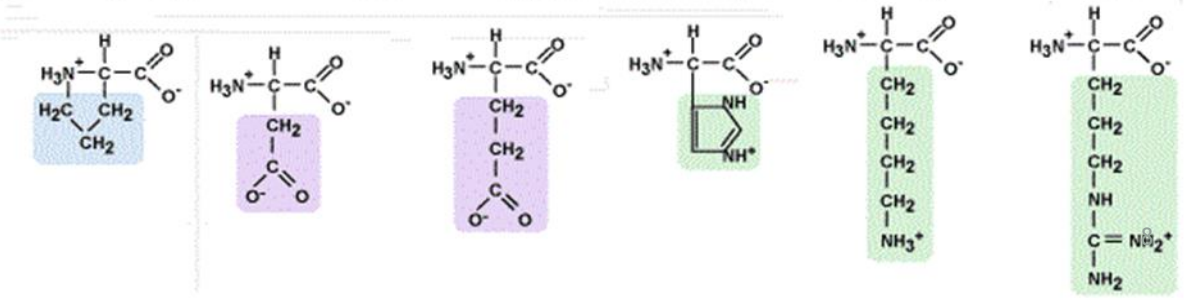
Macromolecular assemblies composed of basic units (amino acids) connected to each other in a regular format (peptide bond), occupying a specific 3-D shape (fold or structure), which conveys the intended (or faulty) function



Glycine (Gly)    Alanine (Ala)    Valine (Val)    Leucine (Leu)    Isoleucine (Ile)    Methionine (Met)    Tryptophan (Trp)



Serine (Ser)    Threonine (Thr)    Cysteine (Cys)    Tyrosine (Tyr)    Asparagine (Asn)    Glutamine (Gln)    Phenylalanine (Phe)

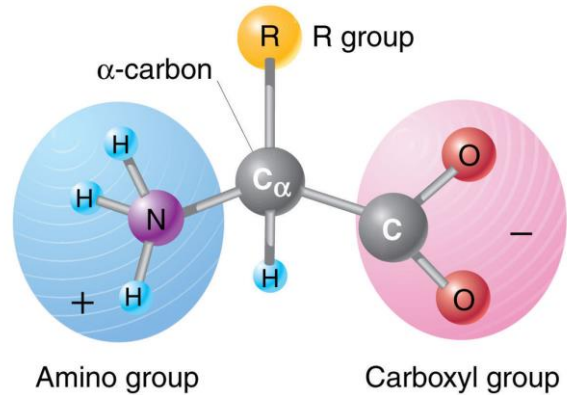


Proline (Pro)    Aspartic Acid (Asp)    Glutamic Acid (Glu)    Histidine (His)    Lysine (Lys)    Arginine (Arg)

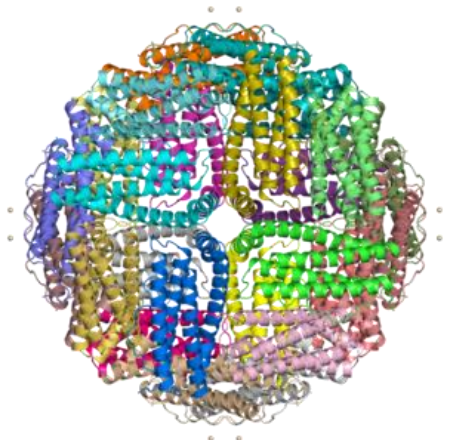
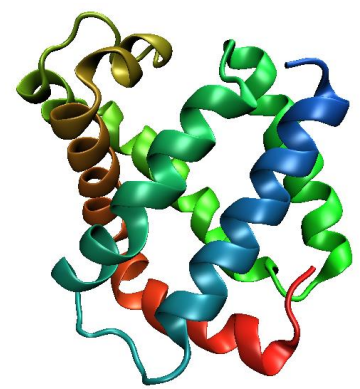
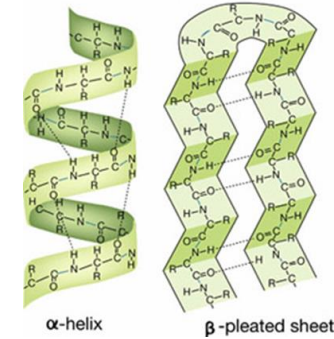


# Proteins...BIOC001 - Biochemistry for Pedestrians

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Secondary structure is the result of hydrogen bonding



