Course: Animal form and function

Chapter: REPRODUCTION AND DEVELOPMENT

- ASEXUAL REPRODUCTION IN INVERTEBRATES
- SEXUAL REPRODUCTION IN INVERTEBRATES
- SOME BASIC VERTEBRATE REPRODUCTIVE STRATEGIES
- EXAMPLES OF REPRODUCTION AMONG VARIOUS VERTEBRATE CLASSES

EXAMPLES OF REPRODUCTION AMONG VARIOUS VERTEBRATE CLASSES

FISHES

- All fishes reproduce in aquatic environments.
- In bony fishes, fertilization is usually external, and eggs contain only enough yolk to sustain the developing fish for a short time.
- After this yolk is consumed, the growing fish must seek food. Although many thousands of eggs are produced and fertilized, few survive and grow to maturity.
- Some succumb to fungal and bacterial infections, others to siltation, and still others to predation.
- Thus, to assure reproductive success, the fertilized egg develops rapidly, and the young achieve maturity within a short time.

AMPHIBIANS

- **Life cycle is still inextricably linked to water.**
- **Among most amphibians, fertilization is still external.**
- **The developmental period is much longer in amphibians than in fishes.**
- **An evolutionary adaptation present in amphibians is the presence of two periods of development: larval and adult stages.**
- **The aquatic larval stage develops rapidly, and the animal spends much time eating and growing.**
- **After reaching a sufficient size, the larval form undergoes a developmental transition called metamorphosis into the adult (often terrestrial) form.**

REPTILES

- first group of vertebrates to completely abandon the aquatic habitat.
- internal fertilization.
- Many reptiles are oviparous, others are ovoviviparous.
- The shelled egg and extraembryonic membranes, also first seen in reptiles, constitute two other important evolutionary adaptations to life on land.
- As the embryo develops, the extraembryonic chorion and amnion help protect it, the latter by creating a fluid-filled sac for the embryo.
- The allantois permits gas exchange and stores excretory products. Complete development can occur within the eggshell.

BIRDS

- Birds have retained the important adaptations for life on land that evolved in the early reptiles.
- With the exception of most waterfowl, birds lack a penis.
- Males simply deposit semen against the cloaca for internal fertilization.
- All birds are oviparous, and the eggshells are much thicker than those of reptiles.
- Brooding, or incubation, hastens embryo development.
- Extensive parental care and feeding of young are more common among birds than fishes, amphibians, or reptiles.

MAMMALS

- The most primitive mammals, the **monotremes** (e.g., the duckbilled platypus and spiny anteater), lay eggs, as did the reptiles from which they evolved.
- All other mammals are **viviparous.**
- The **marsupials** developed the ability to nourish their young in a pouch after a short gestation inside the female.
- The **placentals**—retain the young inside the female, where the mother nourishes them by means of a placenta.
- Even after birth, mammals continue to nourish their young.
- **Mammary glands** to nourish the young
- Some mammals nurture their young until adulthood, when they are able to mate and fend for themselves.

