

Chapter 18: Endocrine Glands

I. Functions of the Endocrine System

A. List and describe the eight major functions of the endocrine system:

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

II. Pituitary Gland and Hypothalamus

A. Structure of the Pituitary Gland

1. What bony structure is the pituitary associated with? _____
2. What is the infundibulum? _____
3. Posterior Pituitary or Neurohypophysis
 - a. It is continuous with the _____
 - b. It develops from an outgrowth in the area of the _____
 - c. The outgrowth forms the _____
 - d. The enlarged distal end of the outgrowth forms the _____
 - e. Secretions from posterior pituitary are properly called _____
4. Anterior Pituitary or Adenohypophysis
 - a. Arises as an outpocketing of the _____
 - b. List the three subdivisions of the anterior pituitary:
 1. _____
 2. _____
 3. _____
 - c. Does the anterior pituitary also secrete neurohormones? _____

B. Relationship of the Pituitary to the Brain

1. The hypothalamohypophysial portal system connects what to what? _____

- a. The first capillary network is in _____
- b. The second capillary network is in _____
2. What substances travel in this portal system? _____
3. If a neurohormone causes the secretion of an anterior pituitary hormone it is specifically called _____
4. If a neurohormone prevents the secretion of an anterior pituitary hormone it is specifically called _____
5. Hormones produced in the anterior pituitary enter the _____
and are carried by _____ to their _____
6. Refer to Table 18.1 in the text for names and functions of the neurohormones
7. What is the hypothalamohypophysial tract? _____

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8. Where are the neurohormones produced? _____
 9. Where are the neurohormones stored until released? _____
 10. What stimulates release of the stored neurohormones? _____
-

III. Hormones of the Pituitary Gland

A. Posterior Pituitary Hormones

1. Antidiuretic Hormone (ADH)

- a. Functionally ADH _____
- b. ADH is also called _____
 1. What does this name refer to? _____
- c. ADH is synthesized in the _____ of the hypothalamus
- d. The primary target tissue for ADH is _____
 1. Where it functionally:
 - a. Promotes _____
 - b. Reduces _____
- e. Secretion of ADH varies in response to changes in _____ & _____
- f. What is an osmoreceptor? _____
- g. Osmoreceptors connect to _____
- h. In response to an increase in blood osmolality:
 1. Osmoreceptors send action potentials at a _____
 2. The neurosecretory cells respond by _____
 3. ADH causes the kidneys to _____
 4. The additional water dilutes blood solutes thus _____ blood osmolality
 5. In addition, the increase in blood osmolality may directly _____
- i. In response to a decrease in blood osmolality:
 1. Frequency of action potentials from osmoreceptors _____

2. So the neurosecretory cells release _____ ADH
3. Therefore the kidneys:
 - a. Retain _____ water
 - b. Produce _____ urine
4. Blood osmolality _____
- j. The ADH neurosecretory cells are also influenced by receptors that detect changes in _____
- k. Lower than normal blood pressure causes _____ ADH secretion
- l. Higher than normal blood pressure causes _____ ADH secretion
2. Oxytocin
 - a. Oxytocin is synthesized in the _____ of the hypothalamus
 - b. Functionally oxytocin:
 1. Stimulates _____
 2. Also causes _____
 3. Responsible for _____
 - c. Release of oxytocin is stimulated by:
 1. Stretch _____
 2. Mechanical _____
 3. Stimulation _____

B. Anterior Pituitary Hormones

1. General
 - a. Release of hormones from the anterior pituitary is controlled by _____ from the hypothalamus
 - b. Chemically the hormones from the anterior pituitary are: _____
 - c. The anterior pituitary hormones are transported _____
 - d. Anterior pituitary hormones have a half-life measured in _____
 - e. Anterior pituitary hormones bind to _____ receptors
2. Growth Hormone (GH)
 - a. Is also known as _____
 - b. Functionally growth hormone:

1. Stimulates _____
 2. Plays _____
 3. Regulator _____
 4. Increases _____
 5. Favors _____
 6. Also increases _____
 7. Increases glycogen _____
 8. Plays a role in regulating _____
- c. What are somatomedins? _____
- d. Functionally somatomedins:
1. Stimulate growth in _____ & _____
 2. Increase _____ muscles
- e. When growth hormone binds to membrane-bound receptors they cause _____ inside the cell
- f. Secretion of growth hormone is regulated by two neurohormones from the hypothalamus called:
1. _____
 2. _____ or _____
- g. What body conditions act on the hypothalamus to:
1. Increase GH secretion _____
 2. Decrease GH secretion _____
- h. Highest levels of GH are usually associated with _____
3. Thyroid Stimulating Hormone (TSH)
- a. Is also known as _____
 - b. TSH stimulates _____
 - c. TSH also increases the activity of _____
 - d. Functionally phospholipase _____
 - e. TRH from the hypothalamus _____ TSH secretion
 - f. Thyroid hormones _____ TRH and TSH secretion
 - g. TSH levels are normally highest _____

4. Adrenocorticotrophic Hormone (ACTH) and Related Substances
- The precursor molecule is called _____
 - ACTH
 - Functionally ACTH increases _____ primarily _____ from _____
 - ACTH also binds to _____ & _____
 - Lipotropins attach to membrane-bound receptors on _____
 - This results in _____ & _____
 - β endorphins have the same effects as _____
 - They can play a role in _____
 - Secretion increases in response to _____
 - Melanocyte-stimulating hormone (MSH)
 - Binds to receptors on _____ and stimulates _____
5. Luteinizing Hormone (LH), Follicle Stimulating Hormone (FSH) and Prolactin
- Hormones that stimulate growth and function of the gonads are called: _____
 - LH and FSH stimulate the production of:
 - Gametes:
 - Males: _____ in the _____
 - Females: _____ in _____
 - LH and FSH control the production of:
 - Reproductive hormones:
 - Females: _____ & _____ in the _____
 - Males: _____ in the _____
 - Release of LH and FSH is stimulated by the hypothalamic-releasing hormone _____
 - Prolactin plays an important role in _____
 - Prolactin also increases the number of receptors for _____ in the _____
 - After ovulation prolactin can _____

h. Neurohormones involved in the control of prolactin secretion include:

1. _____
2. _____

IV. Thyroid Gland

A. Structure and Histology

1. The thyroid gland is composed of _____ lobes connected by an _____ called _____
2. The two lobes lie on either side of the _____
3. Anatomically the thyroid gland is just inferior to the _____
4. Why does it appear redder than surrounding tissue? _____
5. What is a follicle? _____
6. A follicle is composed of a single _____
7. Where is thyroglobulin found? _____
8. Thyroglobulin is a _____ to which _____ is bound
9. Where are parafollicular cells found? _____
10. What is produced by the parafollicular cells? _____
 - a. This hormone plays a role in _____

B. Thyroid Hormones

1. The two forms of thyroid hormone are:
 - a. _____
 - b. _____ also called _____
2. Thyroid Hormone Synthesis
 - a. Which hormone from the anterior pituitary is required for synthesis of thyroid hormones? _____
 - b. Synthesis of thyroid hormones also requires _____ in the diet
 - c. The synthesis and secretion of thyroid hormone involves:
 1. Iodide ions are taken up by _____ by _____
 2. Follicle cells synthesize the protein _____
 - a. This protein contains numerous _____ amino acids
 3. One or two iodine atoms are bound to each _____

- a. Thyroglobulin enters the lumen of the follicle by _____
4. In the lumen of the follicle:
 - a. T₄ is formed by _____
 - b. T₃ is formed by _____
5. Thyroglobulin enters follicle cells by _____
 - a. What fuses with the vesicle? _____
6. _____ enzymes (from the lysosomes) break down thyroglobulin
 - a. When _____ & _____ are released they move by _____ into the _____ & finally _____
3. Transport in the Blood
 - a. Thyroid hormones are transported in the circulatory system with
 1. 70-75% bound to _____
 2. 20-30% bound to _____ including _____
 - b. Thyroid hormone bound to proteins increases _____
 - c. Approximately 33-40% of _____ is converted to _____
 1. Which form is the major hormone? _____
 2. Which form is more potent? _____
4. Mechanism of Action of Thyroid Hormones
 - a. Thyroid hormones interact with receptors _____
 - b. After binding to the receptor the hormone causes _____
 - c. The newly made _____ moves to the _____
 - d. In the cytoplasm new _____ are made
 - e. The newly synthesized _____ cause the _____
 - f. This process can take up to a _____ for maximal effect
5. Effects of Thyroid Hormones
 - a. Thyroid hormones affect _____
 1. _____ is primarily affected in some tissues
 2. _____ & _____ are influenced in others
 - b. Functions of thyroid hormones include:
 1. Normal rate _____