# Proteins...BIOC001 - Biochemistry for Pedestrians

## Major protein functions:

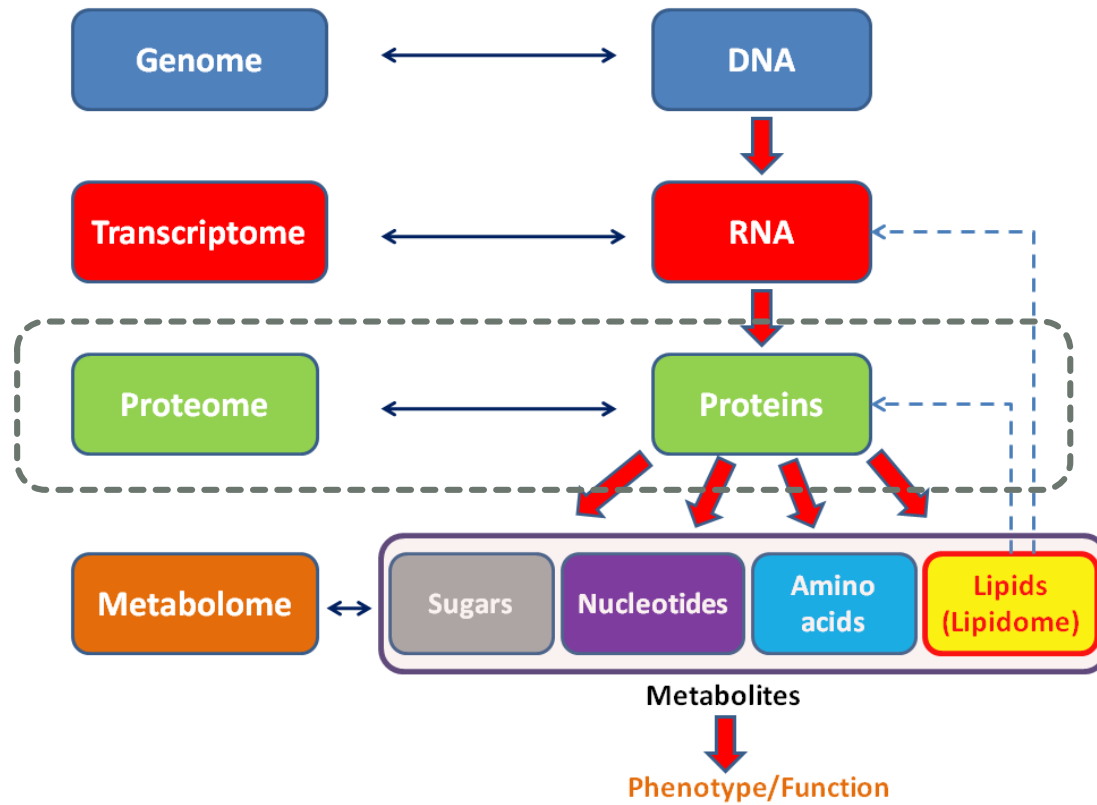
1. Structural (bones, muscles, cytoskeleton, ECM, etc.)
2. Catalytic (enzymes, enzyme-like actors)
3. Binding (hormones, transporters, immune response, etc.)
4. Switching (signal transduction, control, etc.)



Proteome



# Parallelism



First coined by Marc Wilkins in 1994...

The “proteome” is the complete set of genome proteins (from a cell, tissue, organ, or organism) expressed at a certain time, under certain conditions.

“Proteomics” is the study of the proteome



# Ways to tackle proteomics

- ▶ Protein separation techniques
- ▶ Mass spectrometry
- ▶ Light spectroscopies
- ▶ Electron microscopy
- ▶ NMR
- ▶ X-ray crystallography
- ▶ Neutron scattering
- ▶ Bioinformatics



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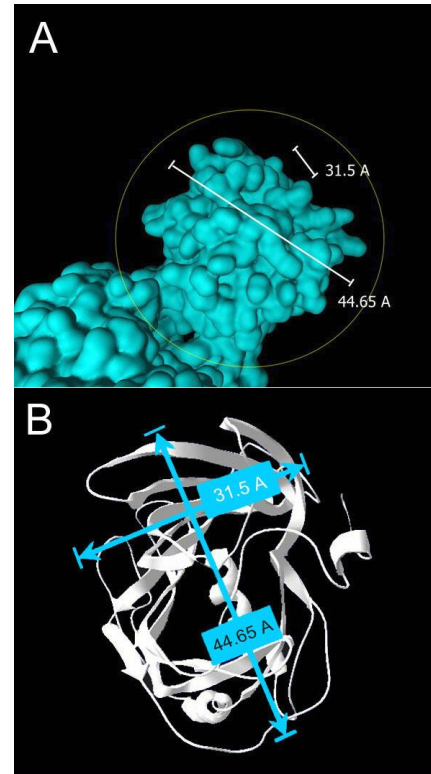
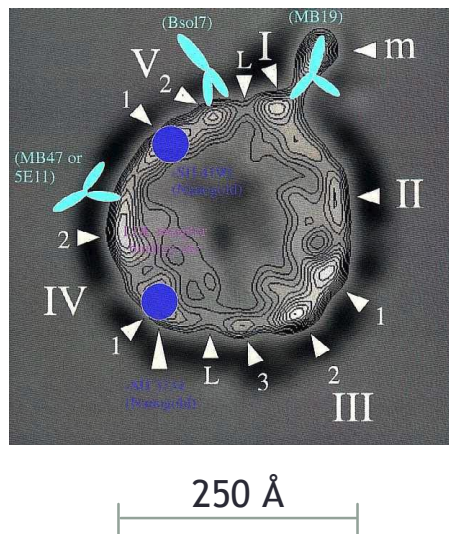
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# Size matters ...

