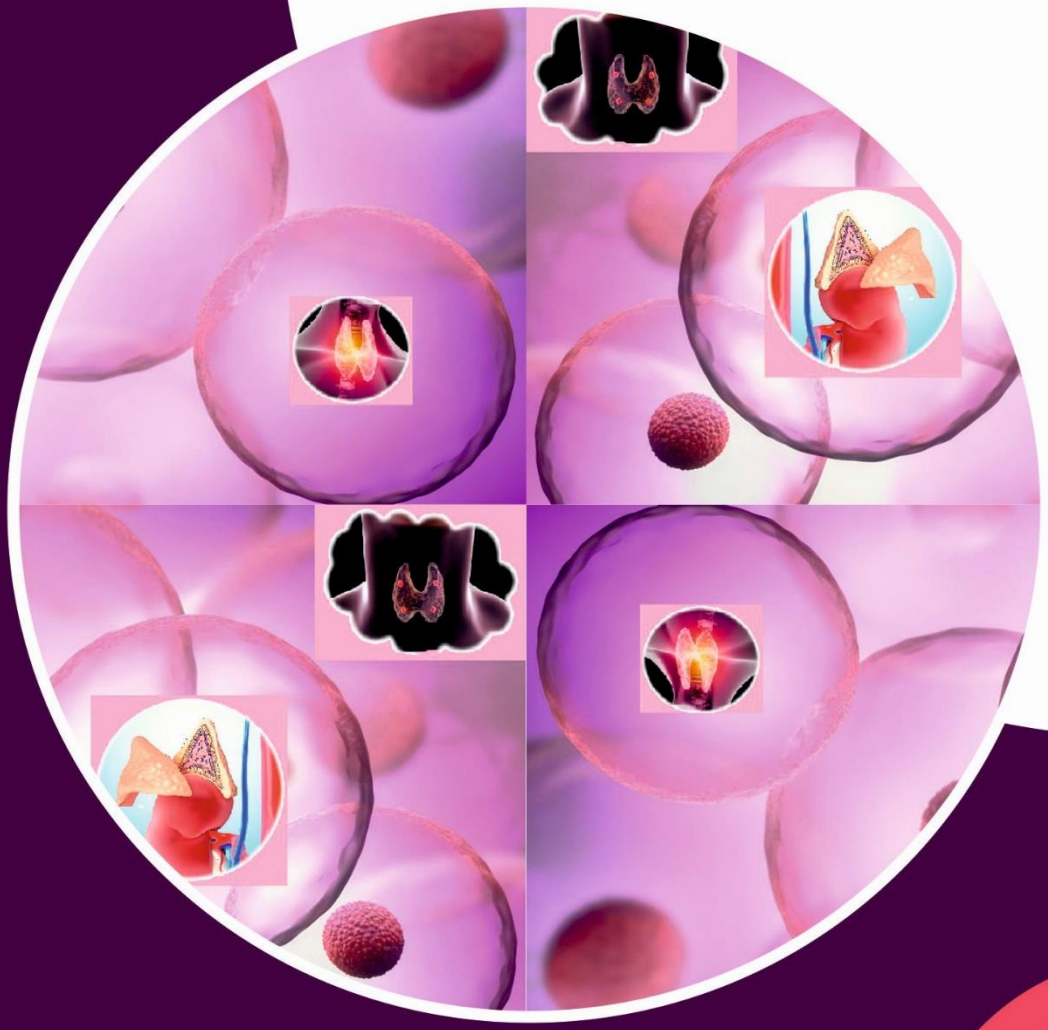
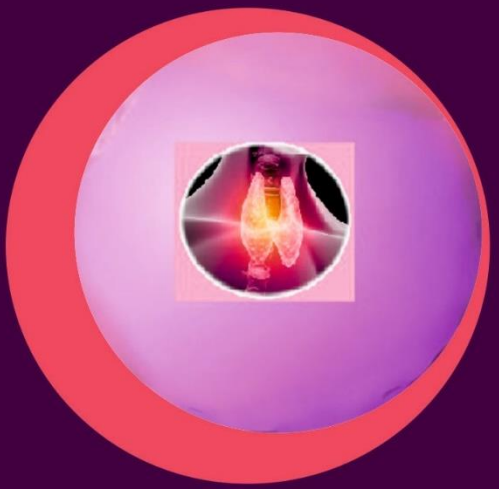
A GLOSSARY OF TERMS USED IN ENDOCRINOLOGY





VIVEK ROY

A GLOSSARY OF TERMS USED IN ENDOCRINOLOGY

Vivek Roy

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Author by: **Vivek Roy**

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A/ 503, Poorva Height, SNO 148/1A/1/1A,
Sus Road, Pashan- 411021, Pune,
Maharashtra, India.
Mob: +91-8007068686
Email: editor@kdpublications.in
Web: https://www.kdpublications.in

PREFACE

From the very first day of our school life till we complete our PG degree, one or the other must have experienced this awkward situation, that though we find one or few topics uninteresting, and difficult to digest, but for the sake of ourselves and the fear of being scolded from our parents, teachers, we robotically learn all of them and try to achieve fruitful grades. A decade earlier, I was going through all this scenario. Being a UG and PG student in Zoology, I and few of my friends always used to sit for group studies to discuss about our syllabi and the books recommended by our teachers. We always used to complain that there must be a book of a kind which would give a clear and instant picture for the terminologies, which we go through in our text or reference books. A decade back, cell phones and internet was stepping into our life; there was no word like android- which is common and popular today. Hardly, one or two of our friend could access the internet. During this transformation period, our only source of information were text books and the lectures delivered by our professors.

In the early of 2015 when I got the opportunity to serve in a college (now a university), I found that the problem is still ongoing, which I and many of my friends have faced a decade earlier. While facing the enthusiastic students, I realized that how well-decorated and informative a book may be, without a clear vision of the terminologies, the students are going to lack the basic fundamental about the topic. This gave me a motivation and a scope to do something for my students. From the very beginning of my service, I was very eager to prepare a book of glossary (or

dictionary) which would cover up the whole of my subject. Although, there exist an international edition of literature named as- The Dictionary of Cell Biology, The Dictionary of embryology and developmental biology, neither an international nor an Indian edition of Endocrinology exist. Later, I shifted my focus and gave effort to write a book mainly on endocrinology and topics related to it.

Such a book would be convenient for an undergraduate students, graduate students, professors, and researchers. Undoubtedly, most of the terms used in this book may be accessible on the internet; but, it is often not always convenient to boot up our PC or tap on cell phones and initiate a search for the term in question. During the making of this book I realized that my knowledge was poor and incomplete about Endocrinology. Being a teacher I still feel as a student. I will be happy if my students and students with Life science, Zoology find this book useful and interesting. In this very first edition I have selected the terminologies strictly related to endocrinology and few from developmental biology of animal. The author would like the inclusions of figures and new terms in the subsequent editions based on the response of the students.

Vivek Roy

Acknowledgement

Guru Govind dou khade, kake lagoon pay; Balihari Guru aapne, Govind diyo batay. I am really grateful to my teachers of Banaras Hindu University (BHU) who with their motherly and fatherly nature and with their simple teaching skills and methods have enlightened us about Zoology.

I really appreciate the new ideas and thought from my students. I am grateful to my friends and well wishers mainly Nilu, who have encouraged me in my life and have given continuous mental support during writing this book.

I am also thankful to the faculty members of my department and also to the faculty from department of Botany, Raiganj University for their continuous encouragement.

Finally, I would like to thank my family for their constant support throughout this process.

I apologize to anyone left out unconsciously.

Dedication

I dedicate this book to my beloved high- school teacher, Mr. Bibhuty Tarafdar, without whom this journey would not have been possible; my professors at Acharya Brojendra Nath Seal Government College, notably Dr. Rahul Kumar Datta, who have always been my inspiration, raised my self-confidence; and especially to my guide at Raiganj University,

Dr. Ayon Pal, who fascinated me with his

way of working, mind-set even

in the worst condition.

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A

Abortion (L. *Aboriri* = to miscarry)

Expulsion of a conceptus (embryo or fetus) before it is unable, i.e., capable of living outside the uterus.

Absorption

1. Process in which a chemical passes through a membrane or tissue surface and becomes incorporated into a body fluid or tissue. **2.** Any process in which one substance passes into another and becomes a part of it.

Accessory sex organ

Any structure, other than a gonad (primary organ), that serves primarily to produce or to deliver a germ cell (e.g., yolk gland, oviduct, vas deferens), or to provide nourishment of the developing offspring by the mother (e.g., placenta, uterus).

The accessory organs of the male reproductive tract are those tissues that support the function and activity of the system. The male accessory organs include the prostate gland, the seminal vesicles, and the bulbourethral glands. These structures provide secretions to form the bulk of the seminal fluid of an ejaculate.

Acclimation

It is a laboratory phenomenon in which the chronic response of an animal to a change in environment is measured; normally the old and new environments differ in one or two highly specific ways.

Acclimatization

The (usually slow) process of changing physiological processes to function more optimally under new conditions is called as acclimatization.

Acetylcholine (ACh)

A neurotransmitter released by somatic motor fibers, parasympathetic fibers, and some other neurons, composed of choline and an acetyl group.

Acetylcholinesterase (AChE)

An enzyme that hydrolyzes acetylcholine, thus halting signal transmission at a cholinergic synapse.

Acid

A proton (H+) donor; a chemical that releases protons into solution.

Acidosis

An acid–base imbalance in which the blood pH is lower than 7.35

Acinus

A sac of secretory cells at the inner end of a gland duct.

Acromegaly

Excessive production of growth hormone in adults over long periods produces a condition called acromegaly. The features of acromegaly are quite different from gigantism, because bones can no longer lengthen in adults. Instead, under the influence of growth hormone there is gradual thickening of the bones in the face, hands, and feet. The most notable visible effect is a change in facial features. Excessive production of growth hormone in adults usually results from a tumor of either the pituitary or the hypothalamus. Acromegaly is no longer common because growth hormone–secreting tumors are now usually diagnosed and treated early enough to prevent the development of the condition. Excessive growth hormone secretion is diagnosed by measuring growth hormone levels.

Acrosome

1. The acrosome, or rather, the acrosomal complex, is the apparatus with which a typical spermatozoon penetrates and fuses with the egg. It is located in the anterior region of the cell, applied to the nucleus, and is divided into two parts, the acrosome proper and the perforatorium. The acrosome originates from the Golgi complex of the spermatid; it is surrounded by a membrane that is formed by the fusion of many Golgi vesicles and is cap-shaped, with its convex surface outward. It contains a complex of enzymes that allows the spermatozoon to penetrate egg investments.

2. The acrosome is a lysosome-like organelle that covers the anterior portion of the sperm nucleus. The acrosome is structurally located on the anterior half of the sperm head The membrane that overlies the nucleus has been called inner acrosomal membrane, and the portion that underlies the plasma membrane is known as outer acrosomal membrane. The

acrosome contains soluble and particulate compartments (the latter known as acrosomal matrix), constituted by many proteins with hydrolytic properties.

Acrosome reaction

It is an irreversible process that involves a complex series of intracellular events, which result in the fusion of the outer acrosomal membrane and the overlying plasma membrane, with the subsequent release of the acrosomal content and the exposure of the inner acrosomal membrane.

The occurrence of this reaction facilitates sperm penetration through the zona pellucida (ZP), and exposure of certain molecules on the sperm equatorial segment that participate in the fusion with the oolemma. These reactions are required for fertilization and defects in these steps have negative implications on fertility.

Active site

The region of a protein that binds to a ligand, such as the substrate binding site of an enzyme or the hormone-binding site of a receptor.

Active transport

Transport of particles through a selectively permeable membrane, up their concentration gradient, with the aid of a carrier that consumes ATP.

Activins

Members of the same family of peptides as the inhibins, are homodimers or heterodimers of the β-subunit of the inhibins. They are synthesized in many adult tissues and cell types, and their receptors have been identified in those same tissues, a pattern more consistent with autocrine or paracrine mechanisms of action. At the pituitary, locally produced activin opposes inhibin's actions and favors the synthesis of β-FSH.

Acute

Pertaining to a disease with abrupt onset, intense symptoms, and short duration.

Adaptation

1. An evolutionary process leading to the establishment of species characteristics that favor survival and reproduction. **2.** Any characteristic of anatomy, physiology, or behavior that promotes survival and

reproduction. **3.** A sensory process in which a receptor adjusts its sensitivity or response to the prevailing level of stimulation, such as dark adaptation of the eye.

Addison's disease

Addison's disease is caused by failure of the adrenal cortex to secrete sufficient cortisol and aldosterone. Lack of cortisol lowers blood glucose levels, and lack of aldosterone lowers blood sodium. Addison's disease tends to develop slowly, with chronic symptoms of fatigue, weakness, abdominal pain, weight loss, and a characteristic "bronzed" skin color. It can be successfully treated with medications that replace the missing hormones.

Addison disease is a primary adrenal insufficiency in which the levels of both mineralocorticoids and glucocorticoids are usually extremely low. In North America and Europe, the most prevalent cause of Addison disease is autoimmune destruction of the adrenal cortex. Because of the cortisol deficiency, ACTH secretion increases. Elevated levels of ACTH can compete for the melanocortin-1 receptor (MC1R) in melanocytes, causing an increase in skin pigmentation, particularly in skin creases, scars, and gums. The loss of the mineralocorticoids results in contraction of extracellular volume, producing circulatory hypovolemia and therefore a drop in blood pressure. These people are also prone to have hypoglycemia when stressed or fasting. The hyperglycemic actions of other hormones, such as glucagon, epinephrine, and growth hormone, generally will prevent hypoglycemia at other times. Although volume depletion occurs because of the loss of mineralocorticoids, water intoxication can develop if a water load is given. The loss of cortisol impairs the ability to increase free-water clearance in response to a water load and hence rid the body of the excess water. Patients with Addison disease exhibit hyperkalemic acidosis. Because cortisol is important for muscle function, muscle weakness occurs in cortisol deficiency. The loss of cortisol results in anemia, decreased GI motility and secretion, and decreased iron and vitamin B12 absorption. The appetite decreases because of the cortisol deficiency, and this decreased appetite, coupled with the GI dysfunction, will predispose these persons to weight loss. These patients often show disturbances in mood and behavior and are more susceptible to depression.

Adenine (Gr. *aden*= gland, + *ine*= suffix) A purine base; component of nucleotides and nucleic acids.

Adenohypophysis

The adenohypophysis (anterior pituitary) consists of two distinct parts: the anterior pituitary and the intermediate pituitary. The adenohypophysis is attached to the hypothalamus by that part of the pituitary stalk that contains the hypophyseal portal system of blood vessels.

The nerve endings of the neurosecretory cells of the hypothalamus terminate at the median eminence, where their hormones are released into the hypophyseal portal system, through which they are carried to the anterior pituitary. The pituitary stalk thus contains both nerve axons, traveling to the posterior pituitary, and blood vessels that connect the hypothalamus and anterior pituitary gland. This vascular connection between the hypothalamus and the anterior pituitary consists of the superior hypophyseal artery delivering blood to the median eminence of the hypothalamus, where it forms a series of tiny blood vessels (capillaries), called the "primary plexus," into which the hypothalamic hormones are released. These hormones then travel through the hypophyseal portal veins to the secondary plexus, another series of capillaries in the anterior pituitary. Here, the hypothalamic hormones stimulate pituitary cells to release their hormones into the secondary plexus, from which they enter the general circulation. The small parvicellular neurosecretory cells are found in the PVN (CRH cells), preoptic area (GnRH cells) and the arcuate nucleus (GnRH, GHRH cells), and project to the median eminence. The parvicellular neurosecretory cells terminating at the median eminence release their hypothalamic hormones into the hypophyseal portal system. These hormones modulate the release of anterior pituitary hormones and are referred to as the hypophysiotropic hormones.

Adenosine diphosphate (ADP)

A nucleotide composed of adenine, ribose sugar, and two phosphate units; along with ATP, ADP, serves as a phosphate bond-energy transfer system in cells.

Adenosine triphosphate (ATP)

A molecule composed of adenine, ribose, and three phosphate

groups that functions as a universal energy-transfer molecule; yields adenosine diphosphate (ADP) and an inorganic phosphate group (Pi) upon hydrolysis.

Adenylate cyclase

The membrane-bound enzyme that is activated by a G-protein intermediary in response to binding of an extracellular messenger with a surface membrane receptor and that, in turn, removes two phosphate molecules from ATP and makes cyclic adenosine monophosphate (cAMP); important in the activation of the cAMP second-messenger system.

Adipocyte

A fat cell.

Adipose tissue

A connective tissue composed predominantly of adipocytes.

Adrenal cortex

The outer portion of the vertebrate adrenal gland; secretes three classes of steroid hormones: glucocorticoids, mineralocorticoids, and sex hormones.

Adrenal medulla

The inner portion of the vertebrate adrenal gland; an endocrine gland that is a modified sympathetic ganglion that secretes the hormones epinephrine and norepinephrine into the blood in response to sympathetic stimulation.

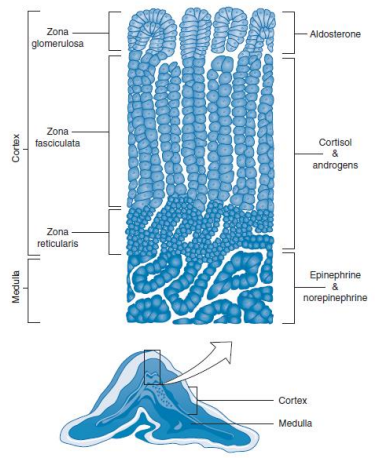
Adrenal glands

The adrenal glands are two small endocrine organs located just above the kidneys. Each gland has an outer layer called the adrenal cortex, and an inner core called the adrenal medulla. The cortex and medulla function as two separate endocrine glands. (Cortex and medulla are general terms for outer and inner regions of any organ). The outer adrenal cortex is derived from mesodermal tissue and accounts for approximately 90% of the weight of the adrenals. The cortex is divided into 3 zones: reticularis, fasciculata, and glomerulosa. The cells that make up the 3 zones have distinct enzymatic capacities, leading to a relative specificity in the products of each of the adrenal cortex zones. The principal hormones synthesized and released by the adrenal cortex are the glucocorticoid: cortisol, the mineralocorticoid: aldosterone,

and the androgen:

dehydroepiandrosterone (DHEA) in response to hypothalamic-pituitary-adrenal hormone stimulation.

These steroid hormones are derived from cholesterol. The inner medulla is derived from a subpopulation of neural crest cells and makes up the remaining 10% of the mass of the adrenals. The medulla synthesizes catecholamines (eg, epinephrine and norepinephrine) in response to direct sympathetic (sympatho-adrenal) stimulation.



Adrenaline (L. *ad*= to, + *renalis*= pertaining to kidneys)

A hormone produced by the adrenal, or suprarenal, gland; also commonly known as epinephrine.

Adrenarche

1. Adrenal androgens, especially DHEAS, the main product of the zona reticularis, become detectable in the circulation at about 6 years of age. This onset of adrenal androgen production is called adrenarche and contributes to appearance of axillary and pubic hair at about age 8 years.

2. Adrenarche, which typically precedes gonadarche, is associated with increased secretion of adrenal androgens and leads to the appearance of sexual hair (pubarche). The major adrenal bioactive C19 androgens are dehydroepiandrosterone (DHEA), dehydroepiandrosterone sulfate (DHEAS), and androstenedione. Adrenarche occurring late in prepubertal development appears to be peculiar to our own species and to the great apes; and, in humans, the absence of adrenarche does not prevent gonadarche or the attainment of fertility.

Adrenocorticotropic hormone (ACTH)

Adrenocorticotropic hormone (ACTH) is synthesized as part of the precursor proopiomelanocortin (POMC). The ACTH peptide consists of 39

amino acids, is a single polypeptide chain, and has a molecular weight of 4.5 kDa. The N-terminal 12 amino acids are highly conserved between species, thus reflecting the importance of this region for biological activity. In comparison with the human sequence, ACTH in other mammals has only one or two substitutions, which are in the region of amino acids 24 to 39. The hypothalamic secretion of corticotropin-releasing hormone (CRH) stimulates ACTH synthesis and release from the anterior pituitary, which in turn regulates the synthesis of glucocorticoids in the adrenal cortex. The major role of ACTH is to stimulate steroidogenesis in the adrenal cortex, which results in the synthesis and release of cortisol in humans and corticosterone in rodents.

The hormone controls the function of adrenal cortex by adjusting the glucocorticoid output of the adrenal cortex. The adrenal cortex atrophies in the absence of ACTH, and administration of ACTH stimulates the release of cortical hormones, viz. cortisol, corticosterone, aldosterone, etc. ACTH also acts on adipose tissue and increases fatty acid concentration in the blood. It also regulates the ACTH secretion from the hypophysis. Larger doses of ACTH would inhibit its production from the adenohypophysis. ACTH is also associated with melanophore-regulating action.

ACTH secretion is regulated in two ways: There is evidence to show that the neurosecretory cells of the posterior part of the hypothalamus and median eminence secrete into the hypophysial portal system some neurohumoral substances which reach the sinusoids of adenohypophysis and stimulate the cells to produce hormones. These neurohumoral chemical substances are releasing factors which are probably small polypeptide chains.

Adrenogenital syndrome

It is a disease which results from hyperplasia of the adrenal cortex, with excessive secretion of the androgens. The secretion of the gonadotropins of the anterior pituitary is inhibited blocking ovulation.

The syndrome is generally found in female sex. The main symptoms are diminished menstrual flow, growth of hair over the beard area, breasts under developed with loss of fat and enlargement of the clitoris.

Agonist

A nonnative signal molecule (e.g., a drug or toxin) that mimics the effects of a native signal molecule (for opposing term, see *antagonist*).

Albumin

A class of small proteins constituting about 60% of the protein fraction of the blood plasma; plays roles in blood viscosity, colloid osmotic pressure, and solute transport.

Aldosterone

A steroid hormone secreted by the adrenal cortex. Aldosterone is the hormone primarily responsible for regulating the amounts of sodium and potassium in the body. With ADH, it helps maintain body water balance. It acts on the kidneys to promote sodium and water retention and potassium excretion, thus increasing blood volume and pressure.

Alkalosis

An acid–base imbalance in which the blood pH is higher than 7.45.

Allantois (Gr. *allas*= sausage, + *eidos*= form)

One of the extraembryonic membranes of the amniotes that functions in respiration and excretion in birds and nonavian reptiles and plays an important role in the development of the placenta in most mammals.

Allele (Gr. *allelon*= of one another).

Alternative forms of a gene coding for the same trait and situated at the same locus in homologous chromosomes.

Amino acids

Small organic molecules with an amino group and a carboxyl group; A fundamental subunit of proteins and peptides.

Amino Acid–derived hormones

Amino acid–derived hormones are those hormones that are synthesized from the amino acid tyrosine and include the catecholamines norepinephrine, epinephrine, and dopamine; as well as the thyroid hormones, derived from the combination of 2 iodinated tyrosine amino acid residues.

Amniocentesis (Gr. *amnion*= membrane around the fetus, + *centes*= puncture)

Procedure for withdrawing a sample of fluid around the developing embryo for examination of chromosomes in the embryonic cells and other tests.

Amnion (Gr. *amnion*= membrane around the fetus)

The innermost of the extraembryonic membranes forming a fluid-filled sac around the embryo in amniotes.

Amniote

Having an amnion; as a noun, an animal that develops an amnion in embryonic life; refers collectively to nonavian reptiles, birds, and mammals.

Amniotic egg

A vertebrate egg containing three membranes that surround the embryo (amnion, allantois, chorion)

Amphiphilic (Gr. *amphi*= on both sides, + *philia*= love, friendship)

Synonymous with **amphipathic.**

1. A molecule containing both hydrophobic and hydrophilic properties.

2. A substance that contains both polar and non-polar regions and is therefore both hydrophilic and hydrophobic. Also called an amphipathic substance.

Ampulla

A wide or saclike portion of a tubular organ such as a semicircular duct or uterine tube.

Anabolism (Gr. *ana*= up, + *bol*= to throw, + *ism*= suffix meaning state of condition) Any metabolic reactions that consume energy and construct more complex molecules with higher free energy from less complex molecules with lower free energy; for example, the synthesis of proteins from amino acids.

Anamniote

A vertebrate that lacks an amniotic membrane around the embryo. Includes fishes and amphibians.

Anastomosis (Gr. *ana*= again, + *stoma*= mouth).

A union of two or more blood vessels, fibers, or other structures to form a branching network.

Androgen (Gr. *Andros*= man, + *genes*= born)

1. Any of a group of steroid male sex hormones. Testosterone or a related steroid hormone. Stimulates somatic changes at puberty in both sexes, adult libido in both sexes, development of male anatomy in the fetus and adolescent, and spermatogenesis.

2. The term androgen refers to any natural or synthetic compounds that stimulate or control development and maintenance of masculine characteristics.

Most commonly, androgens refer to endogenous steroid sex hormones responsible for virilizing the accessory male sex organs and secondary sex characteristics. Androgens are mainly synthesized by the testes, although females also produce small amounts, which are important for positive protein balance, maintaining strong muscles and bones, and contribute to libido. There are two major androgens secreted by the testes: testosterone and 5α-dihydrotestosterone (5α–DHT). Two weaker androgens primarily synthesized in the adrenal cortex and in smaller amounts by the testes and ovaries are dehydroepiandrosterone (DHEA) and androstenedione, which are converted metabolically to testosterone and other androgens.

Androgen Insensitivity Syndrome (AIS)

AIS results from a hereditary defect of the X chromosome gene controlling androgen receptor (AR) expression.

Because the defect can range from partial to complete inability of the AR to respond to androgens, the degree of feminization of AIS is variable. Because the karyotype is 46, XY, the gonad develops into the testis, which produces testosterone and MIS in utero.

The mesonephric (wolffian) duct does not develop into male structures, however, because androgen action is deficient, and MIS causes the mullerian duct to regress. Consequently, there are no functional internal genitalia. The external genitalia typically develop as female, and the phenotype is female.

Andropause

Andropause is a period of declining reproductive function that becomes noticeable, if at all, typically in the early 50s.

It is brought on by falling levels of testosterone and inhibin. Also known as Male climacteric.

Anejaculation

Anejaculation occurs when the patient fails to ejaculate.

Angiogenesis

The growth of new blood vessels.

Angiotensin II (Gr. *angeion*= vessel, + L. *tension*= to stretch)

A hormone produced from angiotensinogen (a plasma protein) by the interaction of kidneys and lungs; raises blood pressure by stimulating vasoconstriction and stimulating the adrenal cortex to secrete aldosterone.

Anion

An ion with more electrons than protons and consequently a net negative charge

Antagonism

A process opposing another; e.g., when one hormone causes the loss of another hormone's receptors, reducing the effectiveness of the second hormone.

Antagonist

1. A muscle that opposes the agonist at a joint. 2. A nonnative signal molecule (such as a drug or toxin) blocking the effects of a native signal molecule.

Antagonistic effects

When one hormone opposes the action of another hormone it is said to be antagonism.

For example, insulin lowers blood glucose level and glucagon raises it. During pregnancy, estrogen from the placenta inhibits the mammary glands from responding to prolactin; thus milk is not secreted until the placenta is shed at birth.

Anterior

Pertaining to the front (facial-abdominal aspect) of the body; ventral; head end of a bilaterally symmetrical animal.

Anterior pituitary

The non-neural endocrine portion of the vertebrate pituitary gland, having three parts with variable representation in various species:

pars tuberalis, pars intermedia, and pars distalis; stores and secretes six different hormones: GH, TSH, ACTH, FSH, LH, and prolactin.

Antidiuretic hormone (ADH)

A hormone released by the posterior lobe of the pituitary gland in response to low blood pressure; promotes water retention by the kidneys. Also known as *arginine vasopressin.*

Antigen

Any large molecule capable of binding to an antibody and triggering an immune response.

Antiport

A cotransport protein that moves two or more solutes in opposite directions through a cellular membrane; for example, the Na^+–K^+ pump.

Antral follicles

They are highly differentiated endocrine structures, characterized by the formation of fluid-filled cavity (antrum) next to the oocyte, and they correspond to Type 6–8 follicles in the Pedersen classification.

These follicles are responsive to gonadotropins and participate actively in the hypothalamic–pituitary–gonadal (HPG) axis. Unless rescued by FSH, the granulosa cells of most early antral follicles undergo widespread apoptosis and ultimately follicular death.

Antrum (of ovary)

The fluid-filled cavity formed within a developing ovarian follicle.

Apical surface

The uppermost surface of an epithelial cell, usually exposed to the lumen of an organ.

Apocrine (Gr. *apo*= away, + *krinein*= to separate)

1. Pertaining to certain sweat glands with large lumens and relatively thick, aromatic secretions and to similar glands such as the mammary gland; formerly thought to form secretions by pinching off bits of apical cytoplasm.

2. In this the secretion from an exocrine cell involves the loss of cytoplasm as well as the secretory product. The apical portion of the cytoplasm becomes packed with secretory vesicles and is then shed. Milk production in the mammary glands involves a combination of merocrine and apocrine secretions.

Apoptosis

1. It is a strictly regulated programmed cell death utilized by somatic cells for proper development, homeostasis, and removal of damaged or dangerous cells. It is marked by chromatin condensation, plasma membrane blebbing, nucleosome-sized as well as a high molecular weight (50–100 kb) DNA fragmentation, the externalization of certain inner-membrane constituents, and cell fragmentation into compact membrane-enclosed structures termed apoptotic bodies which contain cytosol, the condensed chromatin, and organelles.

2. It is a normal process by which cell numbers within various tissues are adjusted and controlled. During development, extra tissue is removed by apoptosis, such as cells between the developing fingers and toes, to fine-tune the contours of the developing fetus. The number of cells in most adult tissues is maintained at a specific level. Apoptosis eliminates excess cells produced by proliferation within some adult tissues to maintain a constant number of cells within the tissue. Damaged or potentially dangerous cells, virus-infected cells, and potential cancer cells are also eliminated by apoptosis. Apoptosis is regulated by specific genes. The proteins coded for by those genes initiate events within the cell that ultimately lead to the cell's death. As apoptosis begins, the chromatin within the nucleus condenses and fragments. This is followed by fragmentation of the nucleus and finally by death and fragmentation of the cell. The cell fragments are cleaned up by specialized cells called macrophages.

Aquaporins (AQPs)

They are water channels. They are a family of membrane channel proteins that serve as selective pores through which water crosses the plasma membranes of cells. They form tetramers in the cell membrane, and facilitate the transport of water.

They control the water content of cells. Agre and MacKinnon were awarded Nobel Prize for Chemistry in 2003 for their contributions on aquaporins and ion channels. Diseases, such as nephrogenic diabetes insipidus are due to impaired function of these channels. Aquaporins (AQP) are a family of channels responsible for the transport of water across membranes. At least 11 aquaporin proteins have been identified in mammals with 10 known in humans.

Assisted hatching

A technique in which the zona pellucida (outer shell of the egg) is chemically or mechanically thinned prior to embryo transfer in order to improve the likelihood of subsequent hatching and implantation of the embryo. Hatching is performed potentially to increase the chance of implantation of the embryo.

Assisted reproductive technology (ART)

ART is by definition any treatment or procedure that includes the handling of oocytes and sperm or embryos outside the body for the purpose of establishing a pregnancy. In vitro fertilization (IVF) is the most common ART procedure. The first IVF baby was conceived in 1978 (Louise Brown) in Lancashire, England. IVF has been used in the United States since 1981.

Asthenozoospermia

The term asthenospermia refers to defects in sperm movement, less than 40% motility or less than 32% of progressively motile sperm based on the 2010 WHO semen analysis parameters. This may be manifested by a low percentage of sperm that demonstrate any movement (motility) or by sperm that move forward slowly (poor forward progression). Prolonged abstinence periods, genital tract infections associated with pyospermia, antisperm antibodies, spermatozoal ultrastructural defects, partial ejaculatory duct obstruction, varicoceles, defective transport through the genital ductal system, and idiopathic causes may account for asthenospermia.

Atrial natriuretic peptide (ANP)

Atrial natriuretic peptide (ANP) is a hormone released by the atrial walls of the heart when they become stretched. Because heart failure almost always increases both the right and left atrial pressures that stretch the atrial walls, the circulating levels of ANP in the blood may increase 5- to 10-fold in severe heart failure. The ANP in turn has a direct effect on the kidneys to increase greatly their excretion of salt and water. Therefore, ANP plays a natural role to help prevent extreme congestive symptoms during cardiac failure.

When specific cells of the cardiac atria are stretched because of plasma volume expansion and

increased atrial blood pressure, they secrete atrial natriuretic peptide (ANP). Increased levels of this peptide in turn directly inhibit the reabsorption of sodium and water by the renal tubules, especially in the collecting ducts. ANP also inhibits renin secretion and therefore angiotensin II formation, which in turn reduces renal tubular reabsorption. This decreased sodium and water reabsorption increases urinary excretion, which helps to return blood volume back toward normal. ANP levels are greatly elevated in congestive heart failure when the cardiac atria are stretched because of impaired pumping of the ventricles.

Atrophy (a=without, + trophy= nourishment) A decrease in the size of cells, with a subsequent decrease in the size of the affected tissue or organ; wasting away.

Autocrine

A locally acting signal molecule regulating a cellular process of the cell that secreted it

("self-stimulation").

Autosome

Any chromosome except the sex chromosomes. Genes on the autosomes are inherited without regard to the sex of the individual.

Axial (L. *axis*= axle)

Pertaining to the head, neck, and trunk; the part of the body excluding the appendicular portion.

Axillary

Pertaining to the armpit.

Axoneme (L. *axis*= axle, + Gr. *nema*= thread)

The microtubules in a cilium or flagellum, usually arranged as a circlet of nine pairs enclosing one central pair; also, the microtubules of an axopodium.

Azoospermia

The term azoospermia refers to the absence of sperm from the semen. Azoospermia is commonly categorized into either obstructive azoospermia or non-obstructive azoospermia. The term non-obstructive Azoospermia refers to a lack of sperm production, whereas obstructive azoospermia implies adequate sperm production in the presence of obstruction of the ductal system.

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B

Bartholin gland

On each side of the vagina is a pea-size greater vestibular gland with a short duct opening into the vestibule or lower vagina. These glands are homologous to the bulbourethral glands of the male. They keep the vulva moist, and during sexual excitement they provide most of the lubrication for intercourse.

