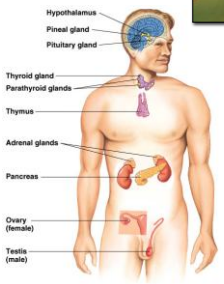


Endocrine System Hormones

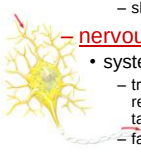
- Living with Type 1 Diabetes

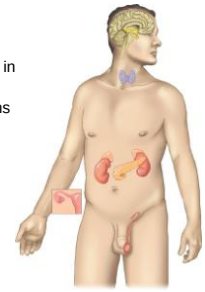
Type 1 Diabetes

- results from the autoimmune destruction of the insulin- producing beta-cells in the pancreas.
- The lack of insulin leads to increased blood and urine glucose.
- Insulin is a peptide hormone that causes cells in the liver, skeletal muscles, and fat tissue to absorb glucose from the blood.

Regulation & Communication

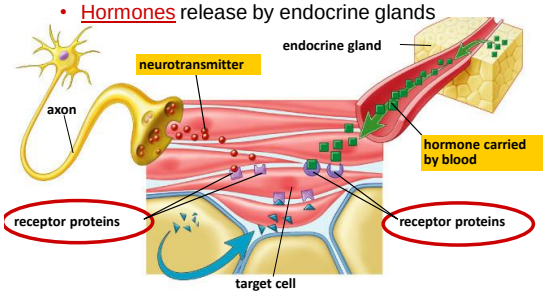
- Animals rely on 2 systems for regulation
  - endocrine system
    - system of ductless glands
      - secrete chemical signals directly in
      - chemical travels to target tissue
      - target cells have receptor proteins
      - slow, long-lasting response
  - nervous system
    - system of neurons
      - transmits "electrical" signal & release neurotransmitters to target tissue
      - fast, short-lasting response





Regulation by chemical messengers

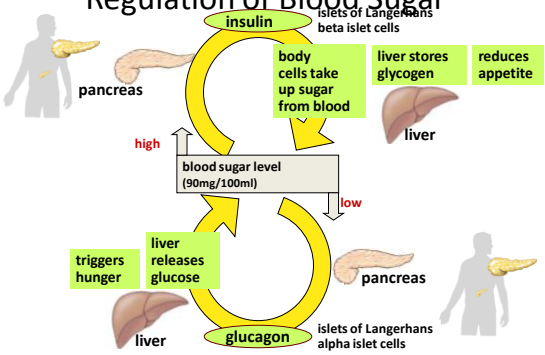
- Neurotransmitters released by neurons
- Hormones release by endocrine glands



Endocrine System Control

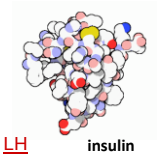
Feedback

Regulation of Blood Sugar



Classes of Hormones

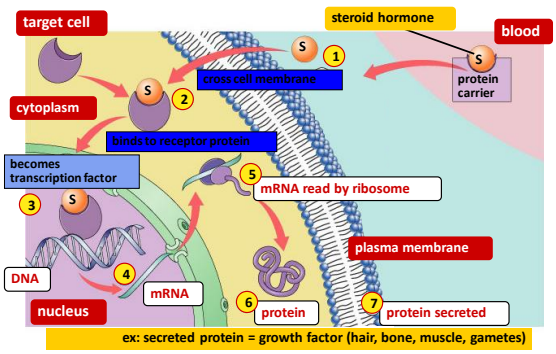
- Protein-based hormones
  - polypeptides
    - small proteins: insulin, ADH
  - glycoproteins
    - large proteins + carbohydrate: FSH, LH
  - amines
    - modified amino acids: epinephrine, melatonin
- Lipid-based hormones
  - steroids
    - modified cholesterol: sex hormones, aldosterone


insulin

How do hormones act on target cells?

