Cell Communication 11/01/2014

How Do Cells Communicate

- Cell-to-cell contact is critical
- Cell membranes have specific-protein receptors which bind and transmit extracellular signal molecules converting signals into responses

Universal Principles Of Cell Communciation

- Different signal molecules and receptors but mechanism is still same throughout time
- Analogy: car industry parts are same but patterns are endless

Signal Transduction

- Most common method of cell communication
- Exogenous molecule received by cell and converted (transduced) into a response by receiving cell
- Receives, transduced, responded
- Pattern is similar in all cells/highly conserved
- Developed before multi-cellular organisms
- 1. Reception
- 2. Transduction – Conformational changes yield cellular activity
- 3. Response

Signaling can be Local or Distant

- Paracrine (local signaling)

    - Local regulator chemical receptors are targeted to specific receptors
    - Includes growth factor proteins that promote cell division/growth and neurotransmitters that move across synapse to other neurons (synaptic signaling)
    - Paracrine and Synaptic signaling)
- Endocrine (distant signaling)
    - Specialized cells release molecules (hormones) into blood vessels of circulatory system and hormones move to distant target cells

Examples of Communication

- Mating in Yeast Cells
    - 1. Exchange of Mating Factors (a and b)
    - 2. Mating (A and B)
    - 3. New A/B cell
    - Sex-1 is “a” cell – releases “a” factor (peptide of 12 amino acids) that binds to sex-2 cell receptor
    - Sex-2 is “b” cell – releases “b” factor that binds to sex-1 cell receptor
    - Results in fusion of two cells producing diploid cell

Cell-to-cell contact

- where signaling is direct is probably how cell communication began
- examples:
    - gap junctions and plasmodesma
        - results in cytoplasmic activity favoring cellular interactions
        - gap junctions are in animal cells (0.2nm)
        - plasmodesmata are in plant cells (70nm)

    - Cell surface contacts
        - Receptor protein specificity
        - Cell to cell contact is probably how multicellularity began
        - Cell to cell contact leads to embryonic induction

Stages of Cell Signaling Process

- 3 properties of signal transduction pathway
- Reception, Transduction, Response
- 1. Reception
    - Same as enzyme recognition of substrate (ES complex)
    - Same as lock-key hypothesis of enzyme recognition (Km and Vmax)
    - Ligand molecules (water soluble) are recognized by only one receptor protein bound within a cell membrane
- 2. Transduction
    - leads to conformation change in receptor
    - shape change means receptor interacts with other inter-cellular molecules
    - may result in multiple conformation changes in other cell proteins (inactive enzymes become active)
- 3. Response
    - either cellular activity
    - or enzyme catalysis
    - or rearrangement of cytoskeleton (movement)
    - or specific gene activity