Basal body

Also called kinetosome and blepharoplast, a cylinder of nine triplets of microtubules found at the base of a flagellum or cilium; same structure as a centriole.

Basal metabolic rate (BMR)

Even when a person is at complete rest, considerable energy is required to perform all the chemical reactions of the body. This minimum level of energy required to exist is called the basal metabolic rate (BMR) and accounts for about 50 to 70 percent of the daily energy expenditure in most sedentary persons. Because the level of physical activity is highly variable among different persons, measurement of the BMR provides a useful means of comparing one person's metabolic rate with that of another. The usual method for determining BMR is to measure the rate of oxygen utilization over a given period under fixed standard conditions.

Base

1. A chemical that binds protons from solution; a proton acceptor. **2.** Any of the purines or pyrimidines of a nucleic acid (adenine, thymine, guanine, cytosine, or uracil) serving in part to code for protein structure. **3.** The broadest part of a tapered organ such as the uterus or the inferior aspect of an organ such as the brain.

Basement membrane

1. A thin layer of glycoproteins, collagen, and glycosaminoglycans beneath the deepest cells of an epithelium, serving to bind the epithelium to the underlying tissue.

2. The extracellular matrix (acellular) found below any epithelium. It creates a cellular barrier between the epithelium and its underlying mesenchyme

and is of major importance to the differentiation and maintenance of an epithelium. It is made up primarily of type IV collagen, laminin, fibronectin, and heparan sulfate proteoglycan.

β-Endorphin

Small peptides formed from POMC have endogenous morphine-like or opiate-like activity. They are responsible for increasing the threshold of pain, especially under conditions of stress. Morphine binds to the receptors for endorphins, by which morphine induces the pain relief.

Binding proteins

Hormones released into the circulation can circulate either freely or bound to carrier proteins, also known as binding proteins. The binding proteins serve as a reservoir for the hormone and prolong the hormone's half-life , the time during which the concentration of a hormone decreases to 50% of its initial concentration. The free or unbound hormone is the active form of the hormone, which binds to the specific hormone receptor. Thus, hormone binding to its carrier protein serves to regulate the activity of the hormone by determining how much hormone is free to exert a biologic action. Most carrier proteins are globulins and are synthesized in the liver.

Biogenic amines

1. A class of chemical messengers with neurotransmitter and hormonal functions, synthesized from amino acids and retaining an amino group; also called monoamines. Examples include epinephrine and thyroxine.

2. Amines are chemicals that possess an amine (–NH2) group attached to a carbon atom. Amines that function in cellular signaling are termed biogenic amines. Many amines are synthesized from amino acids. The catecholamines (dopamine, norepinephrine, and epinephrine) are synthesized from the amino acid tyrosine. Dopamine, which is found in all animal taxa, acts as a neurotransmitter. Norepinephrine and epinephrine are known only from vertebrates, and can act as neurotransmitters, paracrines, and hormones. Octopamine and tyramine, which are also synthesized from the amino acid tyrosine, are important neurotransmitters in the invertebrates. Other biogenic amines include the thyroid hormones, Serotonin, Melatonin,

Histamine and Acetylcholine. Most biogenic amines are hydrophilic molecules that are packaged into vesicles and released into the extracellular fluid by exocytosis. They can either be synthesized on demand or be stored for later release.

Blastocoel (Gr. *blastos*= germ, + *koilos*= hollow) Cavity of the blastula

Blastocyst (Gr. *blastos* = bud/germ, *kystis* = bladder)

It is a hollow sphere which forms at late morula stage when fluid passes into intercellular spaces between the inner and outer layers of cells and forms a fluid-filled cavity.

The blastocyst has an outer layer of squamous cells called the trophoblast, an inner cell mass called the embryoblast, and an internal cavity called the blastocoels.

Blastomere (Gr. *blastos*= germ, + *meros*= part) An early cleavage cell.

Blastopore (Gr. *blastos*= germ, + *poros*= passage, pore)

External opening of the archenteron in the gastrula.

Blastula (Gr. *blastos*, germ, + L. *ula*, dim.).

Early embryological stage of many animals; consists of a hollow mass of cells.

Blood-testis barrier (BTB)

In the mammalian testis, the blood-testis barrier (BTB) is composed of specialized junctions between adjacent Sertoli cells near the basement membrane of seminiferous epithelium. BTB is formed by tight junctions between two adjacent Sertoli cells. BTB divides the germinal epithelium into basal and adluminal compartments. The basal compartment is populated by the spermatogonial stem cells and primary spermatocytes. The adluminal compartment is closer to the tubular lumen and is populated by the secondary spermatocytes, spermatids and mature sperm. The unique functional compartmentalization of BTB creates a special micro-environment where germ cell meiosis and further development occur.

Body

1. The entire organism. **2.** Part of a cell, such as a neuron, containing the nucleus and most other

organelles. **3.** The largest or principal part of an organ such as the stomach or uterus; also called the corpus.

Bradykinin

An oligopeptide produced in inflammation that stimulates vasodilation, increases capillary permeability, and stimulates pain receptors.

Breast

The breast is a mound of tissue overlying the pectoralis major muscle. It enlarges at puberty and remains so for life, but most of this time it contains very little mammary gland.

Brush border

A fringe of microvilli on the apical surface of an epithelial cell, serving to enhance surface area and promote absorption.

Bulbourethral Glands

These are two yellow, pea-sized glands located one on each side of membranous urethra. These glands secrete alkaline mucus that is poured into the penile urethra just before ejaculation of the semen. Also called as Cowper's Glands.

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C

Calcification

The hardening of a tissue due to the deposition of calcium salts.

Calcitonin

A calcium-regulating hormone secreted by specialized cells (C cells) in the thyroid gland of mammals and in the ultimobranchial glands of other vertebrates . C cells are located between the follicles in the connective tissue of the thyroid gland in mammals. Calcitonin is released in response to elevated levels of calcium in the blood.

Calcitonin is a straight-chain peptide with 32 amino acids. It is synthesized and secreted by the parafollicular or C ("C" for calcitonin) cells of the thyroid gland. The calcitonin gene directs the synthesis of preprocalcitonin and a signal peptide is cleaved to yield procalcitonin; other peptide sequences are then removed, and the final hormone, calcitonin, is stored in secretory granules for subsequent release. The major stimulus for calcitonin secretion is increased plasma Ca^{2+} concentration. The major action of calcitonin is to inhibit osteoclastic bone resorption, which decreases the plasma Ca^{2+} concentration.

Calorie (L. *calere*= to be warm)

The amount of thermal energy that will raise the temperature of 1 g of water by 1°C. Also called a small calorie.

Cancer

Refers to a malignant, spreading tumor and the illness that result from such a tumor. Malignant tumors normally do not have capsules and they can spread by local growth and tissue destruction into healthy surrounding tissues. The margins of malignant tumors are very irregular and inflammation is normally evident between the tumor and the normal surrounding tissues. Malignant tumors also spread to distant sites by metastasis, which occurs when tumor cells separate from the main mass and are carried by the lymphatic or circulatory system to a new site, where a second neoplasm is formed. The illness associated with cancer usually occurs as tumors invade and destroy healthy surrounding tissue, eliminating its function. Benign tumors are usually less

dangerous than malignant tumors, but they can cause problems. As a benign tumor enlarges, it can compress surrounding tissues and impair their functions. In some cases (e.g., brain tumors), the results can be death.

Capacitation

is the process that permits the acrosome reaction to occur and creates biochemical modifications to the acrosome of the sperm head, allowing penetration of the outer layer, and changes in the tail permitting greater mobility. These are ultimately facilitated by removal of sterols, glycoproteins, and increased permeability and influx of calcium.

Capsule

The fibrous covering of a structure or organ such as the spleen or a diarthrosis.

Carbohydrate (L. *carbo*= charcoal, + Gr. *hydor*=water) Compounds of carbon, hydrogen, and oxygen having the generalized formula $(CH_2O)n$; aldehyde or ketone derivatives of polyhydric alcohols, with hydrogen and oxygen atoms attached in a 2:1 ratio. ; includes sugars, starches, glycogen, and cellulose.

Carbonic anhydrase

An enzyme found in erythrocytes and kidney tubule cells that catalyzes the decomposition of carbonic acid into carbon dioxide and water or the reverse reaction.

($H_2CO_3 \leftrightarrow CO_2 + H_2O$)

Carcinogen

An agent capable of causing cancer, including certain chemicals, viruses, and ionizing radiation.

Carrier

1. A protein in a cellular membrane that performs carrier-mediated transport. **2.** A person who is heterozygous for a recessive allele and does not exhibit the associated phenotype, but may transmit this allele to his or her children; for example, a carrier for sickle-cell disease.

Carrier-mediated transport

A process of transporting materials through a cellular membrane that involves reversible binding to a membrane transport protein.

Catabolism (Gr. *kata*= downward, + *bol*= to throw, +

ism= suffix meaning state of condition)

Any metabolic reactions that release energy and break relatively complex molecules with high free energy into less complex molecules with lower free energy; for example, digestion and glycolysis.

Catecholamine

Catecholamines are amino acid–derived hormones, synthesized from the amino acid tyrosine, that includes epinephrine, norepinephrine, and dopamine. Catecholamines are released in response to sympathetic stimulation and are central to the stress response to a physical or psychological insult such as severe blood loss, decrease in blood glucose concentration, traumatic injury, surgical intervention, or a fearful experience.

Because catecholamines are part of the "fight or flight" response, their physiologic effects include arousal, papillary dilation, piloerection, sweating, bronchial dilation, tachycardia, inhibition of smooth muscle activity, and constriction of the sphincters in the gastrointestinal tract.

Cation

An ion with more protons than electrons and consequently a net positive charge.

Caucasian

A member of the human race that is white skinned.

Caudal

1. Pertaining to a tail or narrow tail-like part of an organ. **2.** Pertaining to the inferior part of the trunk of the body, where the tail of other animals arises. **3.** Relatively distant from the forehead, especially in reference to structures of the brain and spinal cord; for example, the medulla oblongata is caudal to the pons.

Celiac

Pertaining to the abdomen.

Cell

The basic living unit of the body is the cell. Each organ is an aggregate of many different cells held together by intercellular supporting structures.

Almost all cells also have the ability to reproduce additional

cells of their own kind. Fortunately, when cells of a particular type are destroyed, the remaining cells of this type usually generate new cells until the supply is replenished.

Cervix (L. *cervix*= neck)

Opening or neck of the uterus or womb of a mammal.

The cervix represents the inferior extension of the uterus that projects into the vagina. It has a mucosa that lines the endocervical canal, which has a highly elastic lamina propria, and a muscularis that is continuous with the myometrium. The cervix acts as a gateway to the upper female tract; at midcycle, the endocervical canal facilitates sperm viability and entry. During the luteal phase, changes in the endocervical canal serve to impede the passage of sperm and microbes, thereby minimizing the chance of superimplantation of a second embryo, as well as inhibiting ascending infections into the placenta, fetal membranes, and fetus. The cervix physically supports the weight of the growing fetus. At term, cervical softening and dilation allow passage of the newborn and placenta from the uterus into the vagina.

Channel protein

A protein in the plasma membrane that has a pore through it for the passage of materials between the cytoplasm and extracellular fluid.

Chemical bond

A force that attracts one atom to another, such as their opposite charges or the sharing of electrons.

Chemical synapse

A meeting of a nerve fiber and another cell with which the neuron communicates by releasing neurotransmitters.

Chemoreceptor

An organ or cell specialized to detect chemicals, as in the carotid bodies and taste buds.

Chemotaxis

Chemotaxis is the directed movement of cells along a chemical concentration gradient.

Chief cells

The majority type of cell in an organ or tissue such as the parathyroid glands or gastric glands.

Cholecystokinin (CCK)

1. A hormone released from the vertebrate duodenal mucosa primarily in response to the presence of fat; inhibits gastric motility and secretion, stimulates pancreatic enzyme secretion, and stimulates gallbladder contraction.

2. The functions of CCK are coordinated to promote fat digestion and absorption. CCK is a 33–amino acid peptide, which is structurally related to gastrin and a member of the "gastrin-CCK family". CCK is secreted by the I cells of the duodenal and jejunal mucosa in response to two types of physiologic stimuli: (1) monoglycerides and fatty acids (but not triglycerides) and (2) small peptides and amino acids.

Cholesterol

A steroid that functions as part of the plasma membrane and as a precursor for all other steroids in the body.

Cholinergic

Pertaining to acetylcholine (ACh), as in cholinergic nerve fibers that secrete ACh, cholinergic receptors that bind it, or cholinergic effects on a target organ.

Chorion (Gr. *chorion*= skin)

1. A fetal membrane external to the amnion that surrounds the embryo of nonavian reptiles, birds, and mammals; forms part of the placenta and has diverse functions including fetal nutrition, waste removal, and hormone secretion.

2. One of the four extraembryonic membranes formed during the development of higher vertebrates, including humans. It provides the fetal contribution to the formation of the placenta. The chorion is made up of trophoblast and extraembryonic somatic mesoderm; it develops outgrowths called villi.

Chorioallantoic membrane (Gr. *chorion*= skin, + *allas*= sausage, + *eidos*= form)

A vascular envelope around some amniote embryos formed by fusion of mesoderm from the chorion and allantois.

Chorioallantoic placenta (Gr. *chorion*= skin, + *allas*= sausage)

A type of placenta that occurs in placental mammals and some marsupials in which materials are exchanged between the embryo and mother through a structure

modified from the embryonic chorionic and allantoic membranes.

Chorionic villi (Gr. *chorion*= skin, + L. *villi*, pl. of *villus*= shaggy hair, tuft of hair) Fingerlike extensions containing blood vessels that lie on the outer surface of a vertebrate chorionic membrane.

Choriovitelline placenta (Gr. *chorion*= skin, + *vittel*= yolk of an egg)

An often transitory placenta that forms during the early developmental stages of marsupials and placental mammals. Also called the "yolk sac placenta," it is formed from the yolk sac and chorionic membrane of the embryo.

Chromatin

Filamentous material in the interphase nucleus, composed of DNA and associated proteins.

Chromatophores

Pigment-containing cells that are found in the integument of some animals and are responsible for physiological color change; the color granules are dispersed or concentrated depending on the animal's perception of its surroundings

Chromosome

A complex of DNA and protein carrying the genetic material of a cell's nucleus. Normally there are 46 chromosomes in the nucleus of each human cell except germ cells.

Chronic

1. Long-lasting. **2.** Pertaining to a disease that progresses slowly and has a long duration.

Circadian rhythm

1. Circadian rhythms are diurnal rhythms based on endogenous, cyclic events that occur approximately once each day.

2. The most obvious source of environmental rhythmicity is the daily light/dark cycle, and almost all taxonomic groups have evolved complementary circadian (from the Latin circa [about] dies [a day]) rhythms of behaviour to accommodate it, if only in alternating phases of activity and rest. Circadian clocks are so-called because their periodicity is generally not exactly 24 h, and, under constant light conditions, tend to drift. Nevertheless, they

provide the underlying mechanism for some other, longer-term, behavioural rhythms.

Circumcision

The removal of the foreskin of the penis, is an elective procedure for a baby boy. Certain religions conduct a ceremonial circumcision, as in the bris practiced in the Jewish faith when the infant is 8 days old. In the brief medical process of circumcision, the penis is anesthetized locally. A clamp or ring is applied to remove the prepuce. Circumcision in an adult may require a general anesthetic. A circumcised penis is easier to keep clean. The risk of developing a sexually transmitted disease, which can flourish under the foreskin, is decreased. However, these risks can also be managed by teaching the boy to practice careful personal hygiene.

Cleavage

Series of mitotic divisions of the zygote to form early embryonic cells—the blastomeres.

Climacteric

A period in the lives of men and women, usually in the early 50s, marked by changes in the level of reproductive hormones, a variety of somatic and psychological effects, and in women, cessation of ovulation and menstruation (menopause).

Clitoris

The clitoris**,** a small organ partly enclosed by the labia minora, is important in the female sexual response. The clitoris and the penis originate from the same tissue during early fetal development, and like the penis, the clitoris contains erectile tissue that is highly sensitive to stimulation. Between the clitoris and the vaginal opening lies the urethral opening.

It is homolog of the penis. The clitoris is composed of erectile tissue that undergoes the process of erection in essentially the same manner as the penis.

Unlike the penis, clitoral tissue is completely separate from the urethra. Thus, the only function of the clitoris is involved with sexual arousal and climax at orgasm.

Clone

A population of cells that are mitotically descended from the same parent cell and are identical to each other genetically or in other respects.

Coenzyme

A small organic molecule, usually derived from a vitamin, that is needed to make an enzyme catalytically active; acts by accepting electrons from an enzymatic reaction and transferring them to a different reaction chain.

Cofactor A non-protein such as a metal ion or coenzyme needed for an enzyme to function.

Colloid

An aqueous mixture of particles that are too large to pass through most selectively permeable membranes but small enough to remain evenly dispersed through the solvent by the thermal motion of solvent particles; for example, the proteins in blood plasma.

Colostrum

1. The fluid secreted during the last few days before and the first few days after parturition is called colostrum; it contains essentially the same concentrations of proteins and lactose as milk, but it has almost no fat and its maximum rate of production is about 1/100 the subsequent rate of milk production.

2. In late pregnancy, the mammary acini and ducts are distended with a secretion called colostrum. This is similar to breast milk in protein and lactose content but contains about one-third less fat. It is the infant's only natural source of nutrition for the first 1 to 3 days postpartum. Colostrum has a thin watery consistency and a cloudy yellowish color. The amount of colostrum secreted per day is at most 1% of the amount of milk secreted later, but since infants are born with excess body water and ample fat, they do not require high calorie or fluid intake at first. A major benefit of colostrum is that it contains immunoglobulins, especially IgA. IgA resists digestion and may protect the infant from gastroenteritis. It is also thought to be pinocytosed by the small intestine and to confer wider, systemic immunity to the neonate.

Concentration gradient

A difference in chemical concentration from one point to another, as on two sides of a plasma membrane.

Conception

The fertilization of an egg, producing a zygote.

Conceptus

All products of conception, ranging from a fertilized egg to the full term fetus with its embryonic membranes, placenta, and umbilical cord.

Conformation

The three-dimensional structure of a protein that results from interaction among its amino acid side groups, its interactions with water, and the formation of disulfide bonds.

Congenital

Present at birth; for example, an anatomical defect, a syphilis infection, or a hereditary disease.

Conjugated

A state in which one organic compound is bound to another compound of a different class, such as a protein conjugated with a carbohydrate to form a glycoprotein.

Conn syndrome

It is a condition in which autonomous benign tumors of the adrenal glands hypersecrete aldosterone. The excess aldosterone leads to hypertension because of Na^+ and H_2O retention and hypokalemia because of excess K^+ secretion. The release of renin is suppressed.

Primary hyperaldosteronism is called Conn syndrome. It frequently occurs as a result of aldosterone-secreting tumors. Excessive mineralocorticoid secretion results in potassium depletion, sodium retention, muscle weakness, hypertension, and hypokalemic alkalosis. Although extracellular fluid volume increases, edema is not common because of hypervolemia-induced ANP release that results in natriuresis.

Connective tissue

A tissue usually composed of more extracellular than cellular volume and usually with a substantial amount of extracellular fiber; forms supportive frameworks and capsules for organs, binds structures together, holds them in place, stores energy (as in adipose tissue), or transports materials (as in blood).

Contraception

The term contraception generally mean any procedure or device intended to prevent pregnancy.

Contractility

1. The ability to shorten. **2.** The amount of force that a contracting muscle fiber generates for a given stimulus; may be increased by epinephrine, for example, while stimulus strength remains constant.

Cooperative effect

Effect in which two hormones, or both divisions of the autonomic nervous system, work together to produce a single overall result.

Copulation (L. *copulare,* to couple)

1. Sexual union to facilitate the reception of sperm by the female.

2. Also known as sexual intercourse, (or coitus), is a reproductive act in which the male reproductive organ enters the female reproductive tract. If the reproductive act is complete, sperm cells are passed from the male body into the female, in the process fertilizing the female egg and forming a new organism. In some vertebrates, such as fish, eggs are laid outside of the body and fertilized externally.

Corona (L. crown)

Head or upper portion of a structure; A halo- or crown-like structure, as in the corona radiata or the coronal suture of the skull.

Corona radiata

1. An array of nerve tracts in the brain that arise mainly from the thalamus and fan out to different regions of the cerebral cortex. **2.** The first layer of cuboidal cells immediately external to the zona pellucida around an egg cell. **3.** The layer of follicular cells immediately surrounding the egg or ovum is called the corona radiata (meaning "radiating crown"). When the oocyte is ovulated, this layer will remain attached to the egg and travel with it into the oviduct. At fertilization, the sperm will have to penetrate the corona radiata and the zona pellucida in order to get to the egg surface.

Corpora allata (L. *corpus* = body, + *allatum* = aided)

1. Endocrine glands in insects that produce juvenile hormone. 2. It is the source of juvenile hormone, in insect larvae, which inhibits metamorphosis. Secretory cells of the corpora allata are active during larval molts but inactive during the metamorphic molt. See: prothoracic gland.

Corpora cardiaca (L. *corpus*= body, + Gr. *kardiakos*= belonging to the heart)

Paired organs behind the brain of insects serving as storage and release organs for prothoracicotropic hormone (PTTH).

Corpus

Body or mass; the main part of an organ, as opposed to such regions as a head, tail, or cervix.

Corpus albicans

1. The functional lifespan of the corpus luteum in a non-fertile cycle is normally 14±2 days. Unless pregnancy occurs, the corpus luteum is transformed into an avascular scar referred to as the corpus albicans.

2. During the regression of the corpus luteum, the granulosa lutein cells degenerate and are replaced with collagenous scar tissue. Because of its white color, the former corpus luteum now becomes known as the corpus albicans ("white body").

Corpus luteum

Once the luteal phase starts, after ovulation, the granulosa cells increase in size and initiate an accumulation of a yellow pigment called lutein (hence the name corpus luteum). Corpus luteum has the ability to produce estrogen and progesterone.

When fertilization does not occur, the corpus luteum begins to degenerate and the levels of estrogen and progesterone diminish, stimulating the growth of new follicles. However, when fertilized, the corpus luteum increases progesterone production to inhibit the growth of new follicles. The continuity of the corpus luteum is maintained by human chorionic gonadotropin (hCG) at the start of pregnancy, then the placenta takes the function of producing the necessary estrogen and progesterone.

Cortex (plural, *cortices*)

The outer layer of some organs such as the adrenal gland, cerebrum, lymph node, and ovary; usually covers or encloses tissue called the medulla.

Corticosteroid

Any steroid hormone secreted by the adrenal cortex, such as aldosterone, cortisol, and sex steroids.

Cortisol

Cortisol (also known clinically as hydrocortisone) is the most potent glucocorticoid, but the adrenals also secrete a weaker one called corticosterone. Glucocorticoids are secreted by the zona fasciculata and zona reticularis in response to ACTH from the pituitary.

They stimulate fat and protein catabolism, gluconeogenesis, and the release of fatty acids and glucose into the blood. This helps the body adapt to stress and repair damaged tissues. Glucocorticoids also have an anti-inflammatory effect; hydrocortisone is widely used in ointments to relieve swelling and other signs of inflammation. Excessive glucocorticoid secretion or medical use, however, suppresses the immune system for reasons we will see later in the discussion of stress physiology.

Cotransport

A form of carrier-mediated transport in which a membrane protein transports two solutes simultaneously or within the same cycle of action by either facilitated diffusion or active transport; for example, the sodium–glucose transporter and the Na^+–K^+ pump.

Countercurrent

A situation in which two fluids flow side by side in opposite directions, as in the countercurrent multiplier of the kidney and the countercurrent heat exchanger of the scrotum.

Cowper glands

The cowper glands, often called bulbourethral glands, are pea-shaped glands located beneath the prostate gland at the beginning of the internal portion of the penis. The fluid excreted by these glands is clear and thick and acts as a lubricant. It is thought to function as a flushing agent that washes out the urethra before the semen is ejaculated and may also help make the semen less watery and provide a suitable living environment for the sperm.

Cranial

1. Pertaining to the cranium. **2.** In a position relatively close to the head or a direction toward the head.

Cretinism

Cretinism is caused by extreme hypothyroidism during fetal life, infancy, or childhood. This condition is characterized

especially by failure of body growth and by mental retardation. It results from congenital lack of a thyroid gland (congenital cretinism), from failure of the thyroid gland to produce thyroid hormone because of a genetic defect of the gland, or from a lack of iodine in the diet (endemic cretinism).

Skeletal growth in a child with cretinism is characteristically more inhibited than is soft tissue growth. As a result of this disproportionate rate of growth, the soft tissues are likely to enlarge excessively, giving the child with cretinism an obese, stocky, and short appearance. Occasionally the tongue becomes so large in relation to the skeletal growth that it obstructs swallowing and breathing, inducing a characteristic guttural breathing that sometimes chokes the child.

Cross section

A cut perpendicular to the long axis of the body or an organ.

Crural

Pertaining to the leg proper or to the crus of a organ.

Crus (plural, *crura*)

1. The leg proper; the region from the knee to the ankle. **2.** A leg-like extension of an organ such as the penis and clitoris.

Cryptorchidism

It is unilateral or bilateral absence of the testes from the scrotum because of failure of normal testicular descent from the genital ridge through the external inguinal ring. Between 1% and 8% of full-term and 20% to 25% of premature male infants have cryptorchidism. In most cases of cryptorchidism noted at birth, spontaneous testicular descent occurs during the first year of life, reducing the incidence to 0.2% to 0.8% at 1 year of age. Unilateral cryptorchidism is five to ten times more common than bilateral cryptorchidism.

Almost 50% of cryptorchid testes are located at the external inguinal ring or in a high scrotal position; about 20% lie within the inguinal canal between the internal and external inguinal rings; about 10% are intra-abdominal; and about 25% are ectopic (i.e., located away from the normal pathway of descent from the abdominal cavity to the scrotum). Most ectopic testes are found in a superficial inguinal pouch above the external inguinal ring.

Cuboidal

A cellular shape that is roughly like a cube or in which the height and width are about equal; typically looks squarish in tissue sections.

Cumulus oophorus

The cumulus oophorus cells are the inner granulosa cells that surround the oocyte. The innermost layer (relative to the oocyte) of cumulus cells maintains gap and adhesion junctions with the oocyte. Cumulus cells are released from the ovary with the oocyte (collectively referred to as the cumulus-oocyte complex) during the process of ovulation.

Current

A moving stream of charged particles such as ions or electrons.

Cushing's syndrome

Hypercortisolism is termed Cushing syndrome. The symptoms of Cushing's syndrome are due to the exaggerated effects of too much cortisol, including (1) excessive production of glucose from glycogen and protein, and (2) retention of too much salt and water. Blood glucose concentration rises, and muscle mass decreases because of the utilization of protein to make glucose. Some of the extra glucose is converted to body fat, but only in certain areas of the body, including the face, abdomen, and the back of the neck. Symptoms of Cushing's syndrome include muscle weakness and fatigue, edema (swelling due to too much fluid), and high blood pressure. The disease can be caused by tumors of the adrenal gland or the ACTH-secreting cells of the pituitary. It can also be due to excessive use of cortisol and cortisol-like drugs (cortisone, prednisone, dexamethasone, and others) to control chronic inflammatory conditions such as allergies and arthritis.

Pharmacologic use of exogenous corticosteroids is now the most common cause of Cushing syndrome. The next most prevalent cause is ACTH secreting tumors (pituitary or extra-pituitary). The form of Cushing syndrome caused by a functional pituitary adenoma is called Cushing disease. A fourth cause is primary hypercortisolism resulting from a functional adrenal tumor. If the disorder is primary or a result of corticosteroid treatment, ACTH secretion will be suppressed, and increased skin pigmentation will not occur.

However, if the hypersecretion of the adrenal is a result of an ACTH-secreting nonpituitary tumor, ACTH levels sometimes become high enough to increase skin pigmentation even in the presence of hypercortisolism. Increased cortisol secretion causes a tendency to gain weight, with a characteristic abdominal and interscapular (buffalo hump) fat. The face appears round (moon face), and the cheeks may be reddened (plethora), in part because of the polycythemia and in part due to thinning of the skin.

The limbs will be thin as a result of skeletal muscle wasting (from increased proteolysis), and muscle weakness will be evident (from muscle proteolysis and hypokalemia). Proximal muscle weakness is apparent, so the patient may have difficulty with stair climbing or rising from a sitting position.

The abdominal fat accumulation, coupled with atrophy of the abdominal muscles and thinning of the skin, will produce a large, protruding abdomen. Purple abdominal striae are seen as a result of the damage to the skin by the prolonged proteolysis, increased intra-abdominal fat, and loss of abdominal muscle tone.

Cutaneous

Pertaining to the skin.

Cyclic adenosine monophosphate (cAMP)

A cyclic molecule produced from ATP by the action of adenylate cyclase; serves as a second messenger in many hormone and neurotransmitter actions.

Cytokines/Lymphokines

Cytokines and lymphokines are messengers and regulators within the immune system. Cells of the immune system are widespread over the entire organism and are often mobile, in contrast to cells of the endocrine system, which are fixed in defined organ structures.

Cytoplasm

The contents of a cell between its plasma membrane and its nuclear envelope, consisting of cytosol, organelles, inclusions, and the cytoskeleton.

Cytosol

A clear, featureless, gelatinous colloid in which the organelles and other internal structures of a cell are embedded.

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D

Dalton

1. A unit of mass very nearly equal to that of a hydrogen atom. Named after John Dalton (1766-1844), who developed the atomic theory of matter.

2. Dalton is a unit of molecular mass; 1/12th the mass of a ^{12}C atom.

Daughter cells

Cells that arise from a parent cell by mitosis or meiosis.

Deamination

Removal of an amino group from an organic molecule; a step in the catabolism of amino acids.

Decomposition reaction

A chemical reaction in which a larger molecule is broken down into smaller ones.

Degranulation

Exocytosis and disappearance of cytoplasmic granules, especially in platelets and granulocytes.

Dehydroepiandrosterone (DHEA)

It is the primary androgen secreted by the zona reticularis of the adrenal cortex. These androgens, which are secreted in small amounts, are converted to testosterone (or estrogens) by other tissues. The significance of this small adrenal androgen secretion in both sexes remains unclear, but DHEA is being promoted as a wonder drug for increasing vitality, strength, and muscle mass. The effects of long-term high doses of DHEA remain largely unknown. However, high levels of DHEA in women have been linked to an increased risk of ovarian cancer as well as to masculinization, due to the conversion of DHEA to testosterone. The International Olympic Committee, NCAA, MLB, and NFL have banned the use of DHEA.

Denaturation

A change in the three dimensional conformation of a protein that destroys its enzymatic or other functional properties, usually caused by extremes of temperature or pH.

Dermis

The deeper of the two layers of the skin, underlying the epidermis and composed of fibrous connective tissue.

Development

Development refer to the characteristic changes that an organism undergoes from its origin (during the fertilization of an egg by sperm) to its final adult form.

Diabetes

Any disease characterized by chronic polyuria of metabolic origin; diabetes mellitus unless otherwise specified.

Diabetes insipidus

A form of diabetes that results from hyposecretion of antidiuretic hormone; unlike other forms, it is not characterized by hyperglycemia or glycosuria.

Diabetes mellitus (DM)

A form of diabetes that results from hyposecretion of insulin or from a deficient target cell response to it; signs include hyperglycemia and glycosuria.

Diabetes mellitus means "a high flow of urine with a sweet taste." Called diabetes for short, it is a disease of sugar regulation. The common feature of the several types of diabetes is an inability to get glucose into cells where it can be used. The result is an abnormally high glucose concentration in the blood—so high that it overwhelms the kidney's ability to reabsorb all that is filtered. Glucose and excessive water appear in the urine (hence the name of the disease), causing dehydration and thirst. In addition to these symptoms, many diabetics experience fatigue, frequent infections, blurred vision, cuts that are slow to heal, and tingling in the feet or hands. Without the ability to metabolize glucose properly, the body turns to the metabolism of fat and proteins. The abnormal metabolism of glucose, fats, and proteins causes most of the other medical problems associated with diabetes, including cardiovascular and neural diseases, renal failure, blindness, and damage to small blood vessels that may lead to the need for amputations. There are two types of diabetes. **Type 1 diabetes** (5–10% of all cases): Type I diabetes mellitus (TIDM), also referred to as insulin-dependent diabetes mellitus (IDDM), is a form of diabetes that involves chronic inflammatory

destruction of the insulin-producing β cells in the islets of Langerhans of the pancreas. This results in little or no insulin production. Insulin facilitates the entry of glucose into cells, where it is metabolized for energy production. In the absence of insulin, levels of blood glucose rise, resulting in increased hunger, frequent urination, and excessive thirst. Other symptoms include weight loss, nausea, and fatigue. A major concern is the development of ketoacidosis, which lowers blood pH. This occurs when cells begin to break down proteins and fatty acids to meet metabolic demands in the absence of glucose.. Typically it occurs more frequently in younger people, hence its other name, juvenile-onset diabetes.

Type 2 diabetes (non-insulin-dependent diabetes) represents 90–95% of all cases. Its hallmark is insulin resistance- cells fail to respond adequately to insulin even when it is present.

Type 2 diabetes usually occurs in adults beyond the age of 40; however, in recent years it has been occurring more frequently and at younger ages. Type 2 diabetes may have a genetic component, but lifestyle factors are thought to be the major determinants.

Diabetic Ketoacidosis

Diabetic ketoacidosis is characterized by hyperglycemia, increased ketone bodies, and metabolic acidosis, resulting directly from decreased insulin availability and simultaneous elevations of the counterregulatory hormones glucagon, catecholamines, cortisol, and growth hormone. The excess blood glucose increases osmolarity, which, if severe, can result in diabetic coma.

The lack of insulin and the high levels of counterregulatory hormones glucagon, epinephrine, and cortisol combine to increase the activity of hormone-sensitive lipase, increase the release of free fatty acids, and decrease the activity of acetyl-CoA carboxylase, thereby impairing the reesterification of free fatty acids and promoting fatty acid conversion into ketone bodies. During diabetic ketoacidosis, high amounts of ketone bodies are released into the blood, and a high ratio (3:1 or higher) of 3-β-hydroxybutyrate to acetoacetate is generated because of the highly reduced state of hepatic mitochondria. These ketone bodies can freely diff use across cell membranes and serve as an energy source for extrahepatic

tissues including the brain, skeletal muscle, and kidneys.

