Exam 8 Physiology Study Guide (3/21)

**Endocrine System (**Other communication system besides nervous system)
-Moves through plasma → blood-carried signals (blood levels tested to see communication)
*Distance is not a problem – has widespread effects
-Regulated by feedback mechanism (like proprioception, NTs)
-Speed – SLOW (endocrine <<< neural)
*But has benefits: lasts longer, more widespread
-Pathway: Gland (neuron) releases endocrine/hormone → effector → physiological change
-Endocrine/hormone differs in:
1. Type – how they are created
2. Mechanism of action (how they act in the body)
-<u>Types of Endocrines</u>
1. Amine endocrines (have nitrogen group)
-All derived from tyrosine (C group) → starting point for all = same basic structure
-Shape and charge important for binding ligands
*protein deficiency leads to other issues such as neurological
-Examples: $T_3$ and $T_4$ – produced by thyroid gland → ONLY nonpolar amine endocrines
Dopamine – produced by hypothalamus
Norepinephrine/epinephrine – produced by adrenal medulla (sympathetic)
2. Peptide endocrines (short amino acid chain)
-Synthesized as prohormone (proendocrine) = inactive form of endocrine
-Why? Protects from doing job within cell → messenger must be released
-Must be exocytosed – packed into secretory vesicles (can then be processed into active endocrine → lose pro prefix)
-Stored in vesicles until signal releases them (only release when needed) → like NTs
-Released on demand
-Examples: Insulin (regulates blood sugar)
Hypothalamic releasing hormones
Pituitary endocrines
Gastrointestinal endocrines (digestive system)
3. Steroid Endocrines – NONpolar
-Synthesized from cholesterol (amphipathic)– everyone has cholesterol (needed in body)
-All have same chemical structure - multiple rings
-Relaxed to sex
- Lipophilic (hydrophobic) → needs binding protein to move through plasma
-Intracellular receptors bind inside the cell
-Alters DNA transcription
-Produced/released by gonads, adrenal cortex, and placenta
*Production requires steroidogenic enzymes (making steroids)
-If not wanted in system can go after enzyme that creates the endocrine
<u>Mechanism of Action</u>
-Endocrines are ligands that go and bind to receptors
-Hydrophilic: bind to membrane-bound receptors → activate 2nd messenger system
-Hydrophobic: activate DNA transcription
-Spots for disruption of ligand/receptor communication (up-regulate or down-regulate)

1. Endocrine (ligand) synthesis or release
2. Receptor expression – can hide them or put out more
3. Alter clearing → how long is it present in blood after its released?
    -Send out agent to catabolize endocrines and/or excrete them (peeing) to get rid of or to communicate
    *Endocrine levels can be tested in blood AND urine

