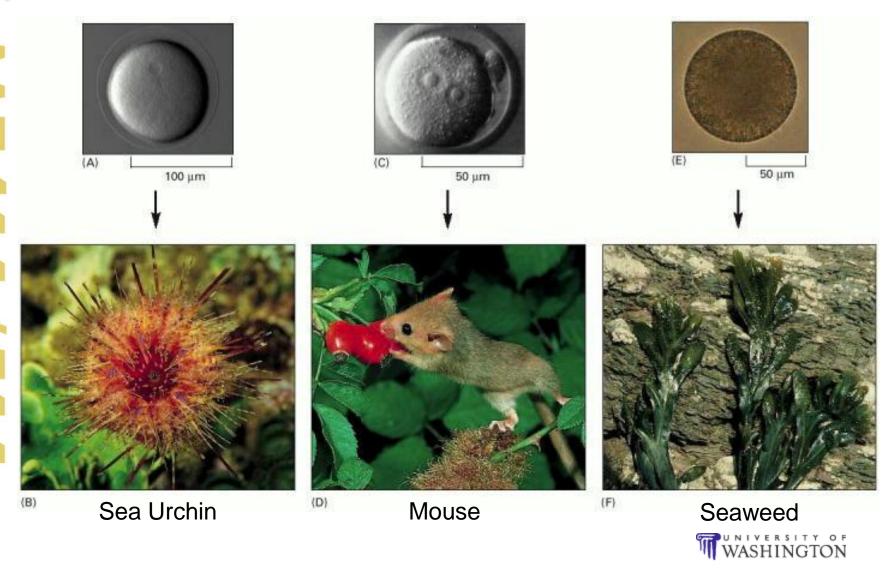
ME 411 / ME 511

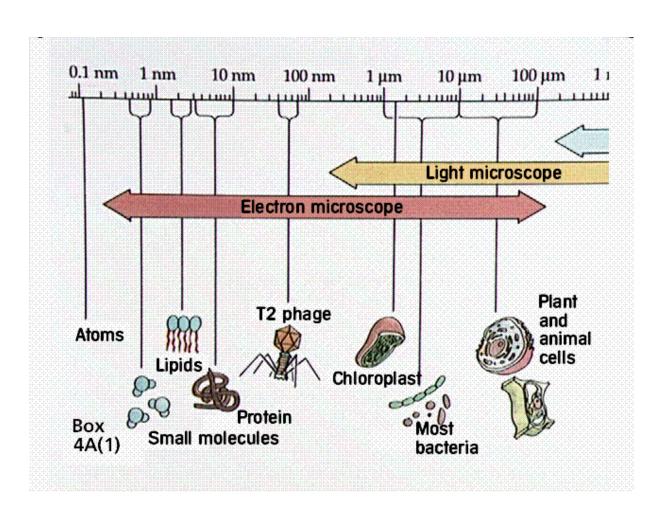
Biological Frameworks for Engineers



What are Cells?



