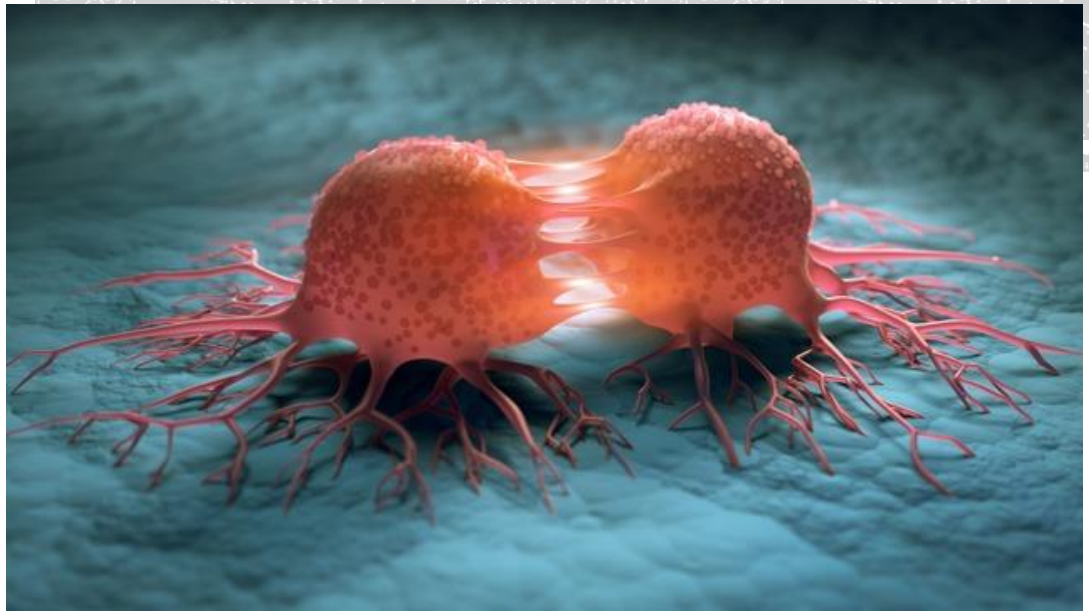
METABOLISM & CELL COMMUNICATION



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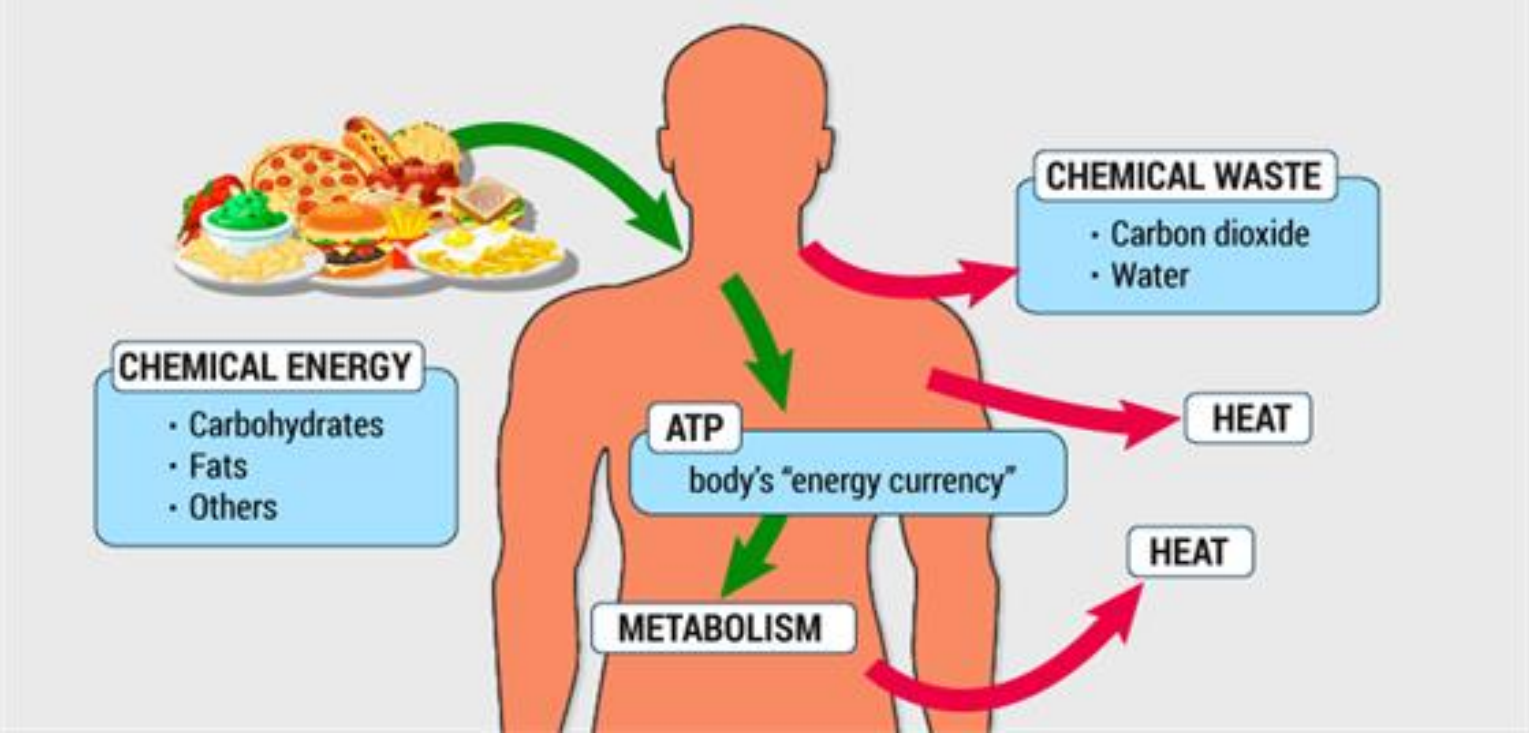
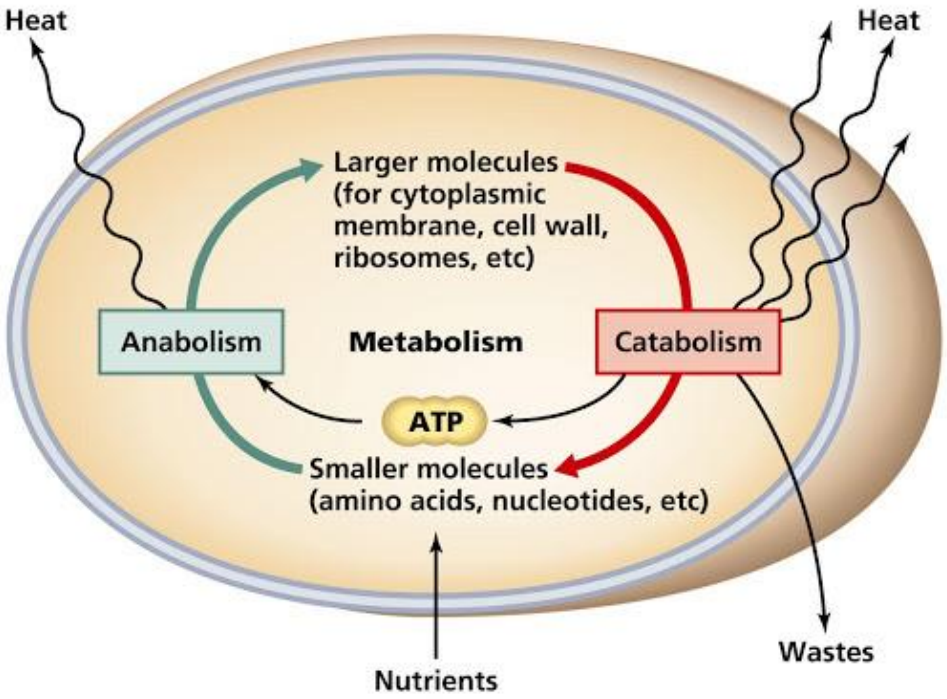
METABOLISM



All the chemical processes that take place in the body in order to sustain life- allowing you to breathe, pump blood, keep your brain functioning and extract energy from your food.