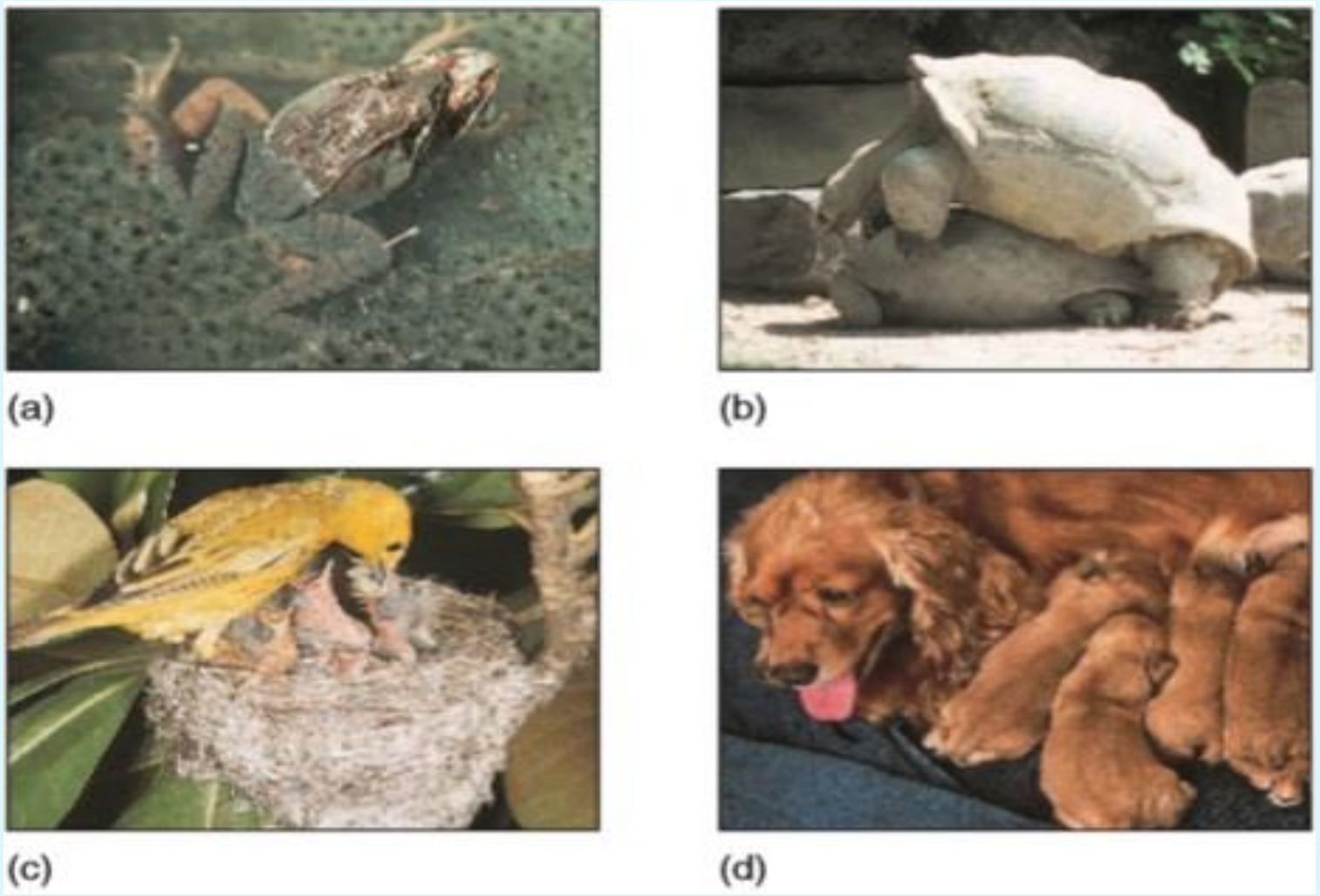

Fig: Vertebrate Reproductive Strategies. (a) A male wood frog (Rana sylvatica) clasping the female in amplexus, a form of external fertilization. As the female releases eggs into the water, the male releases sperm over them. (b) Reptiles, such as these turtles, were the first terrestrial vertebrates to develop internal fertilization. (c) Birds are oviparous. Their shelled eggs have large yolk reserves, and the young develop and hatch outside the mother's body. Birds may show advanced parental care. (d) A placental mammal. This female dog is nursing her puppies

THE HUMAN MALE REPRODUCTIVE SYSTEM

The reproductive role of the human male is to produce sperm and deliver them to the vagina of the female. This function requires the following structures:

1) **Two testes that produce sperm and the male sex hormone, testosterone.**
2) **Accessory glands and tubes that furnish a fluid for carrying the sperm to the penis. This fluid, together with the sperm, is called semen.**
3) **Accessory ducts that store and carry secretions from the testes and accessory glands to the penis.**
4) **A penis that deposits semen in the vagina during sexual intercourse.**

Production And Transport Of Sperm

❖ Testes

- ❑ The paired testes are the male reproductive organs (gonads) that produce sperm.
- ❑ Shortly after birth, the testes descend from the abdominal cavity into the scrotum.