2. Decline in _____
 3. Increased activity of _____
 4. Alter the number and _____
 5. Normal _____ and _____ of organs
 6. Normal _____ and _____ of the brain
 7. Permissive role for _____
- c. What symptoms might a person experience with thyroid hormone:
1. Hypersecretion _____

 2. Hyposecretion _____

- d. If hyposecretion occurs during development a person experiences:
1. Decreased _____
 2. Abnormal nervous _____
 3. Abnormal _____
 4. Abnormal _____ of tissues
 - a. The result is a mentally _____ with _____
stature and distinctive form called a _____
6. Regulation of Thyroid Hormone Secretion
- a. TRH from the hypothalamus and TSH from the anterior pituitary:
 1. Increase in response to _____
 2. Decrease in response to _____
 - b. TSH stimulates _____ secretion from the thyroid gland
 1. TSH also stimulates _____
 - c. Thyroid hormones have a _____ effect
 1. Increasing levels _____ TRH & TSH release
 - d. TSH levels in the blood increase dramatically when _____

- C. Calcitonin
1. Calcitonin secretion is increased in response to _____

2. The primary target tissue for calcitonin is _____
 - a. Decreases _____
 - b. Lengthens _____
3. The net result of calcitonin action is a _____ in blood levels of _____ and _____
4. How important is calcitonin in regulating blood calcium levels? _____
 - a. After a meal it may _____
 - b. How do calcitonin levels change with age? _____
 - c. Complete thyroidectomy _____

V. Parathyroid Glands

- A. Parathyroid glands are usually embedded _____
- B. Parathyroid Hormone (PTH)
 1. PTH is important in the regulation of _____
 2. Functionally PTH:
 - a. Stimulates _____ in bone
 - b. Can cause _____ to increase
 - c. Induces _____ within kidneys
 - d. Also increases _____ in the kidneys
 3. In relation to phosphate ions PTH
 - a. _____ from bone
 - b. _____ absorption in the gut
 - c. _____ in the kidney
 4. The net effect of PTH is to:
 - a. _____ blood levels of calcium ions
 - b. _____ blood levels of phosphate ions
 5. The release of PTH is:
 - a. Stimulated by _____
 - b. Inhibited by _____
 6. Symptoms of hypocalcemia include: _____

VI. Adrenal Glands

A. Structure and Histology

1. The adrenal glands are also called _____
2. What is their position relative to the kidneys? _____
3. What does retroperitoneal mean? _____
4. Composed of an inner _____ and an outer _____
 - a. The inner portion arises from _____
 - b. The outer portion is derived from _____
5. The medulla consists of _____
6. The cortex is composed of _____ and subdivided into:
 - a. _____
 - b. _____
 - c. _____
7. The zona glomerulosa is:
 - a. Immediately _____
 - b. Composed of _____
8. The zona fasciculata is the _____ part of the adrenal cortex:
 - a. The cells form _____ or _____
9. The zona reticularis is the _____ layer of the adrenal cortex:
 - a. Thin _____
 - b. Irregularly _____

B. Hormones of Adrenal Medulla

1. The adrenal medulla produces about:
 - a. 80% _____
 - b. 20% _____
 1. Why are these secretions considered to be neurohormones? _____

2. Functionally epinephrine:
 - a. Increases blood _____
 - b. In skeletal muscle cells _____

- c. In adipose tissue _____
- d. Cause dilation of blood vessels in _____
- 3. Epinephrine and norepinephrine function to:
 - a. Increase the heart's _____ & _____
 - b. Cause vessel constriction to _____
- 4. The effects of epinephrine and norepinephrine are _____
- 5. The release of hormones by the adrenal medulla is stimulated by:

- 6. Conditions resulting in release include: _____

C. Hormones of Adrenal Cortex

- 1. Steroid hormones that are highly _____ derived from _____
- 2. They leave the cells as soon as they are produced by _____
- 3. They are transported in the blood in combination with _____
- 4. They bind to _____ receptors and stimulate synthesis of _____ which are responsible for _____
- 5. Mineralocorticoids are produced in the _____
 - a. _____ is produced in the greatest amount
 - b. Functionally aldosterone:
 - 1. Increases the rate of _____ by the kidneys
 - a. As a result blood levels _____
 - 2. Increases K^+ _____ by the kidneys
 - a. As a result blood levels _____
 - 3. Also increases the rate of _____ excretion into the urine
- 6. Glucocorticoids are produced in the _____
 - a. The major glucocorticoid is _____
 - b. The responses are classified into three categories:
 - 1. _____
 - 2. _____
 - 3. _____

- c. Metabolic responses include:
1. _____ fat catabolism
 2. _____ glucose and amino acid uptake in skeletal muscle
 3. _____ gluconeogenesis
 - a. What is gluconeogenesis? _____
 4. _____ protein degradation
- d. Developmental responses include:
1. Maturation of _____
 2. Development of _____
- e. Anti-inflammatory responses include decreasing both the number of _____ & _____
- f. Control of secretion involves:
1. CRH from the hypothalamus released in response to _____ or _____
 2. CRH stimulates the release of ACTH from the _____
 3. ACTH stimulates the:
 - a. Zona glomerulosa to _____
 - b. Zona fasciculata to _____
 4. CRH release is inhibited by _____ & _____
 5. High levels of cortisol _____ ACTH release
 6. Low levels of cortisol _____ ACTH release
7. Adrenal Androgens
- a. Produced in the _____
 - b. Weak androgens including _____
 - c. Converted by peripheral tissues to _____
 - d. Functionally in females adrenal androgens:
 1. Stimulate _____ & _____ hair growth and _____
 - e. Functionally in males their effects are _____

VII. Pancreas

A. Structure and Histology

1. The pancreas lies _____ between the _____
_____ and the _____
2. Exocrine portion consists of _____ that produce _____
secreted into a _____ system that empties _____
3. Endocrine portion consists of _____ that produce
_____ that enter the _____
4. Each pancreatic islet is composed of:
 - a. 20% _____ that secrete _____
 - b. 75% _____ that secrete _____
 - c. 5% _____ including _____ that
secrete _____
5. The pancreatic islets have "dual innervation" which means _____
_____ (see Chapter 16 if needed for review)

B. Effect of Insulin and Glucagon on Their Target Tissues

1. The main insulin target tissues include _____

2. Insulin causes an increase in active-transport proteins for _____
and _____
3. As a result the general response is an _____ in the ability
to take up and use _____ and _____
4. Even though blood levels of glucose are very high in the absence of insulin
the ability of the cell to take in glucose and amino acids _____
5. In contrast high levels of insulin can cause blood levels of glucose to _____
because target tissues are _____
 - a. This can cause malfunctions of the _____
6. Glucagon primarily effects the _____ but has some effect on _____
_____ & _____
7. Functionally glucagon causes:
 - a. Breakdown of _____

- b. Increased _____
 - c. Increases the breakdown of _____
- C. Regulation of Pancreatic Hormone Secretion
1. Beta cells are directly influenced to:
 - a. Release insulin in response to _____
 - b. Inhibit insulin release in response to _____
 - c. Certain amino acids _____
 2. The autonomic nervous system influences insulin secretion:
 - a. Parasympathetic nerve impulses _____
 - b. Sympathetic nerve impulses _____
 3. What hormones from the gastrointestinal tract stimulate insulin release?

 4. What effect does somatostatin have on insulin and glucagon? _____
 5. Secretion of glucagon is:
 - a. _____ by low blood glucose levels
 - b. _____ by high blood glucose levels
 6. Glucagon secretion is also increased by _____ & _____
 7. After a high-protein meal:
 - a. Amino acids increase _____ & _____ secretion
 - b. Insulin causes _____
 - c. Glucagon increases _____

VIII. Hormonal Regulation of Nutrients

- A. After a meal and under resting conditions:
1. There is reduced secretion of _____, _____, _____, & _____
 2. Insulin secretion increases in response to:
 - a. _____
 - b. _____
 3. This causes target tissues to increase their uptake of _____, _____, and _____.