METABOLITES



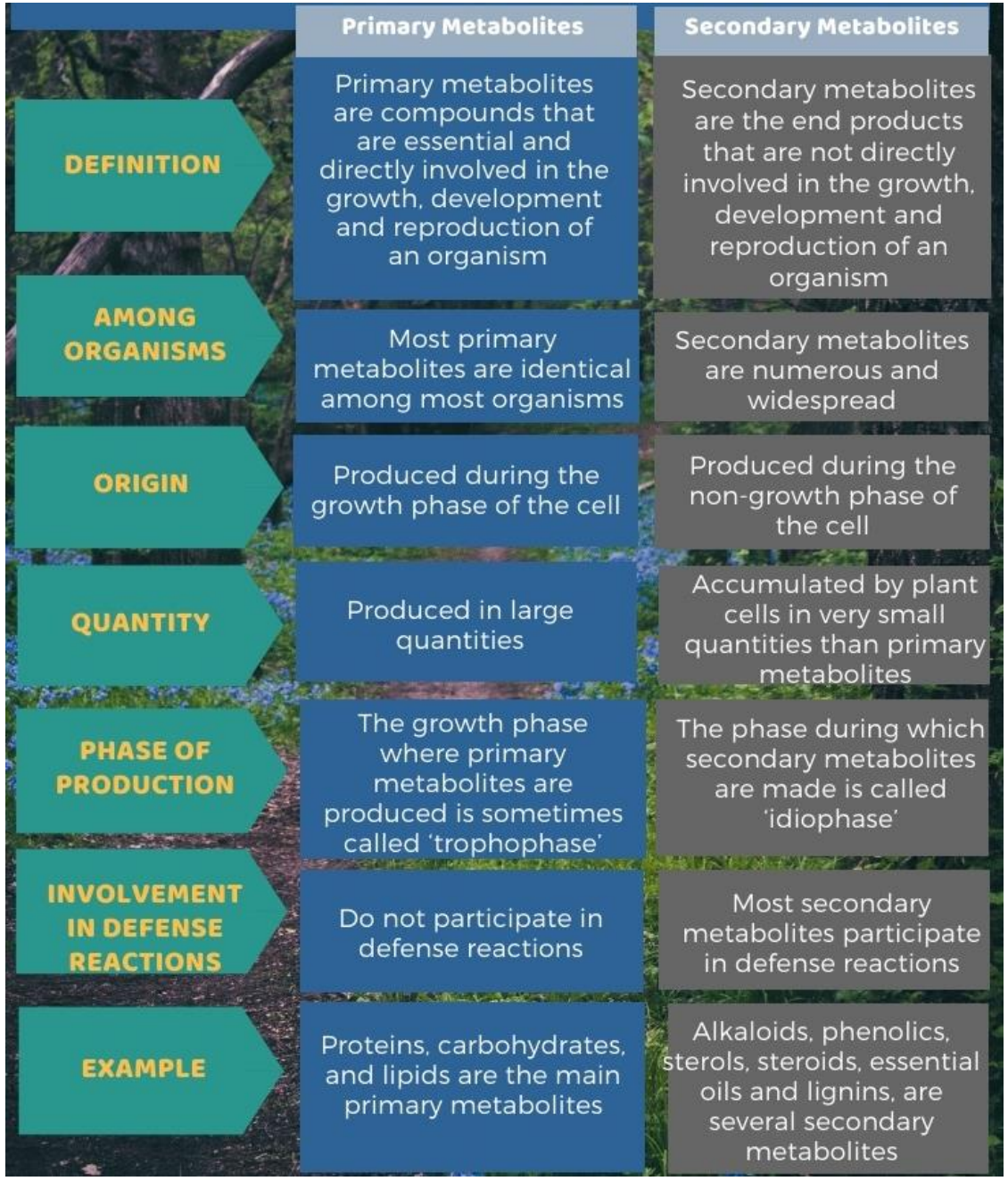
The reactants, intermediates and products of metabolic pathways are referred to as metabolites

Primary Metabolites:
Enzymes, Vitamins, Lactic Acid, Proteins, Lipids, Carbohydrates

Secondary Metabolites:
Steroids, Essentials Oils, Pigments, Antibiotics, Flavonoids, Gums/ Latex/ Tannins

SECONDARY METABOLITES

- Also called specialized metabolites, toxins or natural products, are organic compounds produced by bacteria, fungi, or plants which are not directly involved in the normal growth, development, or reproduction of the organism.
- Mediate ecological interactions, which may produce a selective advantage for the organism by increasing its survivability or fecundity.
- Specific within a phylogenetic group.
- Secondary metabolites often play an important role in plant defense against herbivory and infections.
- Humans use secondary metabolites as medicines, flavorings, pigments, and recreational drugs



METABOLITES IN USE

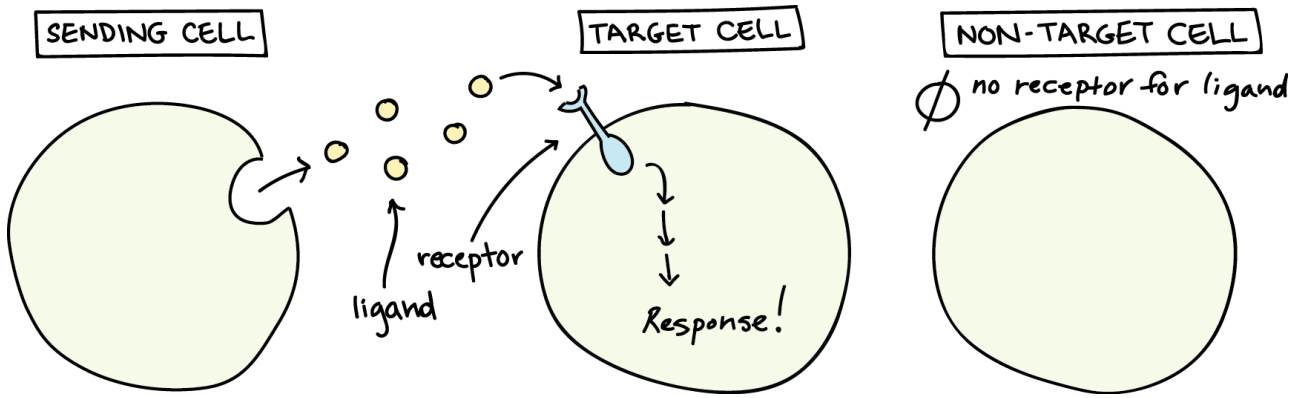
Secondary Metabolites:

Plant-Taxol/ Quinine/ Tannin/ Caffeine/ Nicotine
Bacteria- Botulin
Fungi- Penicillin

CELLS TALK IN CODES

Some UNIVERSAL PRINCIPLES of cell communication are now well known
- **cells may use many different signal molecules including gas (NO)**
- **but only a few mechanisms have survived throughout evolution.**

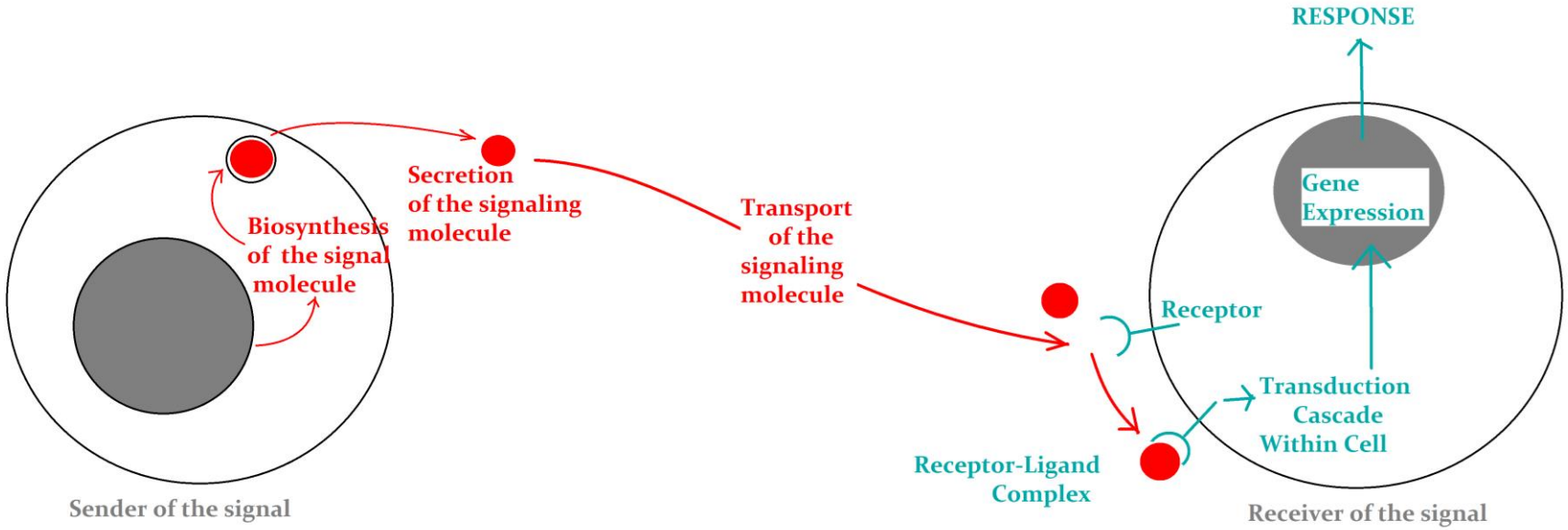
In multi-cell organisms cell-to-cell contact is critical.
- **cell membranes contain specific protein-receptors, which bind & transmit extra-cellular signal molecules converting signals into specific cellular responses.**



Specificity!