Ketone bodies are filtered and reabsorbed in the kidney. At physiologic pH, ketone bodies, with the exception of acetone, dissociate completely.

The resulting liberation of H^+ from ketone body metabolism exceeds the blood's buffering capacity, leading to metabolic acidosis with an increased anion gap. If severe, this condition can lead to coma.

Diabetogenic hormone

GH is considered a diabetogenic hormone, since oversecretion leads to an increase in blood glucose and can cause insulin insensitivity or diabetes mellitus type 2. If produced in excess, GH causes gigantism.

Diastole

A period in which a heart chamber relaxes and fills with blood; especially ventricular relaxation.

Diencephalon

A portion of the brain between the midbrain and corpus callosum; composed of the thalamus, epithalamus, and hypothalamus.

Diestrous

This is the resting phase or the period of sexual inactivity.

Differentiation

Development of a relatively unspecialized cell or tissue into one with a more specific structure and function.

Diffusion

Spontaneous net movement of particles from a place of high concentration to a place of low concentration (down a concentration gradient).

Dimorphism (Gr. *di*= two, + *morphe*= form)

Existence within a species of two distinct forms according to color, sex, size, organ structure, or behavior. Occurrence of two kinds of zooids in a colonial organism.

Dioecious (Gr. *di*= two, + *oikos*= house)

Having male and female gonads in separate individuals.

Diploblastic (Gr. *diploos*= double, + *blastos*= bud) Organism with two germ layers, endoderm and ectoderm.

Diploid (Gr. *diploos*= double, + *eidos*=form)

Having the somatic (double, or 2n) number of chromosomes or twice the number characteristic of a gamete of a given species.

Direct development

A life cycle sequence from zygote to adult without intervening larval stages.

Disaccharide (Gr. *dis*= twice, + L. *saccharum*= sugar)

A carbohydrate composed of two simple sugars (monosaccharides) joined by a glycosidic bond; for example, lactose, sucrose, and maltose.

Disease

It is a more specific term for an illness characterized by a recognizable set of signs and symptoms. A local disease affects one part or a limited region of the body (for example, a sinus infection); a systemic disease affects either the entire body or several parts of it (for example, influenza).

Diseases alter body structures and functions in characteristic ways. A person with a disease may experience symptoms, subjective changes in body functions that are not apparent to an observer.

Examples of symptoms are headache, nausea, and anxiety. Objective changes that a clinician can observe and measure are called signs. Signs of disease can be either anatomical, such as swelling or a rash, or physiological, such as fever, high blood pressure, or paralysis.

Disorder

A disorder is any abnormality of structure or function.

Distal

Relatively distant from a point of origin or attachment; for example, the wrist is distal to the elbow.

Disulfide bond

A covalent bond between the sulfur atoms of two cysteine residues, serving to link one polypeptide chain to another or to hold a single chain in its three-dimensional conformation.

Diuretic

A chemical that increases urine output.

Dominant

1. Pertaining to a genetic allele that is phenotypically expressed in the presence of any other allele. **2.** Pertaining to a trait that results from a dominant allele.

Dopamine

An inhibitory catecholamine neurotransmitter of the central nervous system, especially of the basal nuclei, where it acts to suppress unwanted motor activity.

Dorsal (L. *dorsum*= back)

Toward the back (spinal) side of the body; in humans, usually synonymous with posterior.

Down syndrome

A congenital syndrome including mental disability, caused by the cells in a person's body having an extra chromosome 21; also called trisomy 21.

Ductus deferens

The duct of the epididymis straightens out at the tail, turns 180°, and becomes the ductus deferens, also called the vas deferens. This is a muscular tube about 45 cm long and 2.5 mm in diameter in case of human. It passes upward through the spermatic cord and inguinal canal and enters the pelvic cavity. There, it turns medially and approaches the urinary bladder. After passing between the bladder and ureter, the duct turns downward behind the bladder and widens into a terminal ampulla. The ductus deferens ends by uniting with the duct of the seminal vesicle, a gland considered later. The duct has a very narrow lumen and a thick wall of smooth muscle well innervated by sympathetic nerve fibers.

Dwarfism

Most instances of dwarfism result from generalized deficiency of anterior pituitary secretion (panhypopituitarism) during childhood. In general, all the physical parts of the body develop in appropriate proportion to one another, but the rate of development is greatly decreased. A child who has reached the age of 10 years may have the bodily development of a child aged 4 to 5 years, and the same person at age 20 years may have the bodily development of a child aged 7 to 10 years. A person with panhypopituitary dwarfism does not pass through puberty and never secretes sufficient quantities of gonadotropic hormones to

develop adult sexual functions. In one third of such dwarfs, however, only growth hormone is deficient; these persons do mature sexually and occasionally reproduce. In one type of dwarfism (the African pygmy and the Levi-Lorain dwarf), the rate of growth hormone secretion is normal or high, but there is a hereditary inability to form somatomedin C, which is a key step for the promotion of growth by growth hormone.

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E

Eccrine (Gr. *ek*=out of, + *krinein*= to separate)

Applies to a type of mammalian sweat gland that produces a watery secretion.

Ecdysiotropin (Gr. *ekdysis*= to strip off, escape, + *tropos*=a turn, change)

Hormone secreted in brain of insects that stimulates prothoracic gland to secrete molting hormone. Prothoracicotropic hormone; brain hormone.

Ecdysis (Gr. *ekdysis*= to strip off, escape). Shedding of outer cuticular layer; molting, as in insects or crustaceans.

Ecdysone (Gr. *ekdysis*= to strip off).

Molting hormone of arthropods, stimulates growth and ecdysis, produced by prothoracic glands in insects and Y organs in crustaceans.

Ecdysone is steroid in nature; it is a prohormone of 20-hydroxyecdysone: the active form of ecdysone. All arthropods have a rigid exoskeleton, a hard outer covering that provides both protection and support. In order to grow, an arthropod must shed its exoskeleton in a process called molting. The hormones that regulate molting have been intensively studied in the insects, and one of the most important is the steroid hormone called ecdysone. The steroid hormone ecdysone can stimulate an insect larva to molt to form a larger larva, a pupa, or an adult, depending on the level of an additional hormone, juvenile hormone. When juvenile hormone levels are high, ecdysone stimulates molting from one larval stage to another. When juvenile hormone levels are low, ecdysone triggers the formation of the pupa in holometabolous insects. When juvenile hormone is absent, ecdysone triggers the emergence of the adult insect. The structure of ecdysone is similar to that of the vertebrate steroid hormones, but it contains more hydroxyl groups. Ecdysone secretion is regulated by a neurohormone called prothoracicotropic hormone (PTTH) produced by the insect brain. This neurohormone stimulates the prothoracic gland to secrete ecdysone. Ecdysone is actually a prohormone, and is rapidly converted to the active

hormone 20-hydroxyecdysone (also called ecdysterone) by enzymes found in the hemolymph and various peripheral tissues. 20-Hydroxyecdysone binds to an intracellular receptor that regulates gene expression by binding to a hormone responsive element, as do the vertebrate steroid hormones

Ectopic

In an abnormal location; for example, ectopic pregnancy and ectopic pacemakers of the heart.

Ectopic pregnancy

The term ectopic means out of place, and an ectopic pregnancy is one that occurs outside the uterus. The most common site of an ectopic pregnancy, the uterine tube, produces a tubal pregnancy. The blastocyst may not have reached the uterine cavity by the time it is ready to implant and may implant into the wall of the uterine tube. The uterine tube cannot expand enough to accommodate the growing fetus, and, if the fetus is not removed, the tube eventually ruptures. The ruptured uterine tube causes life-threatening internal bleeding.

Edema (Gr. *oidema*= swelling) Abnormal accumulation of tissue fluid resulting in swelling of the tissue.

Effector (L. *efficere*= bring to pass)

A molecule, cell, or organ that carries out a response to a stimulus.

Efferent (L. *ex*= out, + *ferre*= to bear)

Carrying away or out, such as a blood vessel that carries blood away from a tissue or a nerve fiber that conducts signals away from the central nervous system.

Eicosanoids

The eicosanoids are a group of second messengers that are derived from arachidonic acid, can act as neurotransmitters and paracrine chemical messengers. Eicosanoids differ from other second messengers because they themselves are hormones rather than intracellular signals. The hydrophobic eicosanoids diffuse out of the membrane of the signaling cell and diffuse to the target cell, where they bind to transmembrane receptors. Most eicosanoids have an extremely short half-life in extracellular fluids, and degrade within a few seconds. As a result, they cannot

be transported across long distances, and thus cannot act as hormones. Most eicosanoids are derivatives of arachidonic acid, a 20-carbon fatty acid common in plasma membrane phospholipids. Eicosanoid synthesis proceeds through either the lipoxygenase pathway, which produces the leukotrienes and lipoxins, or the cyclooxygenase pathway, which produces prostaglandins, prostacyclins, and thromboxanes.

Ejaculatory Ducts

The ejaculatory ducts are two hollow tubes, each formed by union of the ampulla of a ductus deferens and the excretory duct of a seminal vesicle. Where the ductus deferens and duct of the seminal vesicle meet, they collectively form a short common duct, the ejaculatory duct, which passes through the prostate gland and empties into the urethra. The ejaculatory duct is the last of the spermatic ducts.

Elastic fiber

A connective tissue fiber, composed of the protein elastin, that stretches under tension and returns to its original length when released; responsible for the resilience of organs such as the skin and lungs.

Elasticity

The tendency of a stretched structure to return to its original dimensions when tension is released.

Electrical synapse

A gap junction that enables one cell to stimulate another directly, without the intermediary action of a neurotransmitter; such synapses connect the cells of cardiac muscle and single-unit smooth muscle.

Electrolyte

A salt that ionizes in water and produces a solution that conducts electricity; loosely speaking, any ion that results from the dissociation of such salts, such as sodium, potassium, calcium, chloride, and bicarbonate ions.

Embryo (Gr. *Embryon*= embryo) A developing individual from the conception when the three primary germ layers have formed, through the end of the eighth week when all of the organ systems are present.

Embryogenesis (Gr. *embryon*, embryo, + *genesis*, origin)

The origin and development of the embryo; embryogeny

Embryology

It is the science that deals with development and growth of an individual within the uterus (female genital tract). It begins with fertilization of an ovum and culminates with the birth of the baby.

Endocrine glands (Gr. *endon*= within, + *krinein*= to separate)

A ductless gland that secretes hormones into the bloodstream; for example, the thyroid and adrenal glands.

Endocrine glands differ from exocrine glands in that they do not have ducts for their secretory products. Instead, endocrine glands are highly vascularized, and their secretory cells are surrounded by rich capillary networks. The close proximity of the secretory cells to the capillaries allows for efficient release of the secretory products into the bloodstream and their distribution to different organs via the systemic circulation.

The endocrine glands can be either individual cells (unicellular glands) as seen in the digestive organs as enteroendocrine cells, endocrine tissue in mixed glands (both endocrine and exocrine) as seen in pancreas and male and female reproductive organs, or as separate endocrine organs as the pituitary gland, thyroid glands, parathyroid glands, and adrenal glands. Individual endocrine cells, called enteroendocrine cells, are found in the digestive organs. Endocrine tissues are seen in such mixed glands as the pancreas and the reproductive organs of both sexes.

Endocrinology

The study of endocrine glands and their hormones is called endocrinology.

Endocytosis (Gr. *endon*= within, + *kytos*= hollow vessel)

1. Any process in which a cell forms vesicles from its plasma membrane and takes in large particles, molecules, or droplets of extracellular fluid; for example, phagocytosis and pinocytosis.

2. It is the uptake of material through the cell membrane by the formation of a membrane-bound sac called a vesicle. The two types of endocytosis are phagocytosis and pinocytosis.

Endoderm (Gr. *endon*= within, + *derma*= skin)

The innermost of the three primary germ layers of an embryo; gives rise to the mucosae of the digestive and respiratory tracts and to their associated glands.

Endogenous

Originating internally, such as the endogenous cholesterol synthesized in the body in contrast to the exogenous cholesterol coming from the diet.

Endometriosis

1. Endometriosis is a condition that is characterized by the presence of functional endometrial glands and stroma outside of the uterine cavity. This condition is found to be highly prevalent in women of reproductive age. However, the exact prevalence of endometriosis is unknown.

2. It is a condition in which endometrial tissue is found in abnormal locations, reduces fertility. Generally, endometriosis is thought to result from some endometrial cells passing from the uterus through the uterine tubes into the pelvic cavity. The endometrial cells invade the peritoneum of the pelvic cavity. Periodic inflammation of the areas where the endometrial cells implant occurs because the endometrium is sensitive to estrogen and progesterone. Endometriosis is a cause of painful menstruation and can reduce fertility.

3. Endometriosis is the name given to the condition in which tissue similar to the endometrium is found outside the uterine cavity. This is a common condition in certain parts of the world, especially in infertile women. Some have estimated that 20% of women have endometriosis at some stage in their lives. The endometriotic tissue can be found in various parts of the body but most commonly in the pelvis. The tissue may be found on the ovaries and tubes. It can also be found on the lining of the pelvic wall (called the peritoneum). The reason why endometrium-like tissue exists outside the uterine cavity is not clear. Some theories have tried but do not provide a complete explanation for the appearance of this tissue in all reported sites. All that is known is that endometriosis is related in some way to menstruation. It is less common in females who start having children early or have many children. It is possible that the absence of menstrual periods during pregnancy and lactation allows the body enough time to tackle and

eliminate any small area of developing endometriosis.

Endometritis

Endometritis is an inflammation of the endometrium and may result from an infection with organisms such as the tuberculosis bacteria. Infertility can arise through the effects of toxins produced by the bacteria and abnormal secretions from the infected endometrial glands.

Endometrium (Gr. *endon*= within, + *metra*=, womb)

The uterine wall consists of an inner mucosa called the *endometrium*; the site of implantation and source of menstrual discharge.

Enteric

Pertaining to the small intestine, as in enteric hormones.

Enteroendocrine system

Endocrine cells dispersed within the lining of the digestive tract. They secrete hormones that may act locally to regulate the digestive processes or be transported to the brain, where they act on neurons and glial cells.

Epidermis (Gr. *epi*= on, upon, + *derma*= skin)

A stratified squamous epithelium that constitutes the superficial layer of the skin, overlying the dermis.

Epididymis (Gr. *epi*= on, upon, + *didymos*= testicle).

It is a comma-shaped structure lying posteriorly and slightly lateral to each testis with vas deferens along its medial side. The epididymis consists of a single convoluted duct (duct of epididymis) formed by the union of the efferent ductules of the testis.

Epigenesist (Gr. *epi*= on, upon, + *genesis*= birth)

The embryological (and generally accepted) view that an embryo is a new creation that develops and differentiates step by step from a zygote undergoing cell division; the progressive production of new parts that were nonexistent as such in the original zygote.

Epigenetics (Gr. *epi*= on, upon, + *genesis*= birth).

The term epigenetics refers to heritable mechanisms that help to control gene expression without

an actual change in the underlying DNA sequence. These mechanisms include histone modifications, non-coding RNAs, and DNA methylation.

The different types of epigenetic modifications interact in numerous ways to influence gene expression.

Epinephrine

A catecholamine that functions as a neurotransmitter in the sympathetic nervous system and as a hormone secreted of the adrenal medulla; also called *adrenaline.*

Epithelium (Gr. *epi*= on, upon, + *thele*= nipple)

A type of tissue consisting of one or more layers of closely adhering cells with little intercellular material and no blood vessels; forms the coverings and linings of many organs and the parenchyma of the glands.

Erectile function

It is the capability of the erectile tissue to store blood under expansion of the penis and to maintain the erection, allowing satisfactory sexual performance.

Erectile Dysfunction

It is a medical condition. Formerly called impotence, erectile dysfunction is defined as the repeated inability to develop and maintain an erection sufficient for satisfactory sexual intercourse or activity. By that measure, erectile dysfunction is rare in 20-yearolds, reaches a prevalence of about 5% by age 40, and rises to 15–25% after age 65.

Erectile tissue

A tissue that functions by swelling with blood, as in the penis and clitoris and inferior concha of the nasal cavity.

Erythrocyte (Gr. *erythros*= red, + *kytos*= hollow vessel)

A red blood cell; has hemoglobin to carry oxygen from lungs or gills to tissues. During formation in mammals, erythrocytes lose their nuclei; those of other vertebrates retain the nuclei.

Erythropoiesis

The production of erythrocytes.

Erythropoietin

A hormone that is secreted by the kidneys and liver in response to

hypoxemia and stimulates erythropoiesis.

Estradiol

Estradiol is the most potent estrogen but is produced in much smaller amounts than estrone. Estradiol is secreted by the ovary and can be synthesized by the conversion of androstenedione to testosterone, which is quickly aromatized. In addition, androstenedione can be aromatized to estrone, which is secreted from the ovary and can be converted to estradiol peripherally.

Estriol

Estriol is one-one hundredth as potent as estradiol and is a metabolic by-product of estrone and estradiol inactivation. Estriol also is a product of the placenta during pregnancy, the only time when estriol is secreted and known to be clinically significant. Its synthesis and measured levels provide indirect evidence of an intact fetoplacental unit.

Estrogens

1. A family of steroid hormones known especially for producing female secondary sex characteristics and regulating various aspects of the menstrual cycle and pregnancy; major forms are estradiol, estriol, and estrone.

2. The estrogens are C18 steroids and differ from androgens in lacking one carbon. Estrogens are synthesized in the ovary, adrenal cortex, placenta and Leydig cells. The estrogenic group of hormones comprises three hormones: 17 β-estradiol is the most active hormone present in almost all vertebrates. Estrone is a circulating hormone. Estriol is found in the urine of pregnant women and in the placenta. The estrogenic or follicular hormones induce estrous cycle and help in maintenance of secondary sex characters and the accessory sex organs. Production of estrogen suppresses the FSH level.

Estrone

Estrone is produced in the ovary by the aromatization of androstenedione, after which estrone can be secreted or converted to estradiol in the granulosa layer. Estrone possesses one-tenth the potency of estradiol but is produced in much greater quantities. Estrone also is produced in skin, muscle, and adipose tissue by the peripheral conversion of circulating androstenedione.

Estrous cycle

Periodic episodes of estrus, or "heat," when females of most mammalian species become sexually receptive.

In most mammals, females are sexually receptive to males only around the time of ovulation, thus ensuring a greater chance for fertilization and pregnancy.

Female sexual receptive behavior occurring around the time of ovulation, when estrogen levels are high, is called estrous behavior (Greek oistros, meaning gadfly or frenzy) or "heat." Animals that exhibit cyclic estrous behavior are said to have estrous cycles.

Estrus (L. *oestrus*, gadfly, frenzy)

1. The period of heat of a female mammal associated with ovulation. Time of maximum sexual receptivity. Adj., estrous.

2. It is the period of heat when the ovaries are considerably enlarged and deep red in colour due to maximal development of ovarian follicles. The ovarian follicles secrete increased quantity of estrogen which is responsible for bringing about psychological manifestations of heat. It is during this period the animal allows mating. In rats, only estrogen can bring about heat, whereas in guinea pigs traces of progesterone are also necessary. In certain domestic animals like cows and mares, quiet heat sometimes occurs which, is due to lack of enough estrogen quantity.

In the heat period many animals show increased activity which is caused by estrogen:

Large amounts of mucus are secreted from the cervix during estrous period.

Evagination (L. *e*= out, + *vagina*= sheath). An outpocketing from a hollow structure.

Evolution (L. *evolvere*= to unfold)

A change in the relative frequencies of alleles in a population over a period of time; the mechanism that produces adaptations in human form and function.

Excitability

The ability of a cell to respond to a stimulus, especially the ability of nerve and muscle cells to produce membrane voltage changes in response to stimuli; irritability.

Excitation–contraction coupling

Events that link the synaptic stimulation of a muscle cell to the onset of contraction.

Excitatory postsynaptic potential (EPSP)

A partial depolarization of a postsynaptic neuron or muscle cell in response to a neurotransmitter, making it more likely to reach threshold and produce an action potential.

Excretion

The process of eliminating metabolic waste products from a cell or from the body.

Exocrine gland (Gr. *exo*= outside, external, + *crine*= secretion)

1. A type of gland that releases its secretion through a duct; for example, salivary and gastric glands. 2. These glands secrete through ducts to the outside of organisms (or into a cavity that communicates with the outside). Examples are sweat and digestive glands. If, in contrast, the connecting cells disappear during development and the secretory gland cells are isolated from the surface, an endocrine gland is formed.

Exocytosis (Gr. *exo*= outside, + *kytos*= hollow vessel)

A process in which a vesicle in the cytoplasm of a cell fuses with the plasma membrane and releases its contents from the cell; used in the elimination of cellular wastes and in the release of gland products and neurotransmitters.

Exogenous

Originating externally, such as exogenous (dietary) cholesterol; extrinsic.

Extracellular fluid (ECF)

1. Any body fluid that is not contained in the cells; for example, blood, lymph, and tissue fluid.

2. The extracellular fluid (ECF) is the fluid that surrounds the cells of any particular animal. In the case of the protozoans the ECF is the fluid of their external environment. The ECF of some simple multicellular marine animals is more-or-less identical to the environment in which they live- for example, some jellyfish

have a solute composition identical to seawater with the exception that their sulfate concentration is only half that of seawater. The reason for this discrepancy is that the sulfate ion is dense (relative to other ions). This means that alterations to the concentration of sulfate ions in body fluids will have significant effects on the overall density of the animal and, therefore, its buoyancy. Life is thought to have originated in the oceans, so it is not unreasonable that such simple animals should have a similar composition to seawater. However, more advanced marine animals, freshwater and terrestrial animals all maintain an ECF that is quite different in composition from that of seawater. The precise composition of the ECF will vary from animal to animal, but some generalizations may be made. The main extracellular cation is almost always Na^+ and the main extracellular anion is Cl^-. A cation is a positively charged ion, which moves towards the negative pole (cathode) in an electric field. An anion is a negatively charged ion that will move towards the positive pole (anode) in an electric field.

Extraembryonic membranes

Embryonic development of fish and amphibians took place in water (indirect development), so embryos face no problem of mechanical shock, desiccation and expelling metabolic wastes. When the vertebrates started moving toward dry land, they must have adapted ways to protect their developing embryos from mechanical shock, desiccation and accumulation of metabolic wastes. In the tetrapods of vertebrate classes Reptilia, Aves and Mammalia, several membranes develop outside the embryo proper, namely amnion, chorion, yolk sac and allantois. These membranes are collectively called extraembryonic membranes and perform several functions of the developing embryos including nourishment, protection, respiration and excretion. Among these extraembryonic membranes, the amnion is surrounding the embryo, which is important feature of reptiles, birds and mammals, and they are also called amniota.

Initially, there is no distinction between embryonic and extraembryonic regions. With the shaping of embryo and formation of body fold, the embryo becomes isolated from yolk and, embryonic and extraembryonic domains are established. Extraembryonic membranes arise from extensions of ectoderm, endoderm and lateral plate mesoderm the later splits

into somatic and visceral (or splanchnic) mesoderm. The combination of ectoderm and somatic mesoderm is referred to as somatopleure from which amnion and chorion are formed. Accordingly, the combination of endoderm and visceral mesoderm is referred to as splanchnopleure, from which yolk sac and allantois is formed.

Extraembryonic membranes in mammals are essentially same as in chick but there are some modifications in response to intrauterine development. The most interesting fact is that a yolk sac is formed though there is virtually no yolk in the ovum.

The hypoblast cells delaminate from the inner cell mass and spread out beneath the trophoblast layer to surround the blastocoel. This is called the yolk sac.

The amniotic epiblast delaminates from embryonic epiblast and the space between two layers becomes fluid-filled the amniotic cavity. The embryo developed from the embryonic epiblast is enclosed in the amniotic cavity.

With the establishment of hind gut, a diverticulum is formed from it- the allantois. In most mammals, the distal portion of allantois is dilated and come in close touch with chorion. The extraembryonic mesoderm lining the allantois becomes richly vascular.

The chorion is found from hypoblast tissue and underlying blood vessel containing mesoderm. After the formation of amnion, chorion completely encircles the embryo and other extraembryonic membranes. The chorion serves as the interface between the embryonic and maternal tissue to form the placenta.

Extrinsic

1. Originating externally, such as extrinsic blood clotting factors; exogenous. **2.** Not fully contained within an organ but acting on it, such as the extrinsic muscles of the hand and eye.

Extrinsic factor

An environmental variable that influences the biological properties of a population, such as observed number of individuals or rate of growth.

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F

Facilitated diffusion

The process of transporting a chemical through a cellular membrane, down its concentration gradient, with the aid of a carrier that does not consume ATP; enables substances to diffuse through the membrane that would do so poorly, or not at all, without a carrier.

Facilitation

Making a process more likely to occur, such as the firing of a neuron, or making it occur more easily or rapidly, as in facilitated diffusion.

Fat

1. A triglyceride molecule.
2. Adipose tissue.

Fatty acid

An organic molecule composed of a chain of an even number of carbon atoms with a carboxyl group at one end and a methyl group at the other; one of the structural subunits of triglycerides and phospholipids.

Fecundity

It refers to the probability of producing a live birth arising from a given menstrual cycle.

Fertility

The term refers to the capability to conceive or induce a pregnancy.

Fertilization

It is the starting point for the development of pregnancy. After intercourse, two sex cells, or gametes, fuse together, giving rise to an ovum, or zygote, where the chromosomes of the two gamete unite. In humans, these sex cells are the sperm and the egg. For conception of a new life, a sperm must fertilize the egg in a tough competition with hundreds of millions of other sperm.

Fertilization cone

A volcano-like structure forming on the surface of some animal eggs into which the fertilizing sperm will be drawn. The egg surface responds to chemicals released by the incoming sperm.

Fetus (L. *Unborn* = offspring)

In human development, an individual from the beginning of the ninth week when all of the organ systems are present, through the time of birth. During this period (fetal period), differentiation and growth of the tissues and organs formed during the embryonic period takes place.

Fight-or-flight response

The changes in activity of the various organs innervated by the vertebrate autonomic nervous system in response to sympathetic stimulation, which collectively prepare the body for strenuous physical activity in the face of an emergency or stressful situation, such as a physical threat from the outside environment.

Flagellum (pl. **flagella** (L. a whip)

Whip-like organelle of locomotion.

Fluid compartment

Any of the major categories of fluid in the body, separated by selectively permeable membranes and differing from each other in chemical composition. Primary examples are the intracellular fluid, tissue fluid, blood, and lymph.

Follicle

1. A small space, such as a hair follicle, thyroid follicle, or ovarian follicle.
2. An aggregation of lymphocytes in a lymphatic organ or mucous membrane.

Follicle-stimulating hormone (FSH)

A hormone secreted by the anterior pituitary gland that stimulates development of the ovarian follicles and egg cells.

Follicle Stimulating hormone is one of the three gonadotropins. In females, it leads to growth and maturation of Graafian follicles with estrogen production.

In males, it induces development of the germinal epithelium of the seminiferous tubules. Removal of hypophysis leads to degeneration or atrophy of gonads.

FSH has been prepared is a purified form from the hypophysis of sheep and swine.

It is a protein in nature whose molecular weight varies depending on the source. FSH from sheep has molecular weight of 67,000.

Follicular Atresia

Most ovarian follicles undergo the degenerative process called atresia, in which follicular cells and oocytes die and are disposed of by phagocytic cells. Follicles at any stage of development, including nearly mature follicles, may become atretic. Atresia involves apoptosis and detachment of the granulosa cells, autolysis of the oocyte, and collapse of the zona pellucida. Early in this process, macrophages invade the degenerating follicle and phagocytose the debris, followed later by fibroblasts. Although follicular atresia takes place from before birth until a few years after menopause, it is most prominent just after birth, when levels of maternal hormones decline rapidly, and during both puberty and pregnancy, when qualitative and quantitative hormonal changes occur again.

Folliculogenesis

Folliculogenesis is the process by which the female germ cell develops within the somatic cells of the ovary and matures into a fertilizable egg. Follicle development is complex and involves the integration of signals from multiple organ systems. While early folliculogenesis appears to be directed by signals within the ovary, endocrine hormones from the pituitary are necessary for folliculogenesis to proceed beyond these early stages. In turn, the ovary produces a number of feedback and feed forward hormones that regulate hypothalamic and pituitary function. Within the ovary, cross-talk between the oocyte and the somatic-derived granulosa and theca cells occurs at every stage for normal follicle development.

Foramen

A hole through a bone or other organ, in many cases providing passage for blood vessels and nerves.

Free energy

The potential energy in a chemical that is available to do work.

Free radical

A particle derived from an atom or molecule, having an unpaired electron that makes it highly reactive and destructive to cells; produced by intrinsic processes such as aerobic respiration and by extrinsic agents such as chemicals and ionizing radiation.

Frontal plane

1. An anatomical plane that passes through the body or an organ from right to left and superior to inferior and at right angles to the sagittal plane.

2. The plane that divides the body or an organ into an anterior (front) portion and a posterior (rear) portion is called so. The frontal plane is often referred to as a coronal plane. ("Corona" is Latin for "crown.")

Fundus

The base, the broadest part, or the part farthest from the opening of certain viscera such as the stomach and uterus.

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G

Gamete (Gr. *gamos*= marriage)

An egg or sperm cell. Also called as sex cells.

Gamete intrafallopian transfer (GIFT)

A procedure that involves removing oocytes from a woman's ovary, combining them with sperm, and using laparoscopy to assist in placing the unfertilized oocytes and sperm into the fallopian tubes.

Gametocyte (Gr. *gametes*= spouse,+ *kytos*= hollow vessel)

The mother cell of a gamete; an immature gamete.

Gametogenesis

The production of eggs or sperm.

Gap junction

A junction between two cells consisting of a pore surrounded by a ring of proteins in the plasma membrane of each cell, allowing solutes to diffuse from the cytoplasm of one cell to the next; functions include cell-to-cell nutrient transfer in the developing embryo and electrical communication between cells of cardiac and smooth muscle.

Gastric

Pertaining to the stomach.

Gastrin

The functions of gastrin are coordinated to promote hydrogen ion (H^+) secretion by the gastric parietal cells. Gastrin, a 17– amino acid straight chain peptide, is secreted by G (gastrin) cells in the antrum of the stomach.

Gastrin has two major actions:

(1) It stimulates H^+ secretion by gastric parietal cells, and (2) it stimulates growth of the gastric mucosa, a trophic effect.

Gastrocoel (Gr. *gaster*=stomach, + *Koilos*= hollow)

An embryonic cavity forming in gastrulation that becomes the adult gut; also called an archenteron.

Gastrula (Gr. *gaster*= stomach, + L. *ula*= dim.)

Embryonic stage, usually cap- or sac-shaped, with walls of two layers of cells surrounding a cavity (archenteron) with one opening (blastopore).

Gastrulation (Gr. *Gaster* = stomach)

Process by which an early animal embryo becomes a gastrula, acquiring first two and then three layers of cells. It is the most characteristic event during the third week of gestation.

Gate

A protein channel in a cellular membrane that can open or close in response to chemical, electrical, or mechanical stimuli, thus controlling when substances are allowed to pass through the membrane.

Gated channels

Pores in the plasma membrane created by transmembrane proteins that open or close in response to a specific signal, such as binding of a chemical (chemically-gated), a change in membrane potential (voltage-gated), or a membrane distortion (mechanically gated). When open, these channels allow ions and water to move through the plasma membrane by diffusion.

Gene (Gr. *genos*= descent)

An information-containing segment of DNA that codes for the production of a molecule of RNA, which in most cases goes on to play a role in the synthesis of one or more proteins.

Gene locus

The site on a chromosome where a given gene is located.

Gene pool

A collection of all of the alleles of all of the genes in a population

Genital herpes

A sexually transmitted disease caused by a herpes virus and characterized by painful blisters in the genital area.

Genome (Gr. *genos*= offspring, + *oma*=abstract group)

All the DNA in a haploid set of chromosomes (nuclear genome), organelle (mitochondrial genome, chloroplast genome) or virus (viral genome, which in some viruses consists of RNA rather than DNA)., estimated at 20,000 to 25,000 genes in humans.

Genotype (Gr. *genos*= offspring, + t*ypos*= form)

The pair of alleles possessed by an individual at one gene locus on a pair of homologous chromosomes; strongly influences the individual's phenotype for a given trait.

Germ cell

A gamete or any precursor cell destined to become a gamete. A haploid cell (ovum or sperm) whose fertilization by one of the opposite kind produces a diploid zygote; also called a gamete.

Germinal vesicle

Mature nucleus of a primary oocyte, enlarged and filled with RNA.

Germ layer

Any of first three tissue layers of an embryo: ectoderm, mesoderm, or endoderm.

Gestation (L. *Gestatio* = bearing, carrying in the womb)

The duration of embryo in the uterus from fertilization of the ovum until delivery (the period of normal pregnancy).

Gestational age

The gestational age of embryo/fetus is calculated from presumed first day of the last normal menstrual period.

The oocyte is not fertilized until approximately 14 days (2 weeks after the preceding menstruation); hence the fertilization age of an embryo or fetus is 14 days less than the gestation age.

Gestational surrogacy

Treatment by which the gametes of the intended parents (genetic parents) are used to produce embryos, which are subsequently transferred to a woman who agrees to act as a host or surrogate carrier of the pregnancy.

Ghrelin

Ghrelin is secreted by gastric cells just before ingestion of a meal.

It acts oppositely to leptin and insulin to stimulate orexigenic neurons and inhibit anorexigenic neurons, thus increasing appetite and food intake.

Periods of starvation and weight loss strongly stimulate ghrelin secretion.

Gigantism

In gigantism, the acidophilic, growth hormone–producing cells of the anterior pituitary gland become excessively active, and sometimes even acidophilic tumors occur in the gland. As a result, large quantities of growth hormone are produced. All body tissues grow rapidly, including the bones. If the condition occurs before adolescence, before the epiphyses of the long bones have become fused with the shafts, height increases so that the person becomes a giant—up to 8 feet tall.