- ▶ Viruses: 20 - 400 nm
  - ▶ LDL: 20.4 - 24.7 nm
  - ▶ Hb: 5.5 nm
- ⇒ Nanoscale structures



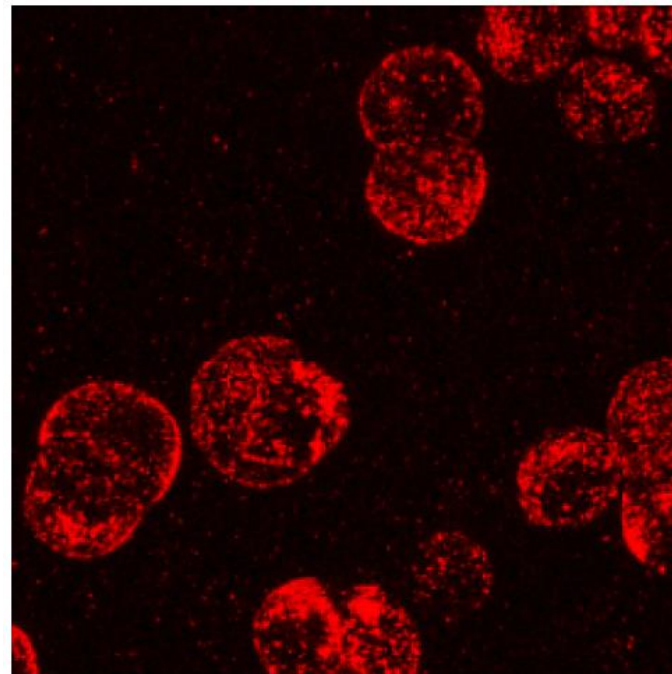
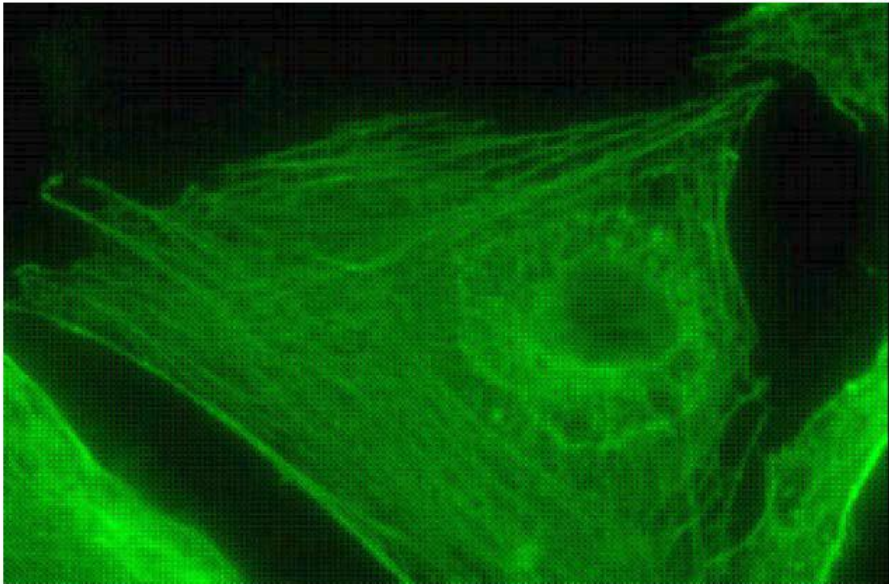