WHY DO CELLS SIGNAL?

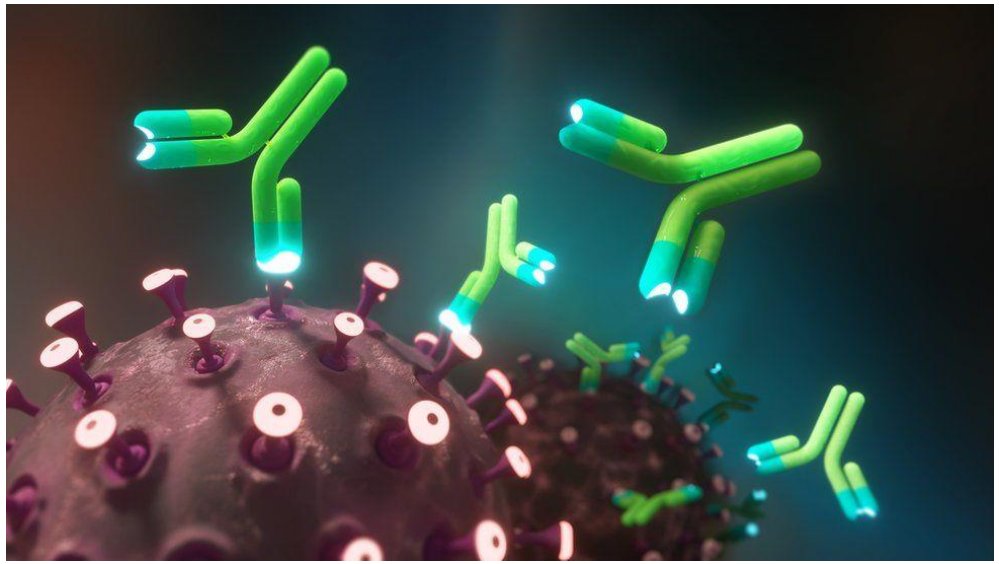
- Regulate gene expression- (Vitamin D, Thyroid)
- Warn of possible infection
- Regulate metabolism
- Allow enzyme secretion in stomach
- Relay messages to-and-from brain-to-body and vice versa
- Fight or flight reaction



RECEPTORS

- 0.01% of the total mass of protein in a cell
- Search through:

1. Gene analysis
2. Monoclonal antibodies



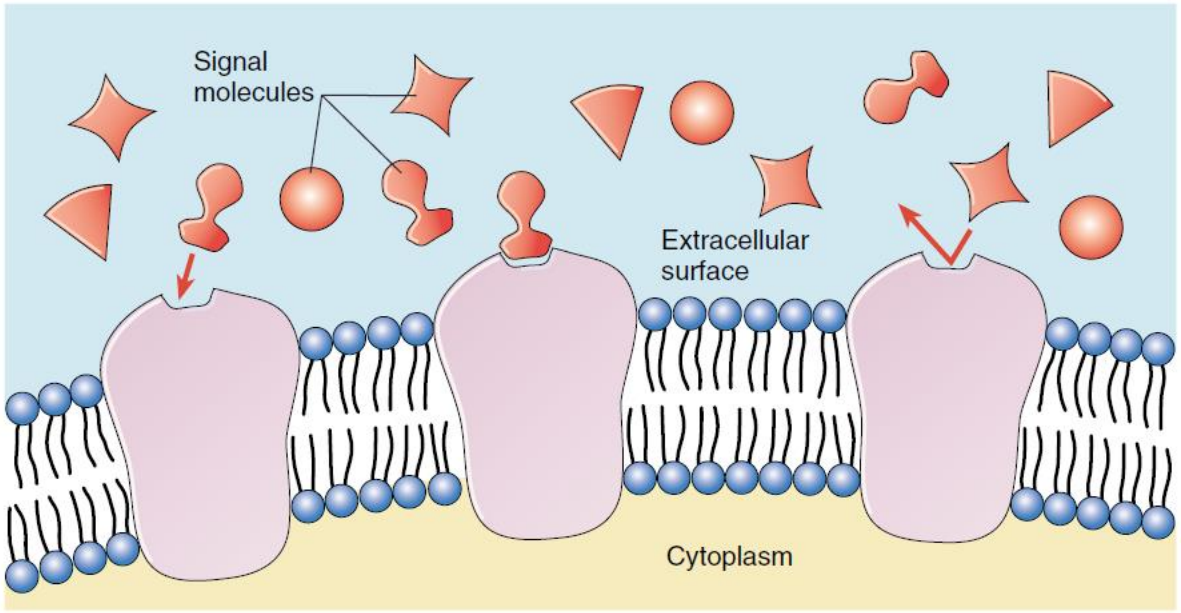


FIGURE 7.2
Cell surface receptors recognize only specific molecules. Signal molecules will bind only to those cells displaying receptor proteins with a shape into which they can fit snugly.