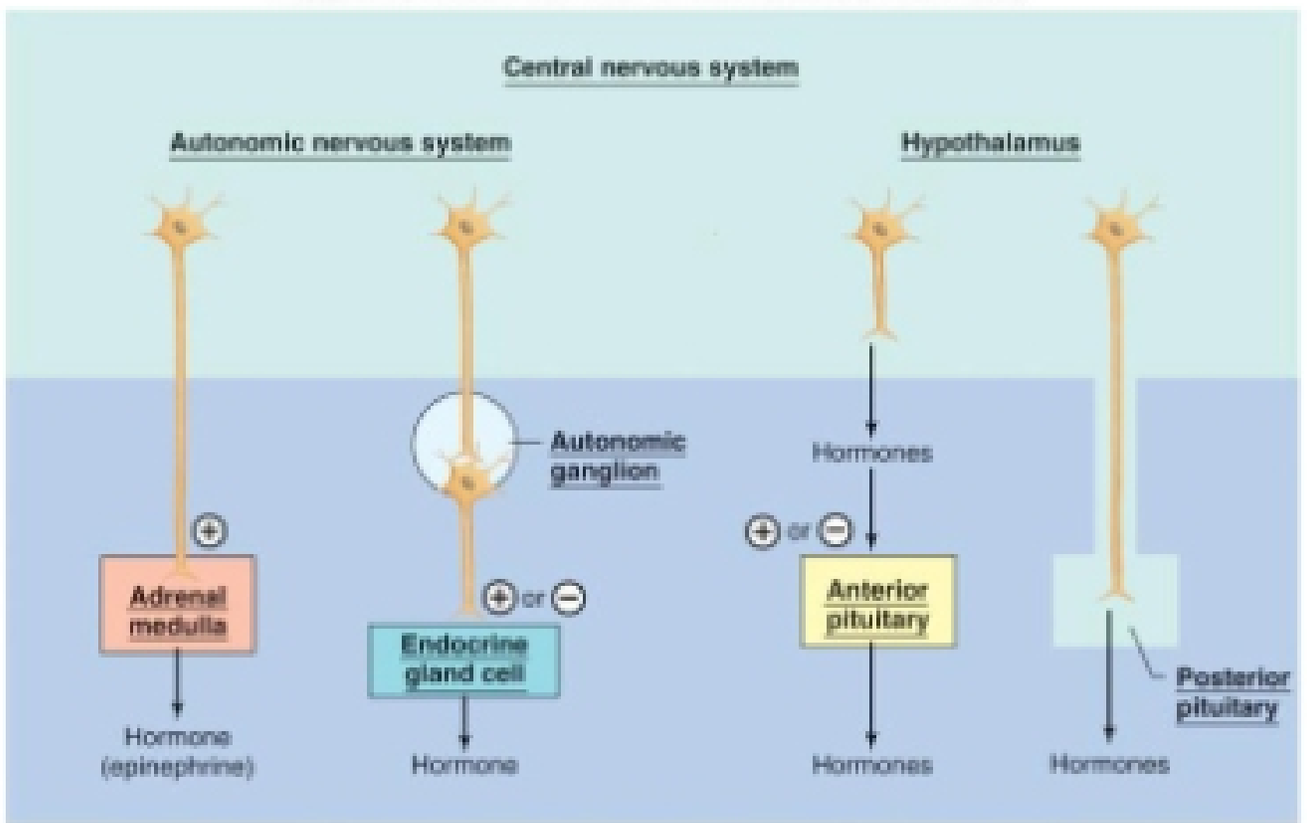
-Ex: dogs sniffing other dog's buts to determine endocrine communication in body
-Ex: pregnancy tests measure endocrine levels

<u>Regulation of Secretion</u>

-Concentration of substances in plasma - monitors chemosensory levels (homeostasis)
    -Ions → like $Na^+/K^+/Ca^{2+}$
    -Nutrients → like glucose (needed for energy)
-Neurotransmitters – trigger endocrine release
    -ACh stimulates adrenal medulla to release epinephrine/norepinephrine

**NOTE: interface between nervous/endocrine system = hypothalamus
    -Hypothalamic neurons receive input from NTs to release endocrines
-Other endocrines → often cause release of other endocrines to get final response
    -Ex: pituitary endocrines stimulate other glands to release other endocrines