Function



Structure

Sometimes, we need small size

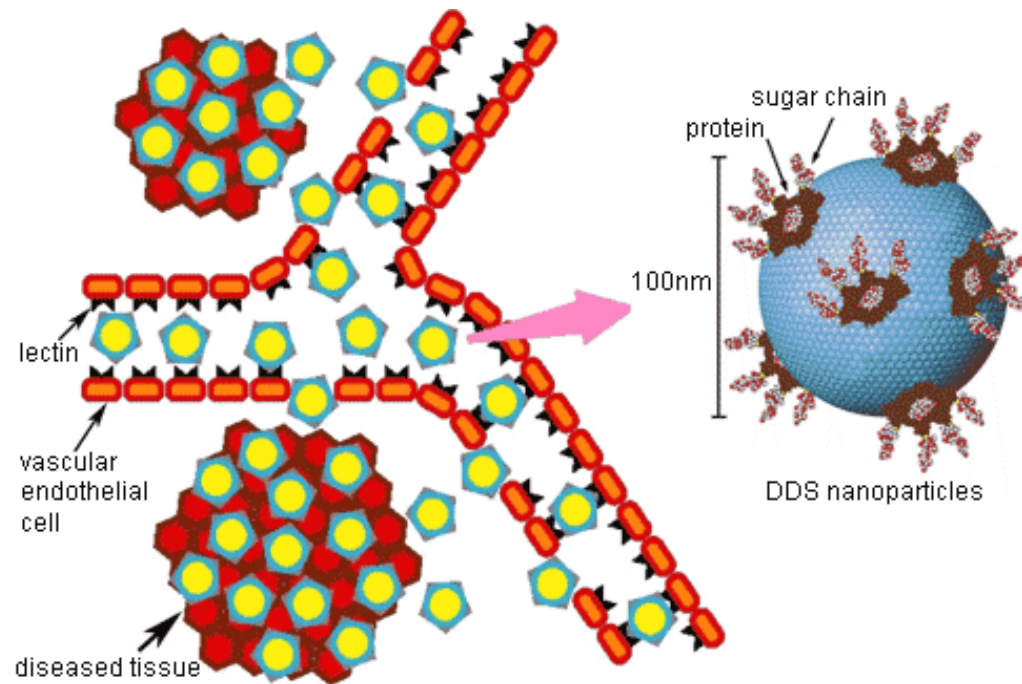


P1: Flow Cytometry with GFP & RFP

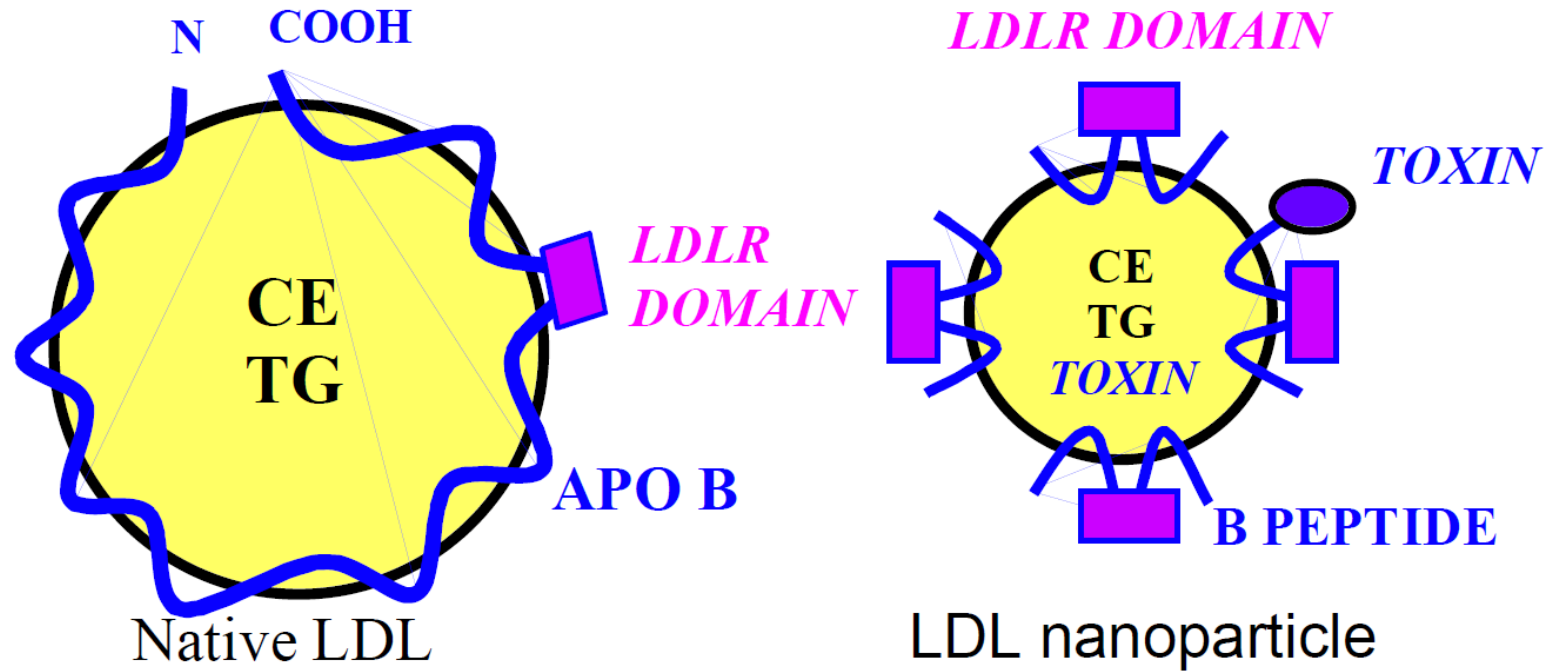




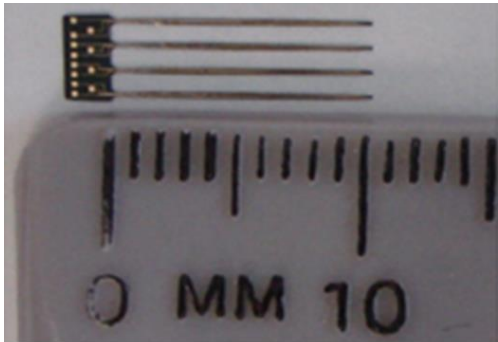
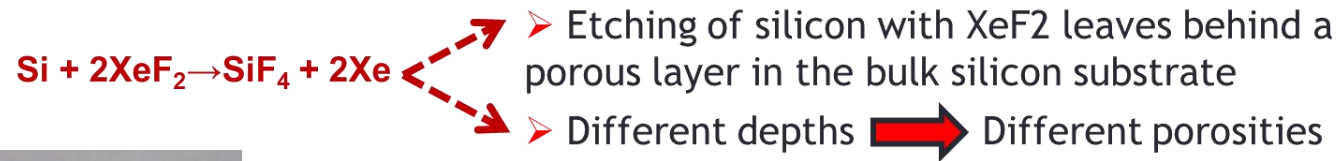