RECEPTORS

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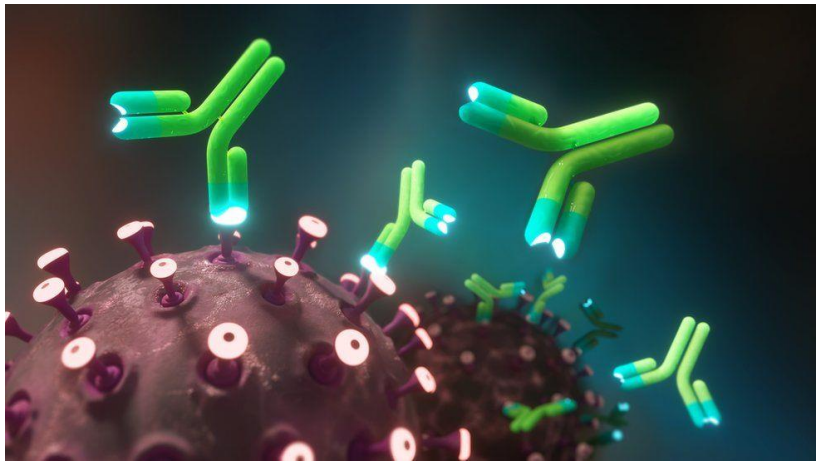
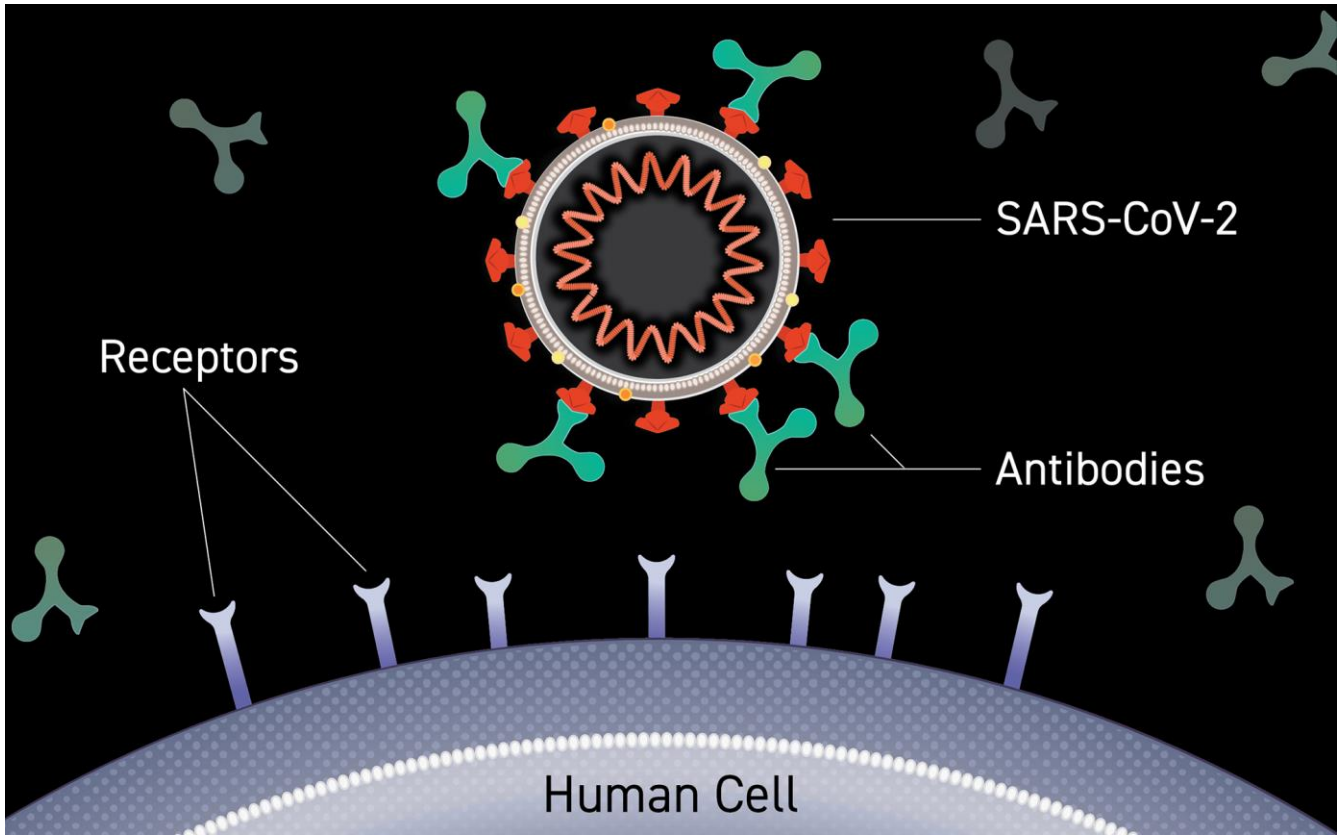
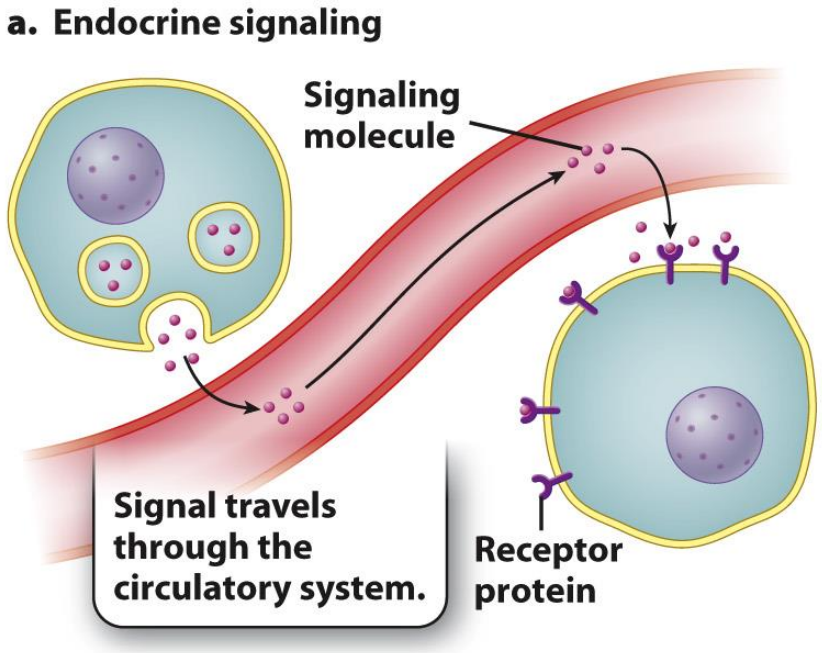
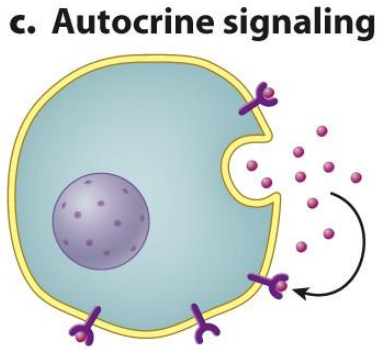