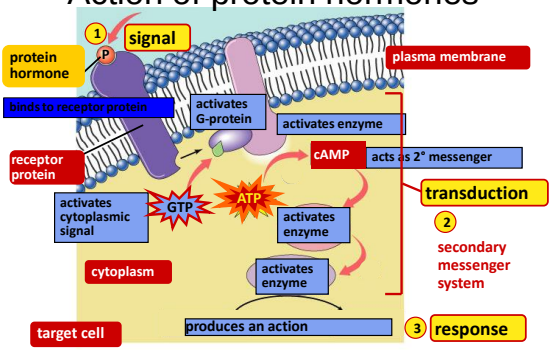
- Lipid-based hormones (Steroids)
  - hydrophobic & lipid-soluble
    - diffuse across cell membrane & enter cells
    - bind to receptor proteins in cytoplasm & nucleus
    - bind to DNA as transcription factors
      - turn on genes
- Protein-based hormones
  - hydrophilic & not lipid soluble
    - can't diffuse across cell membrane
    - bind to receptor proteins in cell membrane
    - trigger secondary messenger pathway
    - activate internal cellular response
      - enzyme action, uptake or secretion of molecules…

Action of lipid (steroid) hormones

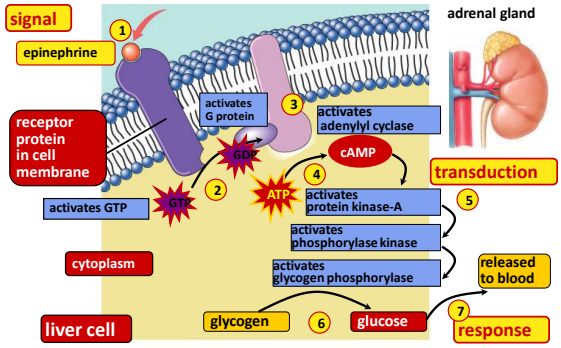


signal-transduction pathway

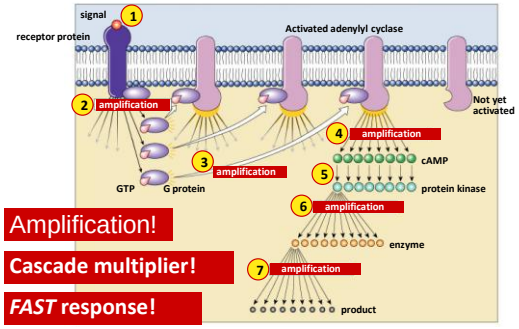
Action of protein hormones



Ex: Action of epinephrine (adrenaline)



Benefits of a 2° messenger system

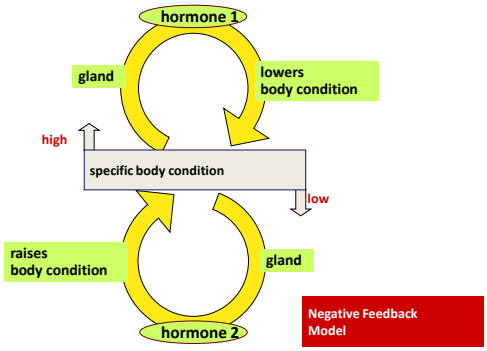


Amplification!

Cascade multiplier!

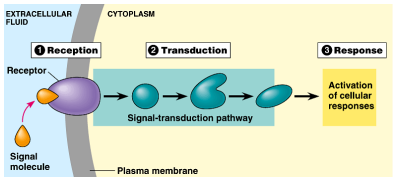
FAST response!

Maintaining homeostasis



Causing a Response

- Three steps:
  - Reception
  - Transduction
  - Response



Step 1: Reception

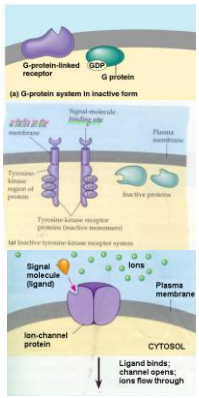
- Signal interacts with receptor site on a membrane or in a cell (RECEPTION)
  - We call this a signal a ligand.
- Ligand attachment to a receptor causes a SHAPE CHANGE in the receptor.
- Shape change starts a domino effect of chemical reactions in the cell (TRANSDUCTION) causing the RESPONSE.