# P2: Protein-directed magnetic nanoparticles



# P3: Synthetic LDL for GBM cancer therapy

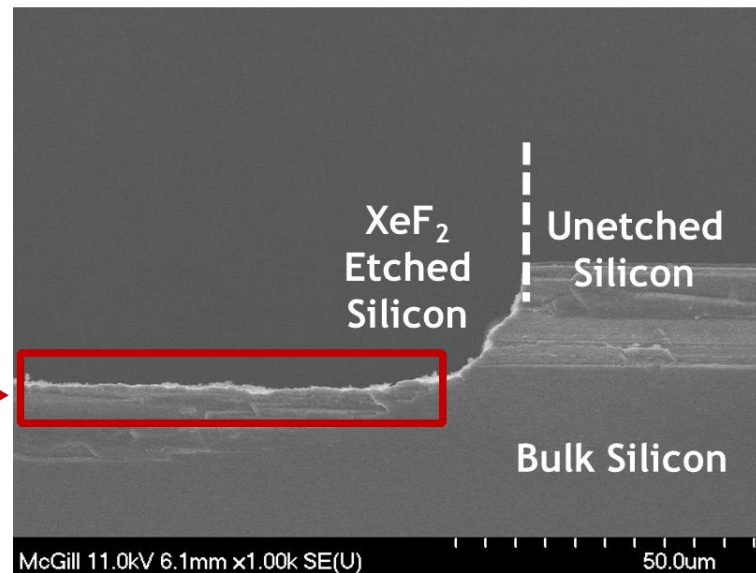


# P4: Porous silicon with NGF for immune response suppression

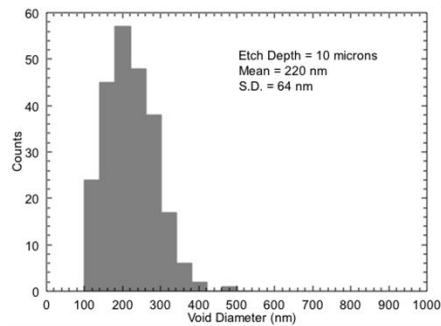
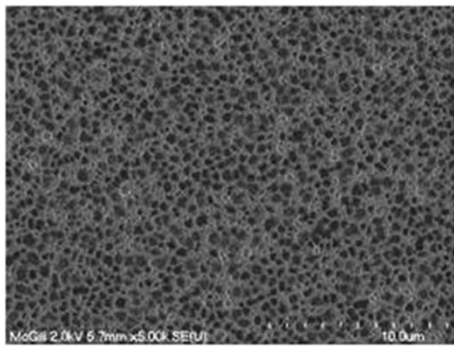