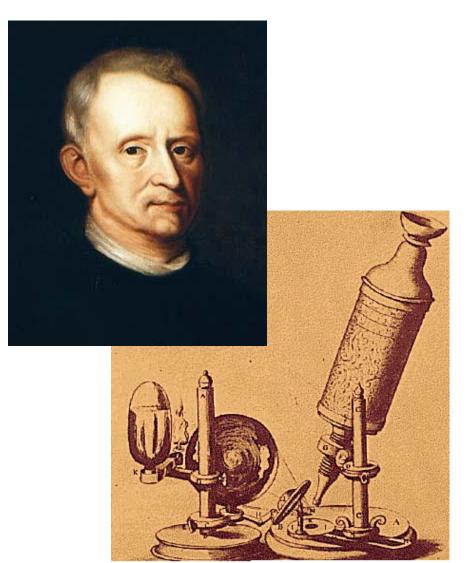
Cellular Dimensions

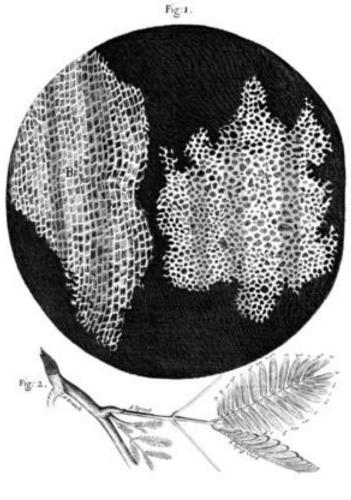




Robert Hooke









gical Frameworks for **Engineers**

68 Basic Building Blocks

Nucleic Acids Glycans (DNA and RNA) Nucleic Acids 8 Glycans nucleosides 32+ sugars Deoxyadenosine, Deoxycytidine, Fucose, Galactose, Glucose, Glucuronic Acid, Mannose, N-Acetylgalactosamine, N-Acetylglucosamine, Neuraminic Acid, Deoxyguanosine, Deoxythymidine, Xylose, Nononic Acid, Octulosonic Acid, Arabinose, Adenosine, Cytidine, Guanosine, Uridine Arabinofuranose, Colitose, Fructose, Galactofuranose, Galacturonic Acid, Glucolactillic Acid, Heptose, Legionaminic Acid, Mannuronic Acid, N-Acetylfucosamine, N-Acetylgalacturonic Acid, N-Acetylmannosamine, N-Acetylmannosaminuronic Acid, N-Acetylmuramic Acid, N-Acetylperosamine, N-Acetylquinovosamine, Perosamine, Pseudaminic Acid, Rhamnose, Talose **Proteins** dA, dC, dG, dT, rA, rC, rG, rU Lipids A, R, D, N, C, E, Q, G, H, I, L, K, M, F, P, S, T, W, Y, V Fuc, Gal, Glc, GlcA, Man, GalNAc, GlcNAc, **Proteins** _ipids NeuAc, Xyl, Kdn, Kdo, Ara, Araf, Col, Frc, Galf, GalUA, GlcLA, Hep, Leg, ManUA, FucNAc, GalNAcUA, ManNAc, ManNAcUA, MurNAc, 20 amino acids 8 types PerNAc, QuiNAc, Per, Pse, Rha, Tal Fa, Gl, Glpl, Pk, Pl, Scl, Sphl, Stl Alanine, Arginine, Aspartic Acid, Asparagine, Cysteine, Glutamic Acid, Glutamine, Glycine, Histidine, Isoleucine, Leucine, Lysine, Fatty Acyls, Glycerolipids, Glycerophospholipids, Methionine, Phenylalanine, Proline, Serine, Polyketides, Prenol Lipids, Saccharolipids, Sphingolipids, Sterol Lipids Threonine, Tryptophan, Tyrosine, Valine

"From the construction, modification, and interaction of these components, the cell develops and functions." –James Marth

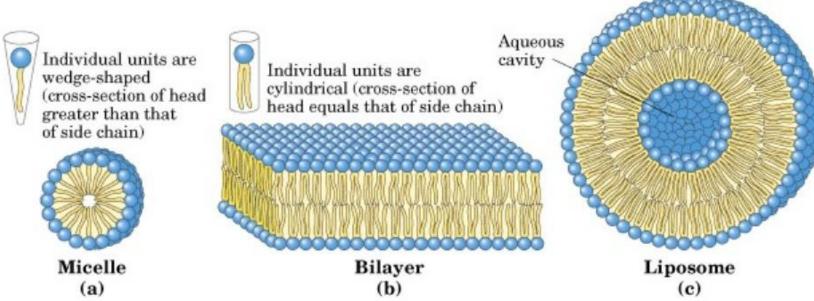
J. Marth *Nature Cell Biology*, 2008,10(9):1015-16

