Chapter 46: **Animal Reproduction**

46.1 Summarize the major forms of asexual and sexual reproduction in animals.

46.2 Use examples to illustrate adaptations that facilitate fertilization and the survival of fertilized eggs.

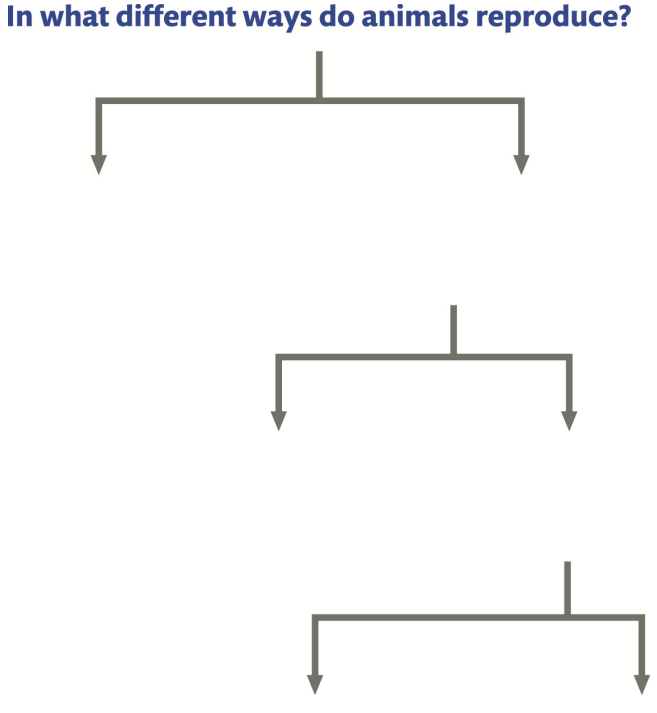
46.3 Describe how the reproductive systems of humans bring about the development and delivery of eggs and sperm.

46.4 Compare and contrast hormonal regulation of gamete production in human males and females.

46.5 Discuss how the female reproductive system supports the embryo along its path to complete development.

In this chapter, you will look at solutions to the problem of fertilization and development in a terrestrial environment, and then focus primarily on human reproduction. Keep in mind how hormones interact in sexual development and gamete production, and the feedback mechanisms involved. You will also review how meiosis produces eggs and sperm.

Study Tip: Figure 46.1 is a summary of the evolution of reproduction. Using the dichotomous division from the figure, place the headings and the brief description of reproduction at each category depiction.



Concept 46.1 Both asexual and sexual reproduction occur in the animal kingdom

LO 46.1: Summarize the major forms of asexual and sexual reproduction in animals.

1. Distinguish between *sexual reproduction* and *asexual reproduction*.

2. In the following blanks, place either *asexual* or *sexual* as the mode of reproduction.

   a. _____ relies entirely on *mitosis*
   b. _____ forms *gametes*
   c. _____ results in offspring genetically identical to the parent
   d. _____ produces a *zygote*
   e. _____ occurs in *budding*
   f. _____ is seen in *parthenogenesis*

3. Return to the previous list and define the terms that are in italics.

4. For animals that are *sessile* (stationary), finding a mate presents a problem. What is one solution to this problem? What is this type of sexual reproduction called?

5. Here's an interesting concept—in some animals the sex is not fixed but can change during an individual's life span. Males can become female, and females can become males! What is a possible trigger for these sex reversals?

6. Reproductive cycles are often cued by environmental signals. How has global warming affected the reproductive cycle of caribou?

7. Why sex? What is the cost of sexual reproduction (see Figure 46.4 in your text)? What advantage does sexual reproduction provide? In what type of an environment is it favored? Lots of questions, but do we really understand the widespread use of sexual reproduction in animals?

Concept 46.2 Fertilization depends on mechanisms that bring together sperm and eggs of the same species

LO 46.2: Use examples to illustrate adaptations that facilitate fertilization and the survival of fertilized eggs.

