The Endocrine System
C18 Study Guide // Tortora & Derrickson

1. What is the difference between an endocrine and exocrine glands? // Cells of Exocrine glands deliver secretions onto a surface by way of a duct. // Endocrine glands transport their secretions (hormones) to target tissue by using the blood stream.

2. What are the two communication systems in the body? Compare them? /// Nervous System = electrochemical communication = fast (milliseconds) // Endocrine System = chemical messengers (hormones) = slow (minutes – hours – days – months)

3. What is the advantage of enzyme amplification? Why is it discussed in endocrinology? /// A small number of enzymes can produce a lot of product since they are not consumed in the catalytic reaction and can be used over and over // Hormones direct changes in the target tissue's metabolism which is regulated by enzymes.

4. What two word phrase describes the function of a hormone? /// Chemical messenger

5. What is the difference between a hormone and a paracrine? /// Hormones influence cellular metabolism throughout the body because the hormones are transported throughout the body by the blood // Paracrines are also chemical messengers secreted by cells however paracrines do not enter the blood stream and only affect cells in the immediate area of their production.

6. What is the "working model" of a hormone? Draw picture. //Hormone produced by variety of cells types // secreted into blood // only cells throughout body with receptor matched to hormone will bind hormone // only after hormone binds to target tissue with appropriate receptor will hormone modify metabolism of target tissue

7. What is the importance of the hypophyseal-pituitary- axis? /// Hypophyseal pituitary axis shows the regulatory relationship between the hypothalamus and pituitary. Hypothalamus produces chemical messengers (hormones) with travel down infundibulum to stimulate release of hormones from pituitary (i.e. the "master gland" of the endocrine system // most influential endocrine gland in human body)

8. What hormones are hyperglycemic? /// Glucagon, growth hormone, epinephrine, norepinephrine, cortisol, corticosterone

9. Which hormone is hypoglycemic? /// Insulin

10. Be able to list the anterior and posterior hormones and describe their functions: (see list at bottom of page)

11. What is the hypothalamo-hypophyseal tract? Function and structure. /// Tract tells you that this structure consists of axons. They connect areas of the hypothalamus that produces hormones (ADH and oxytocin) with the posterior pituitary that release these two hormones

12. What is the hypothalamo-hypophyseal portal system? Function and structure. /// A portal system is a blood circulatory circuit which consists of two capillary beds between an artery and a vein. In this case it allows hormones to be produced in one area (hypothalamus) and transported directly to a specific location (anterior pituitary)

13. Where are the hormone's receptors located (hint: hydrophobic vs hydrophilic hormones)? /// Hormone receptors maybe either on the surface of the target cell's plasma membrane or inside the cell (e.g. the nucleoplasm)

14. What events happen following hyposecretion of insulin? /// Blood glucose levels rise.

15. What is the difference between diabetes insipidus, type I diabetes mellitus, type II diabetes mellitus, and gestational diabetes? /// Diabetes implies an increase is urine volume. In diabetes insipidus the cause for the increase in urine volume is due to the reduced secretion of ADH. // In diabetes mellitus type I the cause in lack of insulin secretion which causes high blood glucose levels. This then results in glucose exceeding the kidneys transport maximum for glucose, the kidney can not reabsorb all the glucose it filters and some glucose "spills" into the urine which increases urine volume by an osmotic force (i.e. osmotic drag). // In DM type II blood glucose levels are elevated because the target tissue are insensitive to insulin. The kidney responds to elevated glucose levels similar to what was experienced in type I. /// mother's cells become resistant to insulin so fetus gains too much weight

16. What hormones regulate calcium metabolism? /// Parathyroid hormone stimulates the breakdown of bone calcium-phosphate crystals therefore it allows calcium to move into the blood // Calcitonin stimulates new bone growth which requires moving calcium from the blood into the bone (i.e. lowers blood calcium levels)

17. What four hormones are secreted by the adrenal cortex? /// Aldosterone and cortisol (much lower concentrations androgens and estrogens // not principle secretory gland for these two hormones)

18. How are hydrophilic and hydrophobic hormones transported? /// Hydrophillic hormones dissolve in blood // hydrophobic hormones need to be "transported" because do not dissolve in blood – often hydrophobic hormones are attached to albumin which is a soluble blood protein.

19. What endocrine gland is most affected by stress? /// Adrenal gland.

20. Explain the anatomy of the pituitary gland and related structures. (see figure in book)

21. List the hormones secreted by these organs and explain their function(s) and target(s): thymus, thyroid, parathyroid, adrenal, gland, pancreas, gonads. (see separate worksheet)

22. Explain positive and negative feedback mechanisms using oxytocin and thyroid stimulating hormone: /// Oxytocin regulation is our reference model for positive feedback. It is a "neuron – endocrine pathway" seen in both the let down of milk from the mammary gland and in parturition. Never tracts go into hypothalamus to increase production-release of oxytocin into blood which goes to target tissue where it further stimulates the nerve tracts going to the hypothalamus // TSH is our reference model for negative feedback. TSH is secreted from the pituitary and its target tissue is the thyroid glands which secretes thyroid hormone which then goes back to the pituitary and stops the secretion of TSH (i.e. negative feedback)

23. What type of molecules are hormones? /// Steroids (e.g. estrogen and testosterone) // peptides (e.g. insulin) // monoamines (e.g. epinephrine)

24. What hormone "types" are hydrophobic and hydrophilic? How does this affect their function? Location of receptors? /// Steroids are hydrophobic and require a carrier molecule in the blood which has the effect of making the steroid hormones have longer half lives. Peptides and monoamines are soluble in blood and tend to have shorter half lives.

