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. _____

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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 _____

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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:

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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 _____

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

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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 _____

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a. Thyroglobulin enters the lumen of the follicle by _____

4. In the lumen of the follicle:
   a. T_4 is formed by _____
   b. T_3 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 _____

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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 _____
      _____

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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: _____

    _____

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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 _____

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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. _____

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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 _____

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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 _____

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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 _____.

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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 _____

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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 _____

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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. _____

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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 _____

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