8. What conditions are required for *external fertilization*?

9. How have animal species solved the problem of moving sperm to egg in a dry environment?

   How have plants solved that same problem?

10. Consider the problems of fertilization and protection for the offspring. Compare these groups by filling in the blanks in the following chart with the word *high* or *low*.

Group	# Eggs Produced	# Offspring Produced	Protection of the Embryo/Parental
Salmon			
Oysters			
Frogs			
Chicken			
Horse			

11. In populations that are stable in size, each mating pair of animals must produce a pair of offspring over their life span. The preceding exercise was designed to lead you to make the following generalizations: Animals that have internal fertilization tend to produce _____ (many/few) offspring. Animals that have greater parental care tend to produce _____ (many/few) offspring. Animals that have external fertilization tend to produce _____ (many/few) eggs.

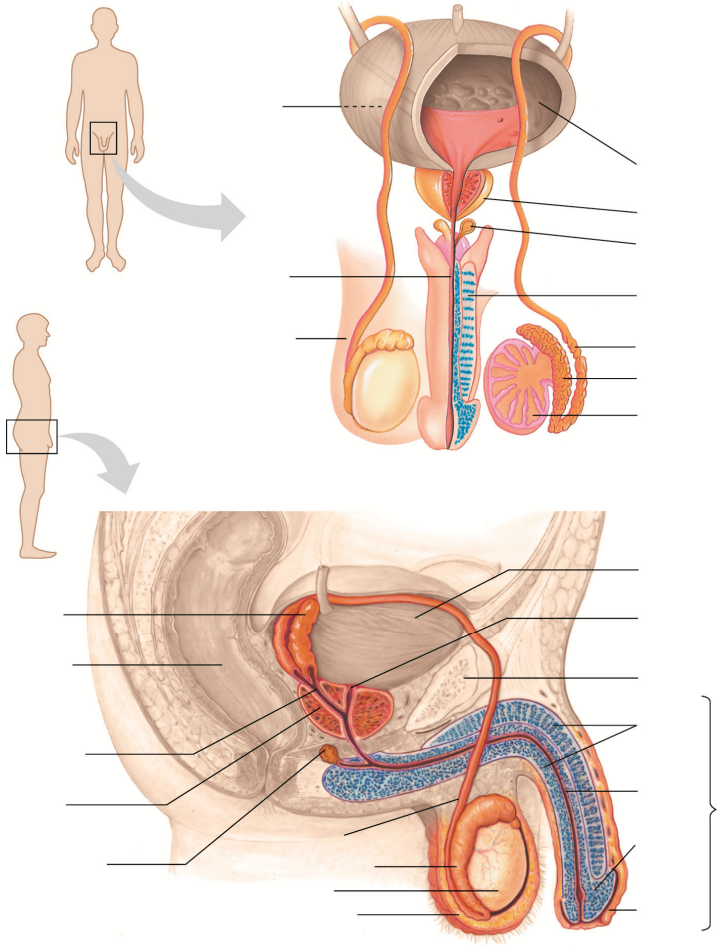
Concept 46.3 Reproductive organs produce and transport gametes

LO 46.3: Describe how the reproductive systems of humans bring about the development and delivery of eggs and sperm.

Male Reproductive Anatomy

12. What are the male gonads and what do they produce?

13. Use Figure 46.9 for the front and side view of the anatomy of the male reproductive system. Label all structures on both views.



14. What is the role of the *seminiferous tubules*?

15. What is the pathway that takes sperm from its point of origin to the outside of the male body? List the structures in order.

    a.

    b.

    c.

    d.

16. Why are human *testicles* (a testis within a scrotum is a testicle) found in the scrotum but an elephant's testes are not?