McGill Array

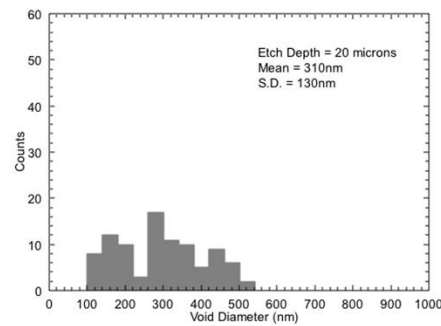
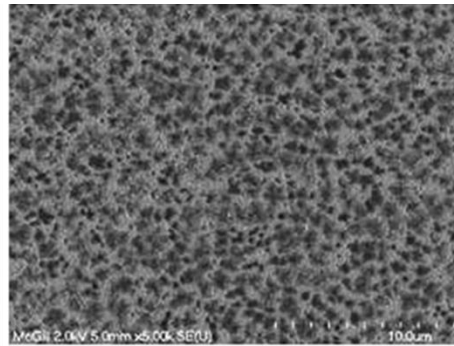
Porous silicon layer →



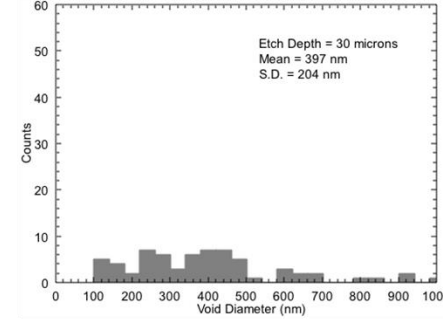
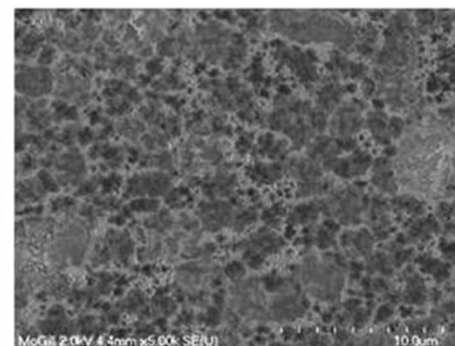
# P4: Porous silicon with NGF for immune response suppression



220 nm



310nm



397nm

# P5: Biosteel

- ▶ Spider silk-like protein, expressed in (goat) milk
- ▶ 10+ times stronger than steel; comparable to kevlar
- ▶ Can stretch up to 20 times its original size without losing mechanical properties
- ▶ Can withstand temps from  $-20^{\circ}\text{C}$  to  $300^{\circ}\text{C}$
- ▶ Originally produced by Nexia, then now by Prof. Randy Lewis of Utah State U.

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## BRIDGES MADE OF SPIDER SILK? YOU CAN THANK THE GOATS FOR THAT.

Liz Boatman In the news and Research highlights 7 years ago 12  
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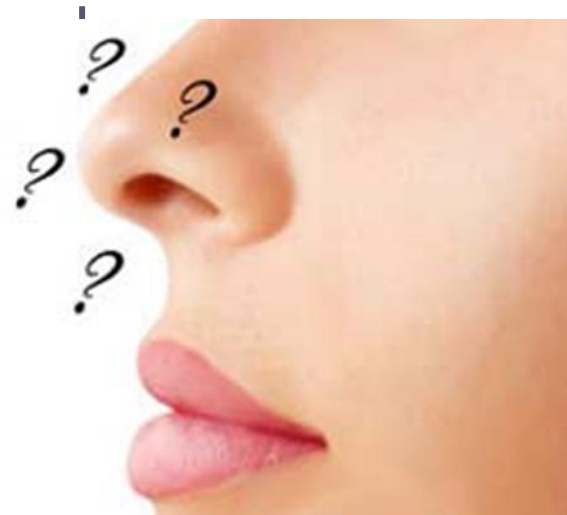
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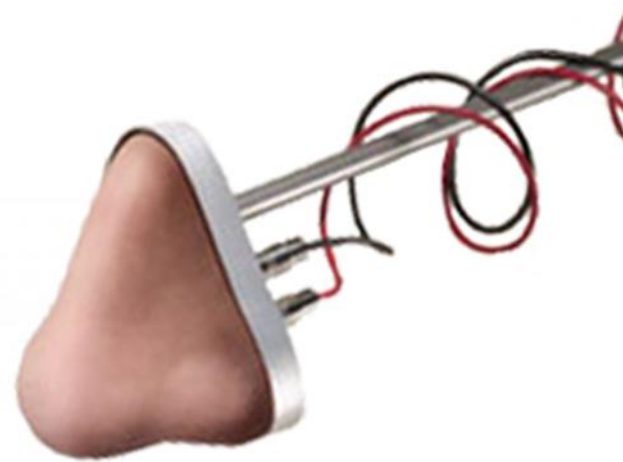
# P6: E-nose