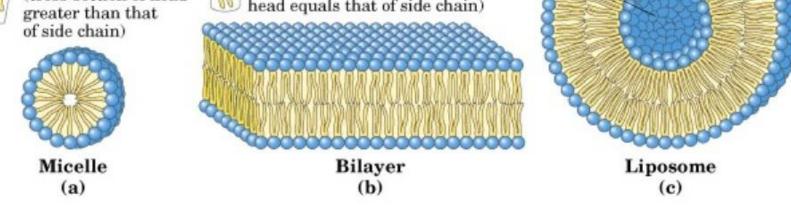






Lipid Bilayer

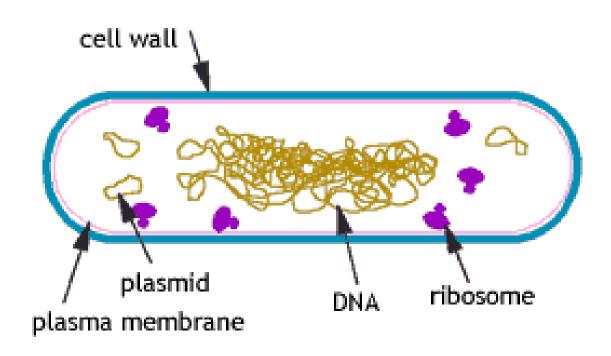






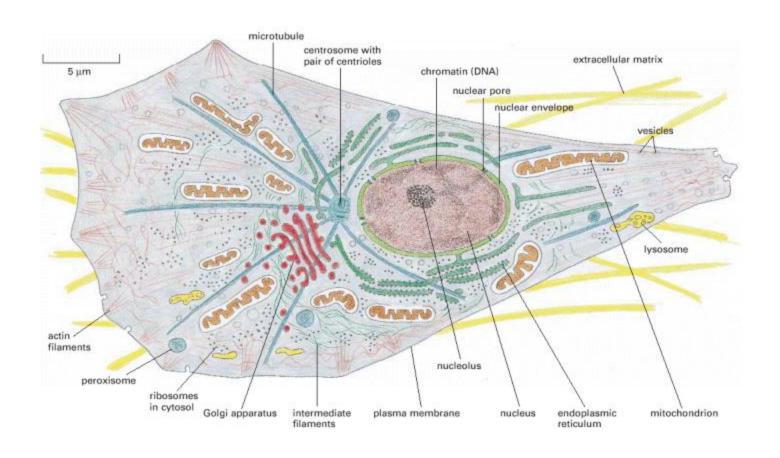


Prokaryotic Cells





Eukaryotic Cells



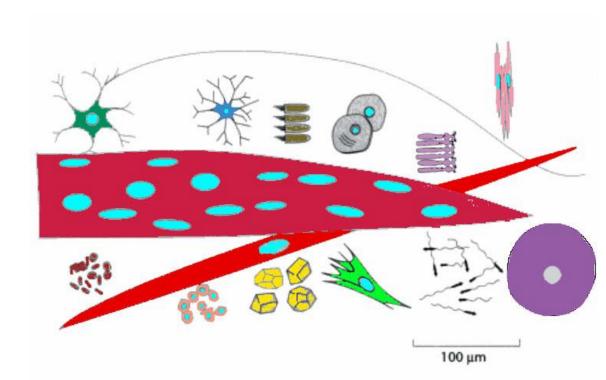




Cell Function Follows Form

Cell types:

- motor neuron
- osteocyte
- hair cell
- adipocyte
- rods and cones
- endothelials
- skeletal muscle
- smooth muscle
- RBC
- lymphocyte
- epithelial (separated)
- fibroblasts
- sperm and egg cells