Glands

1. A gland is a cell or organ that secretes substances for use elsewhere in the body or for elimination as waste. 2. They are epithelial tissue derivatives that are specialized for secretion. Secretion is the release from a cell, in response to appropriate stimulation, of specific products that have in large part been synthesized by the cell. Glands are formed during embryonic development by pockets of epithelial tissue that dip inward from the surface. There are two categories of glands: exocrine and endocrine. If during development the connecting cells between the epithelial surface cells and the secretory gland cells within the depths of the invagination remain intact as a duct between the gland and the surface, an exocrine gland is formed.

Globulin (L. *globus*= a globe, ball, + *ulus*= ending denoting tendency)

A globular protein such as an enzyme, antibody, or albumin; especially a family of proteins in the blood plasma that includes albumin, antibodies, fibrinogen, and prothrombin.

Glucagon

Glucagon, is a 29–amino acid polypeptide hormone secreted by the α-cells of the islets of Langerhans, that plays an important role in the regulation of glucose homeostasis by producing antagonistic effects on insulin action. The primary sequence of glucagon is almost perfectly conserved among vertebrates, and it is structurally related to the secretin family of peptide hormones. Glucagon is synthesized as proglucagon and then proteolytically processed to yield glucagon. The prohormone proglucagon is expressed in the pancreas, and also in other tissues, such as enteroendocrine cells in the intestinal tract and in the brain.

However, the processing of the prohormone differs among tissues. The 2 main products of proglucagon processing are glucagon in the α-cells of the pancreas and GLP 1 in the intestinal cells. GLP 1 is produced in response to a high concentration of glucose in the intestinal lumen. GLP 1 is known as an incretin , a mediator that amplifies insulin release from the β-cell in response to a glucose load. Glucagon has a short half-life (5–10 minutes) and is degraded mostly in the liver.

The principal target tissue for glucagon is the liver. Glucagon's main physiologic effect is to increase plasma glucose concentrations by stimulating de novo hepatic glucose production through gluconeogenesis and glycogen breakdown; overall, these actions counteract the effects of insulin.

Glucagon-like peptide-1 (GLP-1)

It is produced from the selective cleavage of proglucagon. It is synthesized and secreted by the L cells of the small intestine. Like GIP, GLP-1 is classified as an incretin, because it binds to receptors on the pancreatic β cells and stimulates insulin secretion. In complementary actions, it also inhibits glucagon secretion, increases the sensitivity of pancreatic β cells to secretagogues such as glucose, decreases gastric emptying, and inhibits appetite (i.e., increases satiety). For these reasons, analogues of GLP-1 have been considered as possible treatments for type II diabetes mellitus.

Glucocorticoid

A corticosteroid hormone produced and secreted from the cortex of the adrenal gland. Glucocorticoids as their name imply play an important role in regulation of glucose homeostasis. Glucocorticoids affect intermediary metabolism, stimulate proteolysis and gluconeogenesis, inhibit muscle protein synthesis, and increase fatty acid mobilization. Their hallmark effect is to increase blood glucose concentrations, hence the name "glucocorticoids."Two such hormones are cortisol and corticosterone.

Gluconeogenesis (Gr. *glykys*= sweet, + *neos*= new, + *genesis*= origin).

The synthesis of glucose from non-carbohydrates such as fats and amino acids.

Glucose

A monosaccharide ($C_6H_{12}O_6$) also known as blood sugar; glycogen, starch, cellulose, and maltose are made entirely of glucose, and glucose constitutes half of a sucrose or lactose molecule.

The isomer involved in human physiology is also called dextrose.

Glucose-sparing effect

An effect of fats or other energy substrates in which they are used as fuel by most cells, so that those cells do not consume glucose; this makes more glucose available to cells such as neurons that cannot use alternative energy substrates.

Glycocalyx

A layer of carbohydrate molecules covalently bonded to the phospholipid and protein molecules of a plasma membrane; forms a surface coat on all human cells.

Glycogen (Gr. *glykys*= sweet, + *genes*= produced)

A glucose polymer synthesized by liver, muscle, uterine, and vaginal cells that serves as an energy-storage polysaccharide.

Glycogenesis

The synthesis of glycogen.

Glycogenolysis

The hydrolysis of glycogen, releasing glucose.

Glycolipid

A phospholipid molecule with a carbohydrate covalently bonded to it, found in the plasma membranes of cells.

Glycolysis ((Gr. *glykys*= sweet, + *lysis*= a loosening)

A series of anaerobic oxidation reactions that break a glucose molecule into two molecules of pyruvic acid and produce a small amount of ATP.

Glycoprotein

A protein molecule with a smaller carbohydrate covalently bonded to it; found in mucus and the glycocalyx of cells, for example.

Glycosaminoglycans (GAG)

A polysaccharide composed of modified sugars with amino groups; the major component of a proteoglycan. GAGs are largely responsible for the viscous

consistency of tissue gel and the stiffness of cartilage.

Glycosuria

The presence of glucose in the urine, typically indicative of a kidney disease, diabetes mellitus, or other endocrine disorder.

Goiter

Production of active thyroid hormones requires iodine. In fact, the main reason we need iodine in our diet is to ensure adequate production of thyroxine. Iodine deficiency can result in a thyroid-deficiency disease. When thyroxine is absent or abnormally low, the normal feedback inhibitory controls on the hypothalamus and pituitary are missing, so the hypothalamus and pituitary continue to secrete large quantities of the releasing hormone and TSH unchecked. The high TSH levels stimulate the thyroid gland to grow to enormous size in an effort to get the thyroid to make more hormone, which it cannot do because it lacks iodine. An enlarged thyroid, as a result of iodine deficiency or other factors, is called a goiter. Goiter is less common today in industrialized nations because iodine is added to table salt. However, it is still a public health problem in certain areas of the world, most notably in Africa, China, and mountainous regions where rain has leached iodine from the soil.

Gonad (L. *gonas*= primary sex organ)

An organ that produces gametes (ovary in the female and testis in the male).

Gonadarche

It comprises growth and maturation of the gonads and is associated with increased secretion of sex steroids and with the initiation of folliculogenesis and ovulation in the female and spermatogenesis in the male. Gonadarche is responsible for thelarche and menarche in girls and testicular enlargement in boys.

Gonadotropin

A peptide hormone secreted by the anterior pituitary gland that acts on the gonads (ovaries of females and testes of males). FSH and LH are called gonadotropins because they stimulate the growth, development, and function of the reproductive organs (gonads) in both males and females. FSH promotes egg production in the female and sperm production in

the male. LH induces ovulation, corpus luteum production, and sex steroid secretion in females, and sex steroid secretion in males.

Gonadotropins

Gonadotropins are glycoprotein hormones that consist of a 92–amino acid α subunit and an approximately 120–amino acid β subunit. The α subunit is common to LH, FSH, and TSH (which is also a glycoprotein), and the β subunit confers specificity to the hormone. Both subunits have a cystine knot motif, which consists of three loops that are attached to each other with disulfide bonds. The α–β heterodimer is held together by disulfide bonds as well.

Gonadotropin-releasing hormone (GnRH)

Gonadotropin releasing hormone (GnRH) is a 10 amino acid peptide that is synthesized in the neuronal bodies of the arcuate nucleus of the medial basal hypothalamus and transported to the median eminence by neuroendocrine cell terminals.

GnRH is transported from the hypothalamus to the pituitary through the portal circulation. GnRH binds to its receptor on the cell surface of the gonadotrophs. There, it activates adenylate cyclase and stimulates gonadotropin release. GnRH can stimulate the synthesis and release of both FSH and LH from the same cell. The variation in pulse frequency alters the ratio of FSH to LH. GnRH is secreted in a pulsatile manner.

Gonorrhea

A sexually transmitted bacterial disease caused by *Neisseria gonorrhoeae*. *C*ommonly called "the clap."

G protein

A protein of the plasma membrane that is activated by a membrane receptor and, in turn, opens an ion channel or activates an intracellular physiological response; important in linking ligand–receptor binding to second-messenger systems.

Gradient

A difference or change in any variable, such as pressure or chemical concentration, from one point in space to another; provides a basis for molecular movements such as gas exchange, osmosis, and facilitated diffusion, and for bulk movements such as blood flow and air flow.

Graves' Disease

Graves' disease is an example of an autoimmune disease in which antibodies directed against a hormone receptor act as agonists and activate rather than interfere with the activity of the receptor. For reasons not yet understood, patients with this disease develop auto-antibodies against receptors for thyroid-stimulating hormone (TSH) that are expressed on the surface of thyroid cells. Figure 13.9B shows that the interaction of auto-antibodies with the TSH receptor activates the cell in a manner similar to TSH activation, thereby stimulating excess production of thyroid hormone. Normally, TSH produced by the pituitary binds to TSH receptors on the thyroid, activating the gland to produce and secrete thyroid hormones. When the level of thyroid hormones gets too high, the production of TSH and thus the production of thyroid hormones is shut down via a negative feedback loop. However, in Graves' disease the auto-antibodies continuously stimulate the TSH receptors, resulting in excessive production of thyroid hormone, which leads to hyperthyroidism. One of the main symptoms of hyperthyroidism is an increase in metabolism. Other signs and symptoms include heart palpitations, heat intolerance, insomnia, nervousness, weight loss, hair loss, and fatigue. In addition, patients with severe disease may develop eye problems, including inflammation of the soft tissue surrounding the eye, bulging of the eye, and double vision. Some patients with Graves' disease develop an enlarged thyroid gland known as a goiter. The disease most commonly affects women in their 30s and 40s.

Gross anatomy

Bodily structure that can be observed without magnification.

Growth factors

They are chemical messengers that are synthesized in various types of cells and act to stimulate tissue growth or maintain cell survival. A large number of growth factors are now known, but three of the most familiar are nerve growth factor (NGF), which is synthesized in innervated structures such as the heart and brain; epidermal growth factor (EGF), which is synthesized in the salivary glands; and fibroblast growth factor (FGF), which is synthesized throughout the neural and endocrine systems. Growth factors tend to act locally, in an autocrine/paracrine fashion,

although there is now evidence that some may also be intracrine messengers. Growth factors in the brain are often called neurotrophins and these include NGF and BDNF (brain-derived neurotrophic factor).

Growth hormone (GH)

Growth hormone or somatotrophic hormone stimulates tissue growth. It is proteinaceous in nature and secreted by acidophils of adenohypophysis. A hormone of the anterior pituitary gland with multiple effects on many tissues, generally promoting tissue growth. GH is a 191 amino acid peptide hormone, with a molecular weight of approximately 22 kDa and structural similarity to prolactin and chorionic somatomammotropin, a placental-derived hormone. GH exists in various molecular isoforms, and this heterogeneity is reflected in the wide variability in GH levels determined by different immunoassays. However, it is the 22 kDa that is the principal form with physiologic effects found in humans. GH is released from the somatotrophs, an abundant cell type in the anterior pituitary. GH is released in pulsatile bursts, with the majority of secretion occurring nocturnally in association with slow-wave sleep. The basis of the pulsatile release of GH and the function of this pattern are not fully understood; however, nutritional, metabolic, and age-related sex steroid mechanisms, adrenal glucocorticoids, thyroid hormones, and renal and hepatic functions are all thought to contribute to the pulsatile release of GH and appear to be essential in achieving optimal biologic potency of the hormone.

Most of the GH in the circulation is bound to growth hormone binding protein.

Excessive secretion of the growth hormone, before the union of epiphyses causes gigantism due to acceleration of bone growth. If the epiphyses are closed, the bones do not grow in length but thickening takes place. Growth hormone has striking effects on the bones, muscles, kidney, adipose tissue and liver. In addition to growth function, somatotrophic hormone has other functions also.

Gynaecomastia

The male breast contains the same tissue components as the female breast in the undeveloped, prepubescent state. If the male breast enlarges, the condition is known as gynaecomastia.

Gynandromorphy (Gr. *gyn*=female, + *andr*=male, + *morphe*= form)

An abnormal individual exhibiting characteristics of both sexes in different parts of the body; for example, the left side of a bilateral organism may show female characteristics, while the right side shows male characteristics.

Gynecology

The branch of medicine that deals with the functions and diseases specific to women and girls affecting the reproductive system.

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H

Half-life (T1/2)

1. The time required for one-half of a quantity of a radioactive element to decay to a stable isotope (physical half-life) or to be cleared from the body through a combination of radioactive decay and physiological excretion (biological half-life). **2.** The time required for one-half of a quantity of hormone to be cleared from the bloodstream.

Haploid (*n*) (Gr. *haploos*= single)

The reduced, or ***n***, number of chromosomes, typical of gametes, as opposed to the diploid, or **2*n***, number found in somatic cells. In certain groups, mature organisms may have a haploid number of chromosomes. In humans, having 23 unpaired chromosomes instead of the usual 46 chromosomes in homologous pairs; in any organism or cell, having half the normal diploid number of chromosomes for that species.

Hashimoto's thyroiditis

It is an autoimmune disease of the thyroid gland named after the Japanese physician Hakaru Hashimoto, who first described it in 1912. This disease, most commonly found in middle-aged women, is characterized by the production of antibodies to two major thyroid proteins, thyroid peroxidase and the hormone thyroglobulin.

These auto-antibodies play a major role in the destruction of the thyroid gland, eventually causing a decline in the output of thyroid hormones resulting in hypothyroidism. Symptoms of hypothyroidism include dry skin, brittle hair and nails, cold intolerance, weight gain, muscle cramps, depression, and extreme fatigue.

Hemizygous (Gr. *hemi*= half, + *zygotos*= yoked)

For animals having chromosomal sex determination in which one sex (termed the heterogametic sex) has only one copy of a particular sex chromosome, genotypes of heterogametic individuals consist of a single copy of all genes located on that sex chromosome.

Hemopoiesis

Production of any of the formed elements of blood.

Heredity (L. *heres*= heir)

The faithful transmission of biological traits from parents to their offspring.

Hermaphrodite

(Gr. *hermaphrodites*= containing both sexes; from Greek mythology, Hermaphroditic, son of Hermes and Aphrodite).

An organism with both male and female functional reproductive organs.

Hermaphroditism

It is usually refers to an aberrant individual in a dioecious species; monoecy implies that this is the normal condition for the species.

Heteroecious

A parasite that starts its life cycle on one organism and then affects a second host species to complete the cycle, e.g., peach-potato aphid.

Heterogamy

Producing gametes of two different types from unlike individuals, e.g., egg and sperm. The tendency for unlike types to mate with unlike types.

Heterosexual

Having an affection for members of the opposite sex, i.e., male attracted to female.

Heterozygous

Having non-identical alleles at the same gene locus of two homologous chromosomes.

Heterozygote (Gr. *heteros*= different, + *zygotos*= yoked)

An organism in which homologous chromosomes contain different allelic forms (often dominant and recessive) of a locus; derived from a zygote formed by union of gametes of dissimilar allelic constitution.

High-density lipoprotein (HDL)

A lipoprotein of the blood plasma that is about 50% lipid and 50% protein; functions to transport phospholipids and cholesterol from other organs to the liver for disposal. A high proportion of HDL to low-density lipoprotein (LDL) is desirable for cardiovascular health.

Hilum

A point on the surface of an organ where blood vessels, lymphatic

vessels, or nerves enter and leave, usually marked by a depression and slit; the midpoint of the concave surface of any organ that is roughly bean-shaped, such as the lymph nodes, kidneys, and lungs. Also called the *hilus.*

Histogenesis (Gr. *histos*= tissue, + *genesis*= descent)

Formation and development of tissue.

Histology (Gr. *histos*= web, tissue, + *logos*= discourse)

1. The microscopic structure of tissues and organs. 2. The study of tissues and how they are arranged into organs is called histology, or microscopic anatomy

Holoblastic cleavage (Gr. *holo*= whole, + *blastos*= germ)

Complete and approximately equal division of cells in an early embryo; occurs in mammals, amphioxus, and many aquatic invertebrates that have eggs with a small amount of yolk.

Holocrine (*holos*= entire, + *crine*= secretion)

During holocrine secretion, the gland cell get destroyed. During holocrine secretion, a superficial cell in a stratified glandular epithelium becomes packed with secretory vesicles and then bursts, releasing the secretion, but killing the cell. Further secretion depends on replacing destroyed gland cells by the division of underlying stem cells. Sebaceous glands, associated with hair follicles, produce an oily hair coating by means of holocrine secretion.

Holometabolous (Gr. *holo*= complete, + *metabole*= change)

Complete metamorphosis during development.

Homeostasis (Gr. *homeo*=alike, similar, + *stasis*= state or standing).

The tendency of a living body to maintain relatively stable internal conditions in spite of greater changes in its external environment.

Homeostasis is the existence and maintenance of a relatively constant environment within the body. Various physiological processes act to prevent harmful changes in the composition of body fluids and the environment inside our cells. Maintaining homeostasis is absolutely vital to an organism's survival. Failure to maintain homeostasis soon leads

to illness or even death. Each cell of the body is surrounded by a small amount of fluid, and the normal functions of each cell depend on the maintenance of its fluid environment within a narrow range of conditions, including temperature, volume, and chemical content. These conditions are called variables because their values can change. For example, body temperature is a variable that can increase in a hot environment or decrease in a cold environment. Homeostatic mechanisms, such as sweating or shivering, normally maintain body temperature near an ideal normal value, or set point. But these mechanisms are not able to maintain body temperature precisely at the set point. Instead, body temperature increases and decreases slightly around the set point, producing a normal range of values. As long as body temperatures remain within this normal range, homeostasis is maintained. The organ systems help control the internal environment so that it remains relatively constant. For example, the digestive, respiratory, circulatory, and urinary systems function together so that each cell in the body receives adequate oxygen and nutrients and so that waste products do not accumulate to a toxic level. If the fluid surrounding cells deviates from homeostasis, the cells do not function normally and may even die. Disruption of homeostasis results in disease and sometimes death.

Homeotic gene (Hox gene)

A gene that contains a code called a "homeobox," which gives the gene the ability to activate other genes. Hox genes evolved in an early animal and play a crucial role in building the head-to-tail body structure of nearly all animal embryos. They also contribute to the development of structures in limbs and many other tissues.

Homolog

One member of a set of homologous structures or one of a pair of homologous chromosomes.

Homology (Gr. *homologos*= agreeing). Equivalence of parts or organs of different organisms caused by evolutionary derivation from a corresponding part or organ in a remote ancestor, and usually having a similar embryonic origin. May also refer to molecular (DNA, RNA, protein) sequences or chromosomes whose equivalence represents descent from a common ancestral molecule or

chromosome, respectively. Serial homology is the correspondence in the same individual of repeated structures having the same origin and development, such as the appendages of arthropods.

Homologous

1. Having the same embryonic or evolutionary origin but not necessarily the same function, such as the scrotum and labia majora. **2.** Pertaining to two chromosomes with identical structures and gene loci but not necessarily identical alleles; each member of the pair is inherited from a different parent.

Homosexual

Having an affection for members of the same sex, i.e., male attracted to male or female attracted to female (lesbianism).

Homozygote (Gr. *homos*= same, + *zygotos*= yoked)

An organism having identical alleles at one or more genetic loci.

Homozygous

Having identical alleles at the same gene locus of two homologous chromosomes.

Hormonal contraceptives

Are widely known as birth control pills, are synthetic steroid hormones that suppress the release of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) from the anterior lobe of the pituitary gland in the female body.

Hormone (Gr. *hormon*= to excite)

1. The term hormone is derived from the Greek verb hormao, which means "to set in motion." A chemical messenger that is secreted into the blood by an endocrine gland or isolated gland cell and triggers a physiological response in distant cells with receptors for it. Hormones are effectors of the endocrine system. Starling coined the term hormone.

2. They are long-range chemical messengers that are specifically secreted into the circulation by endocrine (ductless) glands in response to an appropriate signal. Circulatory fluid (blood or hemolymph) carries the messengers to other sites in the body, where they exert their effects on their target cells some distance away from their site of release. Only the target cells of a particular hormone bear receptors to bind with this hormone. Non-

target cells are not influenced by any blood-borne hormones that reach them.

Human chorionic gonadotropin (hCG)

A hormone of pregnancy secreted by the chorion that stimulates continued growth of the corpus luteum and secretion of its hormones. HCG in urine is the basis for pregnancy testing. The first hormone produced by the syncytiotrophoblasts is hCG . The primary action of hCG is to stimulate LH receptors on the corpus luteum. This prevents luteolysis and maintains a high level of luteal-derived progesterone production during the first 10 weeks, after which the syncytiotrophoblasts take over progesterone production. The rapid increase in hCG is responsible for the nausea of morning sickness associated with early pregnancy. The hCG stimulates fetal Leydig cells to produce testosterone before the fetal gonadotropic axis is fully mature. hCG may also stimulate the fetal adrenal cortex during the first trimester.

Human placental lactogen (hPL)

hPL, also called human chorionic somatomammotropin (hCS), is a 191- amino acid protein hormone produced in the syncytiotrophoblasts that is structurally similar to growth hormone (GH) and prolactin (PRL). It can be detected within the syncytiotrophoblast by 10 days after conception and in maternal serum by 3 weeks of gestation. Like GH, hPL is protein-anabolic and lipolytic. Its antagonistic action to insulin contributes to the diabetogenicity of pregnancy.

Glucose is a major energy substrate for the fetus, and hPL increases glucose availability by inhibiting maternal glucose uptake. The lipolytic actions help the mother to shift to the use of free fatty acids for energy. Despite its very high levels in the maternal blood, hPL is probably not essential for normal pregnancy.

Humoral (L. *humor,* a fluid).

Pertaining to an endocrine secretion.

Hyaluronic acid

A glycosaminoglycans that is particularly abundant in connective tissues, where it becomes hydrated and forms the tissue gel.

Hydrocele

The accumulation of serous fluid in any body sac, but especially in the tunica vaginalis of the testis or along the spermatic cord.

Hydrogen bond

A weak attraction between a slightly positive hydrogen atom on one molecule and a slightly negative oxygen or nitrogen atom on another molecule, or between such atoms on different parts of the same molecule; responsible for the cohesion of water and the coiling of protein and DNA molecules, for example.

Hydrolysis (Gr. *hydor*= water, + *lysis*= a loosening)

A chemical reaction that breaks a covalent bond in a molecule by adding an –OH group to one side of the bond and –H to the other side, thus consuming a water molecule.

Hydrophilic

Pertaining to molecules that attract water or dissolve in it because of their polar nature.

Hydrophobic

Pertaining to molecules that do not attract water or dissolve in it because of their non-polar nature; such molecules tend to dissolve in lipids and other non-polar solvents.

Hydrostatic pressure

The physical force generated by a liquid such as blood or tissue fluid, as opposed to osmotic and atmospheric pressures.

Hyperglycemia

An excess of glucose in the blood.

Hyperkalemia

An excess of potassium ions in the blood.

Hypernatremia

An excess of sodium ions in the blood.

Hyperplasia

(hyper= over)

1. The growth of a tissue through cellular multiplication, not cellular enlargement.

2. Increase in the number of cells of a tissue due to an increase in the frequency of cell division.

Hyperprolactinemia

Hypersecretion of PRL is among the most common of pituitary disorders. Hyperprolactinemia is the most prevalent hypothalamic-pituitary dysfunction, with PRL-secreting pituitary adenomas (prolactinomas) being the main cause. In men, galactorrhea and Impotence, and menstrual disturbances, anovulation in women are the most common presenting symptoms of a hypersecreting prolactinoma. The causes of impotence in hyperprolactinemia, whether hormonal or neurogenic, are unclear. Hyperprolactinemia is treated medically by administration of DA agonists, including bromocriptine and cabergoline, or it is treated surgically by resection of the tumor tissue.

Hypersecretion

Excessive secretion of a hormone or other gland product; can lead to endocrine disorders such as Addison disease or gigantism, for example.

Hyperthyroidism

Hyperthyroidism involves an overactive thyroid gland and hypersecretion of thyroid hormones. Hyperthyroidism is excessive functional activity of the thyroid gland, characterized by increased basal metabolism and disturbances in the autonomic nervous system as a result of excess thyroid hormone production. Th e incidence is higher in women than in men. Several conditions can lead to hyperthyroidism: diff use toxic goiter or Graves disease, toxic nodular goiter, toxic adenoma, therapy-induced hyperthyroidism (eg, excess T_4 or T_3 substitution), excess iodine intake, thyroiditis, follicular carcinoma, and TSH-producing tumor of the pituitary. However, the most common cause of hyperthyroidism in adults is diff use toxic goiter or Graves disease. Too much thyroxine increases BMR and causes hyperactivity, nervousness, agitation, and weight loss.

Hypertonic

Having a higher osmotic pressure than human cells or some other reference solution and tending to cause osmotic shrinkage of cells.

Hypertrophy (Gr. *hyper*= over, + trophe= nourishment)

1. The growth of a tissue through cellular enlargement, not cellular multiplication; for example, the

growth of muscle under the influence of exercise. 2. Increase in the size of cells without cell division.

Hypocalcemia

A deficiency of calcium ions in the blood.

Hypodermis (Gr. *hypo*= under, + L. *dermis*= skin)

A layer of connective tissue deep to the skin; also called superficial fascia, subcutaneous tissue, or when it is predominantly adipose, subcutaneous fat.

Hypoglycemia

A deficiency of glucose in the blood. A common complication of tight glycemic control is hypoglycemia resulting from excess insulin dose, fasting, or strenuous exercise.

Hypokalemia A deficiency of potassium ions in the blood.

Hyponatremia A deficiency of sodium ions in the blood.

Hypophysis (Gr. *hypo*= under, + *physis*= growth).

Pituitary body.

Hypophysiotropic hormones

The central nervous system communicates with the anterior pituitary gland by means of neurosecretions released into the hypothalamo-hypophyseal portal system. These neurosecretions are called hypophysiotropic hormones. The neurons that secrete these hormones are clustered in discrete hypothalamic nuclei.

Hyposecretion

Inadequate secretion of a hormone or other gland product; can lead to endocrine disorders such as diabetes mellitus or pituitary dwarfism, for example.

Hypothalamic Nuclei

In the hypothalamus, the neuronal bodies are organized in nuclei. These are clusters or groups of neurons that have projections reaching other brain regions as well as ending in other hypothalamic nuclei. This intricate system of neuronal connections allows continuous communication between the hypothalamic neurons and other brain regions. The hypothalamic nuclei can be classified on the basis of their anatomic location or the principal neuropeptide that

their cells produce. However, these are not discrete definitions of cell groups; some hypothalamic nuclei may contain more than 1 neuronal cell type. It is best to consider the groups of neurons as clusters of neurons and not as well-defined and delineated nuclei made of a single neuronal type.

Hypothalamic thermostat

A nucleus in the hypothalamus that monitors body temperature and sends afferent signals to hypothalamic heat-promoting or heat-losing centers to maintain thermal homeostasis.

Hypothalamus (Gr. *hypo* = under, + *thalamus* = inner chamber)

The hypothalamus is a relatively small but complex region at the base of the brain, lying between the midbrain and the forebrain. It is the inferior portion of the diencephalon of the brain located below the thalamus and between the lamina terminalis and the mamillary bodies, forming the walls and floor of the third ventricle and giving rise to the posterior pituitary gland. The hypothalamus is the region of the brain involved in coordinating the physiologic responses of different organs that together maintain homeostasis. It does this by integrating signals from the environment, from other brain regions, and from visceral afferents and then stimulating the appropriate neuroendocrine responses. In doing so, the hypothalamus influences many aspects of daily function, including food intake, energy expenditure, body weight, fluid intake and balance, blood pressure, thirst, body temperature, and the sleep cycle. The hypothalamus has many different functions, only few of which control reproductive function. Each function is associated with various hypothalamic areas or nuclei, those particularly concerned with reproductive functions being the supraoptic, paraventricular, arcuate, ventromedial and suprachiasmatic nuclei, and also two less easily defined areas, the medial anterior hypothalamic and medial preoptic areas. Most of these hypothalamic responses are mediated through hypothalamic control of pituitary function. This control is achieved by 2 mechanisms:

(1) release of hypothalamic neuropeptides synthesized in hypothalamic neurons and transported through the hypothalamo-hypophysial tract to the posterior pituitary, and (2) neuroendocrine control of the anterior pituitary through the

release of peptides that mediate anterior pituitary hormone release (hypophysiotropic hormones).

Hypothalamic–hypophysial portal system

The hypothalamic–hypophysial portal system is the conduit that connects the brain to the anterior pituitary. The portal system is made up of two capillary beds, one in the median eminence and the other in the anterior pituitary. The portal capillary bed in the median eminence is fed from the superior hypophysial arteries, and is divided into an external and an internal plexus. The capillaries of the external plexus form a hexagonal, chicken wire–like mesh embedded in the external surface of the median eminence. The interior of each hexagonal unit is filled with axon terminals and glial tissue, including tanycyte processes. The internal plexus consists of capillary loops that emanate from the external plexus and rise into the upper regions of the internal zone. Blood coming from the capillary plexus of the median eminence is carried into a capillary bed in the anterior pituitary by long portal veins. From the anterior pituitary capillary bed, portal blood drains into the cavernous and posterior intercavernous sinuses. The capillaries and veins of the portal system are fenestrated; thus, molecules that are normally blocked by the blood–brain barrier can readily pass into and out of the portal circulation.

Hypothesis (Gr. *hypothesis*= foundation, supposition)

An informed conjecture that is capable of being tested and potentially falsified by experimentation or data collection.

Hypothyroidism

Hypothyroidism refers to underactivity of the thyroid gland (hyposecretion of thyroid hormones). Mild cases of hypothyroidism may not have any signs, but more severe deficiencies can cause a variety of symptoms. For example, Cretinism, myxedema.

Hypotonic

Having a lower osmotic pressure than human cells or some other reference solution and tending to caus.

Hysterectomy

The surgical removal of the uterus.

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I

Implantation

The attachment of a conceptus to the endometrium of the uterus. Attachment and subsequent embedding of blastocyst into uterine endometrium, where it develops during gestation. Implantation occurs between fifth and seventh day after fertilization in human being.

Impotence or ejaculatory failure

Impotence, or erectile dysfunction, is an inability to have or maintain an erection long enough to allow sexual intercourse to take place. In ejaculatory failure, the man may have an erection but is unable to ejaculate during sexual intercourse. Both may be caused by psychological factors, but these are not well understood at present. The problems can also be caused by chronic diseases such as diabetes mellitus, multiple sclerosis, thyroid disorders, epilepsy, atherosclerosis and renal failure. Spinal cord injury is also a well-known cause. Certain major abdominal and pelvic operations for cancer can damage nerves supplying the male genital organs and cause problems with erection or ejaculation.

Inclusion

Any visible object in the cytoplasm of a cell other than an organelle or cytoskeletal element; usually a foreign body or a stored cell product, such as a virus, dust particle, lipid droplet, glycogen granule, or pigment.

Indeterminate cleavage

A type of embryonic development in which the fate of the blastomeres is not determined very early as to tissues or organs, for example, in echinoderms and vertebrates; regulative cleavage.

Indigenous (L. *indigena*= native).

Pertains to organisms that are native to a particular region; not introduced.

Indirect development

A life-cycle sequence from zygote to adult with intervening larval stages.

Induction (L. *inducere, inductum*= to lead)

Reasoning from the particular to the general; deriving a general statement (hypothesis) based on individual observations. In embryology, a developmental response resulting from interaction with neighboring cells.

Inductor (L. *inducer*= to introduce, lead in)

In embryology, a tissue or organ that causes the differentiation of another tissue or organ.

Inferior

Lower than another structure or point of reference from the perspective of anatomical position; for example, the stomach is inferior to the diaphragm.

Infertility

It is defined as the failure to induce a pregnancy within one year of regular unprotected intercourse or the inability of a woman to carry a pregnancy to a live birth. Primary infertility defines the condition when no pregnancy at all has been achieved, and secondary infertility means no further pregnancies have occurred. The term infertile can be applied to both men and women. Infertility can affect either the male or the female and can result from a number of causes. About 1 in every 10 couples is infertile, or somewhere between 10 and 15 percent of the population.

Infundibulum (L. funnel)

Stalk of the neurohypophysis linking the pituitary to the diencephalon.

Ingression (L. *ingressus*= to go into, enter)

Migration of individual cells from the embryo surface to the interior of the embryo during development.

Inguinal

Pertaining to the groin.

Inhibin

Inhibins are peptide hormones that belong to the family of glycoprotein hormones and growth factors including TGF-β, mullerian inhibiting substance (MIS), and activin. Inhibin is produced and released from the Sertoli cells in response to FSH stimulation and exerts both paracrine and endocrine responses. Inhibins are heterodimer glycoproteins consisting of an α- and a β-subunit

(βA or βB). Of the 2 forms of inhibin (α-βA and α-βB), inhibin B is the physiologically important form in males. Its main function is to suppress the secretion of FSH from the pituitary in a classic negative feedback endocrine mechanism through binding to a membrane-spanning serine/ threonine kinase receptor. Inhibin B secretion appears to be dependent on Sertoli cell proliferation, maintenance, and spermatogenesis, all of these functions regulated by FSH. Inhibin B levels correlate with total sperm count and testicular volume and can be used as an index of spermatogenesis. The inhibins are protein hormones that are produced primarily in the gonads. They down regulate the synthesis and secretion of FSH from the pituitary. The inhibins are composed of an α subunit and one or two β subunits (βA or βB), the β-dimers with α-βA and inhibin βB form the A and B respectively.

Inner cell mass

A clump of cells near one end of the blastocyst underneath the trophoblast layer is called the inner cell mass. This group of cells gives rise to the embryo. It is also the source of embryonic stem cells.

Insulin

Insulin is a peptide hormone synthesized from preproinsulin. Preproinsulin undergoes posttranslational modification in the endoplasmic reticulum (ER) to form proinsulin. In the endoplasmic reticulum, the active form of insulin is produced by modification of proinsulin by cleavage of the C-peptide structure, by specific endopeptidase, linking the alpha and beta chains. Both insulin and the cleaved C-peptide are packaged in secretory granules and are co-released in response to glucose stimulation. The amino acid sequence of insulin is highly conserved among species. In the past, porcine and bovine insulin were used to treat patients with diabetes. Currently, human recombinant insulin is available and has replaced animal derived insulin, avoiding problems such as the development of antibodies to nonhuman insulin.