- ▶ Response to limited number of mol
- ▶ Olfactory system prone to:
  - ▶ fatigue
  - ▶ inconsistency
- ▶ At low concentrations:
  - ▶ Weak/Slow odor identification
  - ▶ Lack of sensitivity



# P6: E-nose

- ▶ Electronic device for odor detection
- ▶ Based on E-sensing technology
- ▶ Composed of an Array of sensors
- ▶ Purpose: mimic the olfactory system



# P6: E-nose - some examples

## Research



- Growing Research
- Tufts University E-nose

## Industrial



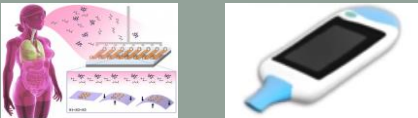
- Detection of contamination, spoilage and pollution

## Food



- Quality assessment in food production

## Medical

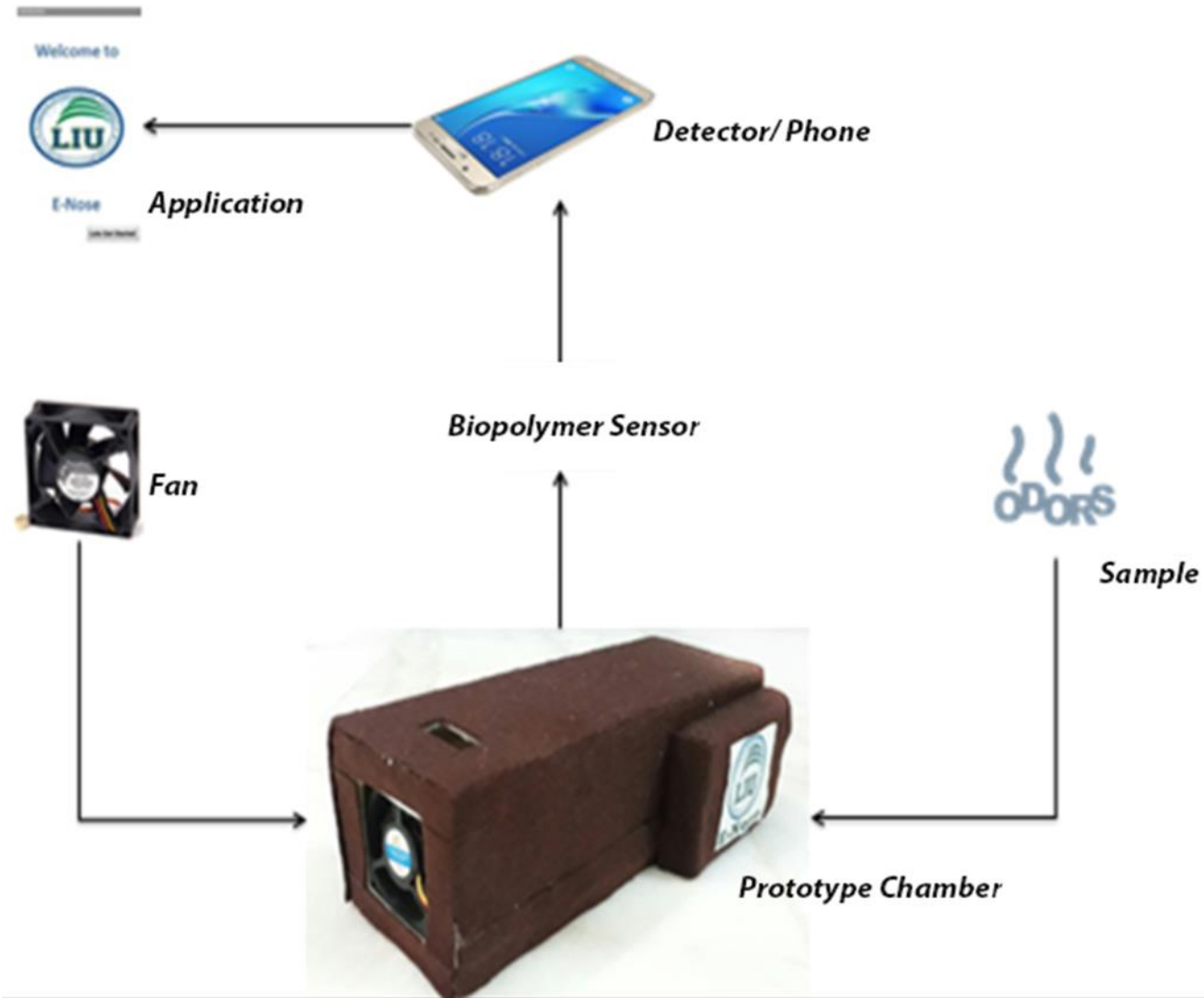


- Applicable as a diagnostic tool
- Na-Nose





# P6: LIU E-nose




# P7: Biocomputing

- ▶ Design
  - ▶ Biochemical
  - ▶ Biomechanical
  - ▶ Bioelectronic
- ▶ Engineering
- ▶ Economics

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**Ben Rossi**  
29 February 2016

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## Could protein-powered 'biocomputers' be the future of IT?

