

Prenatal Development:

What are the three embryonic germ layers?

Endoderm- endocrine system

Ectoderm- nervous system

Mesoderm- reproductive system

What cell types are present in the germ layers?

Totipotent- have the ability to form all cell types of the conceptus

Multipotent- have the ability to form a limited range of cells and tissues appropriate to their location

Pluripotent- Have the ability to form several types of cells in all three germ layers but not the whole organism

How do the Anterior Pituitary and Posterior Pituitary develop?

Anterior Pituitary- develops from roof of mouth, gives rise to Rathke's pouch

Posterior Pituitary- develops from floor of brain

What is sexual differentiation?

- XX vs. XY
- XX = female No SRY gene → no SRY protein → no testes or AMH
- XY = male, Y chromosome contains SRY gene which undergoes transcription and translation to form SRY protein. SRY protein stimulates development of male reproductive tract
- Wolffian Ducts vs. Mullerian Ducts
 - Wolffian/Mesonephric Ducts (MALE)- develops into ductus deferens and epididymis
 - Mullerian/Paramesonephric Ducts (FEMALE)- develops into cervix, uterus, oviducts, and parts of cranial vagina
- Surge vs. Tonic Center
 - Female- alpha fetoprotein binds to estrogen and prevents it from entering the brain. The hypothalamus is “feminized” and the surge center develops
 - Male- testosterone freely enters the brain because alpha fetoprotein doesn't bind to it. Testosterone is aromatized into estradiol and the male brain is “defeminized” and the surge center does not develop

Puberty:

What are the four things puberty is dependent upon?

1. Body size and “fatness”
 - A. Repro is considered non-vital and is the 1st process to go without proper nutrition
2. Genetics
 - a. kisspeptin
3. Social cues
 - a. enhanced onset of puberty when female are housed together or exposed to a male
4. Environmental changes
 - a. Seasonal breeders

What neurohormone signals for GnRH to be released? How does it work?

Kisspeptin- blood fatty acids, leptin, and blood glucose stimulate kisspeptin neurons to interact with GnRH neurons to release GnRH

How does puberty occur? (overnight or months)

A slow progression over long periods of time

What determines if a female has reached puberty?

- Age at 1st estrus(standing heat)
 - o Shows outward expression of sexual behavior especially in the presence of a male
- Age at 1st ovulation
 - o Manual or visual validation is required by palpation of the ovary
- Age at which pregnancy can be supported without deleterious effects
 - o Female must cross “metabolic threshold” before attaining pregnancy

What determines if a male has reached puberty?

- Behavior expression
 - o Mounting and erection
- Age at 1st ejaculation
 - o Coordinate development of nerves, specific muscles and glands
- Age when spermatozoa appear

- Age when threshold of spermatozoa is reached
 - o Minimum # of spermatozoa to achieve pregnancy

How does GnRH drive puberty attainment? How is it different before and after puberty?

1. Ability to make enough GnRH
2. Secrete GnRH at the correct frequency

Prepubertal- low frequency GnRH pulses, insufficient stimulation of surge center

Postpubertal- higher frequency GnRH pulses, above threshold concentrations to stimulate surge center

Endocrine Glands and Hormones

Paracrine is distant signaling. (True/False)

False, paracrine is adjacent signaling

Autocrine is self-signaling. (True/False)

True

Endocrine is adjacent signaling. (True/False)

False, endocrine is distant signaling

What are the five sources of hormones?

1. Hypothalamic
2. Pituitary
3. Gonadal
4. Placental
5. Pineal

What hormones are synthesized and released by the Anterior Pituitary? What's the main purpose of these hormones?

Synthesizes and releases gonadotropic hormones

- FSH
- LH
- PRL

Stimulates growth and development of the gonads and gametes

What hormone(s) are stored in the Posterior Pituitary? What is the main purpose of this/these hormone(s)?

Oxytocin

Stimulates contractions of smooth muscle

What is the purpose of the Hypothalamo-hypophyseal portal system?

- Carries hypothalamic hormones to the anterior pituitary WITHOUT dilution.
- Allows rapid response, peptide hormones have a short half-life

The placenta is a _____ endocrine gland.

Transient

What hormones are produced by the placenta?

- Equine chorionic gonadotropin
- Human chorionic gonadotropin
- Placental lactogen
- Steroids- estrogen and progesterone

What hormones are produced in the gonads?

Polypeptide

- Relaxin
- Inhibin

Steroids

- Progesterone
- Testosterone
- Estradiol

Why is the pineal gland important? What does it do?

Responds to environmental lighting and senses changes in day light

Produces melatonin

What are the key enzymes involved with synthesis of steroid hormones?

- CYP11A1 (cholesterol → pregnenolone)
- CYP17 (progestins → androgens)
- CYP19A1 (androgens → estrogens)

How are chemical messages received in the body?

- Protein & Peptide:

1. Hormone-Receptor Binding

a. Hormone diffuses from blood and binds to a specific membrane bound G - protein coupled receptor

2. Adenylate Cyclase Activation

a. Alpha subunit of G-proteins activates adenylate cyclase

b. The active form of this enzyme converts ATP to cAMP (cyclic AMP) within cytoplasm of the cell

3. Protein Kinase Activation

a. cAMP activates protein kinases (control enzymes)

b. Protein kinases are responsible for activating downstream enzymes in cytoplasm to convert substrate into products

4. Synthesis of New Products

a. New products drive specific functions that enhance reproductive processes

- Steroid (SLOW):

1. Steroid passes through cell membrane and cytoplasm

2. Binds to nuclear receptor

3. mRNA and protein synthesis

- Steroid (FAST):

1. Steroid binds to membrane receptor

2. Adenylate cyclase activation

3. protein kinase activation

4. Changes in Ca^{2+} permeability

Hormones that Regulate Reproduction:

Gland	Hormone	Chemical Class	Function
Ovary	Estrogen	Steroid	Mating behavior; secondary sex characteristics; maintenance of female duct system
Ovary(CL)	Progesterone	Steroid	Maintains pregnancy; mammary growth; inhibits myometrial contractions
Testis	Testosterone	Steroid	Male mating behavior; spermatogenesis; maintenance of the male duct system
Ovary and Testis	Inhibin	Protein	Inhibits release of FSH from anterior pituitary
Uterine Endometrium	PGF2A	Lipid	Female: Causes regression of CL; stimulates myometrial contractions; ovulation Male: transport of sperm up FRT

Pineal Gland	Melatonin	Biogenic Amine	Controls seasonal reproduction in mare and ewe
Hypothalamus	GnRH	Peptide	Stimulates release of LH and FSH from anterior pituitary
Hypothalamus	Oxytocin	Peptide	Produced by hypothalamus, released by posterior pituitary
Anterior Pituitary	FSH	Glycoprotein	Stimulates follicle growth, estrogen production, spermatogenesis in males
Anterior Pituitary	LH	Glycoprotein	Stimulates ovulation; supports CL formation and progesterone secretion; stimulates testosterone synthesis by Leydig cells of the testis