❖ Seminiferous tubules

- ❑ Produce thousands of sperm each second in healthy young men.
- ❑ The walls are lined with two types of cells: **spermatogenic cells** and **sustentacular cells**.
- ❑ **Interstitial cells** (Leydig cells), secrete the male sex hormone **testosterone.**
- ❑ Merge into a network of tiny tubules called the **rete testis**, which merges into a coiled tube called the **epididymis**.

❖ epididymis

(1) it stores sperm until they are mature and ready to be ejaculated,

(2) it contains smooth muscle that helps propel the sperm toward the penis by peristaltic contractions.

(3) it serves as a duct system for sperm to pass from the testis to the ductus deferens.

❖ ductus deferens

- Formerly called the vas deferens or sperm duct.
- It is the dilated continuation of the epididymis.
- It passes around the urinary bladder and enlarges to form the ampulla. The ampulla stores some sperm until they are ejaculated.

❖ accessory glands

- **Seminal vesicles**
  - **secrete water, fructose, prostaglandins, and vitamin C.**
  - **Provides an energy source for the motile sperm.**
  - **Neutralize the natural protective acidity of the vagina.**
- **The prostate gland**
  - **Secretes water, enzymes, cholesterol, buffering salts, and phospholipids.**
- **The bulbourethral glands**
  - **Secrete a clear, alkaline fluid that lubricates the urethra to facilitate the ejaculation of semen.**