Insulin-like growth factors (IGFs)

Also called as somatomedins. These small peptide hormones are members of a family of insulin-related peptides including relaxin, insulin, IGF-1, and IGF-2. IGF-1 is produced primarily in the liver

in response to GH stimulation. IGF-1 is transported to other tissues, acting as an endocrine hormone. IGF-1 secreted by extrahepatic tissues, including cartilaginous cells, acts locally as a paracrine hormone. GH, parathyroid hormone, and sex steroids regulate the production of IGF-1 in bone, whereas sex steroids are the main regulators of local production of IGF-1 in the reproductive system. The binding proteins regulate the biologic actions of the IGFs. Unlike insulin, IGF-1 retains the C peptide and circulates at higher concentrations than insulin either free (half-life is approximately 15–20 minutes) or bound to one of several specific binding proteins that prolong the half-life of the peptide. These binding proteins, like the IGFs, are synthesized primarily in the liver and are produced locally by several tissues, where they act in an autocrine or paracrine manner. IGF-1 exerts its physiologic effects by binding to specific cell surface receptors. Although IGF-1 binds primarily to the IGF-1 receptor, some effects may be mediated through the IGF-2 and insulin receptors. The similarity in structure to insulin explains the ability of IGF-1 to bind (with low affinity) to the insulin receptor. The main effects of IGF-1 are regulation of somatic growth, cell proliferation, transformation, and apoptosis. IGF-1 mediates the anabolic and linear growth-promoting effects of pituitary GH. IGF-1 stimulates bone formation, protein synthesis, glucose uptake in muscle, neuronal survival, and myelin synthesis. In cartilage cells, IGF-1 has synergistic effects with GH. IGF-1 increases replication of cells of the osteoblastic lineage, enhances osteoblastic collagen synthesis and matrix apposition rates, and decreases collagen degradation in calvariae.

IGF-1 is also thought to stimulate bone resorption by enhanced osteoclastic recruitment, thus acting on both bone formation and resorption, possibly coupling the 2 processes. IGF-1 also reverses negative nitrogen balance during food deprivation and inhibits protein degradation in muscle. The importance of this hormone in linear growth is clearly demonstrated by the severe growth failure in children with congenital IGF-1 deficiency. IGFs act as mitogens, stimulating DNA, RNA, and protein synthesis.

Integral protein

A protein of the plasma membrane that penetrates into or all the way through the phospholipid bilayer.

Integration

A process in which a neuron receives input from multiple sources and their combined effects determine its output; the cellular basis of information processing by the nervous system.

Intercellular (L. *inter*= among, + *cellula*= chamber).

Occurring between body cells.

Interphase

That part of the cell cycle between one mitotic phase and the next, from the end of cytokinesis to the beginning of the next prophase.

Interstitial (L. *inter*= among, + *sister*= to stand)

1. Pertaining to the extracellular spaces in a tissue. **2.** Located between other structures, as in the interstitial cells of the testis.

Interstitial cells

The interstitial cells, or Leydig cells, lying between the seminiferous tubules constitute the mesenchyme of the testis. They are large, about 20 μm in diameter, with a spherical, lightly staining nucleus. Though they are relatively few in number, their role is extremely important. In response to luteinizing hormone, LH, the Leydig cells secrete testosterone, which is required both for spermatogenesis and for development of secondary male characteristics.

Intracellular (L. *intra= inside*, + *cellula*= chamber)

Occurring within a body cell or within body cells.

Intracellular fluid (ICF)

The fluid contained in the cells; one of the major fluid compartments.

Intracellular Receptors

Receptors in this category belong to the steroid receptor superfamily. These receptors are transcription factors that have binding sites for the hormone (ligand) and for DNA and function as ligand (hormone)-regulated transcription factors. Hormone-receptor complex formation and binding to DNA result in either activation or repression of gene transcription. Binding to intracellular hormone receptors requires that the hormone be hydrophobic and cross the plasma membrane. Steroid hormones and the steroid derivative vitamin D_3

fulfill this requirement. Thyroid hormones must be actively transported into the cell.

Intracytoplasmic sperm injection (ICSI)

ICSI is a micromanipulation technique that involves injecting a sperm directly into an egg in order to facilitate fertilization. Since the sperm is being injected directly into the egg, all that is needed to achieve fertilization are a few live sperms.

Intrauterine device (IUD)

Intrauterine devices, or IUDs, are small pieces of plastic or metal that are inserted into the uterus by a health care provider. They should be removed only by a health care provider.

IUDs create a mild chronic inflammation that prevents either fertilization or implantation of the fertilized egg in the uterine wall. On the positive side, they are relatively effective and, like hormonal methods, do not interfere with sexual activity. However, risks include uterine cramping and bleeding, infection, and possible damage to the uterus. IUDs offer no protection from sexually transmitted diseases.

Intravenous (I.V.)

1. Present or occurring within a vein, such as an intravenous blood clot. **2.** Introduced directly into a vein, such as an intravenous injection or I.V. drip.

Intrinsic

1. Arising from within, such as intrinsic blood-clotting factors; endogenous. **2.** Fully contained within an organ, such as the intrinsic muscles of the hand and eye.

Intron (L. *intra*= within)

Portion of mRNA as transcribed from DNA that will not form part of mature mRNA, and therefore does not encode an amino-acid sequence in the protein product.

Invagination (L. *in*= in, + *vagina*= sheath). An infolding of a layer of tissue to form a saclike structure.

inversion (L. *invertere*= to turn upside down)

A turning inward or inside out, as in embryogenesis of sponges; also, reversal in order of genes or reversal of a chromosome segment.

In vitro fertilization (IVF)

IVF is a process including controlled ovarian hyperstimulation, surgical removal (retrieval) of oocytes, fertilization in the laboratory, and transcervical transfer of embryos into the uterus.

Involuntary

Not under conscious control, including tissues such as smooth and cardiac muscle and events such as reflexes.

Involution

Shrinkage of a tissue or organ by autolysis, such as involution of the thymus after childhood and of the uterus after pregnancy.

Ion

A chemical particle with unequal numbers of electrons or protons and consequently a net negative or positive charge; it may have a single atomic nucleus as in a sodium ion or a few atoms as in a bicarbonate ion, or it may be a large molecule such as a protein.

Ionic bond

A chemical bond formed by transfer of one or more electrons from one atom to another; characteristic of salts.

Irisin

The newly discovered hormone, irisin, is secreted when skeletal muscle is active during exercise. Irisin appears to cause an increase in energy expenditure without increasing food intake, as well as improved glucose-regulatory mechanisms. In addition, irisin converts white adipose tissue, which stores energy, into brown adipose tissue, which releases energy as heat

Islets of Langerhans

Scattered within the extensive exocrine portion of the pancreas are numerous small islets of endocrine tissue, called islets of Langerhans. This constitute only 1% to 2% of the total weight of the organ. The islets are without ducts and secrete their hormones directly into blood vessels that extend throughout the pancreas. insulin glucagon, somatostatin are the chief hormones produced by it.

Isotonic (Gr. *isos*=equal, + *tonikos*= tension)

Having the same osmotic pressure as human cells or some other reference solution.

Iteroparity

A life history in which individual organisms of a population normally reproduce more than one time before dying.

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J

Juvenile hormone (JH)

1. A terpenoid hormone produced by the corpora allata of insects; its effects include maintenance of larval or nymphal characteristics during development.

2. JH is secreted by a pair of endocrine glands, the corpora allata; it is situated and attached to the posterior of brain. JH is a hydrophobic molecule of acyclic sesquiterpenoid ($C_{16}H_{26}O_3$).

Molting is not caused by JH, but it play an essential role in its regulation. When the concentration of JH is very low, 20-hydroxyecdysone stimulates molting of pupa.

Juxtaglomerular apparatus

(L. *juxta*= close to, + *glomus*=ball)

Complex of three kinds of sensory cells formed from specialization of the afferent arteriole (granular cells), the glomerulus (mesangial cells), and the distal tubule (macula densa cells) and located close to the glomerulus, where these regions of the nephron are in close apposition. The granular cells of this apparatus produce the enzyme renin.

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K

Kallmann's Syndrome

Kallmann's syndrome is a congenital hypothalamic dysfunction with isolated gonadotrophin (LH and FSH) deficiency.

It occurs in both sporadic and familial forms, and is uncommon with an incidence of 1 in 10,000 men. It is second only to Klinefelter's syndrome as a cause of hypogonadism.17,19

The syndrome, where men have varying degrees of sexual infantilism (prepubertal), underdeveloped testicles and no sperm production, is often associated with anosmia (inability to smell), congenital deafness, hair lip, cleft palate, craniofacial asymmetry, renal abnormalities and colour blindness.

Karyotype

The chromosome complement of a cell or an individual. Often used to refer to the arrangement of metaphase chromosomes in a sequence according to length and centromere position.

Ketone

Any organic compound with a carbonyl (C=O) group covalently bonded to a two-carbon backbone.

Ketone bodies

Certain ketones (acetone, acetoacetic acid, and β-hydroxybutyric acid) produced by the incomplete oxidation of fats, especially when fats are being rapidly catabolized.

Ketonuria

The abnormal presence of ketones in the urine as an effect of ketosis.

Ketosis

An abnormally high concentration of ketone bodies in the blood, occurring in pregnancy, starvation, diabetes mellitus, and other conditions; tends to cause acidosis and to depress the nervous system.

Kilocalorie

The amount of heat energy needed to raise the temperature of 1 kg of water by 1°C; 1,000 calories.

Kinase

Any enzyme that adds an

inorganic phosphate (Pi) group to another organic molecule. Also called a phosphokinase.

Klinefelter syndrome

Men with an extra X chromosome have the genetic disorder called Klinefelter syndrome (also called seminiferous tubular dysgenesis). Klinefelter syndrome (KS) is a sex chromosomal syndrome, affecting 1 in 600 newborn males. This syndrome is characterized by the presence of one or more extra X chromosomes and is among the most common genetic causes of human infertility.

Although there are multiple permutations of the disorder, the most common form results in a 47, XXY karyotype. Affected persons are phenotypically male because of the presence of the Y chromosome, and they appear normal at birth. At puberty, increased levels of gonadotropins fail to induce normal testicular growth and spermatogenesis. Instead, the testis becomes fibrotic and hyalinized and remains small and firm. The seminiferous tubules are largely destroyed, resulting in infertility. However, some patches of tubules may exist, allowing for extraction of sperm to be used in Intracytoplasmic sperm injection (ICSI) into an egg as part of an assisted reproductive procedure. Androgen production is usually low (but this is highly variable among patients), whereas the levels of gonadotropins are elevated, thereby indicating primary hypogonadism. A small penis and lack of body hair are two signs of reduced androgen production. An elevated estradiol-to-testosterone ratio can lead to moderate feminization, including the potential for limited gynecomastia (inappropriate development of breasts). Klinefelter syndrome is associated with a compromised intellectual development, behavioral problems, alterations in bone growth and density, and several other comorbidities.

Kwashiorkor

Malnutrition caused by diet high in carbohydrate and extremely low in protein.

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L

Labium

A lip, such as those of the mouth and the labia majora and minora of the vulva.

Labia majora

Are a pair of thick folds of skin and adipose tissue inferior to the mons pubis.

These are two marked folds of skin that extend from the mons pubis downward and backward to merge with the skin of the perineum. They form the lateral boundaries of the vulval or pudendal cleft, which receives the openings of the vagina and the urethra.

The outer surface of each labium is pigmented and hairy; the inner surface is smooth but possesses sebaceous glands. The labia majora contain fat and loose connective tissue and sweat glands. They correspond to the scrotum in the male and contain tissue resembling the dartos muscle. (singular, labium majus)

Labia minora

Are two small folds of skin, lacking fatty tissue, that extend backward on each side of the opening into the vagina. They lie inside the labia majora. In front, an upper portion of each labium minus passes over the clitoris—the structure in the female corresponding to the penis (excluding the urethra) in the male—to form a fold, the prepuce of the clitoris, and a lower portion passes beneath the clitoris to form its frenulum. The two labia minora are joined at the back across the midline by a fold that becomes stretched at childbirth. The labia minora lack hairs but possess sebaceous and sweat glands. (singular, labium minus).

Lactation

Lactation is the synthesis and ejection of milk from the mammary glands. It lasts for as little as 1 week in women who do not breast-feed, but it can continue for many years as long as the breast is stimulated by a nursing infant or mechanical device (breast pump).

Lactic acid

A small organic acid produced as an end product of the anaerobic

fermentation of pyruvic acid; a contributing factor in muscle fatigue.

Lacuna (pl. **lacunae** (L. pit, cavity)

A small cavity or depression in a tissue such as bone, cartilage, and the erectile tissues.

Lamina

A thin layer, such as the lamina of a vertebra or the lamina propria of a mucous membrane.

Lamina propria

A thin layer of areolar tissue immediately deep to the epithelium of a mucous membrane.

Lateral (L. *latus*= the side, flank)

Away from the midline of an organ or median plane of the body; toward the side.

Leptin (Gr. *leptos*= thin)

Leptin is secreted by fat cells in proportion to the amount of fat stored in adipose tissue. Thus leptin senses body fat levels, is secreted into the circulation, crosses the blood-brain barrier, and acts on neurons of the arcuate nucleus of the hypothalamus. It stimulates anorexigenic neurons and inhibits orexigenic neurons, thereby decreasing appetite and increasing energy expenditure. Because leptin detects stored body fat, it has chronic (long-term) effects to decrease appetite.

Leukotrienes

An eicosanoid that promotes allergic and inflammatory responses such as vasodilation and neutrophil chemotaxis; secreted by basophils, mast cells, and damaged tissues.

Leydig cell

The Leydig cells are irregularly shaped cells that have granular cytoplasm present individually or more often in groups within the connective tissue. They contribute to about 5–12% of the testicular volume. Leydig cells are the prime source of the male sex hormone testosterone

Libido

Sex drive.

Ligand (L. *ligo*= to bind)

A chemical that binds reversibly to a receptor site on a protein, such as a neurotransmitter that binds to

a membrane receptor or a substrate that binds to an enzyme.

Ligand-gated channel

A channel protein in a plasma membrane that opens or closes when a ligand binds to it, enabling the ligand to determine when substances can enter or leave the cell.

Light microscope (LM)

A microscope that produces images with visible light.

Lipase (Gr. *lipos*= fat, + *ase*= enzyme suffix)

An enzyme that hydrolyzes a triglyceride into fatty acids and glycerol.

Lipid (Gr. *lipos*= fat)

A hydrophobic organic compound composed mainly of carbon and a high ratio of hydrogen to oxygen; includes fatty acids, fats, phospholipids, steroids, and prostaglandins.

Lipoprotein

A protein coated lipid droplet in the blood plasma or lymph, serving as a means of lipid transport; for example, chylomicrons and high- and low-density lipoproteins.

Liquor folliculi

In the mammalian ovary, the fluid secreted by follicle cells which accumulates within spaces, that develop between follicle cells. The fluid is clear, viscous, and nutritive, containing high amounts of hyaluronate, hypoxanthine, and adenosine. These last two substances appear to keep the oocyte in meiotic arrest.

Lobule

A small subdivision of an organ or of a lobe of an organ, especially of a gland.

Locus (pl. loci (L. place)) Position of a gene in a chromosome.

Longitudinal

Oriented along the longest dimension of the body or of an organ.

Low-density lipoprotein (LDL)

A blood-borne droplet of about 20% protein and 80% lipid (mainly cholesterol) that transports cholesterol from the liver to other tissues.

Lumen (L. light)

The internal space of a hollow organ such as a blood vessel or the esophagus, or a space surrounded by gated channel cells as in a gland acinus.

Luteal phase

The word 'luteal' stems from 'lutein', which is a xanthophyll carotinoid pigment. Derived from the word luteus (Latin for yellow), this pigment normally accumulates in granulosa cells prior to follicular rupture. Chronologically, the luteal phase begins with the formation of the corpus luteum from an ovarian follicle and ends with either luteolysis or pregnancy if fertilization and implantation are achieved. This phase is characterized by a marked surge in progesterone levels unparalleled by any other stage of the menstrual cycle. Other hormones such as estradiol and inhibin-A are also produced, albeit to a lesser extent, by the corpus luteum. The collective actions of progesterone, estradiol and inhibin-A on the pituitary finally culminate in the suppression of further gonadotropin release, thereby allowing a new cycle to begin and new follicular growth to occur.

Luteinizing hormone (LH)

This is a glycoprotein hormone which is synthesized and stored in pituitary basophils and, as the name implies, it contains sugar moieties covalently linked to asparagines residues in the polypeptide chains. LH is comprised of two peptide subunits, designated alpha and beta, which, though tightly coupled, are not covalently linked. The alpha subunit of all three glycoprotein hormones from the pituitary (LH, FSH and TSH) is identical in its amino acid sequence, and is the product of a single gene located on chromosome 6. The beta subunits of each are somewhat larger than the alpha subunit and confer physiological specificity. Both alpha and beta subunits contribute to receptor binding and both must be present in the receptor binding pocket to produce a biological response. Beta subunits are encoded in separate genes located on different chromosomes. In women LH induces ovulation of the ripe follicle and formation of the corpus luteum from remaining glomerulosa cells in the collapsed, ruptured follicle. It also stimulates synthesis and secretion of the ovarian hormones estrogen and progesterone. In men LH stimulates secretion of the male hormone, testosterone, by

interstitial cells of the testis. Consequently, it has also been called interstitial cell-stimulating hormone (ICSH), but this name largely has disappeared from the literature. LH is a protein whose molecular weight varies from 30,000 to 100.000 depending upon the source.

Luteolysis

It is the process of lysis or regression of the corpus luteum if fertilization does not occur within 1–2 days of ovulation. Luteolysis marks the end of the female reproductive cycle and involves an initial decline in progesterone secretion (functional luteolysis), followed by changes in the cellular structure leading to gradual corpus luteum involution (structural or morphologic luteolysis) to form a small scar of connective tissue known as the corpus albicans.

Luteotrophic hormone (LTH)

LTH or prolactin (PRL), also sometimes called lactogenic hormone, is responsible for maintaining corpus luteum of pregnancy. It promotes development of mammary glands and the formation and secretion of milk during post-natal period. The functions of PRL in men or nonlactating women are not firmly established, but a growing body of evidence suggests that it may stimulate cells of the immune system. This pituitary hormone is closely related to the placental hormone human chorionic somatomammotropin (hCS), which has both growth-promoting and milk-producing activity in some experimental systems. Because of this property, hCS is also called human placental lactogen (hPL). Although the physiological function of this placental hormone has not been established with certainty, it may be regulate maternal metabolism during pregnancy and prepare the mammary glands for lactation.

Prolactin is a protein with a molecular weight of about 25,000-30,000 containing glucose. The trophic hormones secreted by the anterior pituitary (adenohypophysis) are regulated by the blood level of the concerning hormone (such as thyroxine blood level controls TSH). With the exception of prolactin, all hormones are secreted under the stimulus of specific releasing factors or hormones from the hypothalamus. These factors may be secreted under various stimuli which could be either nervous or chemical.

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M

Macrogamete (Gr. *macros*= long, large, + *gamos*= marriage)

The larger of the two gamete types in a heterogametic organism, considered the female gamete.

Macromere (Gr. *macros*= long, large, + *meros*= part)

The largest size class of blastomeres in a cleaving embryo when the blastomeres differ in size from one another.

Macromolecule

Any molecule of large size and high molecular weight, such as a protein, nucleic acid, polysaccharide, or triglyceride.

Magnocellular neurons

Magnocellular neurons are larger in size and produce large quantities of neurohormones. Located predominantly in the paraventricular and supraoptic nuclei of the hypothalamus, their unmyelinated axons form the hypothalamo-hypophyseal tract that traverses the median eminence ending in the posterior pituitary. They synthesize the neurohormones oxytocin and vasopressin, which are transported in neurosecretory vesicles down the hypothalamohypophyseal tract and stored in varicosities at the nerve terminals in the posterior pituitary.

Mammary glands

The adult mammary gland is a compound tubuloalveolar gland that consists of about 20 lobes. All lobes are connected to lactiferous ducts that open at the nipple. The lobes are separated by connective tissue partitions and adipose tissue. The resting or inactive mammary glands are small, consist primarily of ducts, and do not exhibit any developed or secretory alveoli. Inactive mammary glands also exhibit slight cyclic alterations during the course of the menstrual cycle. Under estrogenic stimulation, the secretory cells increase in height, lumina appear in the ducts, and a small amount of secretory material is accumulated.

Before puberty, the mammary glands are undeveloped and consist primarily of branched lactiferous ducts that open at the nipple. In males, the mammary glands remain undeveloped. In

females, mammary glands enlarge during puberty because of stimulation by estrogen. As a result, adipose tissue and connective tissue accumulate and grow, and branching of the lactiferous ducts in the mammary glands increases.

During pregnancy, the mammary glands undergo increased growth owing to the continuous and prolonged stimulatory actions of estrogen and progesterone. These hormones are initially produced by the corpus luteum of the ovary and later by cells in the placenta. In addition, further growth of the mammary glands depends on the pituitary hormone prolactin, placental lactogen, and adrenal corticoids. These hormones stimulate the intralobular ducts of the mammary glands to rapidly proliferate, branch, and form numerous alveoli. The alveoli then undergo hypertrophy and become active sites of milk production during the lactation period. All alveoli become surrounded by contractile myoepithelial cells. At the end of pregnancy, the alveoli initially produce fluid called colostrum that is rich in proteins, vitamins, minerals, and antibodies. Unlike milk, however, colostrum contains little lipid. Milk is not produced until a few days after parturition (birth). The hormones estrogen and progesterone from the corpus luteum and placenta suppress milk production. After parturition and elimination of the placenta, the hormones that inhibited milk secretion are eliminated and the mammary glands begin active secretion of milk. As the pituitary hormone prolactin activates milk secretion, the production of colostrum ceases. During nursing of the newborn, tactile stimulation of the nipple by the suckling infant promotes further release of prolactin and prolonged milk production. In addition, tactile stimulation of the nipple by the infant initiates the milk ejection reflex that causes the release of the hormone oxytocin from the neurohypophysis of the pituitary gland. Oxytocin causes the contraction of myoepithelial cells around the secretory alveoli and excretory ducts in the mammary glands, resulting in milk ejection from the mammary glands toward the nipple. Decreased nursing and suckling by the infant soon results in the cessation of milk production and eventual regression of the mammary glands to an inactive state.

Malignant

Pertaining to a cell or tumor that is cancerous; capable of metastasis.

Matrix (L. *mater* = mother)

1. The extracellular material of a tissue. **2.** The fluid within a mitochondrion containing enzymes of the citric acid cycle. **3.** The substance or framework within which other structures are embedded, such as the fibrous matrix of a blood clot. **4.** A mass of epidermal cells from which a hair root or nail root develops.

Mechanoreceptor

A sensory nerve ending or organ specialized to detect mechanical stimuli such as touch, pressure, stretch, or vibration.

Medial

Toward the midline of an organ or median plane of the body.

Median eminence

At the floor of the third ventricle, the 2 halves of the hypothalamus are rejoined to form a bridge-like region known as the median eminence. The median eminence is important because this is where axon terminals of hypothalamic neurons release neuropeptides involved in the control of anterior pituitary function. In addition, the median eminence is traversed by the axons of hypothalamic neurons ending in the posterior pituitary. The median eminence funnels down to form the infundibular portion of the neurohypophysis (also called the pituitary or infundibular stalk). In practical terms, the neurohypophysis or posterior pituitary can be considered an extension of the hypothalamus.

Median Eminence

Positioned at the base of the third ventricle, the median eminence is part of the anatomic link between the hypothalamus and anterior pituitary. The internal zone of the median eminence is located along the ventral floor of the third ventricle and is largely composed of axonal fibers from both magnocellular neurons (larger neurons that secrete vasopressin and oxytocin) and hypophysiotropic neurons as they travel from hypothalamic nuclei/areas to their final destinations—the neurohypophysis (posterior pituitary) and the external zone of the median eminence, respectively. The external zone contains hypophysiotropic neuron terminals, which release hypophysiotropic hormones into an extensive capillary plexus—the proximal end of the hypophyseal portal system.

Median plane

The sagittal plane that divides the body or an organ into equal right and left halves; also called midsagittal plane.

Medulla ((L. marrow)

Tissue deep to the cortex of certain two- layered organs such as the lymph nodes, adrenal glands, hairs, and kidneys.

Meiosis (Gr. *mieoun*= to make small)

A form of cell division in which a diploid cell divides twice and produces four haploid daughter cells; occurs only in gametogenesis.

Melanin (Gr. *melas*= black)

Black or dark-brown pigment found in plant or animal structures.

Melanophore (Gr. *melania*= blackness, + *pherein*= to bear)

Black or brown chromatophore containing melanin.

Melatonin

A major hormone secreted by the pinealocyte is melatonin. It is a highly lipophilic hormone, permitting its ready penetration of biologic membranes and its ability to reach each cell in the body. The effects of melatonin appear to be mediated via specific melatonin receptors, two of which (MT1 and MT2) have been cloned and characterized in mammals.

Both melatonin and serotonin are derived from tryptophan, with the characteristic feature of all of these compounds being the indole ring. Tryptophan is the precursor of melatonin. After uptake from the extracellular blood vascular system, this amino acid is converted, in the pinealocyte, to 5-hydroxytryptophan catalyzed by tryptophan hydroxylase. Serotonin is the product of the next step in the pathway achieved by the action of aromatic L-amino acid decarboxylase on 5-hydroxytryptophan. Melatonin circulates in the blood and is metabolized by the liver. Apparently, some or all of the melatonin is secreted either into the blood directly or into the cerebrospinal fluid before entering the bloodstream.

Melatonin from the pineal gland provides input into the circadian clock in the suprachiasmatic nucleus. Cells in the pars tuberalis measure the circannual rhythm via the nightly melatonin production:

a drop in seasonal melatonin level signals springtime and enhanced prolactin production. Formation of melatonin occurs in a light–dark cycle: in the dark, tenfold more melatonin is released than in brightness. The zeitgeber is located in mammals in the suprachiasmatic nucleus, a hypothalamic region near the optic nerve from where noradrenergic neurons control pineal activity. Mostly "β-adrenergic receptors on the pinealocytes mediate the enzymatic activity.

Menarche

The first menstrual period.

Menopause (Gr. *men*= month, + *pauein*= to cease)

The cessation of menstruation. Menopause is the cessation of menstrual cycles, usually occurring between the ages of 45 and 55.

Menopause, or the climacteric, is the cessation of menstrual cycles in women, and it occurs at approximately 50 years of age. For several years preceding menopause, anovulatory cycles (menstrual cycles in which ovulation does not occur) become more common and the number of functioning ovarian follicles decreases. Accordingly, estrogen secretion gradually declines and eventually ceases. Because of the decreased level of estrogen, there is reduced negative feedback on the anterior pituitary and, accordingly, increased secretion and pulsatility of FSH and LH at menopause. The symptoms of menopause are caused by the loss of the ovarian source of estrogen and include thinning of the vaginal epithelium, decreased vaginal secretions, decreased breast mass, accelerated bone loss, vascular instability ("hot flashes"), and emotional lability. Estrogen replacement therapy is aimed at replacing the ovarian source of estrogen, thus minimizing or preventing the symptoms of menopause.

Menorrhagia

The condition of experiencing extremely heavy bleeding at menstruation.

Menstrual cycle

The menstrual cycle is a highly coordinated series of events that results in ovulation of a single follicle and preparation of the uterus to receive the embryo after fertilization. This cycle is driven by activity of the hypothalamic

GnRH pulse generator and surge center. Gonadotropins released from the pituitary induce changes in steroid secretion by the ovaries. In addition to these hormonal fluctuations, structural changes occur in the ovaries and the uterine endometrium. During these cycles, a woman's reproductive system is in constant flux, and the hormonal changes affect non-reproductive tissues as well. The word menstrual has its root in the Latin word mensis, which means "month"; the menstrual cycle averages the length of a lunar month (29.5 days). Cycle length can vary greatly in a single woman and even more so among different women. Most cycles are 25 to 30 days long, but some last less than 25 days or longer than 30 days. Younger women tend to have longer cycles than older women. Each menstrual cycle can be divided into three main phases: (1) the menstrual ("destructive") phase, also called menses; (2) the follicular ("proliferative" or "estrogenic") phase; and (3) the luteal (or "secretory," "progestational") phase.

Menstrual phase

This phase begins when the ovulated oocyte is not fertilized and no implantation occurs in the uterus. Reduced levels of circulating progesterone (and estrogen), as a result of the regressing corpus luteum, initiate this phase. Decreased levels of these hormones induce intermittent constrictions of the spiral arteries and interruption of blood flow to the functionalis layer of the endometrium, while the blood flow to the basalis layer remains uninterrupted. These constrictions deprive the functionalis layer of oxygenated blood and produce transitory ischemia, causing necrosis (death) of cells in the walls of blood vessels and degeneration of the functionalis layer in the endometrium. After extended periods of vascular constriction, the spiral arteries dilate, resulting in the rupture of their necrotic walls and hemorrhage (bleeding) into the stroma. The necrotic functionalis layer then detaches from the rest of the endometrium. Blood, uterine fluid, stromal cells, secretory material, and epithelial cells from the functionalis layer mix to form the menstrual flow.

Menstruation (L. *menstrual*= the menses, from *mensis*= month)

1. The discharge of blood and uterine endometrial tissue from the vagina at the beginning of a menstrual cycle. It occurs during the first few days of the ovarian cycle.

2. Menstruation is the periodic discharge from the vagina of blood, secretions, and disintegrating mucous membrane that had lined the uterus.

Meroblastic (Gr. *meros*= part, + *blastos*= germ)

Partial cleavage occurring in zygotes having a large amount of yolk at the vegetal pole; cleavage restricted to a small area on the surface of the egg.

Merocrine (*meros*= part, + *crine*= secretion)

1. Pertaining to gland cells that release their product by exocytosis; also called eccrine.

2. In this type of secretion, the product is released from an exocrine cell by secretory vesicles through exocytosis. This is the most common method of exocrine secretion. For example, mucin is a merocrine secretion. The mucous secretions of the salivary glands coat food and reduce friction during swallowing. In the skin, merocrine sweat glands produce the watery perspiration that helps cool you on a hot day.

Mesenchyme (Gr. *mesos*= middle, + *enchyma*= infusion)

A gelatinous embryonic connective tissue derived from the mesoderm, composed of fine, wispy collagen (protein) fibers and branching mesenchymal cells embedded in a gelatinous ground substance; differentiates into all permanent connective tissues and most muscle. Mesenchyme gives rise to muscle, bone, and blood among other tissues.

Mesentery (L. *mesenterium*= mesentery) Peritoneal fold serving to hold the viscera in position.

Mesoderm (Gr. *mesos*= middle, + *derm*= skin)

The middle layer of the three primary germ layers of an embryo; gives rise to muscle and connective tissue.

Mesentery

A membrane fold (peritoneum) suspending, attaching, and anchoring various organs to the body cavity, such as the small intestine and spleen; provides blood, lymphatic vessels, and nerve supply to and from the organs. The term mesentery is used generically describing peritoneal extensions not only from the intestine but from all abdominal and pelvic organs.

Metabolism

The sum of all chemical reactions in the body.

Metabolite (Gr. *metabole*= change)

Any chemical produced by metabolism.

Metamere (Gr. *meta*= after, + *meros*= part)

A repeated body unit along the longitudinal axis of an animal, a somite, or segment.

Metamerism (Gr. *meta*=between, after, + *meros*= part)

Condition of being composed of serially repeated parts (metameres); serial segmentation.

Metamorphosis (Gr. *meta*= between, among, after, + *morphe*= form, + *osis*= state of)

Sharp change in form during postembryonic development, for example, tadpole to frog or larval insect to adult.

Metaplasia (meta=change)

The transformation of one type of cell into another.

Metastasis

The spread of cancer cells from the original tumor to a new location, where they seed the development of a new tumor.

Metestrous

This is a stage when ovulation occurs and corpus luteum is formed. The events are under the influence of progesterone; hence it is progestional phase.

Microgamete (Gr. *micros*=small, + *gamos*= marriage)

The smaller of the two gamete types in a heterogametic organism, considered the male gamete.

Micromere Gr. *micros*= small, + *meros*= part)

The smallest size class of blastomeres in a cleaving embryo when the blastomeres differ in size from one another.

Microsurgical epididymal sperm aspiration (MESA)

A technique whereby a small needle is used to extract fluid and relatively mature sperm directly from an epididymal tubule.

Mineralocorticoids (M. E. *minerale*= ore, + L. *cortex*= bark, + *oid*= suffix denoting likeness of form).

Steroid hormone of the adrenal cortex that Regulate salt balance. The principal physiologic function of aldosterone is to regulate mineral (sodium and potassium) balance; specifically renal potassium excretion and sodium reabsorption, hence the name "mineralocorticoid."

Miscarriage

Miscarriage is the spontaneous expulsion of the embryo or fetus from the uterus before the 20th week of pregnancy, prior to the conceptus having sufficiently developed to live without maternal support. An estimated 10 to 25 percent of recognized pregnancies are lost as a result of miscarriage, with the risk of loss being highest in the first six weeks of pregnancy. Because many miscarriages occur prior to a woman knowing she is pregnant.

Mitosis (Gr. *mitos*= thread, + *osis*=state of)

A form of cell division in which a cell divides once and produces two genetically identical daughter cells; sometimes used to refer only to the division of the genetic material or nucleus and not to include cytokinesis, the subsequent division of the cytoplasm.

Mixed gland

A gland producing both exocrine and endocrine secretions is called so. Pancreas is a mixed gland.

Moiety

A chemically distinct subunit of a macromolecule, such as the heme and globin moieties of hemoglobin or the lipid and carbohydrate moieties of a glycolipid.

Molarity

A measure of chemical concentration expressed as moles of solute per liter of solution.

Mole

The mass of a chemical equal to its molecular weight in grams, containing 6.023 × 1023 molecules.

Molting

Shedding of the outer cuticular layer.

Molting hormone

A steroid produced by the prothoracic gland. Also called as ecdysone.

Monoecious (Gr. *monos*= single, + *oikos*= house)

Having both male and female gonads in the same organism, usually denoting that this is the typical condition of a species; hermaphroditic.

Monogamy (Gr. *monos*= single,+ *gamos*= marriage)

The condition of having a single mate at any one time.

