Proteomics:
From Nano-Structures to Mega Functions

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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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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.
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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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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
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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 -20º C to 300º C
- Originally produced by Nexia, then now by Prof. Randy Lewis of Utah State U.
P6: E-nose

- Response to limited number of molecules.
- 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

- 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
P7: Biocomputing - cellular mimetics
A wrap up: proteins

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