CELLS TALK IN CODES

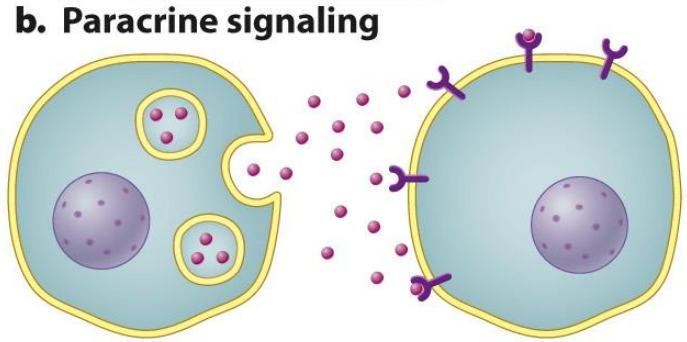
Hormones

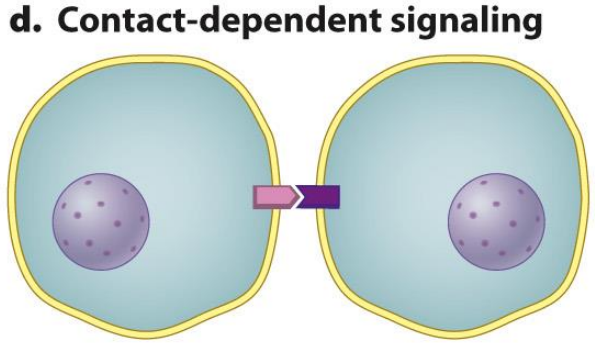




Cancer

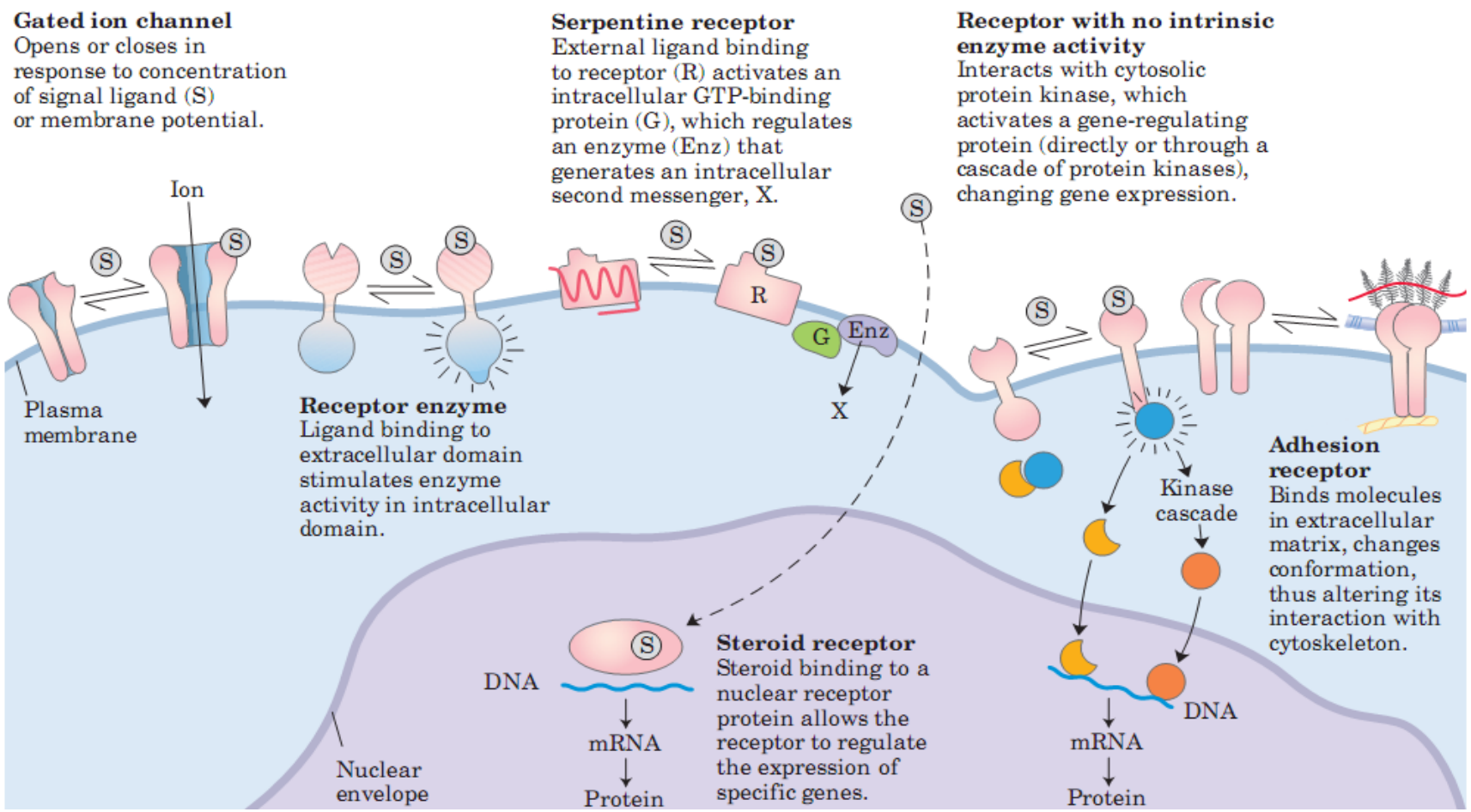
Growth factors/
Neurotransmitters

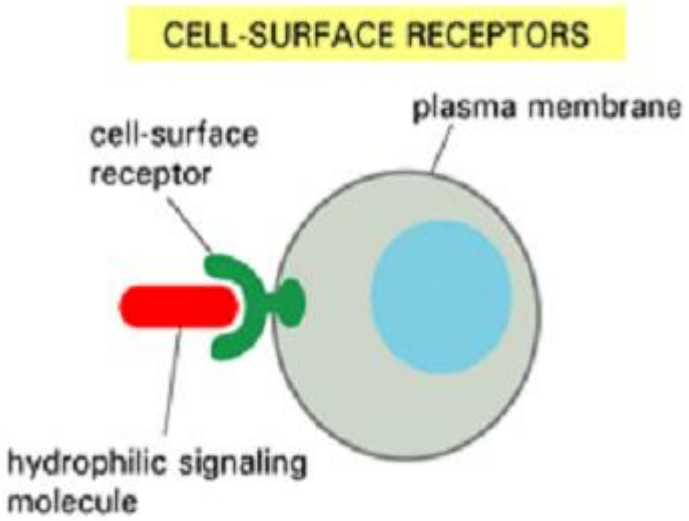




Immune cells
(T-cell)

CELL SIGNALLING





Extra cellular Hormone

a) Hydrophilic- Glucagon, Insulin, Epinephrine and Norepinephrine

b) Lipophilic-

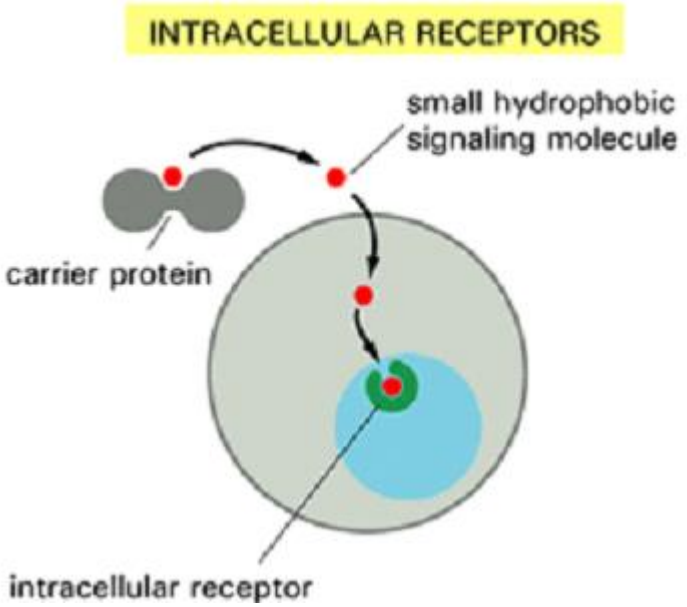
1) Membrane Receptor-Prostaglandins

2) Nuclear Receptor- sex hormones, thyroxine, Vitamin D, Retinoic Acid

Intra cellular Hormone

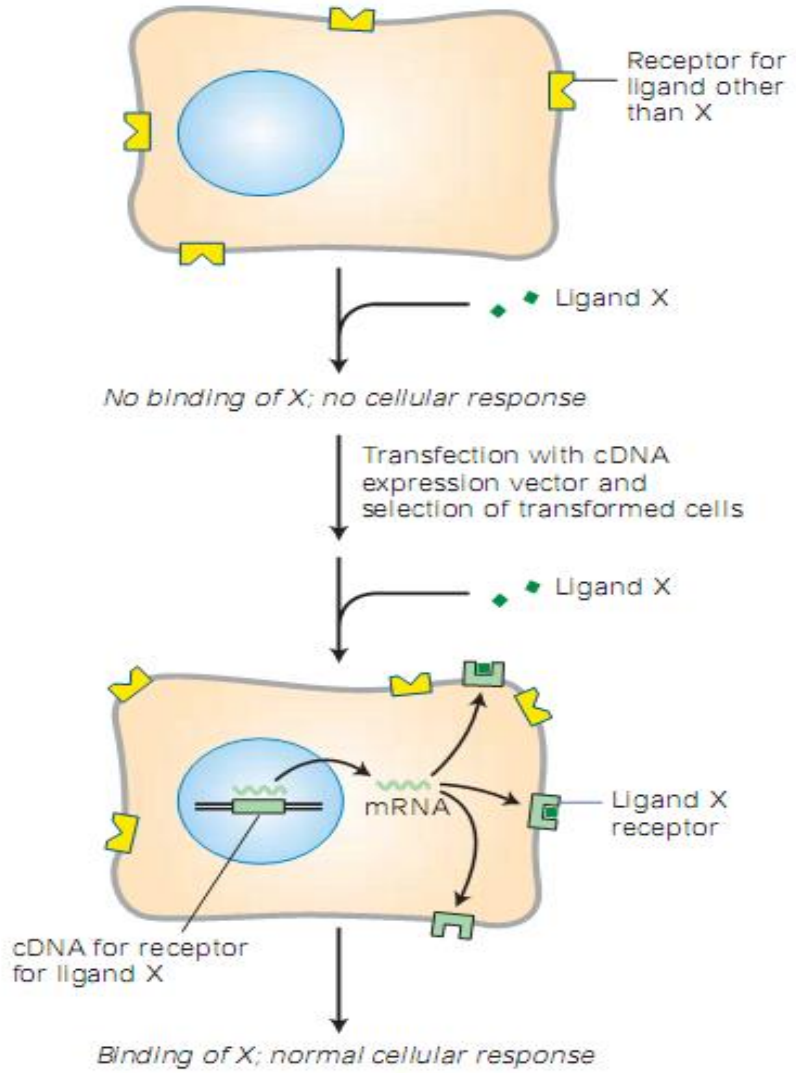
a) Proteinaceous- Kinase, Phosphatase, GTPase switch protein (ras, rab)