A computer made of biocircuits could use much less energy, as it uses the proteins present in all living things to function

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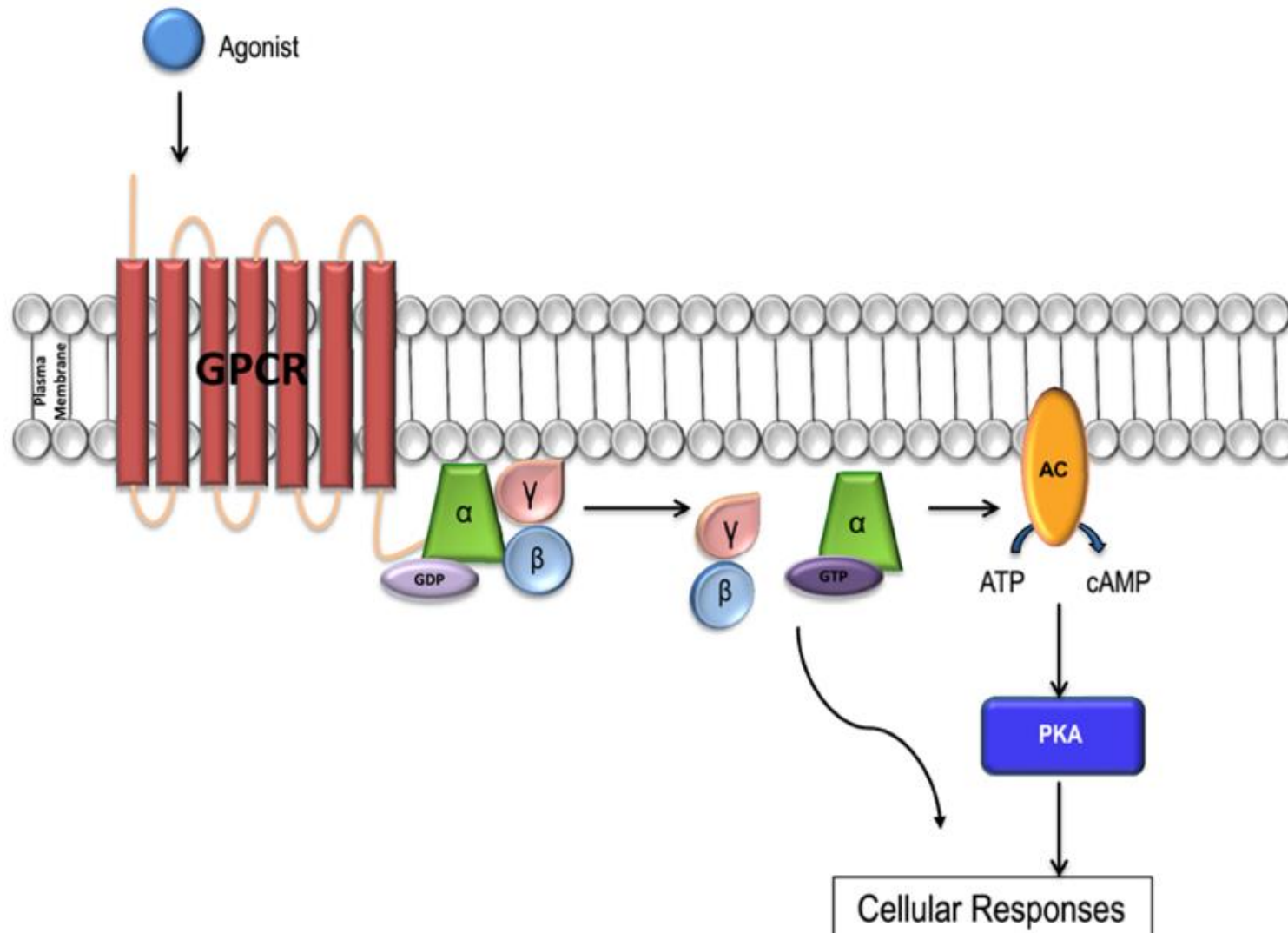
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# P7: Biocomputing - cellular mimetics



# A wrap up: proteins

- ▶ Central role in human lives
- ▶ Attractive design
- ▶ Signal transduction
- ▶ Economic
- ▶ Sustainable