Step 1: Reception

- The location of the receptor is depends on the BIOCHEMISTRY of the signal.
- Protein Signals
  - Proteins can't enter the cell membrane.
  - Bind to receptor proteins on the extracellular side of membrane
    - Remember Protein signals stay on periphery
- Lipid or Steroid Signals
  - Are hydrophobic just like the membrane!
  - They "sneak by the membrane" and bind INTRACELLULAR RECEPTORS.
    - Remember: lipids leak right into cells OR steroids slip right into cells

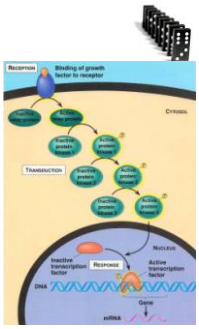
Receptor Types

- The three main receptors that you should be familiar with are:
  - G – coupled protein receptor
  - Tyrosine kinase receptors
  - Ion channel receptors
- They all do the same thing, just a little differently.
- Main Idea:
  - 1. They bind signaling molecule
  - 2. This causes a shape change.
  - 3. This "activates" a cellular response.



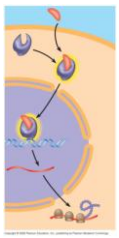
Step 2: Signal Transduction

- Transduction = signal processing.
  - A multistep
- Involves activating other proteins by phosphorylating them.
  - Phosphorylating = kicks them into action.
  - Protein kinases = the enzymes that do this.



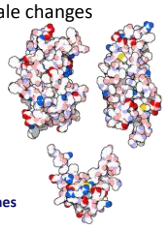
Step 3: Response

- Two main types of cellular responses:
  - 1. Activating enzymes within a cell
    - PROTEIN signals do this, why?
    - Cant get into the cell so must communicate from the outside
  - 2. Turning on/ off genes in your DNA
    - Aka "transcription factors"
    - STEROID signals do this, why?
    - They can sneak right past the membrane and bind intracellular receptors.



Regulation

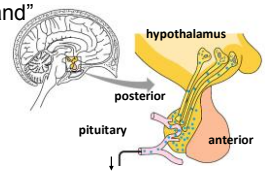
- Why are hormones needed?
  - chemical messages from one body part to another
  - communication needed to coordinate whole body
  - daily homeostasis & regulation of large scale changes
    - solute levels in blood
      - glucose, Ca++, salts, etc.
    - metabolism
    - growth
    - development
    - maturation
    - reproduction



growth hormones

Nervous & Endocrine systems linked

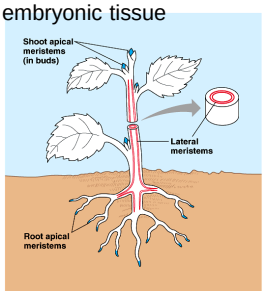
- Hypothalamus = "master nerve control center"
  - nervous system
  - receives information from nerves around body about internal conditions
  - releasing hormones: regulates release of hormones from pituitary
- Pituitary gland = "master gland"
  - endocrine system
  - secretes broad range of "tropic" hormones regulating other glands in body



Plant Growth

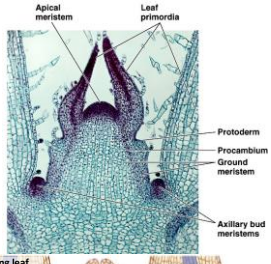
Growth in Plants

- Specific regions of growth: meristems
  - stem cells: perpetually embryonic tissue
  - regenerate new cells
    - apical shoot meristem
      - growth in length
      - primary growth
    - apical root meristem
      - growth in length
      - primary growth
    - lateral meristem
      - growth in girth
      - secondary growth