b) Non-proteinaceous (sec. messenger)- cAMP, IP3, DAG, Ca2+, Phosphoinoside



CELL RECEIVING

- Modulation of the gene activity



RECEPTOR COMPLEX

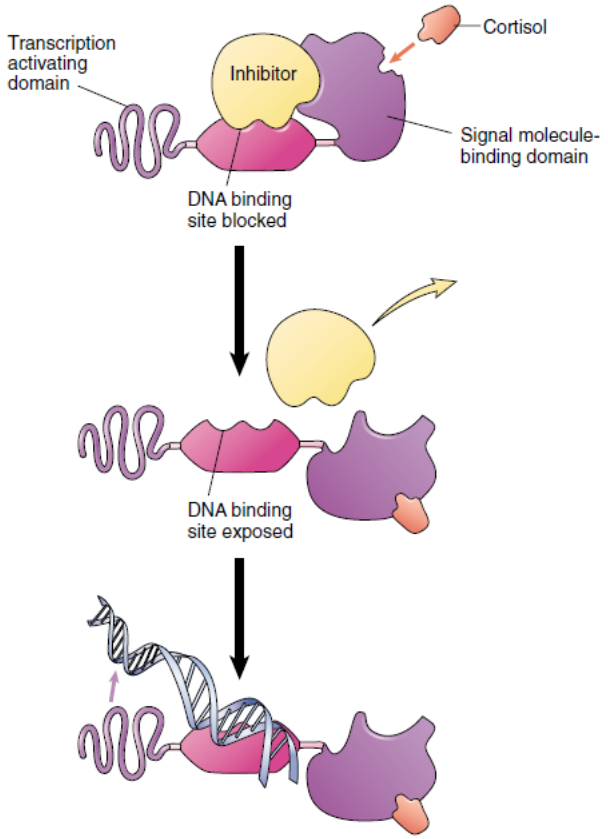
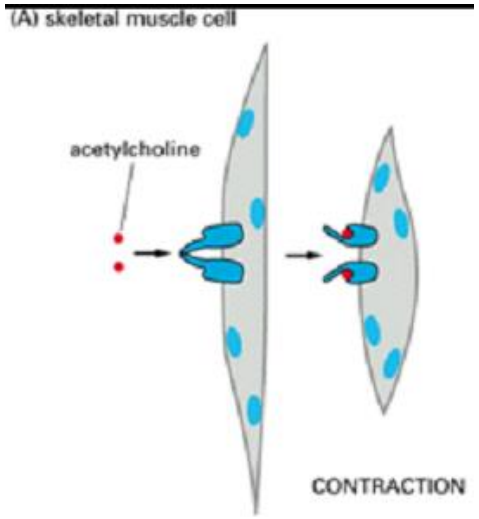
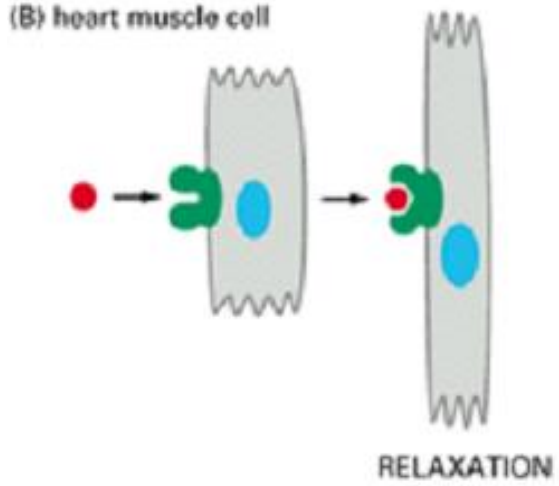
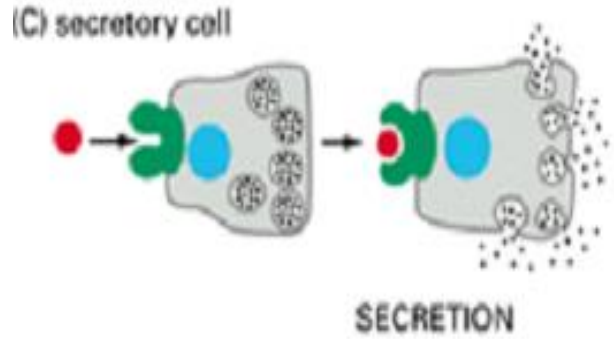


FIGURE 7.5
How intracellular receptors regulate gene transcription. In this model, the binding of the steroid hormone cortisol to a DNA regulatory protein causes it to alter its shape. The inhibitor is released, exposing the DNA binding site of the regulatory protein. The DNA binds to the site, positioning a specific nucleotide sequence over the transcription activating domain of the receptor and initiating transcription.