Monomer (Gr. *monos*= single, + *meros*= part)

1. One of the identical or similar subunits of a larger molecule in the dimer to polymer range; for example, the glucose monomers of starch, the amino acids of a protein, or the nucleotides of DNA. **2.** One subunit of an antibody molecule, composed of four polypeptides.

Monosaccharide (Gr. *monos*= one, + *sakcharon*= sugar, from Sanskrit *sarkar*a= gravel, sugar)

A simple sugar, or sugar monomer; chiefly glucose, fructose, and galactose.

Mons Pubis

The mons pubis is a cushion of fatty tissue, covered by skin and pubic hair, that lies over the pubic symphysis. The skin of this area has many touch receptors and only a few pressure receptors. The distribution and the amount of pubic hair vary in different individuals. Usually the pubic hair forms the shape of an inverted pyramid. In about 25% of women, this hair extends in a line up to the navel.

Morphogen (Gr. *morphe*= form, + *genesis*= origin)

1. Soluble molecule acting on target cells, or forming a gradient from producing cells to target cells, to specify cell fates; an agent of embryonic induction and epigenesis.

2. A protein that acts on target cells at a distance from its cell of origin, that forms an expression or activity gradient over a field of responsive cells, and that drives different cellular responses at different concentrations or activity thresholds. 3. Any molecule (usually a transcription factor or a signaling molecule)

that influences cellular behavior on the basis of concentration differences. Competent cells or tissues exhibit differential responses according to the concentration gradient of the morphogen.

Morphogenesis (Gr. *morphe*= form, + *genesis*= origin)

Development of the architectural features of organisms; formation and differentiation of tissues and organs.

Morphogenetic determinant

Certain protein or messenger RNA in egg cytoplasm distributed among descendant cells during cleavage to direct later gene expression and to specify cell fate; the basis of mosaic development.

Morphology (Gr. *morphe*= form, + L. *logia*=study, from Gr. *logos*= work).

The science of structure. Includes cytology, the study of cell structure; histology, the study of tissue structure; and anatomy, the study of gross structure.

Mosaic development

Embryonic development characterized by independent differentiation of each part of the embryo; determinate cleavage.

Morula (L. *Morus* = mulberry)

1. Solid ball of 12–32 cells (blastomeres) formed 3–4 days after fertilization, just at the time when embryo enters the uterus. 2.

The second important stage of development prior to the formation of blastocyst. It forms from the repeated mitosis of the zygote. Initially its interior contains 16 blastomeres, which are the first cells that develop from the zygote. Inside the morula, these cells are uniform in shape, size, and physiological potential.

Motilin

It is a 22–amino acid peptide. It is neither a member of the gastrin-CCK family nor the secretin-glucagon family. It is secreted from the upper duodenum during fasting states. Motilin is believed to increase gastrointestinal motility and, specifically, to initiate the interdigestive myoelectric complexes that occur at 90-minute intervals.

Motor protein

Any protein that produces movements of a cell or its

components owing to its ability to undergo quick repetitive changes in conformation and to bind reversibly to other molecules; for example, myosin, dynein, and kinesin.

Mucosa

A tissue layer that forms the inner lining of an anatomical tract that is open to the exterior (the respiratory, digestive, urinary, and reproductive tracts). Composed of epithelium, connective tissue (lamina propria), and often smooth muscle (muscularis mucosae).

Mucous membrane

A mucosa.

Mucus (L. *mucus*= nasal mucus).

Viscid, slippery secretion rich in mucins produced by secretory cells such as those in mucous membranes. Adj., **mucous.**

Mullerian inhibitory substance (MIS)

The Mullerian inhibitory substance (MIS) is another member of the TGFβ family of glycoprotein hormones that presents certain patterns of expression in follicles at various stages of development. This hormone was identified as a testicular product that induces regression of Mullerian ducts in males. Also known as anti-Mullerian Hormone (MIS), it is expressed in granulosa cells of small and early growing follicles.

Multipotent

Pertaining to a stem cell that has the potential to develop into two or more types of fully differentiated, functional cells, but not into an unlimited variety of cell types.

Multipara

A woman who has previously given birth.

Mutagen

Any agent that causes a mutation, including viruses, chemicals, and ionizing radiation.

Mutation (L. *mutare*= to change)

Any change in the structure of a chromosome or a DNA molecule, often resulting in a change of organismal structure or function.

Myometrium

The uterine wall consists of a

middle muscular layer called the myometrium

Myosin

A motor protein that constitutes the thick myofilaments of muscle and has globular, mobile heads of ATPase that bind to actin molecules.

Myxedema

Myxedema develops in persons who have almost total lack of thyroid hormone function. Patients usually have bagginess under the eyes and swelling of the face. In this condition, for reasons that are not explained, greatly increased quantities of hyaluronic acid and chondroitin sulfate bound with protein form excessive tissue gel in the interstitial spaces, which causes the total quantity of interstitial fluid to increase. Because of the gel nature of the excess fluid, it is mainly immobile and the edema is the nonpitting type.

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N

Negative feedback

A self-corrective mechanism that underlies most homeostasis, in which a bodily change is detected and responses are activated that reverse the change and restore stability and preserve normal body function.

Negative feedback inhibition

A mechanism for limiting the secretion of a pituitary tropic hormone. The tropic hormone stimulates another endocrine gland to secrete its own hormone, and that hormone inhibits further release of the tropic hormone.

Neonate

An infant up to 6 weeks old.

Neoplasia

Abnormal growth of new tissue, such as a tumor, with no useful function.

Neural tube

A dorsal hollow tube in the embryo that develops into the central nervous system.

Neuroendocrinology

It is the study of how the brain controls the endocrine systems that keep us alive and able to reproduce. However, an essential and critical characteristic of this neural control of the endocrine systems is that endocrine hormones in turn have profound effects on brain function through feedback systems. Neuroendocrinology actually deals with how the endocrine and nervous systems affect each other to produce an integrated functional neuroendocrine system that influences physiological and behavioral responses.

Neurohormones

These are hormones released by neurosecretory neurons. These respond to and conduct electrical signals like neurons, but instead of directly innervating target cells, they release neurohormones into the circulatory fluid. The neurohormone is then distributed to the target cells. Thus, like endocrine cells, neurosecretory neurons release blood- or hemolymph-borne chemical messengers, whereas ordinary neurons secrete short-range

neurotransmitters into a confined space.

Neurohypophysis

The neurohypophysis (posterior pituitary) consists of neural tissue and contains the nerve terminals (about 100,000) of axons whose cell bodies are located in the paraventricular nucleus (PVN) and supraoptic nucleus (SON) of the hypothalamus. The axons of these large magnocellular neurosecretory cells project down from the hypothalamus through the part of the pituitary stalk called the infundibulum and terminate in the posterior pituitary gland. The neurosecretory cells of the PVN and SON manufacture the hormones oxytocin and vasopressin (also called antidiuretic hormone, ADH), which are transported down the axons and stored in nerve terminals in the posterior pituitary. The axon terminals in the posterior pituitary are surrounded by supporting cells called pituicytes. The posterior pituitary gland receives its blood supply from the inferior hypophyseal artery and when the hypothalamic PVN and SON neurons are stimulated oxytocin and/or vasopressin are secreted into the bloodstream and travel to their target cells throughout the body.

Neuromodulators

They are substances that act on the presynaptic cell to alter the amount of neurotransmitter released in response to stimulation. Alternatively, a neuromodulator may be cosecreted with a neurotransmitter and alter the response of the postsynaptic cell to the neurotransmitter.

Neuropeptide

A peptide secreted by a neuron, often serving to modify the action of a neurotransmitter; for example, endorphins, enkephalin, and cholecystokinin.

Neurophysins

Neurophysins are by-products of post-translational prohormone processing in the secretory vesicles. The release of AVP and oxytocin is accompanied by the release of neurophysins from the secretory granules. Although the exact function of these by-products is not clear, it appears that neurophysins play an important role in AVP release. This role has become more evident since the identification of the inherited disease of familial neurogenic diabetes insipidus (DI). This disease is characterized

by AVP deficiency caused by mutations in neurophysins and improper targeting of the hormone to neurosecretory granules. Neurophysins thus have an important role in the transport of AVP from the cell bodies of magnocellular neurons to their final release from the posterior pituitary. Impairment in hormone targeting leads to retention of the mutated neuropeptide precursor in the endoplasmic reticulum of the magnocellular neurons, and these cells progress to programmed cell death (apoptosis).

Neurosecretory cells

These are specialized nerve cells capable of synthesizing and secreting hormones. Their products, called neurosecretory hormones or neurohormones, are discharged directly into body fluids, and serve as a crucial link between the nervous and endocrine systems.

Neurotransmitter

1. A chemical released at the distal end of an axon that stimulates an adjacent cell; for example, acetylcholine, norepinephrine, or serotonin. 2. These are intercellular chemical messengers used by neurons (nerve cells), which communicate directly with the cells they innervate (their target cells) by releasing these signal molecules in response to electrical signals. Like paracrines, neurotransmitters are very short-range chemical messengers, which diffuse from their site of release across a narrow extracellular space to act locally on only an adjoining target cell, which is usually another neuron, a muscle, or a gland.

Neurulation (Gr. *Neuron* = nerve) Process by which neural plate forms the neural tube.

Nitrogenous base

An organic molecule with a single or double carbon–nitrogen ring that forms one of the building blocks of ATP, other nucleotides, and nucleic acids; the basis of the genetic code.

Nitrogenous waste

Any nitrogen-containing substance produced as a metabolic waste and excreted in the urine; chiefly ammonia, urea, uric acid, and creatinine.

Non-disjunction

Failure of the chromosomes to properly segregate during meiosis or during the mitotic anaphase.

Non-disjunction generates cells with abnormal number of chromosomes that can result in genetic diseases or abnormalities.

Non-genomic action

Nongonococcal urethritis

Nongonococcal urethritis (NGU) is any urethral inflammation caused by agents other than the gonorrhea bacterium. NGU often produces pain or discomfort on urination. The most common bacterial NGU is chlamydia, caused by Chlamydia trachomatis.

Non-tropic hormone

A hormone that exerts its effects on non-endocrine target tissues.

Norepinephrine

A catecholamine that functions as a neurotransmitter and adrenal hormone, especially in the sympathetic nervous system.

Nucleic acid (L. *nucleus*= kernel)

An acidic polymer of nucleotides found or produced in the nucleus, functioning in heredity and protein synthesis; of two types, DNA and RNA.

Nucleoid (L. *nucleus*= kernel, + *oid*= like) The region in a prokaryotic cell that contains the genome.

Nucleolus (dim. of L. *nucleus*= kernel)

A deeply staining body within the nucleus of a cell and containing ribosomal RNA; nucleoli are specialized portions of certain chromosomes that carry multiple copies of the genes encoding ribosomal RNA and where ribosomal RNA is actively synthesized.

Nucleoplasm (L. *nucleus*= kernel, + Gr. *plasma*= mold)

Protoplasm of a nucleus, as distinguished from cytoplasm.

Nucleoprotein

Any protein structurally associated with DNA or RNA.

Nucleosidase

An enzyme in the plasma membrane of cells lining the intestine that splits nucleosides into ribose and deoxyribose sugars and purines and pyrimidines.

Nucleosome (L. *nucleus*= kernel, + *soma*= body)

A repeating subunit of chromatin in which one and three-quarter turns of the double-helical DNA are wound around eight molecules of histones.

Nucleotide

An organic molecule composed of a nitrogenous base, a monosaccharide, and a phosphate group; the monomer of a nucleic acid.

Nucleus (L. *nucleus*= a little nut, the kernel) 1. A cell organelle containing DNA and surrounded by a double unit membrane. 2. A mass of neurons (gray matter) surrounded by

white matter of the brain, including the basal nuclei and brainstem nuclei. 3. The positively charged core of an atom, consisting of protons and neutrons. 4. A central structure, such as the nucleus pulposus of an intervertebral disc. nurse cells Single cells or layers of cells surrounding or adjacent to other cells or structures for which the nurse cells provide nutrient or other molecules.

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O

Oligozoospermia

Oligozoospermia is defined as low sperm concentration in the ejaculate.

Ontogeny (Gr. *ontos*= being, + *geneia*= act of being born, from *genes*= born)

The course of development of an individual from egg to senescence.

Oocyte

(L. *Ovum* = egg) (Gr. *oion*= egg, + *kytos*= hollow)

1.In the development of an egg cell, any haploid stage between meiosis I and fertilization. 2.Female germ or sex cells produced by ovaries.

Oocyte maturation

The reinitiating and completion of the first meiotic division, which takes place when oocytes have undergone extensive growth and extruded the first polar body, is collectively known as oocyte maturation. This is followed by subsequent progression to metaphase in meiosis II.

Oogenesis

(Gr. *oion*= egg, + g*enesis*= descent)

1. The process of production of a fertilizable egg cell (oocyte) through a series of mitotic and meiotic cell divisions. Oogenesis is accompanied by development and growth of the follicles; female gametogenesis.

2. It refers to the differentiation of female germ cells to form a haploid ovum or egg cell in the ovarian follicle of the ovary. The oocyte divides; one part becomes an ovum, and the other becomes a polar body. There are two major periods of arrest in oogenesis: a fetal arrest during the prophase of meiosis I and a metaphase arrest during meiosis II, which lasts until fertilization occurs.

Oogonium (Gr. *oion*= egg, + *gonos*= offspring)

A cell that, by continued division, gives rise to oocytes; an ovum in a primary follicle immediately before the beginning of maturation.

Oophorectomy

The surgical removal of one or both ovaries.

Ootid (Gr. *oion*= egg, + *idion*= dim)

Stage of formation of ovum after second meiotic division following expulsion of second polar body.

Orchitis

Inflammation of one or both testicles.

Organ

Any anatomical structure that is composed of at least two different tissue types, has recognizable structural boundaries, and has a discrete function different from the structures around it.

Many organs are microscopic and many organs contain smaller organs, such as the skin containing numerous microscopic sense organs.

Organism

A biological individual composed of one or more cells, tissues, and/or organs whose parts are interdependent in producing a collective physiological system. Organisms of the same species may form populations.

Organogenesis

Organizer (Gr. *organos*=fashioning)

Area of an embryo that directs subsequent development of other parts.

Osmolality

The molar concentration of dissolved particles in 1 kg of water.

Osmolarity

The molar concentration of dissolved particles in 1 L of solution.

Osmole

Molecular weight of a solute, in grams, divided by the number of ions or particles into which it dissociates in solution. Adj., osmolar.

Osmoreceptor

A neuron of the hypothalamus that responds to changes in the osmolarity of the extracellular fluid.

Osmoregulation

Maintenance of proper internal salt and water concentrations in a cell or in the body of a living organism; active regulation of internal osmotic pressure.

Osmosis (Gr. *osmos= act* of pushing, impulse)

The net flow of water through a selectively permeable membrane, resulting from either a chemical concentration difference or a mechanical force across the membrane.

Osmotic pressure

The amount of pressure that would have to be applied to one side of a selectively permeable membrane to stop osmosis; proportional to the concentration of non-permeating solutes on that side and therefore serving as an indicator of solute concentration.

Ovary

1. The ovaries are paired structures lying on each side of the upper pelvic cavity, against the back of the pelvic wall and near the uterus. The ovary, or female gonad, serves two essential functions in female reproduction: development of the female gametes (oocytes, or eggs) and the synthesis and release of steroid hormones. These small almond-shaped organs are white or yellowish in color and have a lumpy surface. The ovaries are innervated by autonomic nerves and receive an especially rich blood supply. They are connected to the uterus and pelvic wall by supportive ligaments.

2. The primary reproductive organs of the female are the ovaries. Their main functions are the production of fertilizable oocytes and the secretion of steroid hormones (estrogen and progesterone), which are required for the correct function of the reproductive organs such as the Fallopian tubes, uterus and vagina. The ovary is formed by three main compartments: superficial epithelium, cortex and medulla. The superficial epithelium is constituted by one layer of cubic cells, which are continuous with peritoneal epithelium at the periphery of the ovary. The cortex is a wide peripheral zone containing the follicles, the functional and structural unit of the ovary, and a stroma formed by compact connective tissue. The medulla is a core of fibrous connective tissue occupied by the principal arteries and veins of the ovary. The cortex is the site of the ovarian follicles,

each of which consists of one developing ovum surrounded by numerous small follicular cells. The ovary does not have a system of tubules like the testis; eggs are released one at a time by the bursting of the follicles (ovulation). In childhood, the ovaries are smooth-surfaced. During the reproductive years, they become more corrugated because growing follicles of various ages produce bulges in the surface. After menopause, the ovaries are shrunken and composed mostly of scar tissue. Several connective tissue ligaments hold the ovaries and other internal genitalia in place. The medial pole of the ovary is attached to the uterus by the ovarian ligament and its lateral pole is attached to the pelvic wall by the suspensory ligament. The anterior margin of the ovary is anchored by a peritoneal fold called the mesovarium. This ligament extends to a sheet of peritoneum called the broad ligament, which flanks the uterus and encloses the uterine tube in its superior margin.

Ovarian cycle

The ovarian cycle is a regular pattern of growth, maturation, and release of oocytes from the ovary. At birth, a female has approximately one million primary oocytes already formed and stored in each ovary, and no more are ever produced.

Each primary oocyte has already developed partway through meiosis at birth, but at birth all further development halts until after puberty. By puberty 85% of them have been resorbed, leaving only about 300,000 in both ovaries. Each month perhaps a dozen primary oocytes start the development process, but typically only one completes it.

Only about 400 to 500 oocytes are released during a woman's lifetime. The ovarian cycles normally persist throughout the reproductive life of women except during pregnancy and terminates at menopause.

Ovarian cyst

A condition (usually harmless) in which fluid-filled sacs develop in or on the ovary.

Ovarian reserve

The maximum number of oocytes contained by the ovary at birth and a mammal will have this for the rest of its life. This pool of primordial follicles is called the ovarian reserve. The number of oocytes at birth and their rate of

declination determine the fertile life span of the mammal.

Ovariole

A typical ovariole is an elongate tube in which the developing eggs are disposed one behind the other in a single chain, the oldest oocytes. being situated nearest the union with the oviduct. The wall of an ovariole is a delicate transparent membrane: its inner coat is a layer of epithelium whose cells rest upon a basement membrane or tunica propria: outside the latter is a peritoneal coat of connective tissue which, in many insects, contains a reticulum of muscle fibres.

Oviduct

Another name for fallopian tubes

Oviparity (L. *ovum*= egg, + *parere*= to bring forth)

Reproduction in which eggs are released by the female; development of offspring occurs outside the maternal body. Adj., oviparous.

Oviparous

These are animals that expel the ova from the body, and all development occurs externally using the resources within the egg. Fertilization may be external, as in most fish, or internal, as in birds and reptiles. The level of parental care ranges from none to intense. Few insects exhibit parental care, whereas most birds guard eggs and feed young.

Ovipositor (L. *ovum*= egg, + *positor*= builder, placer, + *or*= suffix denoting agent or doer)

In many female insects a structure at the posterior end of the abdomen for laying eggs.

Ovoviviparity (L. *ovum*=egg, + *vivere*= to live, + *parere*= to bring forth)

A reproduction mode in which young develop (often in an egg) in the uterus, but rely only on their yolk sacs for nutrition, with no placental connection. Also called lecithotropic viviparity. Adj., **ovoviviparous.**

Ovoviviparous

Refer to the animal group which demonstrates features of both ovipary and vivipary. They use internal fertilization, followed by extensive internal development of embryos. While in the uterus, the embryos derive their nutrition from the yolk, rather than the

mother. When mature, the eggs hatch within the mother. This strategy is common in fish, including sharks, reptiles, and many invertebrates.

Ovulation

The release of a mature oocyte by the bursting of an ovarian follicle.

Ovum (L. *ovum*= egg)

Any stage of the female gamete from the conclusion of meiosis I until fertilization; a primary or secondary oocyte; an egg.

Oxidation

A chemical reaction in which one or more electrons are removed from a molecule, lowering its free energy content; opposite of reduction and always linked to a reduction reaction.

Oxidation (Fr. *Oxider*= to oxidize, from Gr. *oxys*= sharp, + *ation)*

The loss of an electron by an atom or molecule; sometimes addition of oxygen chemically to a substance. Opposite of reduction, in which an electron is accepted by an atom or molecule.

Oxidative (aerobic) metabolism

Cellular respiration using molecular oxygen as the final electron acceptor.

Oxidative phosphorylation

The conversion of inorganic phosphate to energy-rich phosphate of ATP, involving electron transport through a respiratory chain to molecular oxygen.

Oxytocin

A polypeptides hormone formed in the neurosecretory cells of the hypothalamus, whose axons extend down the infundibular

stalk and into the posterior lobe of pituitary. Oxytocin has two important specialized reproductive functions in adult female mammals. It stimulates contraction of uterine smooth muscles during parturition (birth of young). Physicians sometimes use it during child birth. It also stimulates secretion of milk from the breasts and the stimulus is obtained from the suckling of the baby.

It is composed of 9 amino acids with a disulphide ring having a molecular weight of about 1,025.

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P

Pampiniform plexus

The pampiniform plexus is an extensive network of veins from the testis that surround the testicular artery in the spermatic cord.

Pancreatic islet

A small cluster of endocrine cells in the pancreas that secretes insulin, glucagon, somatostatin, and other intercellular messengers; also called islet of Langerhans.

Pancreas

It is a large gland located within the first fold of the small intestine (duodenum), close to the stomach. The pancreas is a retroperitoneal gland divided into a head, body, and tail. Most of the pancreatic mass is composed of exocrine cells that are clustered in lobules (acini) divided by connective tissue and connected to a duct that drains into the pancreatic duct and into the duodenum.

The product of the pancreatic exocrine cells is an alkaline fluid rich with digestive enzymes, which is secreted into the small intestine to aid in the digestive process. Embedded within the acini are richly vascularized, small clusters of endocrine cells called the islets of Langerhans.

As an exocrine organ, it secretes digestive enzymes into the duodenum. Embedded in the pancreas are endocrine cells that secrete two hormones, insulin and glucagon, into the bloodstream. Our discussion begins with the anatomy of the pancreas. The pancreas is mostly retroperitoneal and lies in the loop between the inferior border of the stomach and the proximal portion of the small intestine. It is a slender, pale organ with a nodular (lumpy) texture.

Pancreatic Polypeptide

Pancreatic polypeptide is a 36–amino acid peptide hormone that belongs to a peptide family including neuropeptide Y and peptide YY. It is produced in the endocrine type F cells located in the periphery of pancreatic islets and is released into the circulation after a meal, exercise, and vagal stimulation. The effects of pancreatic polypeptide include inhibition of pancreatic exocrine secretion, gallbladder contraction,

modulation of gastric acid secretion, and gastrointestinal motility.

Pancreatic polypeptide crosses the blood-brain barrier and has been postulated to play a role in regulating feeding behavior.

Panhypopituitarism

Panhypopituitarism means decreased secretion of all the anterior pituitary hormones. The decrease in secretion may be congenital (present from birth), or it may occur suddenly or slowly at any time during life, most often resulting from a pituitary tumor that destroys the pituitary gland.

Paracrine

1. A local chemical messenger similar to a hormone whose effects are restricted to the immediate vicinity of the cells that secrete it; sometimes called a local hormone.

2. These are local chemical messengers whose effect is exerted only on neighboring cells in the immediate environment of their site of secretion. (If their action affects the same cell that secreted them, they are called autocrines). Because paracrines are distributed by simple diffusion, their action is restricted to short distances. They do not gain entry to the blood in any significant quantity, because they are rapidly inactivated by locally existing enzymes. One example of a paracrine is histamine, which is released from a specific type of mammalian connective tissue cell during an inflammatory response within an invaded or injured tissue. Among other things, histamine dilates (opens more widely) the blood vessels in the vicinity to increase blood flow to the tissue. This action brings additional blood-borne immune-response supplies into the affected area. Paracrines must be distinguished from chemicals that influence neighboring cells after being released nonspecifically.

Parafollicular Cells

The thyroid gland also contains parafollicular cells. These cells appear on the periphery of the follicular epithelium as single cells or as cell clusters between the follicles. Parafollicular cells are not part of thyroid follicles and are not in contact with colloid.

The parafollicular cells synthesize and secrete the hormone calcitonin (thyrocalcitonin) into capillaries; and therefore they are frequently referred to as C cells.

The main function of calcitonin is to lower blood calcium levels in the body. This is primarily accomplished by reducing the number of osteoclasts in the bones, inhibiting bone resorption, and thereby reducing calcium release. Calcitonin also promotes increased excretion of calcium and phosphate ions from the kidneys into the urine. The production and release of calcitonin by the parafollicular cells depends only on blood calcium levels and is completely independent of the pituitary gland hormones.

The chief cells of the parathyroid glands produce parathyroid hormone (parathormone). The main function of this hormone is to maintain proper calcium levels in the extracellular body fluids. This is accomplished by elevating calcium levels in the blood. This action is opposite or antagonistic to that of calcitonin, which is produced by parafollicular cells in the thyroid glands.

Parathyroid gland

The parathyroid glands are pea-sized glands located at the top and bottom posterior borders of the lateral lobes of the thyroid gland. The glands are richly vascularized and consist primarily of chief cells, with a thin capsule of connective tissue that divides the gland into lobules. The chief cells synthesize and secrete PTH, a polypeptide hormone that plays a major role in bone remodeling and calcium homeostasis. In addition to its central role in the regulation of Ca 2+ levels and bone mass, PTH participates in the renal excretion of phosphate and in the activation of vitamin D.

Parathyroid hormone (PTH)

A hormone secreted by the parathyroid glands that raises blood calcium concentration by stimulating bone resorption by osteoclasts, promoting intestinal absorption of calcium, and inhibiting urinary excretion of calcium.

Paraventricular nucleus

Parenchyma (Gr. anything poured in beside) The tissue that performs the main physiological functions of an organ, especially a gland, as opposed to the tissues (stroma) that mainly provide structural support.

Parturition

Parturition means birth of the baby. Toward the end of pregnancy, the uterus becomes

progressively more excitable, until finally it develops such strong rhythmical contractions that the baby is expelled.

The process of childbirth consists of three distinct stages of labor. The first is the stage of dilation, which culminates with effacement of the cervix. The second stage culminates with expulsion of the infant. The third stage represents the period between delivery of the infant and expulsion of the placenta. The mechanisms underlying the initiation of parturition in the human remain poorly understood.

Parvicellular neurons

These are small in size and have projections that terminate in the median eminence, brain stem, and spinal cord. They release small amounts of releasing or inhibiting neurohormones (hypophysiotrophic hormones) that control anterior pituitary function. These are transported in the long portal veins to the anterior pituitary where they stimulate the release of pituitary hormones into the systemic circulation. The neuropeptides released from the parvicellular neuron terminals in the median eminence (corticotropin-releasing hormone, growth hormone–releasing hormone, thyrotropin-releasing hormone, dopamine, luteinizing hormone–releasing hormone, and somatostatin) control anterior pituitary function.

Pelvic inflammatory disease (PID)

PID is bacterial infection of the female pelvic organs, usually with *Chlamydia* or *Neisseria*. It often results in sterility and may require surgical removal of infected uterine tubes or other organs.

Penis

The penis is a tubular organ for sexual intercourse and conducting urine to the exterior. The penis is the main external genital organ and is divided into three portions, which in a proximal to distal order are named the root, body and free portion, or glans. Structurally the penis is built of three erectile components, two corpa cavernosum and one corpus spongiosus.

The root of penis is the fixed portion that attaches the penis to the body wall. It includes left crus of penis, right crus of penis, and the bulb of penis. This connection occurs immediately inferior to the pubic symphysis. The body of penis (shaft) is the tubular,

movable portion of the organ. The glans penis (head) is the expanded distal end that surrounds the external urethral orifice. The neck of glans is the narrow portion of the penis between the body and the glans penis.

Pelvic cavity

The space enclosed by the true (lesser) pelvis, containing the urinary bladder, rectum, and internal reproductive organs.

Peptide

Any chain of two or more amino acids.

Peptide bond

A group of four covalently bonded atoms (a –C=O group bonded to an –NH group) that links two amino acids in a protein or other peptide.

Perimetrium

The uterine wall consists of an external serosa called the perimetrium.

Perineum

The region between the thighs bordered by the coccoccyx, pubic symphysis, and ischial tuberosities; contains the orifices of the urinary, reproductive, and digestive systems.

Peristalsis (Gr. *peristaltikos*= compressing around))

A wave of constriction traveling along a tubular organ such as the esophagus or ureter, serving to propel its contents.

Peritoneum (Gr. *peritonaios*= stretched around)

A serous membrane that lines the peritoneal cavity of the abdomen and covers the mesenteries and viscera.

Permissive effects

In this condition, one hormone enhances the target organ's response to a second hormone that is secreted later. Estrogen stimulates the up-regulation of progesterone receptors in the uterus. The uterus would respond poorly to progesterone, if at all, had it not been primed by the first hormone. Estrogen thus has a permissive effect on progesterone action.

Phagocytosis

The term means "cell eating" and applies to endocytosis when solid

particles are ingested. A part of the cell membrane extends around a particle and fuses so that the particle is surrounded by the membrane. That part of the membrane then "pinches off" to form a vesicle containing the particle. The vesicle is within the cytoplasm of the cell, and the cell membrane is left intact. White blood cells and some other cell types phagocytize bacteria, cell debris, and foreign particles. Phagocytosis is an important means by which white blood cells take up and destroy harmful substances that have entered the body.

Phenotype (Gr. *phainein,* to show)

1. The visible or expressed characteristics of an organism, influenced by the genotype, although not all genes in the genotype are expressed.

2. Chemical signals that are released into the environment, usually by glands, and travel through the air or water to sensory cells in another animal. Such signals are used for sexual activity (such as signaling of readiness to mate), marking of territories, and other behaviors related to interactions among individuals of a species.

Pheochromocytomas

Pheochromocytomas are catecholamine-secreting tumors that arise from chromaffin cells. Although the majority (90%) occur in the adrenal gland, these tumors can also be found outside of the adrenal, primarily at the base of the bladder and at the aortic bifurcation (organ of Zuckerkandl). Of all cases, 10% are bilateral and 10% are malignant.

Pheromone (Gr. *pherein*= to carry, + *hormone*= exciting, stirring up) Chemical substance released by one organism that influences the behavior or physiological processes of another organism.

Phospholipid

An amphiphilic molecule composed of two fatty acids and a phosphate-containing group bonded to the three carbons of a glycerol molecule; composes most of the molecules of the plasma membrane and other cellular membranes.

Phosphorylation

Addition of an inorganic phosphate (Pi) group to an organic molecule.

Phylogeny (Gr. *phylon*= tribe, race, + *geneia*= origin)

The origin and diversification of any taxon, or the evolutionary history of its origin and diversification, usually presented in the form of a dendrogram.

Physiology (L. *physiologia*= natural science)

A branch of biology covering the organic processes and phenomena of an organism or any of its parts or of a particular bodily process.

Pineal gland (L. *pineas)*

1. The pineal gland is a pea-sized gland located deep within the brain, in the roof of the third ventricle. Its name derives from the fact that it is shaped like a small pine cone. More than 200 million years ago the pineal gland of our ancestors was a photosensitive area, or "third eye," located near the skin's surface. Although it is now shielded from light by the skull, it still retains its photosensitivity because it receives input indirectly from the eyes via the optic nerve and nerve pathways in the brain. The pineal secretes the hormone melatonin (not to be confused with the skin pigment, melanin) in a cyclic manner, coupled to the daily cycle of light and dark. Melatonin is sometimes called the "hormone of darkness" because its rate of secretion rises nearly 10-fold at night and then falls again during daylight. Its secretion appears to be regulated by the absence or presence of visual cues. During the day, nerve impulses from the retina inhibit its release. Also known as pineal body or epiphysis.

2. The pineal gland is a small unpaired organ located near the geometric center of the brain. The pineal gland, or epiphysis cerebri, a neuroendocrine organ, is one of the major parts of the circadian system, which also includes the eyes and the suprachiasmatic nuclei of the hypothalamus. The pineal gland exerts important regulatory influences by secreting its hormone, melatonin, in variable amounts, depending on the time of day; the animal's age; and, in some species, the time of year. The daily rhythm in circulating melatonin is characterized by very low concentrations during the day and high levels at night. This rhythm persists in constant darkness but can be altered by nighttime light exposure, because light can acutely suppress melatonin production. Normal daily variations in melatonin secretion synchronize numerous body

rhythms and, in diurnal species, probably are important for nighttime sleep initiation and maintenance. Since the onset and offset of melatonin production by the pineal gland occur at dusk and dawn, respectively, the length of time per 24 hour period that plasma melatonin levels are elevated can synchronize physiologic processes to seasonal changes and, in seasonal animals, can affect season-dependent functions such as body temperature, locomotor activity, and reproductive behavior.

Embryologically, the pineal organ arises as an evagination of the roof of the diencephalon. The diencephalon also gives rise to the lateral eyes and to the hypothalamus. This common embryologic origin is reflected in a common physiologic property—the capacity to respond to cyclic changes in environmental illumination.

Pinocytosis (Gr. *pinein*= to drink, + *kytos*= hollow vessel, + o*sis*= condition)

Fluid acquisition by a cell in which specific receptors bind ions/ molecules present on plasma membranes, which are invaginated and pinch off to form small vesicles. This means "cell drinking." It is distinguished from phagocytosis in that much smaller vesicles are formed, they contain liquid rather than particles, and the cell membrane invaginates to form the vesicles that are taken into the cell. Pinocytosis is a common transport mechanism and occurs in certain kidney cells, epithelial cells of the intestine, liver cells, and cells that line capillaries.

Pituitary gland

The pituitary gland, situated in a depression on the upper surface of the sphenoid bone, the sella turcica. It is composed of anatomically and functionally distinct entities: the adenohypophysis, including the intermediate and anterior lobes, and the neurohypohysis, which is also called the posterior lobe. Functional anterior pituitary contains five main cell types: somatotrope cells produce growth hormone (GH) and regulate linear growth and metabolism; lactotrope cells produce prolactin (PRL), which regulates milk production in females; thyrotrope cells produce thyroid-stimulating hormone (TSH), which controls the secretion of thyroid hormone from the thyroid gland; gonadotrope cells produce gonadotropins [follicle-stimulating hormone (FSH) and

luteinizing hormone (LH)], which regulate reproductive development and function; and corticotrope cells produce adrenocorticotropic hormone (ACTH), a product of precursor proopiomelanocortin (POMC) cleaved by proteolytic processing, which regulates metabolic function through stimulation of glucocorticoid synthesis in the adrenal cortex; also termed hypophysis.