4. Molecules not needed for immediate metabolism are _____
 - a. Glucose is converted to _____ in _____ & _____
 - b. Glucose is used for _____ synthesis in _____ & _____
 5. The rapid uptake and storage of _____ prevents _____
 6. Amino acids are _____
 7. Ingested fats are _____
- B. Within 1-2 hours after the meal:
1. Absorption of digested material _____ and blood glucose levels _____
 2. This causes increased secretion of _____, _____, _____, & _____
 3. Results in release of _____ from tissues
 4. Insulin secretion _____ & glucose uptake by cells _____
 5. Stored glycogen is converted to _____ and released into _____
 6. This maintains blood glucose levels necessary for _____
 7. Cells using less glucose start using more _____ & _____
 8. Adipose tissue _____ & the liver releases _____
- C. During exercise:
1. Sympathetic nerve impulses stimulates release of _____ from the adrenal gland and _____ from the pancreas
 2. These hormones induce the conversion of _____ to _____ in the liver and the _____
 3. During sustained activity blood glucose levels may fall too low for normal _____
 - a. A decrease in insulin prevents _____
 - b. Fatty acids, triglycerides, and ketones increase in the blood due to increased levels of _____, _____, _____, & _____
 - c. GH also prevents muscles from using themselves as an energy source by _____
 - d. Therefore, in skeletal muscles the metabolism of:
 - a. Glucose _____
 - b. Fat _____

IX. Hormones of the Reproductive System

A. Male Hormones

1. Main endocrine glands of the male reproductive system are the _____
2. Their function depends on _____ from the anterior pituitary
3. Functionally testosterone regulates:
 - a. Production of _____
 - b. Development and _____
4. Inhibin functions to _____
5. Which is the main hormone secreted by the testes? _____

B. Female Hormones

1. Main endocrine glands of the female reproductive system are the _____
2. Their function depends on _____ from the anterior pituitary
3. The main hormones secreted by the ovaries are _____ & _____
4. Functionally these hormones with FSH and LH control:
 - a. Female _____
 - b. Prepare _____
 - c. Maintain _____
5. Estrogen and progesterone are responsible for development of _____
_____ and female _____
6. The ovaries also secrete _____ which inhibits _____ secretion
7. During pregnancy both the _____ and _____ secrete
_____ and _____
8. What is the function of the hormone relaxin? _____

X. Hormones of the Pineal Body

A. List the two hormones secreted by the pineal body:

1. _____
2. _____

B. Functions

1. Melatonin can decrease _____ secretion from the _____

- a. May inhibit _____
- 2. Melatonin may also help regulate _____
- C. Control of Secretion
 - 1. What is photoperiod? _____
 - 2. Increased daylight results in _____ pineal secretions
 - a. Therefore in the spring when the days get longer there will be less _____ of reproductive function
 - 3. Decreased daylight results in _____ pineal secretions
 - a. Therefore in the fall and winter reproductive function is _____
- D. The exact function of pineal body hormones in humans is _____

XI. Hormones of the Thymus

- A. The thymus is located in the neck _____ to the heart
 - B. It secretes the hormone _____
 - C. The thymus and its hormone play a role in _____
-

XII. Hormonelike Substances

- A. Prostaglandins
 - 1. Prostaglandins are involved in a wide range of activities including:
 - a. Regulation of _____
 - b. Process of _____
 - c. Inhibition of _____ luteum
 - d. _____ function
 - e. Modification of the _____
 - f. Pain receptors are _____
 - g. Cause _____ of blood vessels
 - 2. Anti-inflammatory drugs _____
- B. Substances that moderate the sensation of pain include:
 - 1. _____

- 2. _____
- 3. _____

C. Growth Factors

- 1. Epidermal growth factor _____
- 2. Interleukin-2 stimulates _____

XIII. Effects of Aging on the Endocrine System

A. With increased age:

- 1. Secretion levels of GH _____
 - a. There is a greater change in people who _____
 - b. Change in GH secretion may explain _____
- 2. Secretion levels of thyroid hormones _____
 - a. Thyroid gland may also be damaged by _____
- 3. Parathyroid hormone secretion _____
- 4. Reproductive hormone secretion _____
- 5. The ability to regulate blood glucose levels _____
- 6. The immune system becomes less effective because _____