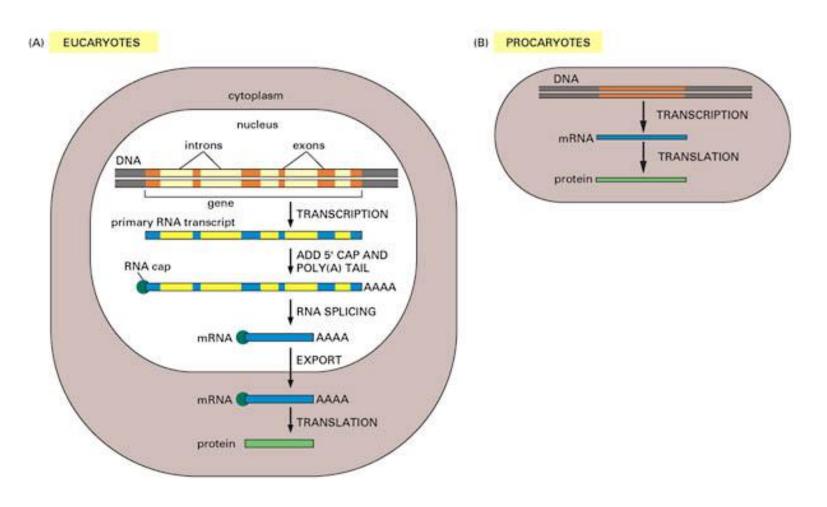


(Drawn to scale)





Central Dogma







Factory Parallels with Cells

- a. The building framework
- b. Doors
- c. Internal walls
- d. The machines that make products
- e. The central computer
- f. The central computer room (eukaryotic cells only)
- g. The combustion engine
- h. The solar cell (photosynthetic organisms)





Factory Parallels with Cells

- a. The building framework cell wall, cytoskeleton, cell membrane
- b. Doors
- c. Internal walls
- d. The machines that make products
- e. The central computer
- f. The central computer room (eukaryotic cells only)
- g. The combustion engine
- h. The solar cell (photosynthetic organisms)





Factory Parallels with Cells

- a. The building framework cell wall, cytoskeleton, cell membrane
- b. Doors pumps, transporters, vesicles, pores
- c. Internal walls
- d. The machines that make products
- e. The central computer
- f. The central computer room (eukaryotic cells only)
- g. The combustion engine
- h. The solar cell (photosynthetic organisms)





Factory Parallels with Cells

a. The building framework cell wall, cytoskeleton, cell membrane

b. Doors pumps, transporters, vesicles, pores

c. Internal walls cell membrane, organelle membranes

d. The machines that make products

e. The central computer

f. The central computer room (eukaryotic cells only)

g. The combustion engine





Factory Parallels with Cells

a. The building framework cell wall, cytoskeleton, cell membrane

b. Doors pumps, transporters, vesicles, pores

c. Internal walls cell membrane, organelle membranes

d. The machines that make products enzymes, ribosomes

e. The central computer

f. The central computer room (eukaryotic cells only)

g. The combustion engine





Factory Parallels with Cells

a. The building framework cell wall, cytoskeleton, cell membrane

b. Doors pumps, transporters, vesicles, pores

c. Internal walls cell membrane, organelle membranes

d. The machines that make products enzymes, ribosomes

e. The central computer

DNA/chromosomes/genome

- f. The central computer room (eukaryotic cells only)
- g. The combustion engine
- h. The solar cell (photosynthetic organisms)





Factory Parallels with Cells

a. The building framework cell wall, cytoskeleton, cell membrane

b. Doors pumps, transporters, vesicles, pores

c. Internal walls cell membrane, organelle membranes

d. The machines that make products enzymes, ribosomes

e. The central computer

DNA/chromosomes/genome

f. The central computer room (eukaryotic cells only)

nucleus

g. The combustion engine





Factory Parallels with Cells

a. The building framework cell wall, cytoskeleton, cell membrane

b. Doors pumps, transporters, vesicles, pores

c. Internal walls cell membrane, organelle membranes

d. The machines that make products enzymes, ribosomes

e. The central computer DNA/chromosomes/genome

f. The central computer room (eukaryotic cells only) nucleus

g. The combustion engine mitochondria (cell membrane)





Factory Parallels with Cells

a. The building framework cell wall, cytoskeleton, cell membrane

b. Doors pumps, transporters, vesicles, pores

c. Internal walls cell membrane, organelle membranes

d. The machines that make products enzymes, ribosomes

e. The central computer DNA/chromosomes/genome

f. The central computer room (eukaryotic cells only) nucleus

g. The combustion engine mitochondria (cell membrane)

h. The solar cell (photosynthetic organisms) chloroplasts



Questions?