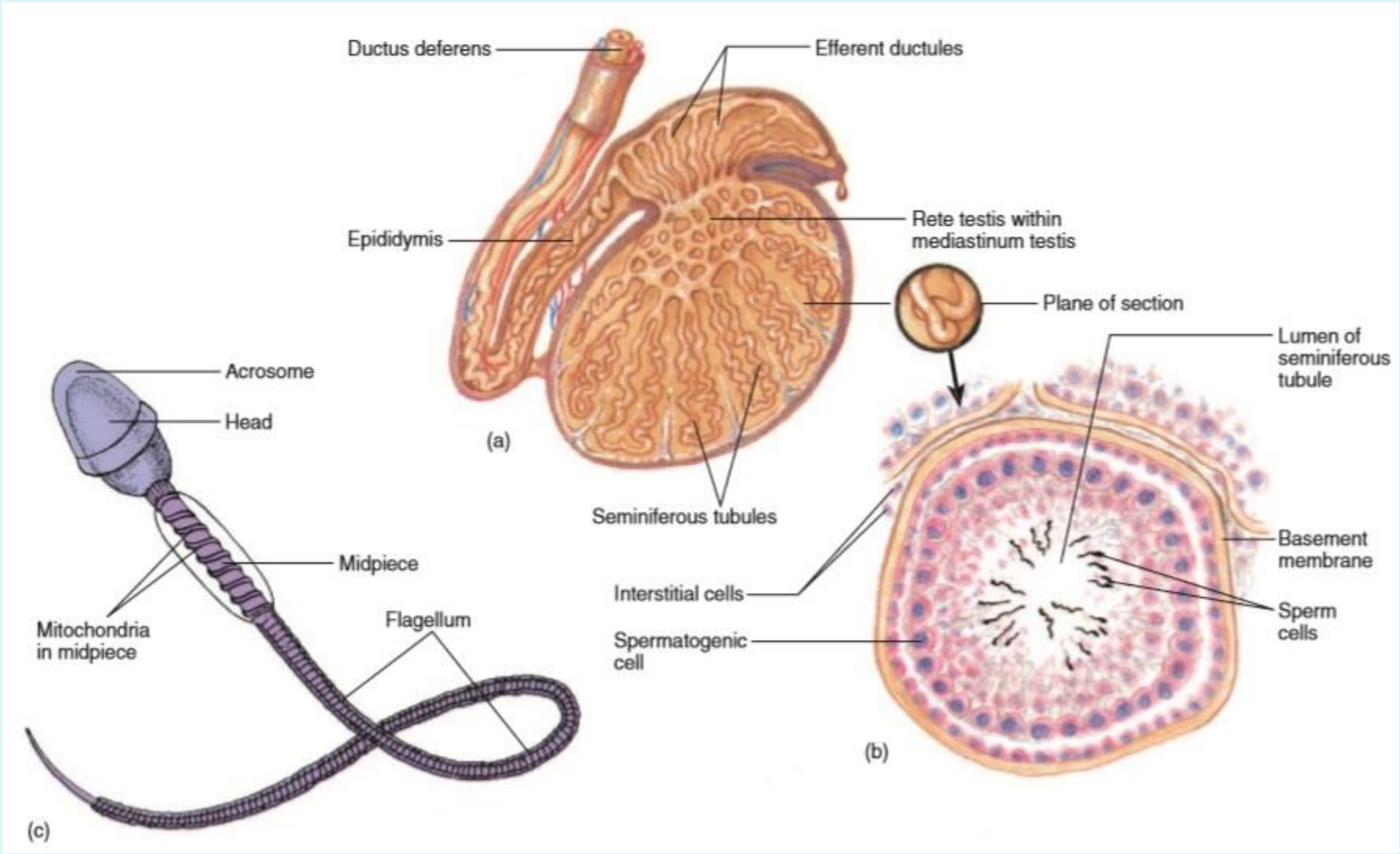

Fig: Human Male Testis. (a) Sagittal section through a testis. (b) Cross section of a seminiferous tubule, showing the location of spermatogenesis. (c) A mature sperm.

hormonal control of male reproductive function

negative feedback mechanisms

When the level of testosterone in the blood decreases, the hypothalamus is stimulated to secrete GnRH.

1) GnRH stimulates the secretion of FSH and LH.

2) FSH causes the spermatogenic cells in the seminiferous tubules to initiate spermatogenesis, LH stimulates the interstitial cells to secrete testosterone.

3) The cycle is completed when testosterone inhibits the secretion of LH, and another hormone, inhibin, is secreted.

4) Inhibin inhibits the secretion of FSH from the anterior pituitary.