17. The fluids from three sets of accessory glands plus sperm contribute to form *semen*. Describe the contributions to semen by the following accessory glands.

    a. seminal vesicles

    b. prostate gland

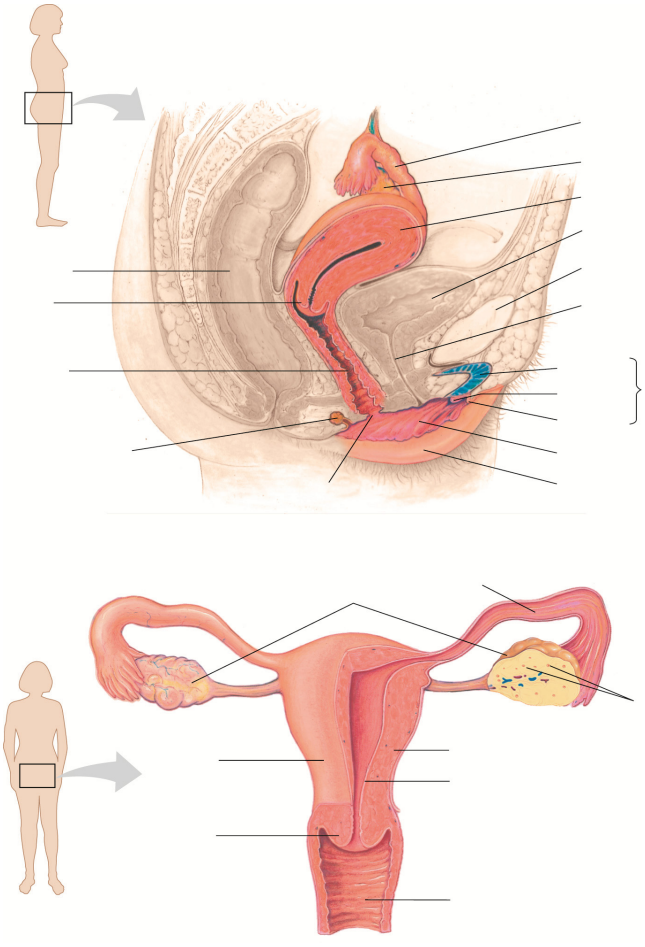
    c. bulbourethral glands

18. How does the spongy erectile tissue of the penis contribute to an erection?

19. What occurs when a male is circumcised?

Female Reproductive Anatomy

20. Use Figure 46.10 for the side and front view of the anatomy of the female reproductive system. Label all structures on both views.



21. What is the relationship between *follicles* and *oocytes*?

22. What is the pathway of the egg in the female reproductive tract?

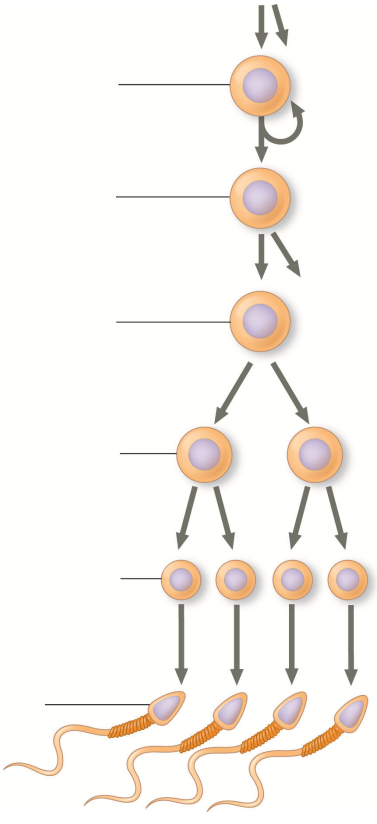
23. Explain the dual role of the vagina.

Gametogenesis

24. What are two similarities between *oogenesis* and *spermatogenesis*?

25. Describe four significant differences between oogenesis and spermatogenesis.

26. Figure 46.11 explores human gametogenesis. Spermatogenesis begins in the *seminiferous tubules* of the testes. On this figure, label the stages of sperm development, the type of division (mitotic or meiotic), and identify the cells as haploid or diploid (n or $2n$). A quick review of meiosis will make this figure more meaningful. Turn to Figure 13.7, p. 259 for a simple overview of meiosis I and meiosis II.