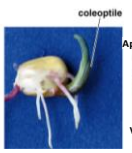


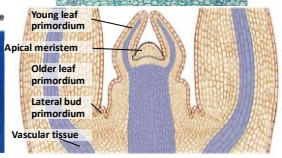
Shoot growth

- Apical bud & primary growth of shoot
  - region of stem growth
  - axillary buds
    - "waiting in the wings"



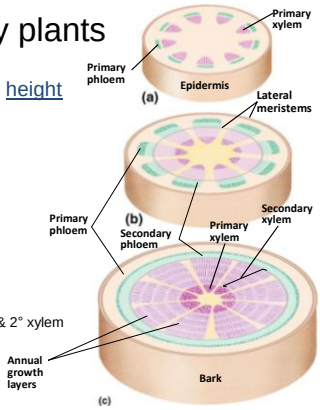
protecting the meristem





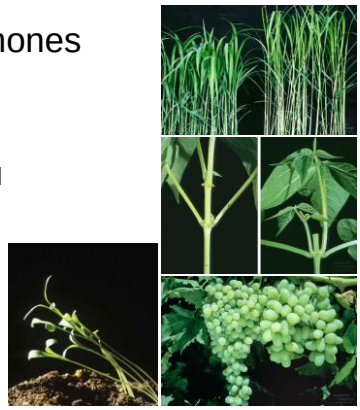
Growth in woody plants

- Woody plants grow in height from tip
  - primary growth
  - apical meristem
- Woody plants grow in diameter from sides
  - secondary growth
  - lateral meristems
    - vascular cambium
      - makes 2° phloem & 2° xylem
    - cork cambium
      - makes bark



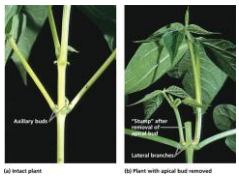
Plant hormones

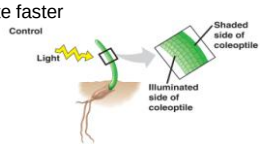
- auxin
- gibberellins
- abscisic acid
- ethylene
- and more…



Auxin (IAA)

- Effects
  - controls cell division & differentiation
  - phototropism
    - growth towards light
    - asymmetrical distribution of auxin
    - cells on darker side elongate faster than cells on brighter side
  - apical dominance





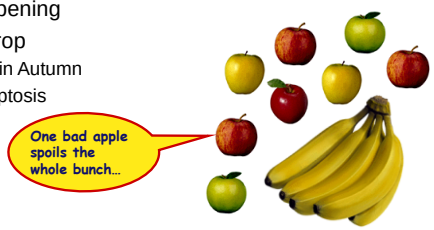
Gibberellins

- Family of hormones
  - over 100 different gibberellins identified
- Effects
  - stem elongation
  - fruit growth
  - seed germination

plump grapes in grocery stores have been treated with gibberellin hormones while on the vine

Ethylene

- Hormone gas released by plant cells
- Effects
  - fruit ripening
  - leaf drop
    - like in Autumn
    - apoptosis



Fruit ripening

- Adaptation
  - hard, tart fruit protects developing seed from herbivores
  - ripe, sweet, soft fruit attracts animals to disperse seed

- Mechanism
  - triggers ripening process
    - breakdown of cell wall
      - softening
    - conversion of starch to sugar
      - sweetening
  - positive feedback system
    - ethylene triggers ripening
    - ripening stimulates more ethylene production

Response to Light

- Phytochromes regulate many plant responses to light
  - Helps plants detect light; keeps track of seasons; day length
- SHORT DAY PLANTS need daylight for less than a critical period to flower
  (flower in late summer, fall, winter)
- LONG DAY PLANTS need daylight for longer than a certain critical period to flower
  (flower in late spring/early summer)