The pituitary has two anatomically and functionally distinct lobes, the posterior pituitary and the anterior pituitary. The posterior pituitary, being derived embryonically from an outgrowth of the brain, consists of nervous tissue from the hypothalamus and thus is also termed the neurohypophysis. The anterior pituitary, in contrast, consists of glandular epithelial tissue derived embryonically from an outpouching of ectoderm that buds off from the roof of the mouth. Accordingly, the anterior pituitary is also known as the adenohypophysis (adeno, "glandular"). The anterior pituitary consists of the pars distalis (PD) (main body of the pituitary gland) and the pars tuberalis (PT), which forms the stalk of the pituitary gland immediately adjacent to the base of the brain. The posterior pituitary is connected to the hypothalamus by a neural pathway, whereas the anterior pituitary is connected to the hypothalamus by a vascular link.

Placenta

The placenta is a temporary organ that is formed when the developing embryo, now called a blastocyst, attaches to and implants in the endometrium of the uterus. The placenta consists of a fetal portion, formed by the chorionic plate and its branching chorionic villi, and a maternal portion, formed by the decidua basalis of the endometrium. Fetal and maternal blood comes into close proximity in the villi of the placenta. Exchange of nutrients, electrolytes, hormones, antibodies, gaseous products, and waste metabolites takes place as the blood passes over the villi. Fetal blood enters the placenta through a pair of umbilical arteries, passes into the villi, and returns through a single umbilical vein.

The placenta is an organ that performs an important function in regulating the exchange of different substances between the maternal and fetal circulation during pregnancy. One side of the placenta is attached to the uterine

wall, and on the other side it is attached to the fetus via the umbilical cord. Maternal blood enters the placenta through blood vessels located in the endometrium and is directed to the intervillous spaces, where it bathes the surface of the villi, which contain the fetal blood. Here, metabolic waste products, carbon dioxide, hormones, and water are passed from the fetal circulation to the maternal circulation. Oxygen, nutrients, vitamins, electrolytes, hormones, immunoglobulins (antibodies), metabolites, and other substances pass in the opposite direction. Maternal blood leaves the intervillous spaces through the endometrial veins.

The placenta also serves as a temporary—yet major—endocrine organ that produces numerous essential hormones for the maintenance of pregnancy. Placental cells (syncytial trophoblasts) secrete the hormone chorionic gonadotropin shortly after implantation of the fertilized ovum. In humans, chorionic gonadotropin appears in urine within 10 days of pregnancy, and its presence can be used to determine pregnancy with commercial kits. Chorionic gonadotropin hormone is similar to luteinizing hormone (LH) in structure and function, and it maintains the corpus luteum in the maternal ovary during the early stages of pregnancy. Chorionic gonadotropin also stimulates the corpus luteum to produce estrogen and progesterone, the two hormones that are essential for maintaining pregnancy. The placenta also secretes chorionic somatomammotropin, a glycoprotein hormone that exhibits both lactogenic and growth-promoting functions.

As pregnancy proceeds, the placenta gradually takes over production of estrogen and progesterone from the corpus luteum and produces sufficient amounts of progesterone to maintain the pregnancy until birth. The placenta also produces relaxin, a hormone that softens the fibrocartilage in the pubic symphysis to widen the pelvic canal for impending birth. In some mammals, the placenta also secretes placental lactogen, a hormone that promotes growth and development of the maternal mammary glands.

Plasma

The non-cellular portion of the blood.

Plasma membrane (Gr. *plasma*= a form, mold)

The unit membrane that encloses a cell and controls the traffic of molecules in and out of the cell.

Plasmalemma (Gr. *plasma*= a form, mold, + *lemma*= rind, sheath)

The cell membrane or plasma membrane.

Pleiotropy (Gr. *pleiōn,* more, + *tropos*, to turn)

Pertaining to a gene producing more than one effect.

Plexus

A network of blood vessels, lymphatic vessels, or nerves, such as a choroid plexus of the brain or brachial plexus of nerves.

Pluripotent stem cell (PPSC)

1. A cell of the inner cell mass of a blastocyst that is capable of developing into any type of embryonic cell, but not into cells of the accessory organs of pregnancy.

2. A hemopoietic stem cell of the red bone marrow that can give rise, through a series of intermediate cells, to leukocytes, erythrocytes, platelets, and various kinds of macrophages.

Polar body

The smaller cells which divides off from the developing ovum as it goes through meiosis. Each meiotic division in the egg is asymmetric, resulting in a large cell that will continue on to become the mature ovum and a small polar body, which is eventually sloughed.

Polyandry (Gr. *polys*= many, + a*ner*= man)

Condition of having more than one male mate at one time.

Polycystic ovarian syndrome (PCOS)

Chronically anovulatory women with high circulating androgen, estrogen, and LH levels often have the disorder called polycystic ovarian syndrome (PCOS). This syndrome may be caused by any of a broad array of underlying problems, and PCOS accounts for 75% of anovulatory infertility. Currently, the diagnosis of PCOS requires two of the following three conditions: amenorrhea, evidence of excessive androgen secretion (i.e., acne, hirsutism), and polycystic ovaries, as usually detected by sonogram. The ovarian cysts represent large antral follicles that have failed to

ovulate and luteinize. The continuous gonadotropin secretion leads to ovarian enlargement, and the ovaries typically show a thickened capsule and numerous follicles, many of which are undergoing atresia. FSH levels are low, which inhibits granulosa cell function, and the high intrafollicular androgen level inhibits follicular maturation. A significant proportion of the circulating estrogen, present in high levels, is estrone formed from peripheral aromatization of androstenedione. These high androgen levels can produce hirsutism and acne. Hirsutism is the abnormal formation of coarse sexual hair in regions atypical for a woman, such as the face, back, and chest.

Polyembryony

Asexual proliferation of a single fertilized egg to produce many embryos.

Polygamy (Gr. *polys*= many, + g*amos*= marriage)

Condition of having more than one mate at a time.

Polygyny (Gr. *polys*= many, + *gyne*= woman)

Condition of having more than one female mate at one time.

Polymer (Gr. *polys*= *many*, + *meros*= part).

A molecule that consists of a long chain of identical or similar subunits (called monomers), such as protein, DNA, or starch.

Polypeptide (Gr. *polys*= many, + *peptein*= to digest)

Any chain of more than 10 or 15 amino acids.

Polyploidy (Gr. *polys*= many, + *ploidy*= number of chromosomes)

An organism possessing more than two full homologous sets of chromosomes.

Polysaccharide (Gr. *polys*= many, + *sakcharon*= sugar, from Sanskrit *sarkar*a= gravel, sugar)

A polymer of simple sugars; for example, glycogen, starch, and cellulose.

Polyspermy (Gr. *polys*= many, + *sperma*= seed)

Entrance of more than one sperm during fertilization of an egg.

Polytene chromosomes (Gr. *polys*= many, + *tainia*= band)

Chromosomes in some somatic cells of some insects in which the chromatin replicates repeatedly without undergoing mitosis.

Portal system (L. *porta*= gate)

Circulatory structure in which a capillary bed drains into another capillary bed through veins; for example, hepatic portal and renal portal systems in vertebrates.

Polyuria

Excessive output of urine.

Posterior (L. latter)

Near or pertaining to the back or spinal side of the body; dorsal.

Postnatal development

The development of an individual continues even after birth up to age of 25 years. This period of development is termed pre-embryo A developing individual from the time of fertilization to the time, at 16 days, when the three primary germ layers have formed..

Prader-Willi Syndrome

This is an inherited secondary hypogonadism disorder. Affected male infants may show reduced muscle tone at birth. Some of the distinguishing features of Prader-Willi syndrome include small testes, diminished mental capacity and obesity.

It is believed that the disorder is caused by a defective mechanism of GnRH secretion by the hypothalamus.

Preimplantation genetic diagnosis (PGD)

A technique used during IVF to test embryos for genetic disorders (aneuploidy or structural chromosomal abnormalities), inheritable single gene disorders, or gender, prior to embryo transfer.

The procedure can involve evaluating the chromosomal composition of the oocyte via the extruded polar body, removing one or two blastomeres from the cleavage stage embryo, or by biopsy of the trophoectoderm of the blastocyst stage.

Premature ejaculation

A common complaint of ejaculating semen sooner than the man desires while achieving orgasm during intercourse.

An estimated 30 percent of men regularly experience the problem.

Premenstrual dysphoric disorder (PMDD)

A collection of physical and emotional symptoms that occurs 5 to 11 days before a woman's period begins, and goes away once menstruation starts. Over 150 signs and symptoms have been associated with the condition.

Premenstrual syndrome (PMS)

PMS is a group of symptoms often associated with the premenstrual period, including food cravings, mood swings, anxiety, back and joint pain, water retention, and headaches. It generally develops in the second half of the cycle, after ovulation, and lasts until menstruation begins. Exercise and medications that reduce pain and water retention can help.

Prenatal development

The whole period of development from fertilization to birth.

Preprohormones

Large precursor proteins that undergo a series of posttranslational modifications to yield the biologically active hormone end product. Peptide hormones are often synthesized as large, inactive polypeptides called preprohormones. Preprohormones contain not only one or more copies of a peptide hormone or hormones, but also a signal sequence that targets the polypeptide for secretion. The signal sequence is cleaved from the preprohormone prior to being packaged into secretory vesicles, forming the prohormone, which like the preprohormone is usually inactive. The secretory vesicle contains proteolytic enzymes that cut the prohormone into the active hormone or hormones. The signaling cell then releases the active peptide hormone by exocytosis.

P

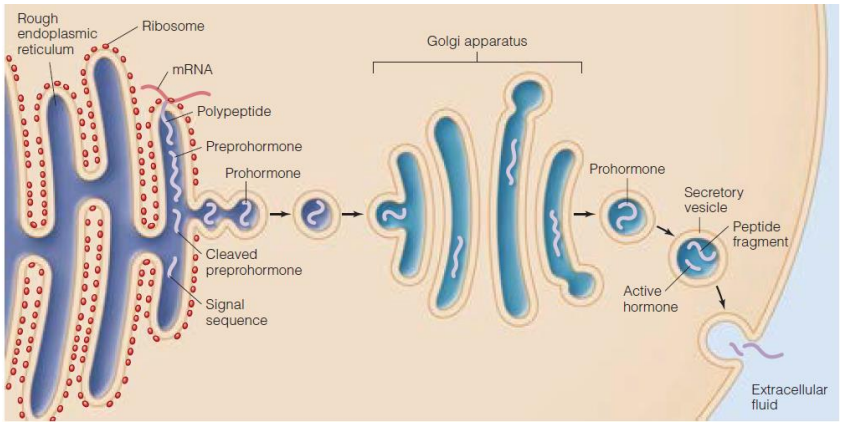

Figure 1 preprohormone and its processing

Primary follicles

In a mammalian ovary, the follicle as it begins to grow. Primary follicles are characterized by the initiation of follicular growth, by a change in the shape of granulosa cells, from flat cells they become cubic, the increase in the size of the oocyte and the formation of the zona pellucida.

The primary follicles is characterized by an oocyte surrounded by one layer of cubic granulosa cells and the basal lamina. Blood vessels are present only in the surrounding connective tissue and do not penetrate through the basal lamina.

Primary germ layers

The ectoderm, mesoderm, and endoderm; the three tissue layers of an early embryo from which all later tissues and organs arise.

Primary oocyte

It is a developing ovum in the primary gonocyte stage, a stage during which the cell is growing and not dividing. At the end of this stage, the cell enters the first meiotic division.

Primary spermatocyte

It refers to the developing sperm in the primary gonial stage, a stage during which the cell is growing and not dividing. At the end of this

stage, the cell enters the first meiotic division.

Primordial follicle

In a mammalian ovary, a follicle that consists of a primary oocyte, get arrested in its first meiotic division, and is surrounded by a single layer of squamous follicular cells. It is the first stage in follicular development.

Primordial germ cells (PGCs)

1. They are the bipotential ancestors of the germ line. These cells can differentiate to either spermatozoa or oocytes.

2. The early population of cells, that gives rise to the germ cells. These are typically identifiable early in development.

3. An undifferentiated precursor germ cell that is set aside from other cells in the developing embryo and that expresses a germ-cell–specific gene profile. Primordial germ cells give rise to oogonia or spermatogonia, depending on the sex of embryo.

Primordium (L. *Primus* = first + *ordior* = to begin)

Beginning or first discernible indication of an organ or structure.

Proestrous

This is follicular phase or the stage when the follicles are ripening.

Progenitor cell

A mitotic cell that is not capable of indefinite self-renewal and that will produce a limited repertoire of cell types.

Progesterone (L. *pro= before*, + *gestare*= to carry)

1. Mammalian steroid hormone secreted by the corpus luteum and the placenta; prepares the uterus for the fertilized egg and maintains the capacity of the uterus to hold the embryo and fetus.

2. Progesterone is a luteal hormone which is synthesized by corpus luteum, adrenal cortex, placenta and the testis. It is, strictly speaking, a pregnancy hormone which acts on genital tissues and induces proper functioning of breast. The hormone has an anti-estrogenic effect and blocks the continued growth of endometrium produced by estrogen. When progesterone begins to act, thickening of the endometrium stops and the endometrial tissue becomes secretory. In case the pregnancy is

established, the progesterone levels decrease and corpus luteum is maintained. However, if fertilization does not occur, the estrogens and progesterone are suddenly decreased at the commencement of the next menstrual cycle.

Prohormone (Gr. *pro*= before, + *hormaein*= *to* excite)

Prohormones are hormone precursors. They tend to be large molecules, often peptides, that are cleaved to form hormones, or molecules which are in other ways modified to form hormones. The best-described prohormone is pro-opiomelanocortin (POMC), a giant peptide molecule which, when split into different segments, produces a number of different hormones. One segment of the prohormone becomes β-lipotropin, which in turn is the prohormone for the endogenous opioid, β-endorphin. β-endorphin functions both as a hormone and a neurotransmitter. Other segments of POMC are cleaved to produce the pituitary hormones melanocyte-stimulating hormone (MSH) and adrenocorticotropic hormone (ACTH).

Prolactin (PRL)

PRL was identified as a pituitary factor that stimulated lactation, and it was then the first pituitary hormone to be biochemically identified and purified. Prolactin is a 198-amino-acid polypeptide hormone synthesized and secreted by lactotrophs, which are acidophilic cells, in the anterior pituitary gland. The lactotrophs account for approximately 15%–20% of the cell population of the anterior pituitary gland. However, this percentage increases dramatically in response to elevated estrogen levels, particularly during pregnancy. Prolactin levels are higher in females than in males, and the role of prolactin in male physiology is not completely understood. Plasma concentrations of prolactin are highest during sleep and lowest during the waking hours in humans. The predominant mammalian actions of PRL are stimulation of lactation, inhibition of reproductive function, and support of maternal behavior. The main physiologic effects of prolactin are stimulation of growth and development of the mammary gland, synthesis of milk, and maintenance of milk secretion. Prolactin stimulates glucose and amino acid uptake and synthesis of the milk proteins β-casein and α-lactalbumin, the milk sugar lactose, and milk fats by the mammary epithelial cells.

Proliferative phase

Also known as preovulatory or follicular phase is characterized by rapid growth and development of the endometrium. The resurfacing and growth of the endometrium during the proliferative phase closely coincides with the rapid growth of ovarian follicles and their increased production of estrogen. This phase starts at the end of the menstrual phase, or about day 5, and continues to about day 14 of the cycle. Increased mitotic activity of the lamina propria and in remnants of the uterine glands in the basalis layer of the endometrium produces new cells that begin to cover the raw surface of the uterine mucosa that was denuded or shed during menstruation. The resurfacing of the mucosa produces a new functionalis layer of the endometrium. As the functionalis layer thickens, the uterine glands proliferate, lengthen, and become closely packed. The spiral arteries begin to grow toward the endometrial surface and begin to show light coiling.

Proopiomelanocortin (POMC)

POMC is a precursor pro-hormone produced by the corticotrophs of the anterior pituitary. The production and secretion of POMC-derived hormones from the anterior pituitary are regulated predominantly by corticotropin-releasing hormone (CRH) produced in the hypothalamus and released in the median eminence. POMC is post-translationally cleaved to ACTH; β-endorphin, an endogenous opioid peptide; and α-, β-, and γ-melanocyte-stimulating hormones (MSHs). The biologic effects of POMC-derived peptides are largely mediated through melanocortin receptors (MCRs).

Prostaglandin

An eicosanoid with a five-sided carbon ring in the middle of a hydrocarbon chain, playing a variety of roles in inflammation, neurotransmission, vasomotion, reproduction, and metabolism.

Prostaglandins are an important class of biological compounds and by far the most important group of physiologically active substances. The prostaglandins comprise a family of lipid acids which exhibit highly potent and manifold effects in biological systems. The name "Prostaglandin" was given by von Euler in 1935 to a principal compound found in human seminal plasma and vesicular

glands of sheep which induced contractions in isolated smooth muscle preparations. The prostaglandins are known to occur widely in almost all kinds of tissues, in very small quantities (nanogram to micrograms) and they have been identified from a great number of human tissues, such as seminal plasma, menstrual fluid, lungs, etc.

Prostaglandins are derivatives of a hypothetical C_{20} saturated fatty acid called prostanoic acid. It consists of a 5-carbon ring with two hydrocarbon chains attached to two neighbouring carbon atoms. All natural prostaglandins contain a hydroxyl group at C-13 and a trans double bond at C-13-14. Naturally occurring prostaglandins are of 4 types: PGE, PGF, PFA and PGB types.

Protamines

They are the most abundant sperm nuclear proteins in many species and are involved in packaging the paternal genome. Protamines were discovered and named by Friedrich Miescher more than a century ago. Miescher identified a nitrogenous base from the sperm of salmon that he called protamine and found that this base was coupled to what he called nuclein, which later was to become known as DNA.

Prostate gland

The name 'prostate' is originally derived from a Greek word 'prohistani' (means 'to stand in front of'). The prostate is the largest accessory sex gland of males. A male pyramidal fibromuscular reproductive gland that encircles the urethra immediately inferior to the bladder and contributes to the semen.

The prostate gland is a chestnut-shaped organ located directly beneath the bladder in the male. The gland surrounds the urethra, the duct that serves for the passage of both urine and semen.

Protandrous (Gr. *protos*= first, + a*ner*= male)

Condition of hermaphroditic animals and plants in which male organs and their products appear before the corresponding female organs and products, thus preventing self-fertilization.

Protein (Gr. *protein*= from *proteios*= primary)

A large polypeptide; while criteria for a protein are somewhat subjective and variable,

polypeptides over 50 amino acids long are generally classified as proteins.

Protein or Peptide Hormones

Protein or peptide hormones constitute the majority of hormones. These are molecules ranging from 3 to 200 amino acid residues. They are synthesized as preprohormones and undergo post-translational processing. They are stored in secretory granules before being released by exocytosis, in a manner reminiscent of how neurotransmitters are released from nerve terminals.

Examples of peptide hormones include insulin, glucagon, and adrenocorticotropic hormone (ACTH). Some hormones in this category, such as the gonadotropic hormone, luteinizing hormone, and follicle-stimulating hormone, together with thyroid-stimulating hormone (TSH) and human chorionic gonadotropin, contain carbohydrate moieties, leading to their designation as glycoproteins.

proteoglycan

A large molecule composed of a bristle-like arrangement of glycosaminoglycans surrounding a protein core in a shape resembling a bottle brush. Binds cells to extracellular materials and gives the tissue fluid a gelatinous consistency.

Prothoracic glands

1. Glands that secrete the hormone ecdysone, or molting hormone, in the prothorax of insects. 2. One of the paired gland in the prothorax of insects, which is the source for ecdysone, which is the prohormone precursor of 20-hydroxyecdysone, the active molting hormone. See: corpora allata.

Prothoracicotropic hormone (PTTH)

1. Hormone secreted by the brain of insects that stimulates the prothoracic gland to secrete ecdysone, or molting hormone.

2. PTTH is a neurohormone secreted by the neurosecretory cell of insect brain. It is peptide in nature: consists of 109 amino acids, with a molecular weight of 40 kDa. PTTH when triggered induces the synthesis and release of ecdysone from the prothoracic gland situated near the brain.

Proximal (L. *proximus*= nearest)

Relatively near a point of origin or

attachment; for example, the shoulder is proximal to the elbow.

Pseudopod

A temporary cytoplasmic extension of a cell used for locomotion (ameboid movement) and phagocytosis.

Pubarche

The appearance of pubic and axillary hair, sebaceous glands, and axillary glands. Androgens from the ovaries and adrenal cortex stimulate pubarche as well as the libido.

Puberty

It is the stage or period of life when a child transforms into an adult normally capable of procreation. The timing of puberty varies from person to person and from country to country owing to genetic, environmental, and other factors but usually occurs between ages 11 and 16. In puberty both girls and boys experience a swift increase in body size, a change in shape and composition of the body, and a rapid development of the reproductive organs and other characteristics marking sexual maturity.

Puberty is the physiologic transition between childhood and adulthood and involves the development of secondary sexual characteristics and the pubertal growth spurt. The process takes place over a period of approximately 4 years. Puberty is triggered by increased pulsatile secretion of GnRH by the hypothalamus, leading to increases in serum gonadotropins and, thus, to increases in gonadal secretion of sex steroids. The hypothalamic-pituitary-gonadal system is active during the neonatal period but enters a dormant state in the juvenile, prepubertal period. During the initial phase of puberty, plasma levels of LH increase primarily during sleep. These sleep-associated surges are later present throughout the day and mediate or result in an increase in circulating testosterone levels.

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R

Radioimmunoassay

It is the prototype technique used for determining the hormone concentration. This technique is based on the principle of competitive binding, and requires an antibody that specifically binds to the hormone plus radioactively labeled hormone. Radioactive hormone is incubated with limiting amounts of antibody, and a standard curve is prepared by adding known amounts of unlabeled hormone to displace radioactive hormone. The standard curve provides the relationship between the radioactivity remaining and the unlabeled hormone concentration; as more unlabeled hormone is added, less radioactivity remains. The standard curve is used to determine the hormone concentrations in plasma samples; there is less radioactivity remaining when a sample contains a large hormone concentration.

Rathke's pouch

In humans, the anterior lobe of the pituitary gland originates from an invagination of the stomodeal epithelium dorsally, termed Rathke's pouch.

Reactive Oxygen Species

The term reactive oxygen species (ROS) covers a wide range of metabolites derived from the reduction of molecular oxygen, including free radicals, such as the superoxide anion ($O2^{-\bullet}$) and powerful oxidants such as hydrogen peroxide (H_2O_2).

The term also covers molecules derived from the reaction of carbon-centered radicals with oxygen including peroxyl radicals ($ROO^{\bullet}$), alkoxyl radicals ($RO^{\bullet}$), and organic hydroperoxides (ROOH).

It may also refer to other powerful oxidants such as peroxynitrite ($ONOO^-$) or hypochlorous acid (HOCl), as well as the highly biologically active free radical, nitric oxide ($NO^{\bullet}$).

Receptor

1. A cell or organ specialized to detect a stimulus, such as a taste cell or the eye. **2.** A protein molecule that binds and responds to a chemical such as a hormone, neurotransmitter, or odor molecule.

Receptor-mediated endocytosis

A process in which certain molecules in the extracellular fluid bind to receptors in the plasma membrane, these receptors gather together, the membrane sinks inward at that point, and the molecules become incorporated into vesicles in the cytoplasm.

Reduction

1. A chemical reaction in which one or more electrons are added to a molecule, raising its free energy content; opposite of oxidation and always linked to an oxidation reaction. **2.** Treatment of a fracture by restoring the broken parts of a bone to their proper alignment.

Reflex

A stereotyped, automatic, involuntary response to a stimulus; includes somatic reflexes, in which the effectors are skeletal muscles, and visceral (autonomic) reflexes, in which the effectors are usually visceral muscle, cardiac muscle, or glands.

Reflex arc

A simple neural pathway that mediates a reflex; involves a receptor, an afferent nerve fiber, sometimes one or more interneurons, an efferent nerve fiber, and an effector.

Regeneration

Replacement of damaged tissue with new tissue of the original type.

Releasing hormones

The hypothalamus contains groups of neurosecretory cells, which are specialized nerve cells that manufacture neurohormones. Those that regulate the anterior pituitary are called releasing hormones or release-inhibiting hormones (or "factors").

Renin (L. *ren*= kidney)

An enzyme secreted by the kidney juxtaglomerular apparatus in response to hypotension; converts the plasma protein angiotensinogen to angiotensin I, leading indirectly to a rise in blood pressure.

Renin-angiotensin-aldosterone system (RAAS)

A decrease in the effective circulating blood volume triggers the release of renin from the juxtaglomerular apparatus in the kidney. Renin cleaves angiotensinogen, the hepatic

precursor of angiotensin peptides, to form angiotensin I. Angiotensin I is converted to angiotensin II by angiotensin-converting enzyme (ACE), which is bound to the membrane of vascular endothelial cells.

Angiotensin II is a potent vasoconstrictor and stimulates the production of aldosterone in the zona glomerulosa of the adrenal cortex. Aldosterone production is also stimulated by potassium, ACTH, norepinephrine, and endothelins.

Rennin (M.E. *renne*= to run).

A milk clotting endopeptidase secreted by the stomach of some young mammals, including bovine calves and human infants.

Residual bodies

In mammalian sperm development, the excess cytoplasm that is pinched off from the developing sperm during spermiogenesis is known as residual body.

Rete testis

The seminiferous tubules empty into a highly convoluted anastomotic network of ducts called the rete testis

Rostral

Relatively close to the forehead, especially in reference to structures of the brain and spinal cord; for example, the frontal lobe is rostral to the parietal lobe.

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S

Sagittal plane (L. *sagittal*= arrow)

1. Any plane that extends from anterior to posterior and cephalic to caudal and that divides the body into right and left portions.

2. Refer to the plane that divides the body or an organ vertically into right and left sides. If this vertical plane runs directly down the middle of the body, it is called the midsagittal or median plane. If it divides the body into unequal right and left sides, it is called a parasagittal plane or less commonly a longitudinal section.

Scrotum (L. bag).

The scrotum is a pendulous pouch of skin, muscle, and fibrous connective tissue, containing the testes in most mammals.

Second messenger

A chemical that is produced within a cell (such as cAMP) or that enters a cell (such as calcium ions) in response to the binding of a messenger to a membrane receptor, and that triggers a metabolic reaction in the cell.

Secondary active transport

A mechanism in which solutes are moved through a plasma membrane by a carrier that does not itself use ATP but depends on a concentration gradient established by an active transport pump elsewhere in the cell.

Secondary follicle

Secondary follicles are characterized by two or more layers of granulosa cells and no antrum. This is a period of intense oocyte growth and rapid proliferation of granulosa cells. During this stage the differentiation of thecal cells takes place. Some of the cells of the connective tissue become arranged parallel to the basal lamina. The cells located closer to the basal lamina give rise to the internal theca and the remaining cells form the external theca. This differentiation begins when the follicle has three layers of granulosa cells. The oocytes in secondary follicles increase their volume and their cytoplasmic organization becomes more complex, due to the synthesis of new RNAs, proteins, glycogen and lipids, as well as increase in

the number of ribosomes, mitochondria and other organelles. One of the main changes during oocyte growth is the secretion of glycoproteins, mainly the proteins ZP1, ZP2 and ZP3, the principal constituents of the zona pellucida. The formation of the zona pellucida is essential for follicular development.

Secondary gonocyte stage

This refers to the developmental stage of germ cells following the first meiotic division. The cell at this stage is haploid. Each of its chromosomes consists of two sister chromatids. At the end of this stage, the cell enters the second meiotic division.

Secondary oocyte

A developing ovum in the secondary gonocyte stage is called as secondary oocyte. A secondary oocyte is haploid in nature. Each of its chromosomes consists of two sister chromatids.

The first meiotic division divides the primary oocyte asymmetrically, producing one secondary oocyte and one tiny polar body. At the end of this stage, the secondary oocyte enters the second meiotic division.

Secondary spermatocyte

Refers to the developing sperm in the secondary gonocyte stage. The cell at this stage is haploid. Each of its chromosomes consists of two sister chromatids. The first meiotic division divides the primary spermatocyte symmetrically, producing two secondary spermatocytes. At the end of this stage, the secondary spermatocyte enters the second meiotic division.

Secretin

Secretin, a 27–amino acid peptide, is structurally homologous to glucagon and is a member of the secretin-glucagon family.

Secretin is secreted by the S cells (secretin cells) of the duodenum in response to H^+ and fatty acids in the lumen of the small intestine. Thus, secretion of secretin is initiated when the acidic gastric contents (pH < 4.5) arrive in the small intestine.

The function of secretin is to promote the secretion of pancreatic and biliary HCO_3^-, which then neutralizes H^+ in the lumen of the small intestine. Neutralization of H^+ is essential for fat digestion; pancreatic lipases have pH optimums

between 6 and 8, and they are inactivated or denatured when the pH is less than 3. Secretin also inhibits the effects of gastrin on the parietal cells (H^+ secretion and growth).

Secretion

1. A chemical released by a cell to serve a physiological function, such as a hormone or digestive enzyme. **2.** The process of releasing such a chemical, often by exocytosis.

Secretory phase

Also called as the postovulatory or luteal phase begins shortly after ovulation on about day 15 and continues to about day 28 of the cycle. This phase is dependent on the functional corpus luteum that was formed after ovulation and the secretion of progesterone and estrogen by the lutein cells (granulosa lutein and theca lutein cells). During the postovulatory phase, the endometrium thickens and accumulates fluid, becoming edematous. In addition, the uterine glands undergo hypertrophy and become tortuous, and their lumina become filled with secretions rich in nutrients, especially glycoproteins and glycogen. The spiral arteries in the endometrium also lengthen, become more coiled, and extend almost to the surface of the endometrium.

Semen

Semen is a combination of sperms and fluids from the seminal vesicles, prostate and the bulbourethral glands. It provides a watery environment in which the sperms can swim and supplies nutrients for the sperm cells. A recognised function of the seminal fluid or plasma is its buffering effect on the acidic vaginal environment to protect the sperms. The major volume of the seminal fluid comes from the seminal vesicles (65 % on an average) and secondarily from the prostate and the bulbourethral glands of Cowper (30%).

Sella turcica

A bony cavity at the base of the brain; it is a saddlelike structure of the sphenoid bone.

Seminal Vesicles

1.The seminal vesicles (accessory sex organ) are two structures, lying between the rectum and the base of the bladder. Their secretions form the bulk of semen. Essentially, each vesicle consists of a much-coiled tube with numerous diverticula or

outpouches that extend from the main tube, the whole being held together by connective tissue. At its lower end the tube is constricted to form a straight duct or tube that joins with the corresponding ductus deferens to form the ejaculatory duct.

2. The seminal vesicles are a pair of glands posterior to the urinary bladder; one is associated with each ductus deferens. It has a connective tissue capsule and underlying layer of smooth muscle. The secretory portion is a very convoluted duct with numerous branches that form a complex labyrinth. The duct empties into the ejaculatory duct. The yellowish secretion of the seminal vesicles constitutes about 60% of the semen.

Seminiferous tubules (L. *semen*= semen, + *ferre*= to bear)

1. Tubes within the testes where sperm develop and that carry the sperm from the testes to become a component of semen.

2. Seminiferous tubules are structural and functional units of testis. The seminiferous tubule is the epithelium that produces sperm. Being an epithelium, it has a free apical surface facing the lumen of the tubule, and a basal surface that sits on a basement membrane.

Senescence

Degenerative changes that occur with age

Septum (L. fence).

A wall between two cavities. pl. septa

Sertoli cells

Sertoli cells were first described by an Italian physiologist Enrico Sertoli in 1865. Sertoli cells are 'nursing' cells with their base attached to the basement membrane of the seminiferous tubule and their apex extending towards the lumen. Sertoli cells are derived from the coelomic epithelium of the genital ridge.

They are non-dividing, tall, columnar cells that extend from the basement membrane to the lumen of the tubule. The nuclei of these cells are irregularly shaped and stain lightly, making them easy to identify. Though one cannot tell from light-microscopic study, the Sertoli cells are contiguous, making an unbroken ring around the tubule. The germ cells at all stages of development sit nested in indentations of the

Sertoli cells, a fact implying that the Sertoli cells function to support and nourish the germ cells throughout their development. Sertoli cells are also responsible for the translocation of the developing sperm toward the lumen and their eventual release. One of their truly significant functions is to create the blood-testis barrier. The developing sperm are isolated from any immune response as long as they are within the seminiferous tubules, since no immunoglobulins can pass this blood-testis barrier.

Serosa (L. *serum*= serum).) *See* serous membrane.

Serotonin (L. *serum*= serum)

A phenolic amine serving as a neurotransmitter in the central nervous system; also occurs in the serum of clotted blood and in many other tissues; 5-hydroxytryptamine.

Serous (L. *serum*= serum)

Watery, resembling serum; applied to glands, tissue, cells, fluid.

Serous fluid

A watery, low protein fluid similar to blood serum, formed as a filtrate of the blood or tissue fluid or as a secretion of serous gland cells; moistens the serous membranes.

Serous membrane

A membrane such as the peritoneum, pleura, or pericardium that lines a body cavity or covers the external surfaces of the viscera; composed of a simple squamous mesothelium and a thin layer of areolar connective tissue.

Sex chromosomes

The X and Y chromosomes, which determine the sex of an individual.

Sexually transmitted diseases (STDs)

STDs are a class of infectious diseases spread by intimate sexual contact between individuals. These diseases include the major venereal diseases such as nongonococcal urethritis, trichomoniasis, gonorrhea, genital herpes, genital warts, syphilis, and acquired immunodeficiency syndrome (AIDS).

Shock

1. Circulatory shock, a state of

cardiac output that is insufficient to meet the body's physiological needs, with consequences ranging from fainting to death.

2 . Insulin shock, a state of severe hypoglycemia caused by administration of insulin. **3.** Spinal shock, a state of depressed or lost reflex activity inferior to a point of spinal cord injury. **4.** Electrical shock, the effect of a current of electricity passing through the body, often causing muscular spasm and cardiac arrhythmia or arrest.