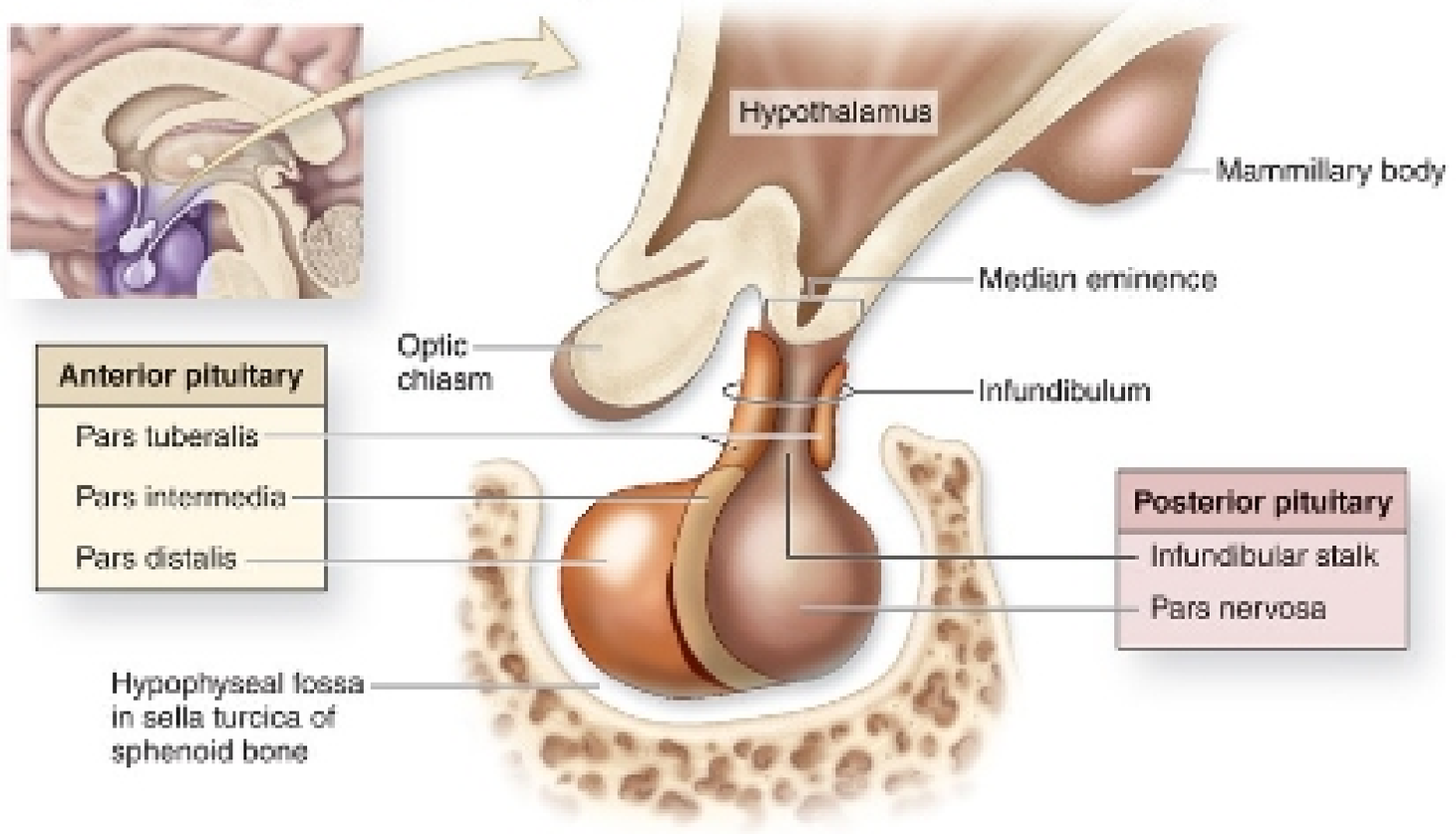

<u>Structure Components</u>

-**Hypothalamus** – surrounds 3rd ventricle (4 total) → part of the brain
    -Contains neurons that release endocrines
    -"Master Gland" (NOT pituitary)
    -2 ways to release endocrines to pituitary (anterior / posterior)

**Pituitary gland** – Hypophysis
    -Infundibulum (tissue) → connects bottom of brain to pituitary
    -2 divisions
        -Anterior (adenohypophysis)
            -Endocrines released by hypothalamus reach it via portal vasculature
            -7 endocrines (hypophysiotrophic)
        -Posterior (neurohypophysis) → Talk of it becoming part of pituitary

-Via terminals of hypothalamic neurons (extension of hypothalamus)
-Doesn't make any endocrines of its own
-2 endocrines released this way






-<u>Communication Overview</u>
Stress (activates it) → Hypothalamus (releases endocrine 1) → anterior pituitary (endocrine binds to receptors and releases endocrine 2) → gland (releases endocrine 3) → effector (target organs/cells) → response
**NOTE: gland (endocrine 3) has 3 jobs → create response and negative feedback on E1 and E2 production (keeps us from overshooting once endocrine is in system)
-Why do we need 3 groupings? So complex!

Benefits:

-Many opportunities to regulate → more opportunity to make adjustments
-Amplification → begins in brain to hypothalamus
*To have more endocrine made, need more production space (more cells)
-But can't increase size of hypothalamus much b/c in brain
*Bigger production area out in body where space less limited (ex: thyroid)
*Few E2s can cause many E3s directly
*Few E1s can indirectly cause many E3s

**E1** = from **hypothalamus** → hypophysiotropic endocrines (7) → impact pituitary gland
-5 stimulate it (pituitary releases endocrines) – Released by hypothalamus

1. Corticotropin-releasing hormone (CRH) → cortex area (in outer adrenal gland)
   → Causes anterior pituitary gland to release adrenocorticotropic hormone (ACTH) = E2 → in adrenal gland
2. Thyrotropin-releasing hormone (TRH)
   → Thyroid stimulating hormone (TSH) = E2 → in thyroid gland
3. Growth hormone-releasing hormone (GHRH)
   → Growth hormone (GH) = E2
4. **Gonadotropin-releasing hormone (GnRH) → releases 2 E2s
   -Luteinizing hormone (LH) and follicle-stimulating hormone (FSH)
5. **Prolactin-releasing factor (PRF)
   -Prolactin released by pituitary → impacts mammary glands