25. What is a second messenger? What type of hormones use second messengers? /// Second messengers are also called metabotrophic. These are transmembrane proteins with a receptor on the outer face of the plasma membrane which the hormone may engage. If the hormone fits into the receptor then on the inner face of the transmembrane protein a "G protein" is release which activates a different transmembrane protein which "makes" a new molecule which is the "second messenger". // peptide and monoamine hormones must use second messenger systems to change metabolism of their target tissues.

26. What hormones are secreted by the ovaries and how are they regulated? /// Ovaries secrete estrogen (stimulated by FSH). The ovaries corpus luteum secretes progesterone, estrogen, relaxin and inhibin.

27. What hormones are secreted by the testes and how are they regulated? /// Testes secrete testosterone and inhibin. FSH stimulate Sertoli cells to produce androgen binding protein and LH stimulates interstitial cell to produce testosterone. Testosterone must be concentrated within seminiferous tubles in order to promote spermatogenisis. /// If sperm are not being used than Sertoli cells produce inhibin that stops FSH secretion to stop spermatogenisis.

Know These Hormones (origin – target tissue - action)

Growth Hormone - GH (released by anterior pituitary gland // all cells of body // stimulate growth, anabolism, mobilize nutrients for growth)

Adrenocorticotrropic Hormone – ACTH (released by anterior pituitary gland // target tissue cortex of adrenal gland // cause release of two hormones aldosterone = salt retention hormone – target tissue kidney also cortisol = anti-inflammatory hormone – targets all cells)

Thyroid Stimulating Hormone - TSH (released by anterior pituitary gland // target tissue = thyroid gland // causes release of thyroxin also commonly known as the thyroid hormone // nicknamed the gas peddle of the human body // increases metabolism of all cells)

Antidiuretic Hormone - AD (released by posterior pituitary gland // target tissue = kidney collection ducts // causes reduced urine volume which conserves water in the body)

Calcitonin (released by "C" cells of the thyroid gland // lowers blood calcium levels by moving calcium into the skeletal system)

Parathyroid Hormone - PH (released by the parathyroid gland // primary target is skeletal system // stimulate osteocytes to break down bone to increase calcium concentration in the blood)

Insulin (released by pancreas beta cells // high glucose levels in blood cause release of insulin // insulin affects most cell membranes to allow glucose to enter cells // as glucose moves into cells blood glucose concentration is reduced)

Glucagon (released by pancreas alpha cells // low glucose levels in blood causes release of glucagon // primary target is liver which under influence of glucagon breaks down stored glycogen to release glucose into the blood)

Aldosterone (released by adrenal cortex - mineralcorticoid // called the salt retention hormone // target tissue is kidney // recovers sodium which also drags water back into the body – has tendency to increase blood pressure)

Cortisol (released by adrenal cortex – gluccocorticoid // target tissue most cells of body // in general stimulate formation of glucose from proteins // anti-inflammatory because it stops new protein synthesis including antibodies)

Estrogen (principle female hormone – steroid // primary source ovaries but placenta also produces hormone during pregnancy // affects many tissue including placental development, mammary gland development, fat distribution, shaping female morphology following puberty // up-regulate uterus for progesterone receptors)

Progesterone (principle female hormone – steroid // primary source corpus luteum of the ovary following release of ovum // after placenta develops also source of progesterone // required to maintain pregnancy)

Follicle Stimulating Hormone - FSH – female (released by anterior pituitary gland // target tissue primordial follicles in the ovaries // stimulate development of egg)

Lutenizing Hormone - LH - female (released by anterior pituitary gland // target tissue = maturing egg in ovary = Graffian follicle // stimulates release of egg into uterine tube but remaining cells of follicle stay on surface of ovary to form corpus luteum which then produces progesterone which is required to maintain pregnancy)

Follicle Stimulating Hormone - FSH – male (released by anterior pituitary gland // target tissue male testes seminiferous tubules to produce androgen binding hormone // this protein required to concentrate testosterone inside seminiferous tubules so spermatogenisis can occur)

Lutenizing Hormone - LH – male (released by anterior pituitary gland // target tissue male testes interstitial cells between seminiferous tubules // causes interstitial cells to produce testosterone which then becomes concentrated within seminiferous tubules due to androgen binding hormone which then allows the formation of new sperm – spermatogenisis