27. How does each of the following contribute to the function of a sperm cell?

    a. acrosome

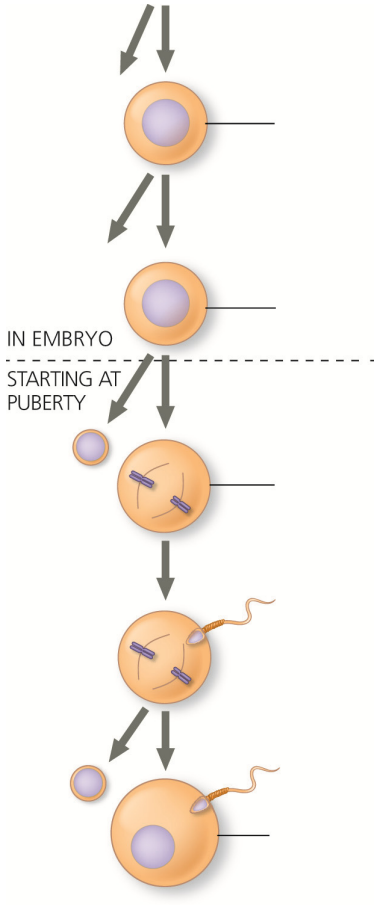
    b. flagella

    c. mitochondria

28. How many viable sperm cells are produced as a result of spermatogenesis?

29. Study oogenesis, also Figure 46.11, on p. 1029 of your text. Note that the process of meiosis begins during embryonic development but is halted before birth. At what stage are all the "eggs" when a female is born?

30. Starting with the primordial germ cell on this figure, label the stages of egg development, the type of division (mitotic or meiotic), and identify the cells as haploid or diploid (*n* or 2*n*). Pay attention to the shift from diploid to haploid.



31. What is the relationship between the developing egg and the follicle?

32. When a female *ovulates*, what is released? (No, it is not an egg.) When is meiosis completed for the ovum?

33. When ovulation occurs, what does the ruptured follicle form? What does this structure secrete?

34. Human males produce hundreds of millions of sperm *per day*! Do a rough count of the number of secondary oocytes a typical human female might produce in her lifetime. (See the end of this *Reading Guide* chapter for a solution.)

35. What is a *polar body*?

36. If the first polar body divided, how many polar bodies could be formed in human female gametogenesis? _____ How many eggs are formed? _____

Concept 46.4 The interplay of tropic and sex hormones regulates reproduction in mammals

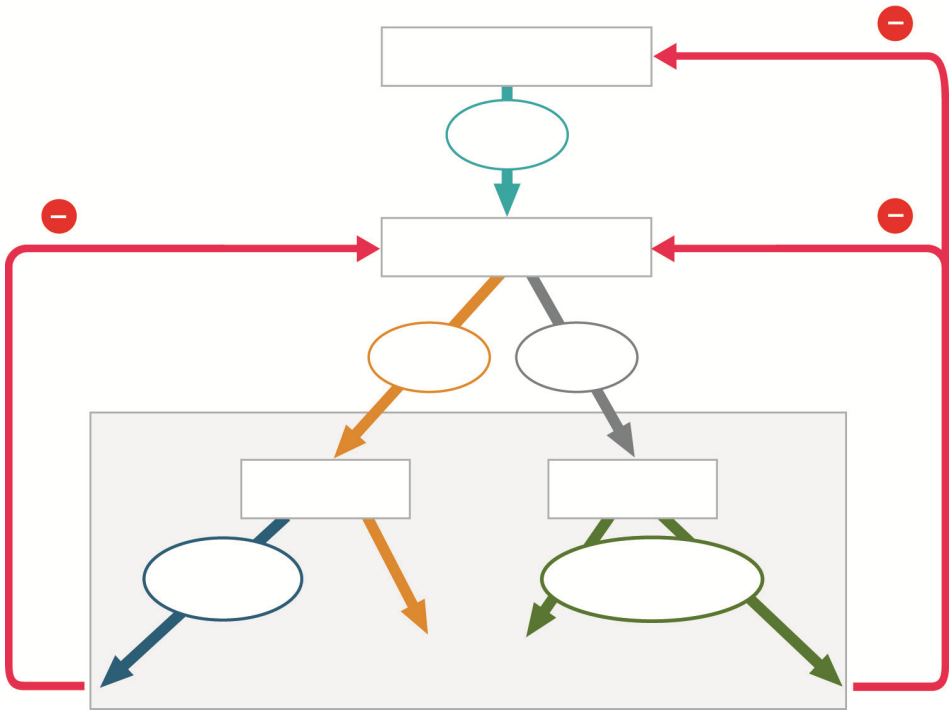
LO 46.4: Compare and contrast hormonal regulation of gamete production in human males and females.