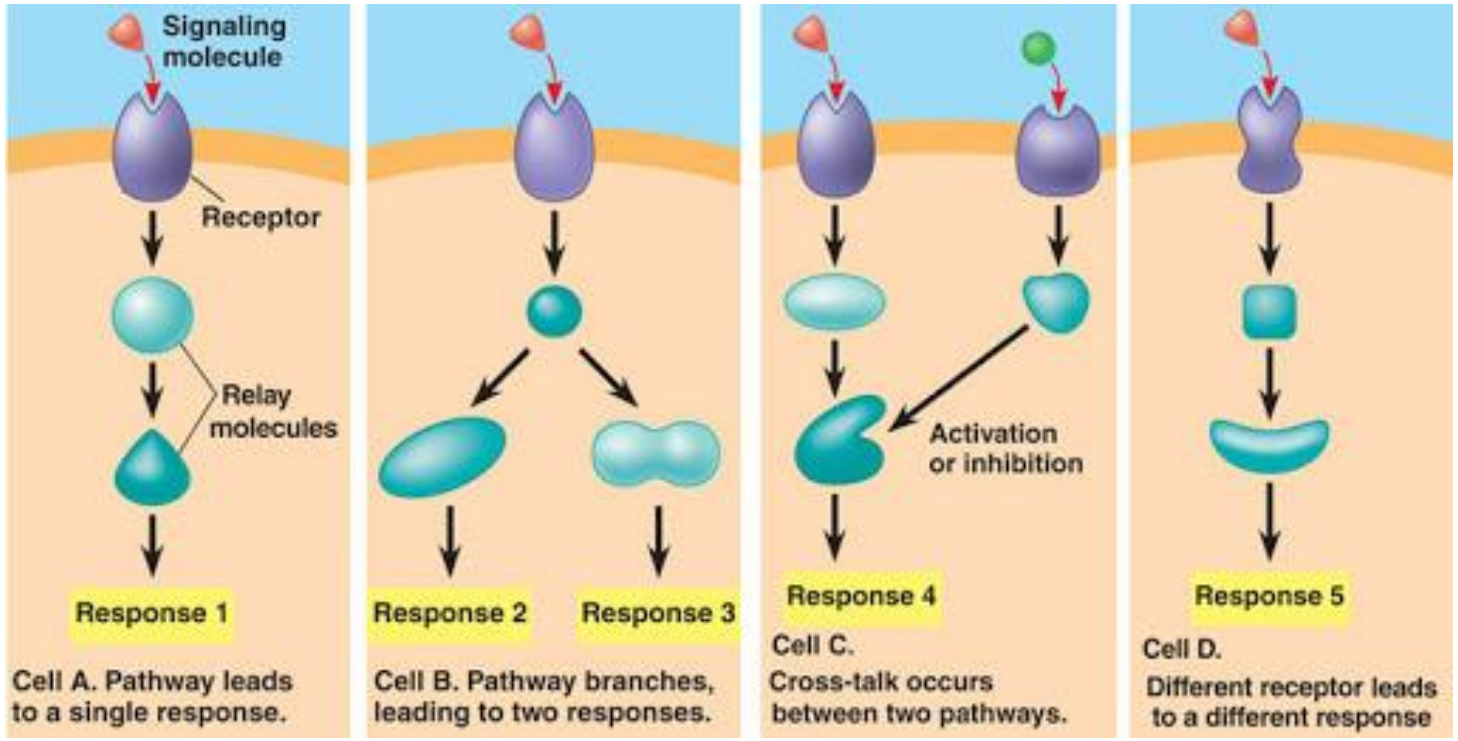
ACETYLCHOLINE AS THE SIGNALING MOLECULE







PERMUTATION-COMBINATIONS



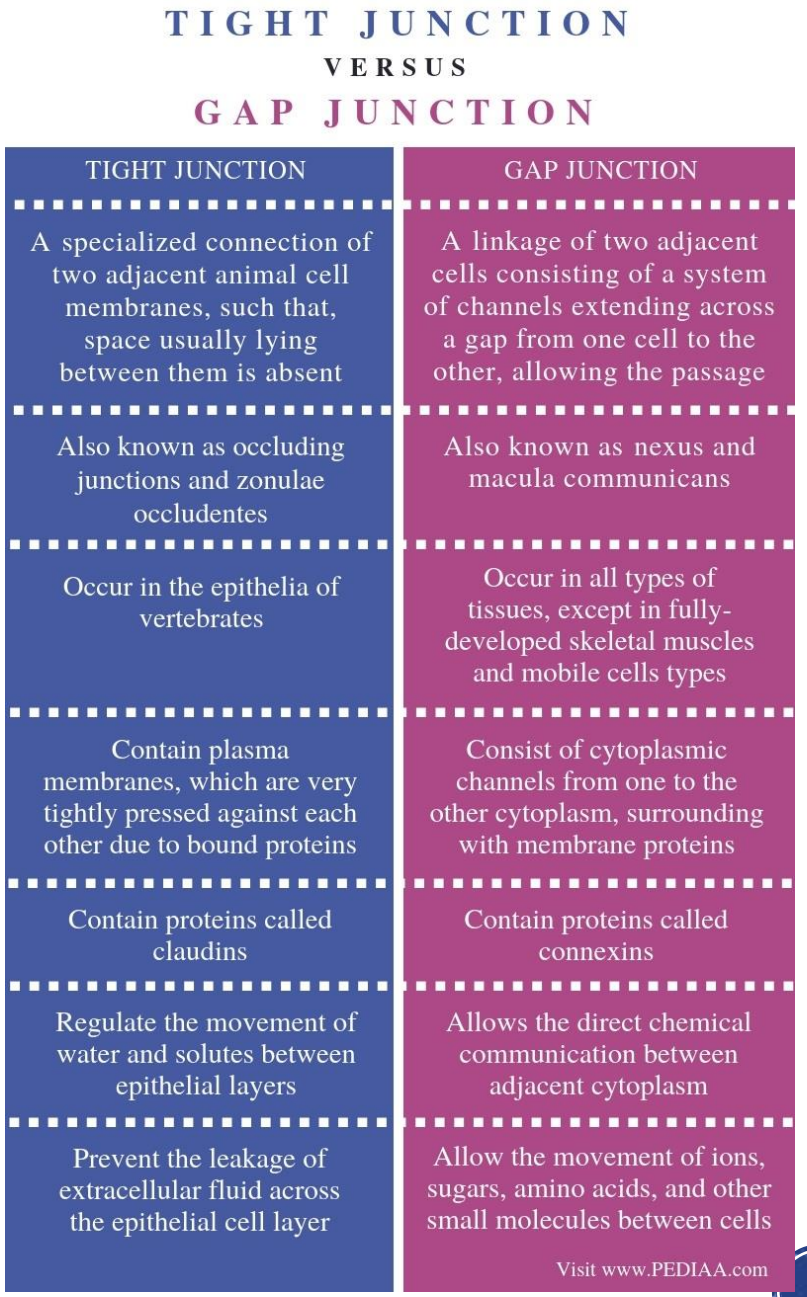
Group I

CELL-CELL JUNCTIONS

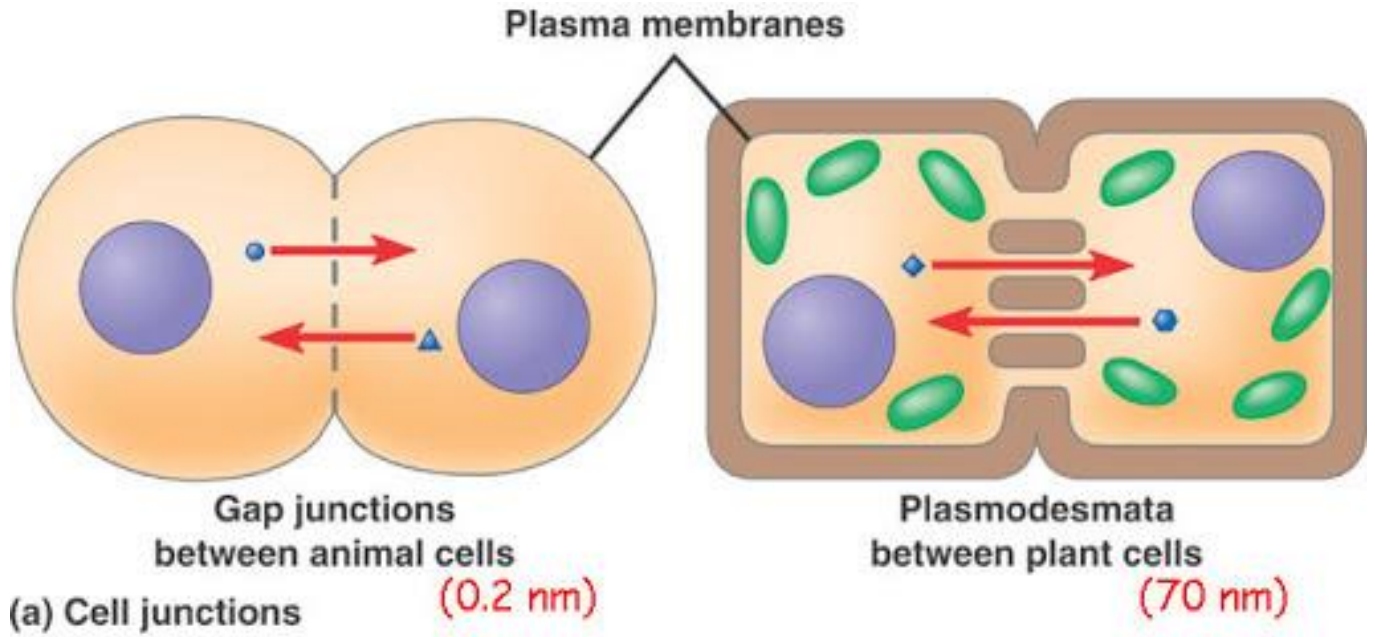
Gap Junctions:
- Tube formed between cells
- Facilitates exchange
- Electrochemical signals in cardiac cells and neuron

Tight Junctions
- Only cells sticking tightly
- Fluid passage
- Intestine and Kidneys

