Fall 9-16-2016

Engineering and Perception

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Overview

• Introduction
• What is STEM? Engineering?
• Engineering and the Senses
• Engineering Innovations
• Your Questions

Pictures say more than words....
Science, Technology, Engineering & Math

• Cornerstone of innovation
• Critical for US to compete successfully in the 21st century

Engineering

• Practical application of science and math to create something of value from natural resources
Where do Engineers Work?

• **Industry (GE, HP, Pfizer)**
  - Product design, development and testing
  - Systems maintenance and upgrade
  - Manufacturing and construction

• **Government agencies (EPA, FDA, HUD)**
  - Establishing technical standards and safety protocols
  - Enforcing environmental regulations

• **Universities and Hospitals**
  - Research projects and technical support
  - Curriculum development and teaching

• **Non-Profit Agencies**
  - Peace Corps, Red Cross, Housing development
  - Military, reserve officers
Scientists discover the world that exists, but engineers create the world that never was.
Sight: The capability to focus and detect images of visible **light**.

- Over 7 million cells
- Arranged in 10 layers
- Contains only photosensitive neurons
Visual Perception
Auditory Perception

Hearing: Ability to perceive sound by detecting vibration through media.
Olfactory & Gustation Perception

**Smell:** Ability to perceive odors via detection of molecular binding.

**Taste:** Sensation produced when a substance reacts chemically with receptor cells.

11 Plants That Repel Mosquitoes

Aspartic acid  | Phenylalanine  | Methanol
Aspartame
Tactile Perception

**Touch:** Ability to interpret signals from various sensory receptors (e.g. temperature, stretch, pain)
Engineering Innovations
Engineering Innovations
100 Billion Neurons in Brain
• Glia are 10X to 100X that!
• Glia scaffold neurons, supply nutrients & \( O_2 \)
  remove dead neurons and pathogens
• Neural migration critical for repair of neurological diseases
Fig 2.B: Images of the migratory response of genetically-transformed GPCs to TGF-α concentration gradients of (A) 100pM/mm, (B) 10pM/mm, (C) 5pM/mm and (D) 1pm/mm within μLane system. Scale = 100μm. Blue denotes nuclei.
µLane Data

- Acquired µLane data is time-lapse imaged
- Same gradient can have distinct effects on different cells (1pM/12mm)

(Fibroblasts)  (Glioma-Derived)  (Medulloblastoma)
Microfluidic Devices

\[ \frac{\partial C}{\partial t} + V \frac{\partial C}{\partial x} = D \frac{\partial^2 C}{\partial x^2} \]
Nanotechnology

- Nanotechnology is STEM at 1-100 nm (nanometers)
- A sheet of paper is 100,000 nm thick
- If a pebble were 1 nm, then 1 meter would be the size of the Earth

**BME Research: Vaz Lab**
Label intracellular proteins & activation of signal transduction

- QD Surfaces can be functionalized with **cross-linker** molecules
- Liposome encapsulation facilitates cytosolic delivery within live cell
Virosome-Mediated Fusion

fusogenic liposome

EGF-R

cell
Virosome-Mediated Fusion
Virosome-Mediated Fusion

fusion with the cellular plasma membrane
release of the Qdots into the cytosol
Virosome-Mediated Fusion

labeling of intracellular EGF-R
Liposome-Mediated Fusion

- Glioma-Derived + QD
- Transferrin/Cholera Toxin B
- <3% Co-localization

- Medulloblastoma + QD
- Transferrin/Cholera Toxin B
- >98% Co-localization
EGFR in Brain Cells

(Figure A) Qdot Tf

(Figure B) Qdot:iEGFR-Ab

(Figure C) Qdot Tf

(Figure D) Qdot:iEGFR-Ab
Engineering and CCNY

• Ideal for Problem-Solvers
• Team Work oriented
• Required creativity and hard work
• Offers a great variety of career choices
  (Engineers, Medical Doctors, Lawyers, Bankers & Finance, Educators, Managers, Politicians, Architects, Consultants)

• CCNY has graduated more Nobel prize winners (8) than any other public university

• Macaulay Honors College has FREE tuition
Thank You!

Questions?