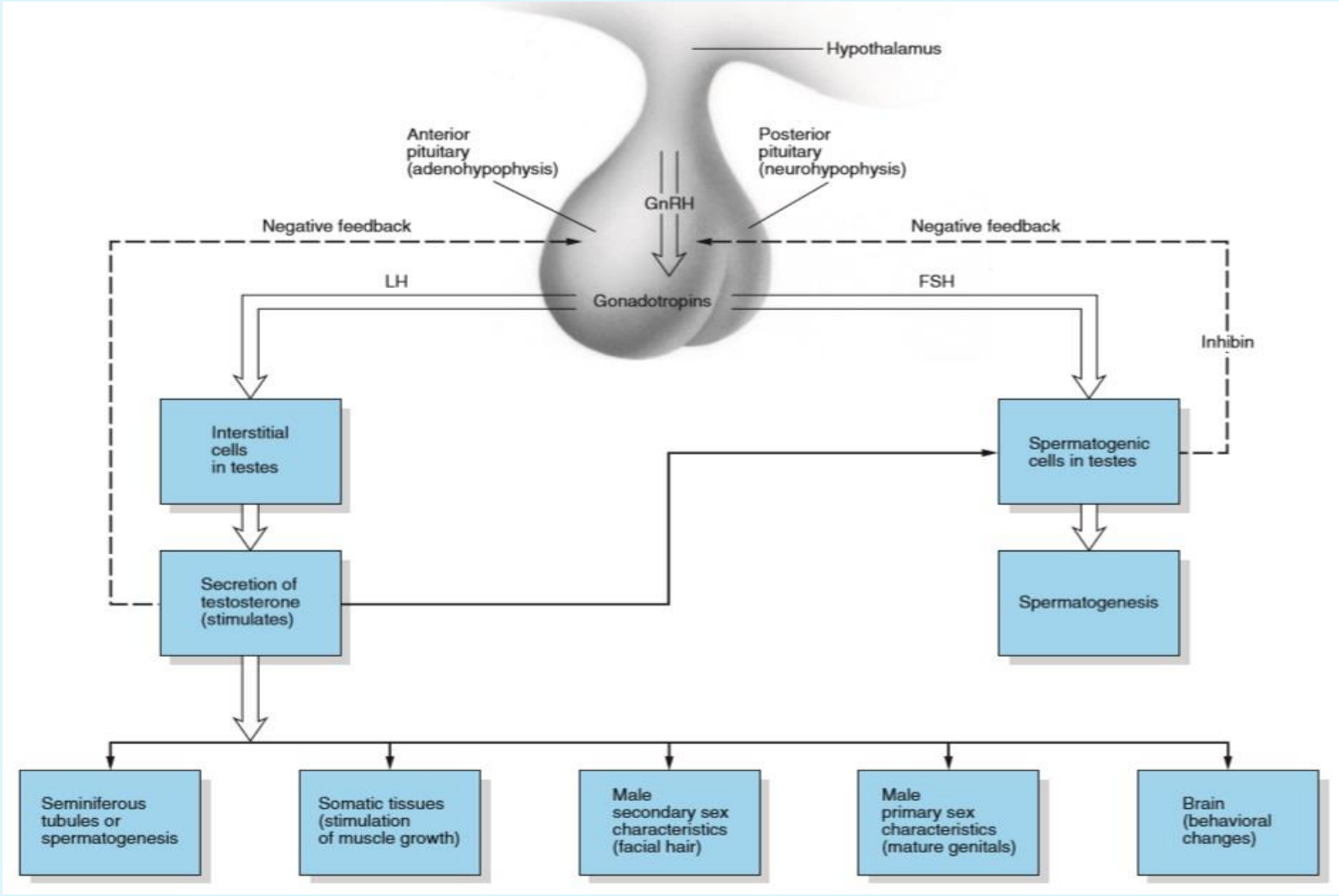

Fig: Hormonal Control of Reproductive Function in Adult Human Males. Negative feedback mechanisms by which the hypothalamus controls sperm maturation and the development of male secondary sexual characteristics. (GnRH; LH; FSH.)

THE HUMAN FEMALE REPRODUCTIVE SYSTEM

The female reproductive system consists of a number of structures with specialized functions:

1) **Two ovaries produce eggs and the female sex hormones estrogen and progesterone.**
2) **Fertilization usually occurs in the upper third of a uterine tube.**
3) **If fertilization occurs, the uterus receives the blastocyst and houses the developing embryo.**
4) **The vagina receives semen from the penis during sexual intercourse.**
5) **The external genital organs**
6) **The mammary glands**

hormonal control of female reproductive function

Hypothalamus releases GnRH, which stimulates the anterior pituitary to secrete FSH and LH

FSH promotes the development of the oocyte in one of the immature ovarian follicles.

The follicles produce estrogen, causing a buildup and proliferation of the endometrium, as well as the inhibition of FSH production.

Elevated estrogen level secretes LH, which causes release of secondary oocyte LH also causes the collapsed follicle to become the corpus luteum.

The corpus luteum secretes estrogen and progesterone, which act to complete the development of the endometrium and maintain it for 10 to 14 days

If the oocyte is not fertilized, the corpus luteum disintegrates into a corpus albicans, and estrogen and progesterone secretion cease.

Without estrogen and progesterone, the endometrium breaks down, and menstruation occurs. The menstrual flow is composed mainly of sloughed-off endometrial cells, mucus, and blood.

As progesterone and estrogen levels decrease further, the pituitary renews active secretion of FSH, which stimulates the development of another follicle, and the monthly cycle begins again

HORMONAL REGULATION IN THE PREGNANT FEMALE

▪ **human chorionic gonadotropin (hCG)**	**Keeps the corpus luteum from disintegrating**
▪ **progesterone**	Necessary to maintain the uterine lining
▪ **prolactin and oxytocin**	Induce the mammary glands to secrete and eject milk after childbirth
▪ **Oxytocin and prostaglandins**	Stimulate the uterine contractions