Your work in Chapter 45 on hormones will help you understand the complex hormonal control of human reproduction. This concept serves as another example of cell signaling and feedback regulation. Let's attack it systematically.

37. The hypothalamus secretes _____, which causes the anterior pituitary to produce two hormones, _____ and _____. These are tropic hormones, and their target tissues are in the ovaries and testes. They will regulate gametogenesis, as well as cause the production of high concentrations of _____ in the testes and _____ in the ovaries. (All blanks in this question should be filled in with the name of a hormone.)

38. Explain the difference between biological sex, gender identity, and sexual orientation.

39. Complete the hormonal control of the testes diagram taking note of the feedback systems to the anterior pituitary and the hypothalamus.



40. How do *Sertoli cells* and *Leydig cells* function in spermatogenesis?

41. The female reproduction cycle involves changes in the uterus and events in the ovaries, so we will look at both, the *ovarian cycle* and the *menstrual (uterine) cycle*, at the same time. Refer to Figure 46.14 in your text and its associated explanations.

    a. What is the primary event of the *ovarian cycle*?

    b. What is the primary function of the *uterine cycle*, also termed the *menstrual cycle* in humans?

    c. How must the two cycles coordinate for the successful implantation of a fertilized egg?

    d. When does menstruation occur in a 28-day cycle and what happens to the uterine lining during menstruation?

42. Continue to use Figure 46.14 in your text to describe:

    a. The follicular phase, ovulation, and luteal phase of the ovarian cycle.

    b. The proliferation phase, secretory phase, and menstrual flow stage of the uterine cycle.

    c. The coordination of the ovarian cycle and the uterine cycle.

43. FSH and LH get their names from events of the female reproductive cycle, but they also function in males. How are their functions in females and males similar?

44. There are two ovarian hormones: *estradiol* and *progesterone*. What hormone does the maturing follicle produce?

45. What event does the LH surge trigger?

46. After ovulation, the follicle is transformed into a *corpus luteum*. What hormone does the *corpus luteum* produce?

47. How do high levels of progesterone and estradiol affect the uterine lining (*endometrium*)?

48. If fertilization does not occur, the corpus luteum disintegrates and the levels of both progesterone and estradiol drop. How do low levels of progesterone and estradiol affect the uterine lining?