Sign

An objective manifestation of illness that any observer can see, such as cyanosis or edema.

Simple epithelium

An epithelium in which all cells rest directly on the basement membrane; includes simple squamous, cuboidal, and columnar types, and pseudostratified columnar.

Skene glands

These are a pair of mucous gland, also called as paraurethral glands, homologous to the male prostate, which open into the vestibule near the external urethral orifice.

Sodium–glucose transporter (SGLT)

A symport that simultaneously transports Na^+ and glucose into a cell.

Soma (Gr. body)

The whole of an organism except the germ cells (germ plasm).

Somatic (Gr. *soma*= body)

1. Pertaining to the body as a whole. **2.** Pertaining to the skin, bones, and skeletal muscles as opposed to the viscera. **3.** Pertaining to cells other than germ cells.

Somatic cell

The term refers to a cell of diverse lineages (extra-embryonic, endoderm, mesoderm, or ectoderm) that will give rise to a differentiated cell of the soma (body) but not to germ cells.

Somatostatin

The stimulated release of GH is inhibited by somatostatin, a peptide synthesized in most brain regions, predominantly in the periventricular nucleus, arcuate

nucleus, and ventromedial nucleus of the hypothalamus.

Axons from somatostatin neurons run caudally through the hypothalamus to form a discrete pathway toward the midline that enters the median eminence.

Somatostatin is also produced in peripheral organs, including the endocrine pancreas,

where it also plays a role in the inhibition of hormone release. Somatostatin is a 14–amino acid peptide hormone produced by the δ-cells of the pancreas. Its release is stimulated by high-fat, high-carbohydrate, and particularly protein-rich meals, and is inhibited by insulin. Somatostatin has a generalized inhibitory effect on virtually all gastrointestinal and pancreatic exocrine and endocrine functions.

Somatostatin, a tetradecapeptide, has been found not only in the hypothalamus but also in the D cells of the pancreatic islets, the gastrointestinal mucosa, and the C cells (parafollicular cells) of the thyroid. The somatostatin precursor has 116 amino acids. Processing of the carboxyl terminal region of preprosomatostatin results in the generation of the tetradecapeptide somatostatin 14 and an amino terminal extended form containing 28 amino acid residues (somatostatin 28). Somatostatin 14 is the major species in the hypothalamus, whereas somatostatin 28 is found in the gut. In addition to its profound inhibitory effect on GH secretion, somatostatin also has important inhibitory influences on many other hormones, including insulin, glucagon, gastrin, secretin, and VIP.

Sperm (Gr. *Sperma* = seed)

Male germ cells (haploid) produced by male gonad (testes).

Spermatheca (Gr. *sperma*=seed, + *theke*= case)

A sac in the female reproductive organs for the reception and storage of sperm.

Spermatic cord

1. The spermatic cord, a bundle of fibrous connective tissue containing the ductus deferens (a sperm duct), blood and lymphatic vessels, and testicular nerves.

2. The spermatic cords are paired structures extending between the abdomino-pelvic cavity and the testes. Each spermatic cord begins

at the entrance to the inguinal canal (a passageway through the abdominal musculature). After passing through the inguinal canal, the spermatic cord descends into the scrotum.

Spermatid (Gr. *sperma*= seed, + *eidos*= form)

A growth stage of a male reproductive cell arising by division of a secondary spermatocyte; gives rise to a spermatozoon.

Spermatocyte (Gr. *sperma*= seed, + *kytos*= hollow vessel)

A growth stage of a male reproductive cell; gives rise to a spermatid.

Spermatocytogenesis

Spermatocytogenesis consists of the meiotic phase in which primary spermatocytes undergo meiosis I and meiosis II to give rise to haploid spermatids. This takes place in the basal compartment.

Spermatogenesis

(Gr. *sperma*= seed, + *genesis*= origin). Spermatogenesis is a highly complex temporal event during which a relatively undifferentiated diploid cell called spermatogonium slowly evolves into a highly specialized haploid cell called spermatozoon. The goal of spermatogenesis is to produce a genetically unique male gamete that can fertilize an ovum and produce offspring.

It involves a series of intricate, cellular, proliferative, and developmental phases. Spermatogenesis is initiated through the neurological axis by the hypothalamus, which

releases gonadotropin-releasing hormone, which in turn signals follicle-stimulating hormone (FSH) and luteinizing hormone (LH) to be transmitted to the reproductive tract. LH interacts with the Leydig cells to produce testosterone, and FSH interacts with the Sertoli cells that provide support and nutrition for sperm proliferation and development.

Spermatogenic cycle

The cycle of seminiferous epithelium refers to synchronous evolution of one stage of spermatogenesis to the next, or a complete, ordered series of cell associations, stages, which occur in a given segment of a seminiferous epithelium over time.

Spermatogenic wave

The wave of the seminiferous epithelium can be defined as the arrangement of the successive stages of cycle along the length of the seminiferous tubule. The progression of the spermatogenic cycle of the seminiferous epithelium is not synchronized along the length of the seminiferous tubule, but rather is distributed in distinct waves because each seminiferous tubule is a loop with both ends open to the rete testis.

Spermatogonia (Gr. *sperma*= seed, + *gone*=offspring)

Precursor of mature male reproductive cell; gives rise directly to a spermatocyte.

They are diploid cells (2n) located on the basal membrane of the seminiferous tubule, which represent the precursors of all male germ cell types. Being the only germ cells that undergo meiosis, their function and integrity is crucial for the entire process of spermatogenesis. (singular, spermatogonium).

Spermatophore (Gr. *sperma/ spermatos*= seed, + *pherein= to* bear).

Capsule or packet enclosing sperm, produced by males of several invertebrate groups and a few vertebrates.

Spermatozoa

Spermatozoa are highly specialized and condensed cells that do not grow or divide.

Spermatozoon

A sperm cell. A spermatozoon consists of a head containing the paternal material (DNA) and the tail, which provides motility. The spermatozoon is endowed with a large nucleus but lacks a large cytoplasm, which is characteristic of most body cells.

Spermiation

A mature spermatid frees itself from the Sertoli cell and enters the lumen of the tubule as a spermatozoon in a process called spermiation.

Spermiogenesis

The process by which the spermatids are transformed into mature spermatozoa is known as spermiogenesis. During this process, morphological changes occur once the process of meiosis is completed.

Spindle

1. An elongated structure that is thick in the middle and tapered at the ends (fusiform). **2.** A football-shaped complex of microtubules that guide the movement of chromosomes in mitosis and meiosis. **3.** A stretch receptor in the skeletal muscles.

Stem cell

Any undifferentiated cell that can divide and differentiate into more functionally specific cell types such as blood cells and germ cells.

Stenosis

The narrowing of a passageway such as a heart valve or uterine tube; a permanent, pathological constriction as opposed to physiological constriction of a passageway.

Steroid

1. A lipid molecule that consists of four interconnected carbon rings; cholesterol and several of its derivatives.

2. Steroids are lipophilic molecules used as chemical messengers by organisms ranging in complexity from water mold to humans. In vertebrates, steroids act on a wide range of tissues and influence many aspects of biology including sexual differentiation, reproductive physiology, osmoregulation, and intermediate metabolism. Major sites of steroid synthesis and secretion include the ovaries, testes, adrenals, and placenta. Steroid hormones are lipid molecules derived from a common cholesterol precursor (Cholestane, C27). There are four major classes of steroid hormones: progestins, androgens, estrogens, and corticoids, which contain 21, 19, 18, and 21 carbons, respectively. Steroid hormones are synthesized by dehydrogenases and cytochrome P450 enzymes, which catalyze hydroxylation and dehydroxylation-oxidation reactions.

Sterol (Gr. *stereos*= solid, + L. *ol*= from *oleum*= oil)

One of a class of organic compounds containing a molecular skeleton of four fused carbon rings; it includes cholesterol, sex hormones, adrenocortical hormones, and vitamin D.

Stimulus

A chemical or physical agent in a cell's surroundings that is capable

of creating a physiological response in the cell; especially agents detected by sensory cells, such as chemicals, light, and pressure.

Stress

1. A mechanical force applied to any part of the body; important in stimulating bone growth, for example. **2.** A condition in which any environmental influence disturbs the homeostatic equilibrium of the body and stimulates a physio logical response, especially involving the increased secretion of certain adrenal hormones.

Stroma (Gr. *stroma*= bedding)

The connective tissue framework of a gland, lymphatic organ, or certain other viscera, as opposed to the tissue (parenchyma) that performs the physiological functions of the organ.

Subcutaneous Beneath the skin.

Substrate

1. A chemical that is acted upon and changed by an enzyme. **2.** A chemical used as a source of energy, such as glucose and fatty acids.

Substrate specificity

The ability of an enzyme to bind only one substrate or a limited range of related substrates.

Symport

A cotransport protein that moves two solutes simultaneously through a plasma membrane in the same direction, such as the sodium-glucose transporter.

Symptom

A subjective manifestation of illness that only the ill person can sense, such as dizziness or nausea.

Synchronous hermaphrodite

A species which has individuals with functional ovaries and testes at the same time. Also called simultaneous hermaphrodite.

Syndrome (Gr. *syn*= with, + *dramein*= to run)

A suite of related signs and symptoms stemming from a specific pathological cause.

Synergist

A muscle that works with the agonist to contribute to the same overall action at a joint.

Synergistic

An effect in which two agents working together (such as two hormones) exert an effect that is greater than the sum of their separate effects. For example, neither follicle-stimulating hormone nor testosterone alone stimulates significant sperm production, but the two of them together stimulate production of vast numbers of sperm.

Synergistic effects

During the synergistic effects, two or more hormones act together to produce an effect that is greater than the sum of their separate effects. Neither FSH nor testosterone alone, for example, stimulates much sperm production. When they act together, however, the testes produce some 300,000 sperm per minute.

Syngamy (Gr. *syn*= with, + *gamos*= marriage)

Fertilization of one gamete with another individual gamete to form a zygote; occurs in most animals with sexual reproduction.

Synkaryon (Gr. *syn*= with, + *Karyon*= nucleus)

Zygote nucleus resulting from fusion of pronuclei.

Syphilis

It is caused by a spiral bacterium named *Treponema pallidum.*

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T

Target cell

A cell acted upon by a nerve fiber, hormone, or other chemical messenger. Each hormone acts only on certain cells. As all hormones circulate together in the same well-mixed blood, how can one hormone specifically regulate red blood cell production whereas another regulates blood calcium concentration? The answer is that each hormone acts only on a certain group of cells, called its target cells, because only the hormone's target cells have the appropriate receptor to fit it. When a hormone binds to a receptor on its target cell, a change occurs within the cell. The cell may grow, divide, or change its metabolism in some way. All other cells of the body fail to respond to the hormone because they lack the appropriate receptor. As an analogy, consider that your car is a cell, the car's ignition switch is the receptor, and the car key is the hormone. Your car key fits only your car (the "target" car) and no other. Fitting your key into the ignition and turning it causes the car to start. Gas is consumed, engine parts rotate, and heat is generated.

Target organ

The target organ contains cells that express hormone-specific receptors and that respond to hormone binding by a demonstrable biologic response.

Teratogens

Teratogens are drugs or other chemicals that can cross the placenta and cause birth defects in the developing embryo. The most famous teratogen is thalidomide, an over-the-counter drug that was given to thousands of pregnant women in the early 1960s.

The drug inhibited normal limb development and resulted in several thousand children being born, mostly in Germany and England, with severely reduced or even absent arms or legs. Thalidomide has been recently discovered effective in treating a variety of diseases, including leprosy, rheumatoid arthritis, tuberculosis, and some complications of AIDS. So although thalidomide was withdrawn from the market in the early 1960s, its return to the market for limited use is now being considered.

Teratozoospermia

It is the term used to identify abnormal sperm morphology that inhibits the ability for normal fertilization.

Tertiary follicle

Also called as early antral phase. This phase is characterized by the formation of an antrum or cavity in the follicle. The antral fluid contains steroids, proteins, electrolytes, proteoglycans, and an ultrafiltrate that forms from diffusion through the basal lamina. Other changes in this phase include further theca cell differentiation. Subpopulations of thecal interstitial cells develop within the theca interna, acquire LH receptors, and are capable of steroidogenesis. The granulosa cells, as well, begin to differentiate into distinct cell layers: the mural granulosa cells line the follicle wall and abut the basement membrane, and the cumulus cells are those adjacent to the oocyte. These two cell populations have different gene expression profiles and exhibit highly divergent behaviors during folliculogenesis, oocyte maturation, and ovulation.

Test (L. *testa*= shell) A shell or hardened outer covering.

Testes

The testes (testicles) are a pair of ovoid organs within the scrotum (combined endocrine and exocrine Glands). Testes are the principal male reproductive organs which are responsible for production of sperm and hormones required for development and maintenance of male sexual characteristics.

Testicular sperm extraction (TESE)

A procedure for extracting sperm by re- moving a small sample of testicular tissue through an incision in the testes under local anesthesia.

Testosterone

Testosterone is the major hormone responsible for development of the male sex organs and masculine characteristics. It was first isolated from testicular extracts in 1935. Its discovery followed that of an androgen called androsterone, which was isolated from urine in 1931. However, testosterone proved to be more potent than androsterone, which was later shown to be a biochemical product (a metabolite) of testosterone. Testosterone has several major physiological actions. For

example, it directs the development of the embryonic Wolffian ducts into the vas deferens (ductus deferens) and seminal vesicles and stimulates the formation of muscle and bone.

Dihydrotestosterone is responsible for sperm maturation during spermatogenesis, for the formation of the prostate gland and external genitalia, and for sexual maturation at puberty.

Thalamus

The largest part of the diencephalon located immediately inferior to the corpus callosum and bulging into each lateral ventricle; a point of synaptic relay of nearly all signals passing from lower levels of the CNS to the cerebrum.

Theca (Gr. *theke*= a case for something, a box)

A protective covering for an organism or an organ.

Thelarche

The earliest noticeable sign of puberty is thelarche, the onset of breast development.

Theory

An explanatory statement, or set of statements, that concisely summarizes the state of knowledge on a phenomenon and provides direction for further study; for example, the fluid mosaic theory of the plasma membrane and the sliding filament theory of muscle contraction.

Thermogenesis

The production of heat, for example, by shivering or by the action of thyroid hormones.

Thermoreceptor

A neuron specialized to respond to heat or cold, found in the skin and mucous membranes, for example.

Thermoregulation

Homeostatic regulation of the body temperature within a narrow range by adjustments of heat-promoting and heat-losing mechanisms.

Thermotaxis

Thermotaxis is the movement of cells in the direction of a temperature gradient. Capacitated human and rabbit spermatozoa have been demonstrated to display thermotaxis.

Threshold

1. The minimum voltage to which the plasma membrane of a nerve or muscle cell must be depolarized before it produces an action potential. **2.** The minimum combination of stimulus intensity and duration needed to generate an afferent signal from a sensory receptor.

Thymus gland

It is a bilobed gland in the mediastinum superior to the heart, behind the sternal manubrium. The thymus plays a role in three systems: endocrine, lymphatic, and immune. In the fetus and infant, it is enormous in comparison to adjacent organs, sometimes extending between the lungs from near the diaphragm to the base of the neck. It continues to grow until the age of 5 or 6 years. In adults, the gland weighs about 20 g up to age 60, but it becomes increasingly fatty and less glandular with age. In the elderly, it is a small fibrous and fatty remnant barely distinguishable from the surrounding mediastinal tissues. Besides forming the blood–thymus barrier, reticular epithelial cells produce several signaling molecules that promote the development and action of T cells, including thymosin, thymopoietin, thymulin, interleukins, and interferon. If the thymus is removed from newborn mammals, they waste away and never develop immunity. Other lymphatic organs also seem to depend on thymosins or T cells and develop poorly in thymectomized animals.

Thyroglobulin (Tg)

Tg is a glycoprotein containing multiple tyrosine residues. It is synthesized in the thyroid follicular epithelial cells and secreted through the apical membrane into the follicular lumen, where it is stored in the colloid. Colloid makes up approximately 30% of the thyroid gland mass. A small amount of non-iodinated Tg is also secreted through the basolateral membrane into the circulation. Tg can be considered a scaffold upon which thyroid hormone synthesis takes place. Once Tg is secreted into the follicular lumen, it undergoes major posttranslational modification during the production of thyroid hormones. At the apical surface of the thyroid follicular epithelial cells, multiple tyrosine residues of Tg are iodinated, followed by coupling of some of the iodotyrosine residues to form triiodothyronine (T_3) or tetraiodothyronine (T_4). Although

circulating levels of Tg can be detected under normal conditions, levels are elevated in diseases such as thyroiditis and Graves disease.

Thyroid gland

The thyroid gland is a highly vascular, ductless alveolar (acinar) gland located in the anterior neck in front of the trachea. The gland weighs 10–25 g and consists of a right and left lobe connected by the isthmus.

The main function of the thyroid gland is the synthesis and storage of thyroid hormone. The secretory or functional unit of the thyroid gland is the thyroid follicle, consisting of a layer of thyroid epithelial cells arranged around a large central cavity filled with colloid. The thyroid epithelial cells are morphologically and functionally polarized. That is, each side or compartment of the cell has specific functions pertaining to the synthesis of thyroid hormones and their release. The apical surface of the follicular cell faces the follicular lumen, where colloid is stored.

The basolateral surface faces the interstitium and is therefore exposed to the bloodstream.

Thyroid hormone

Either of two similar hormones, thyroxine and triiodothyronine, synthesized from iodine and tyrosine.

Thyrotropin-releasing hormone (TRH)

TRH is a tripeptide synthesized in the hypothalamus and released from nerve terminals in the median eminence from where it is transported through the portal capillary plexus to the anterior pituitary.

Human TRH is synthesized from a large precursor of 242 amino acids that contains six copies of TRH.

TRH-secreting neurons are located in the medial portions of the paraventricular nuclei (see Figure 4–2), and their axons terminate in the medial portion of the external layer of the median eminence. The half-life of TRH is approximately 6 minutes.

Thyroid-stimulating hormone (TSH)

A hormone of the anterior pituitary gland that stimulates the thyroid gland; also called thyrotropin.

TSH is a glycoprotein with molecular weight of about 28,000, being secreted from the basophilic cells.

The concentration of thyroid hormone is maintained at a constant level by circulating TSH. However, the secretion of TSH is controlled by a thyroid releasing hormone (TRH) from the hypothalamus.

Extirpation of anterior pituitary causes atrophy of the thyroid gland. The thyroid stimulating hormone controls thyroid function by stimulating formation of thyroxine and its release from the thyroid gland and the synthesis of thyroxine.

Thyrotropin

A peptide hormone that is also called thyroid-stimulating hormone. It stimulates production and secretion of thyroid hormones by the thyroid gland.

Thyroxine (T_4)

One of two thyroid hormones that is also called T_4 because it contains four iodine atoms. It is considered the precursor for triiodothyronine, or T_3, because it is less active than T_3.; also called tetraiodothyronine.

Tight junction

A region in which adjacent cells are bound together by fusion of the outer phospholipid layer of their plasma membranes;

forms a zone that encircles each cell near its apical pole and reduces or prevents flow of material between cells.

Tissue

An aggregation of cells and extracellular materials, usually forming part of an organ and performing some discrete function for it; the four primary classes are epithelial, connective, muscular, and nervous tissue.

Totipotent

Pertaining to a stem cell of the early pre-embryo, prior to development of a blastocyst, that has the potential to develop into any type of embryonic or adult cell.

Trabeculae

A thin plate or layer of tissue, such as the calcified trabeculae of spongy bone or the fibrous trabeculae that subdivide a gland. Also called as septa.

Transmembrane protein

An integral protein that extends through a plasma membrane and contacts both the extracellular and intracellular fluid.

Transverse plane

Refer to the plane that divides the body or organ horizontally into upper and lower portions. Transverse planes produce images referred to as cross sections.

Triglyceride (Gr. *tria*= three, + *glykys*= sweet, + *ide*= suffix denoting compound)

A triester of glycerol with one, two, or three kinds of fatty acids composed of three fatty acids joined to a glycerol; also called a triacylglycerol or neutral fat.

Triiodothyronine

One of two thyroid hormones that is also called T_3 because it contains three iodine atoms. T_3 promotes normal growth and development of the nervous system in growing animals, and also stimulates metabolism.

Trimesters

The nine calendar month gestation period is split into 3-month periods called trimesters. During the first trimester the embryonic and early foetal periods occur. In the second trimester the uterus

becomes much larger as the foetus grows considerably, and symptoms of morning sickness tend to subside. A foetus in the third trimester turns and the head drops into the pelvic cavity (engagement) in preparation for birth. Babies born prematurely during the third trimester may survive, particularly with specialised intensive care treatment.

Triploblastic (Gr. *triploos*= triple, + *blastos*= germ)

Pertaining to animals in which the embryo has three primary germ layers—ectoderm, mesoderm, and endoderm.

Trophoblast (Gr. *trephein*= to nourish, + *blastos*= germ)

Outer ectodermal nutritive layer of blastodermic vesicle; in mammals it is part of the chorion and attaches to the uterine wall.

Tropic (Gr. *trope*= to turn toward)

Related to the tropics (tropical); in endocrinology, a hormone that

influences the action of another hormone or endocrine gland.

Tubal embryo transfer (TET)

A procedure that involves removing oocytes from a woman's ovary and fertilizing them in the laboratory with sperm. The resultant embryo(s) are placed directly into the fallopian tube utilizing laparoscopy 2-3 days later.

Tumor

A tumor is any swelling that occurs within the body, usually involving cell proliferation. But modern usage has limited the term to swellings that involve neoplastic tissue. A neoplasm, meaning "new growth," refers to abnormal tissue growth resulting from cellular divisions that continue after normal cell division of the tissue has stopped or slowed considerably. A tumor can be either malignant (meaning with malice or intent to cause harm), able to spread and become worse, or benign (meaning kind), not inclined to spread and not likely to become worse.

Tunic

A layer that encircles or encloses an organ, such as the tunics of a blood vessel or eyeball.

Tunica albuginea

Literally means, a white cloak. This is a connective tissue sheath found around various organs. Around the testis, it is a tough substantial sheath. Around the ovary, it is thin.

Turner Syndrome

Turner syndrome, or gonadal dysgenesis, is the most common cause of congenital hypogonadism. In about 50% of cases, it results from the complete absence of the Second X chromosome, so the karyotype of the affected person is 45, XO. The germ cells do not develop, and each gonad consists of a connective tissue-filled streak. The major clinical characteristics include short stature, a characteristic webbed neck, low-set ears, a shield-shaped chest, short fourth metacarpals, and sexual infantilism resulting from gonadal dysgenesis. Internal and external genitalia typically are female.

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U

Umbilical (L. *umbilicus*= navel)

Refers to the navel, or umbilical cord.

Uterine cycle

The uterine cycle is a series of structural and functional changes that occur in the endometrium of the uterus as it prepares each month for the possibility that a fertilized egg may arrive. The uterine cycle is linked to the ovarian cycle

Uterine tube

A duct that extends from the ovary to the uterus and conveys an egg or conceptus to the uterus; also called fallopian tube or oviduct.

Uterus

The uterus or womb is a hollow, thicked-wall muscular chamber that opens into the roof of the vagina and usually tilts forward over the urinary bladder. It is shaped like an inverted pear, which is flattened antero-posteriorly Its function is to harbor the fetus, provide a source of nutrition, and expel the fetus at the end of its development.

The uterus has a glandular lining called the endometrium. The narrower, lower end forms the cervix, which projects into the vagina.

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V

Vagina (Latin, "sheath" or "scabbard")

The vagina is a thin-walled, distensible, fibro-muscular canal, covered by specialized epithelium, which extends from the vulva inward to the cervix and uterus. The vagina lies behind the bladder and urethra and in front of the rectum and anal canal. It serves as the portal to the internal female reproductive tract and a route of egress for the fetus during delivery. The orifice of the vagina is guarded by the hymen.

Varicocele

Abnormal dilation of veins of the spermatic cord, so that they resemble a "bag of worms." Reduces testicular blood flow and often causes infertility.

It is defined as a palpable dilated, elongated, and tortuous pampiniform plexus of veins draining the testis. The prevalence of varicocele is high with about 20% of men and increased in patients with primary infertility to 35%. It has been related to different pathologic conditions as male factor infertility, scrotal pain, decreased ipsilateral testicular volume, and testosterone deficiency.

Vas

A vessel or duct. (plural, *vasa*)

Vascular

Pertaining to blood vessels

Vasectomy

It is the chief method for the sterilization of males by a simple surgical operation. Vasectomy is a surgical procedure in which the ductus deferens from each testis is cut and tied off within the scrotal sac. Sexual desire and performance are not affected since testosterone secretion continues normally. Sperm production also continues but they cannot reach outside. After vasectomy sperm are still produced, but they degenerate and are removed by macrophages in the epididymis (and in the scrotal sac if the short portion of the vas is left open-ended). For the first 2 months after vasectomy, viable sperms may be released from their storage in ampullae of seminal vesicles.

Inflammatory and other changes occur in the mucosa of the

epididymis, but serious adverse effects of vasectomy are usually minimal. A vasectomy may be reversed by surgically reconnecting the two ends of each ductus deferens. However, even successful surgery very often fails to restore fertility, due to incomplete sperm maturation in the epididymis changed by postvasectomy inflammation.

Vas deferens (sperm duct)

The deferent duct, or vas deferens, connects the epididymis to the urethra. The mucosa of the vas deferens is lined by a pseudostratified columnar epithelium, and in a manner similar to the epididymis, its cells have long stereocilia.

The muscular layer of this duct is very well developed and consists of a thick circular layer of smooth muscle between thinner inner and outer longitudinal layers.

The muscularis is the structure that makes the deferent duct palpable in the spermatic cord.

During ejaculation, the smooth muscle of the deferent duct contracts reflexively (peristalsis), thus propelling the sperm and fluids forward and transferring them into the urethra.

Vasoconstriction

The narrowing of a blood vessel due to muscular constriction of its tunica media.

asodilation

The widening of a blood vessel due to relaxation of the muscle of its tunica media and the outward pressure of the blood exerted against the wall.

Vasomotion

Collective term for vasoconstriction and vasodilation.

Vasopressin

A polypeptides hormone formed in the neurosecretory cells of the hypothalamus, whose axons extend down the infundibular stalk and into the posterior lobe of pituitary. acts on collecting ducts of the kidney to increase water reabsorption and thus restrict urine flow. called antidiuretic hormone or ADH.

This hormone is also called antidiuretic hormone (ADH) and is composed of 9 amino acids with a disulphide ring. Because the human hormone has an arginine in position 8 instead of the lysine found in the corresponding

hormone originally isolated from pigs, it is called arginine vasopressin (AVP). Both ADH and Oxytocin are nonapeptides and differ by only two amino acid residues. A disulfide bond links cysteines at positions 1 and 6 to form a six amino acid ring with a three amino acid side chain. Similarities in the structure and organization of their genes and in their posttranslational processing make it virtually certain that these hormones evolved from a single ancestral gene. The genes that encode them occupy adjacent loci on chromosome 20, but in opposite transcriptional orientation. Oxytocin and AVP are stored in and secreted by the neurohypophysis, but are synthesized in magnocellular neurons whose cell bodies are present in both the supraoptic and paraventricular nuclei of the hypothalamus. Cells in the supraoptic nuclei appear to be the major source of neurohypophyseal vasopressin, while cells in the paraventricular nuclei may be the principal source of oxytocin. After transfer to the Golgi apparatus the oxytocin and AVP prohormones are packaged in secretory vesicles along with the enzymes that cleave them into the final secreted products. The secretory vesicles are then transported down the axons to the nerve terminals in the posterior gland where they are stored in relatively large amounts.

The AVP hormone promotes water retention in the kidneys, hence the name antidiuretic hormone. Secretion or inhibition of the antidiuretic hormone is controlled by "Osmoreceptors" present in the hypothalamus.

Excessive intake of water would inhibit the secretion of ADH resulting in diuresis, whereas diminished quantity of body fluid would stimulate the secretion of the hormone. Removal of the posterior pituitary causes polyuria with symptoms of excessive thirst (polydipsia) but without glycosuria as in diabetes mellitus. Generally lesions of the posterior lobe and the adjacent hypothalamic parts cause this condition. The disease may have hereditary character; males generally suffer more than the females. The disease is commonly called diabetes insipidus and may be relieved by the administration of ADH suppressing the urine output.

Vegetal pole

Region of an egg with a high concentration of yolk; this region is opposite the animal pole where cytoplasm is concentrated.

Ventral

(L. *venter*= belly)

Pertaining to the front of the body, the regions of the chest and abdomen; anterior.

Vesicle

A fluid-filled tissue sac or an organelle such as a synaptic or secretory vesicle.

Vesicular transport

The movement of particles or fluid droplets through the plasma membrane by the process of endocytosis or exocytosis.

Vestibule

A part of the vagina; is the cleft between the labia minora into which the urethra and vagina open.

Viviparity (L. *vivus*= alive, + *parere*= to bring forth)

Reproduction in which eggs develop within the female body, which supplies nutritional aid as in therian mammals, many nonavian reptiles, and some fishes; offspring are born as juveniles. Adj., viviparous.

Viviparous

Refer to those groups of animals that use internal fertilization, and the young develop within the female body. In early development, the young derive significant resources from the mother. Placental mammals are the most obvious examples of vivipary, but it also occurs in some species of fish, snakes, and skinks. The female reproductive tract produces nutrients for the offspring, which can be a simple slurry of "uterine milk" secreted from the uterus, or more elaborate arrangements that allow the embryo to derive nutrition from the uterine blood vessels.

Vulva

The female external genitalia; they include the mons pubis, labia majora and minora, clitoris, vaginal orifice, and accessory glands and erectile tissues.

Vomeronasal organ (VNO)

In tetrapods, most pheromones are detected in a region of the nostril known as the vomeronasal organ. Nerves transmit signals from the epithelium of the vomeronasal organ to the olfactory lobe. The chemosensors in the vomeronasal organ are distinct from the

olfactory receptors found elsewhere in the nostril. Although pheromone receptors and olfactory receptors are both G-protein-linked receptors, the pheromone receptors are much more sensitive and trigger a distinct signaling pathway. The vomeronasal organ is greatly reduced in size in adult humans compared to the size of this organ in the human fetus and in other adult mammals. Humans also lack an accessory olfactory bulb, the part of the brain responsible for interpreting pheromone signals in other animals. Interestingly, the loss of pheromone-based signaling in the Old World monkeys roughly coincides with the evolution of color vision. It may be that Old World monkeys, apes, and humans rely more on visual signals than on pheromones for detecting gender.

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W

Wolff –Chaikoff effect

A autoregulatory phenomenon consisting of inhibition of the organification of iodine by elevated circulating levels of iodide. This mechanism is important when plasma iodide levels are elevated (15–20-fold above normal) because this elevation inhibits the organic binding of iodine within the thyroid. This effect lasts for a few days and is followed by the so-called escape phenomenon, at which point the organification of intra-thyroidal iodine resumes and the normal synthesis of T_4 and T_3 returns.

Wolffian duct

In a vertebrate embryo, the duct that first serves as the pronephric and then the mesonephric kidney. A synonym for the pronephric and mesonephric duct. In amniotes, it becomes the ductus (vas) deferens, and epididymis.

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X

X chromosome

The larger of the two sex chromosomes; males have one X chromosome and females have two in each somatic cell.

X-organ

Neurosecretory organ in eyestalk of crustaceans that secretes molt-inhibiting hormone.

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Y

Y chromosome

Smaller of the two sex chromosomes, found only in males and having little if any genetic function except development of the testis.

Y-organ

Gland in the antennal or maxillary segment of some crustaceans that secretes molting hormone

Yolk sac

An embryonic membrane that encloses the yolk in vertebrates that lay eggs and serves in humans as the origin of the first blood and germ cells.

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Z

Zona fasciculata

The zona fasciculata, the middle and widest zone, constitutes about 75 percent of the adrenal cortex and secretes the glucocorticoids cortisol and corticosterone, as well as small amounts of adrenal androgens and estrogens. The secretion of these cells is controlled in large part by the hypothalamic-pituitary axis via adrenocorticotropic hormone (ACTH).

Zona glomerulosa

The zona glomerulosa, a thin layer of cells that lies just underneath the capsule, constitutes about 15 percent of the adrenal cortex. These cells are the only ones in the adrenal gland capable of secreting significant amounts of aldosterone because they contain the enzyme aldosterone synthase, which is necessary for synthesis of aldosterone. The secretion of these cells is controlled mainly by the extracellular fluid concentrations of angiotensin II and potassium, both of which stimulate aldosterone secretion.

Zona pellucida

A non-cellular egg coat produced in the ovary during oogenesis and found around the ovulated mammalian egg. The mammalian zona pellucida, secreted by the growing oocyte, is functionally equivalent to the vitelline membrane in invertebrates. The zona pellucida plays two major roles in fertilization: (1) It binds the sperm, and (2) it initiates the acrosome reaction after the spermatozoon is bound.

Zona reticularis

The zona reticularis, the inner zone of the cortex, secretes the adrenal androgens dehydroepiandrosterone and androstenedione, as well as small amounts of estrogens and some glucocorticoids. ACTH also regulates secretion of these cells, although other factors such as cortical androgen-stimulating hormone, released from the pituitary, may also be involved. The mechanisms for controlling adrenal androgen production, however, are not nearly as well understood as those for glucocorticoids and mineralocorticoids.

Zygote (Gr. *zygotos*= yoked)

Z

A single-celled, fertilized egg. 2. Cell formed by union of a sperm and secondary oocyte (ovum). The zygote is the earliest stage of embryo (i.e., the beginning of a new animal).

Zygote intrafallopian transfer (ZIFT)

A procedure that involves removing oocytes from a woman's ovary, fertilizing them in the laboratory with sperm, then placing the single-cell embryo (zygote) directly into the fallopian tube utilizing laparoscopy.

ABOUT THE BOOK

A GLOSSARY OF TERMS USED IN ENDOCRINOLOGY, First edition, will give a brief idea about the terminologies commonly used in cellular, molecular and clinical endocrinology. This work will also provide clear insights and basic knowledge to the reader of life sciences and biology about the terms which they will come across while going through the subject endocrinology.

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