Plasmodesmata
- Cell junction in plants

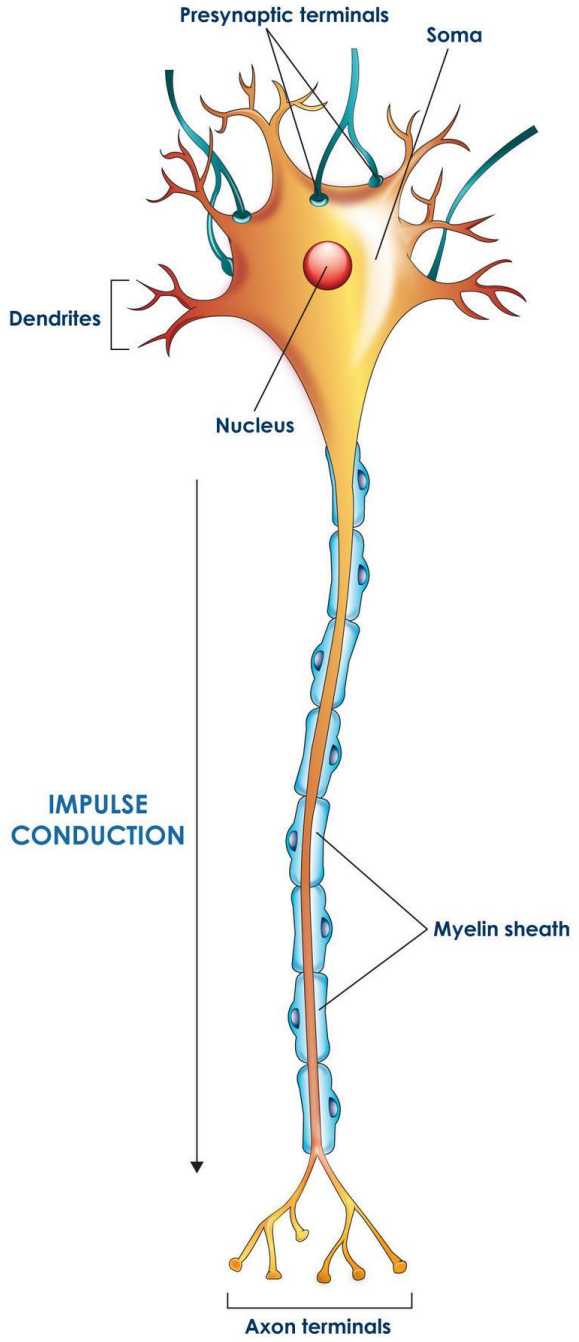


CELL-CELL JUNCTIONS



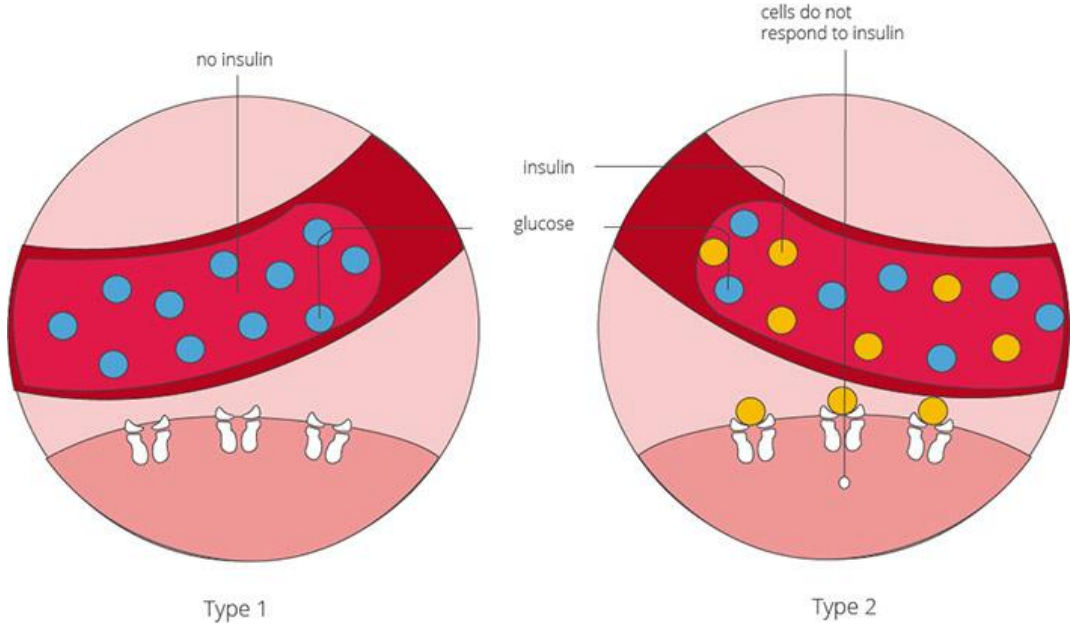
COMMUNICATION LOSS LEADS TO:

Multiple Sclerosis
Myelin sheath that protects nerve cells disappears
Brain and spinal cord
Signal do not pass



COMMUNICATION LOSS LEADS TO:

Diabetes
Target cell receptor not responding to Insulin signal
Diabetes 1- insulin signal is unable to be produced
Diabetes 2- cells have lost the ability to respond to the signals, resulting in abnormally high and dangerous sugar levels in the blood



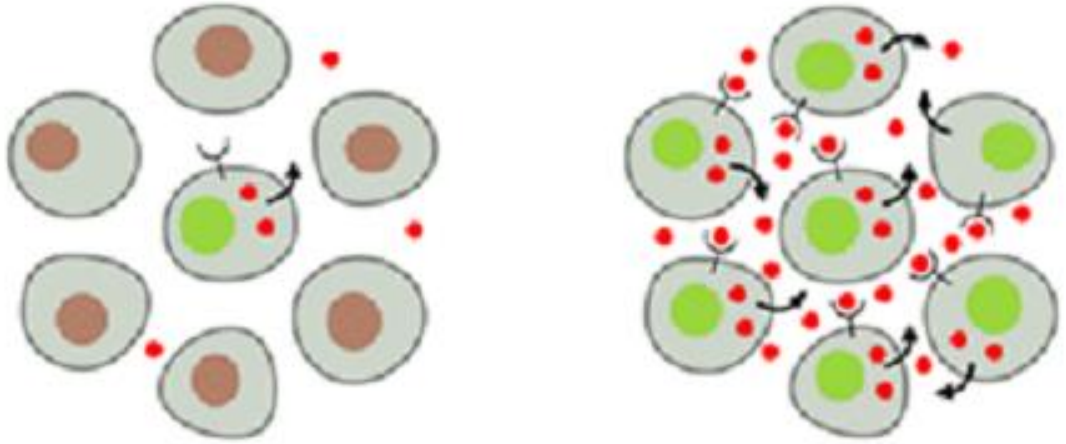
COMMUNICATION LOSS LEADS TO:

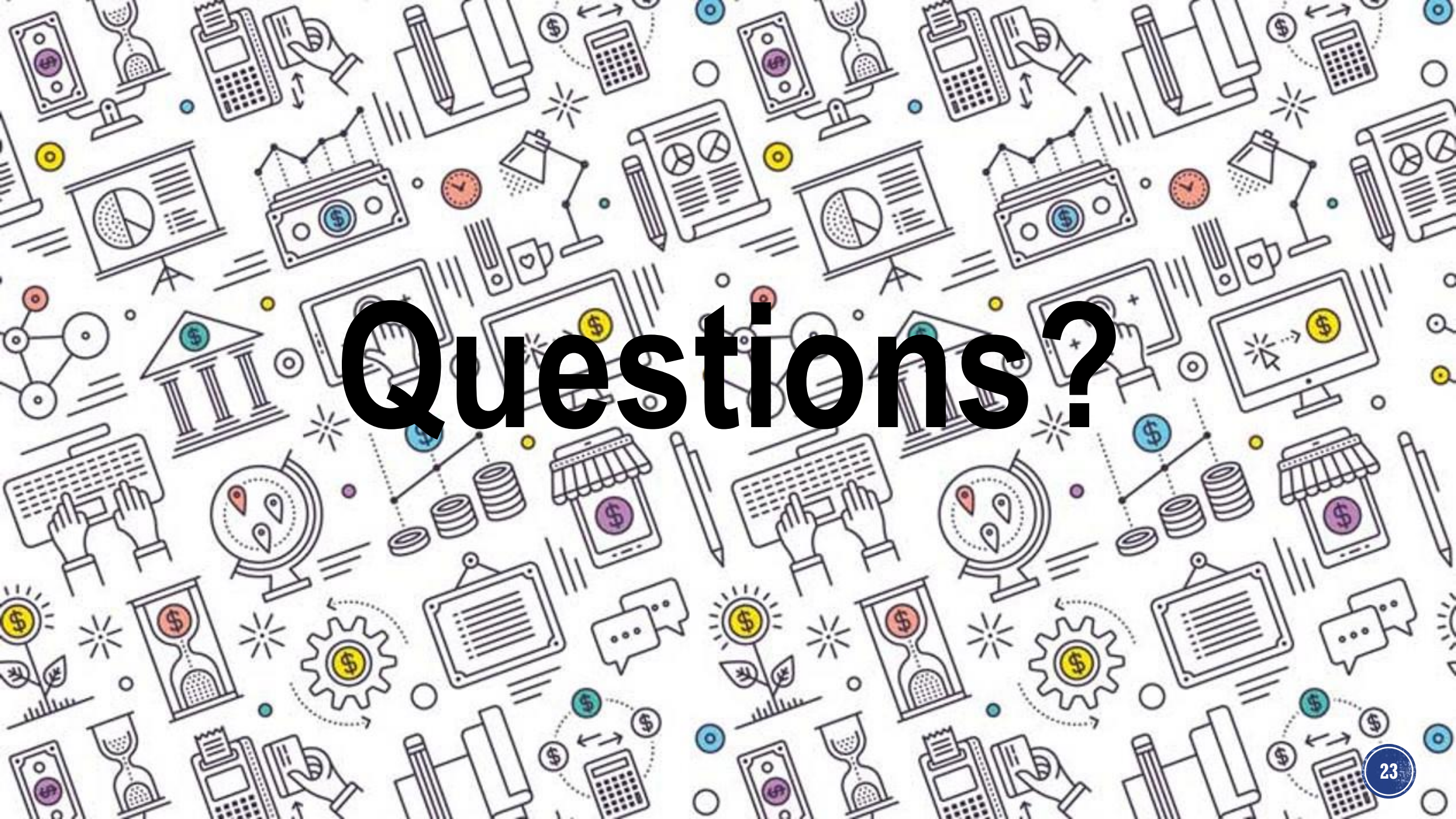
Brain Stroke

- Abnormally high amount of glutamate secreted by dying brain cells
- Kills healthy brain cells (excitotoxicity)
- Extensive brain damage

COMMUNICATION LOSS LEADS TO:

Cancer
Breakdown of multiple signaling pathways
Uncontrolled proliferation of cells- cancer




Questions?