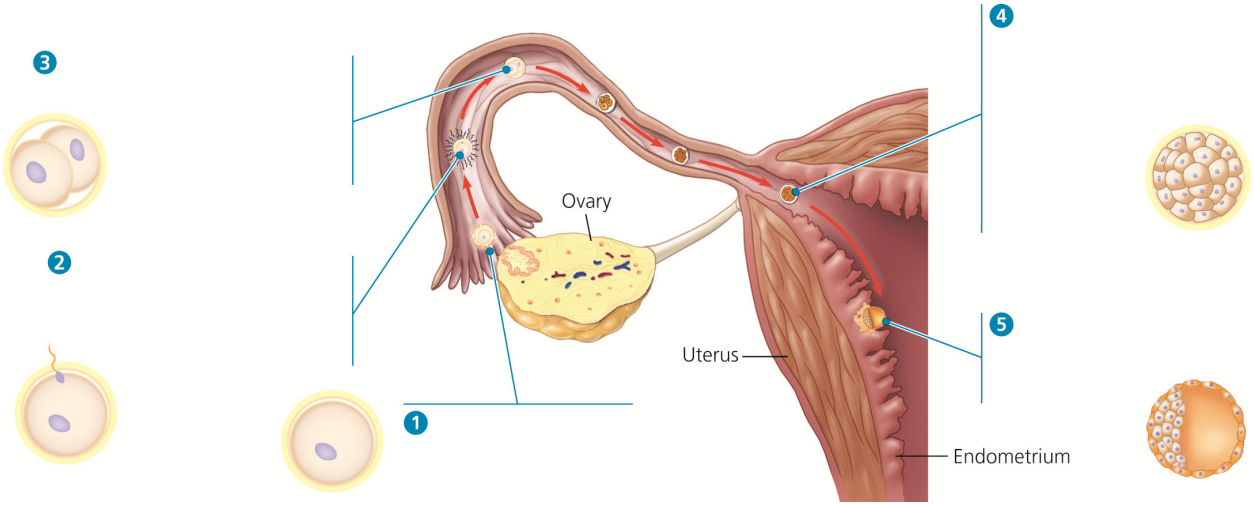
49. By convention, what occurs on *day 1* of the menstrual cycle?

50. What is menopause? What do you think of the suggested evolutionary role of menopause?

Concept 46.5 In placental mammals, an embryo develops fully within the mother's uterus

LO 46.5: Discuss how the female reproductive system supports the embryo along its path to complete development.

51. Figure 46.15 covers the time from ovulation to implantation of the developing embryo (blastocyst). Describe the five events covered in the figure and indicated by the numbers.



52. What is the role of *human chorionic gonadotropin (hCG)* in the early days of pregnancy?

53. Why do pregnancy detection kits use hCG rather than LH or FSH?

54. Describe the formation of the *placenta*.

55. What are four functions of the placenta?

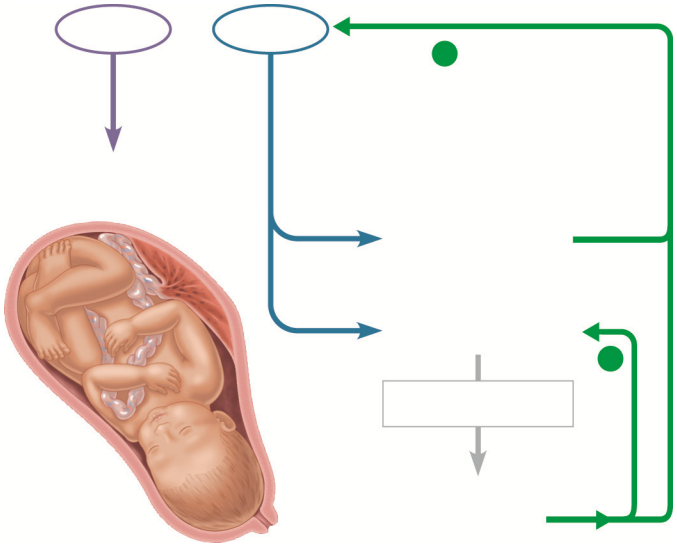
56. What is the difference in development between identical (monozygotic) and fraternal (dizygotic) twins?

57. At the end of the first trimester the embryo is called a *fetus*. What changes have occurred to the embryo in the developmental process?

58. Briefly describe the development of the fetus in the second trimester.

59. Briefly describe the development of the fetus in the third trimester.

60. One of the best examples of positive feedback occurs during labor. Use the figure below to label and indicate the positive feedback loops involved in labor.



61. Briefly describe the three stages of labor.

62. Explain how each of these hormonal contraceptives prevents pregnancy.

    a. birth control pills utilizing synthetic estrogen and synthetic progesterone

    b. progestin

63. Hormone-based contraceptives typically have pregnancy rates of 1% or less. What are their negative side effects?

64. In what ways are tubal ligation and vasectomy similar?

65. Explain how *in vitro* fertilization works.

Test Your Understanding, p. 1041.

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____

7. _____ 8. _____