Chapter 1—Sex and Development

MULTIPLE CHOICE

1. What is the normal number of chromosomes for a human?
   a. 44
   b. 42
   c. 40
   d. 46
   e. 45

   ANS: D PTS: 1 DIF: Easy REF: p. 14

2. Which of the following properties does a zygote possess?
   a. Carries XX, XY, or YY chromosomes.
   b. Cell division occurs before fertilization.
   c. Carries 1 pair of sex chromosomes and 22 pairs of autosomal chromosomes.
   d. Carries an X or Y chromosome and a single set of 22 autosomal chromosomes.
   e. Undergoes multiple meiotic cell divisions to produce an embryo.

   ANS: C PTS: 1 DIF: Easy REF: p. 14

3. Which of the following statements is true about sex ratios?
   a. Based on production of sperm, we would expect the sex ratio to be 2 males for every 1 female.
   b. More females than males are conceived.
   c. By 20 years of age, the ratio of males to females is 1:1.
   d. About the same number of males and females are born.
   e. By 60 years of age, there are more males than females.

   ANS: C PTS: 1 DIF: Moderate REF: p. 14

4. Whether a fetus develops as a male or female depends on
   a. a complex interaction of genes and environment.
   b. hormones produced by the mother during pregnancy.
   c. how many sperm enter the egg.
   d. the number of autosomes present.
   e. only on which sex chromosomes are present.

   ANS: A PTS: 1 DIF: Easy REF: p. 21

5. What is the normal number of pairs of chromosomes for humans?
   a. 21
   b. 22
   c. 23
   d. 24
   e. 42

   ANS: C PTS: 1 DIF: Easy REF: p. 14

6. What is the sex chromosome make-up of a normal male?
   a. XXY
   b. XY
   c. XX
   d. XXX
   e. XO

   ANS: B PTS: 1 DIF: Easy REF: p. 14

7. Autosomes are
   a. non-sex chromosomes.
   b. another term for the sex chromosomes.
   c. a pair of chromosomes.
   d. chromosomes with mutated genes.
   e. capable of forming Barr bodies.

   ANS: A PTS: 1 DIF: Easy REF: p. 14

8. Sperm sorting relies on _____ between sperm carrying the X chromosome and sperm carrying the Y chromosome.
   a. differences in electrical charges
   b. direct microscopic examination and recognition of visual differences
   c. differences in the swimming speed
   d. magnetic differences
   e. differences in the amounts of fluorescent dye binding.

   ANS: E PTS: 1 DIF: Moderate REF: p. 15

9. The process of sex selection
   a. is only possible after the egg has been fertilized.
   b. is only used to avoid having children with genetic disorders.
   c. carries a small risk of miscarriage for the mother.
   d. allows a couple to choose the sex of their child.
   e. allows a couple to alter the sex of their unborn child.

   ANS: D PTS: 1 DIF: Moderate REF: p. 15

10. What is involved in *in vitro* fertilization?
    a. The woman receives hormone treatments.
    b. Eggs are surgically removed from the woman's ovaries.
    c. Both sperm and eggs are placed in a dish to allow fertilization.
    d. A sperm sample must be provided.
    e. All of these are steps in *in vitro* fertilization.

    ANS: E PTS: 1 DIF: Difficult REF: p. 16

11. In humans, fertilization usually occurs
    a. in the ovary.
    b. in the fallopian tube.
    c. in the vagina.
    d. in the uterus.
    e. right at the cervix.

    ANS: B PTS: 1 DIF: Easy REF: p. 17

12. How many sperm usually enter an egg?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

    ANS: A PTS: 1 DIF: Easy REF: p. 17

13. What are the different parts of a blastocyst?
    a. Inner cell mass
    b. Inner cavity
    c. Middle layer of cells
    d. Inner cell mass and inner cavity
    e. All of these .

    ANS: D PTS: 1 DIF: Easy REF: p. 18

14. The chorion
    a. contains human embryonic stem cells (hESC).
    b. is a membrane inside the embryo.
    c. protects the embryo.
    d. forms in the last trimester of pregnancy.
    e. is an extension of the embryo.

    ANS: C PTS: 1 DIF: Moderate REF: p. 18

15. Human chorionic gonadotropin (hCG)
    a. nourishes the embryo.
    b. stimulates the formation of the placenta.
    c. is present in undetectable amounts throughout the pregnancy.
    d. prevents the expulsion of the embryo.
    e. is transported to the embryo through the umbilical cord.

    ANS: D PTS: 1 DIF: Difficult REF: p. 18

16. The villi
    a. extend into the spaces in the uterine wall.
    b. are fingerlike projections.
    c. will eventually form part of the placenta.
    d. come in contact with the maternal blood.
    e. All of these are true.

    ANS: E PTS: 1 DIF: Moderate REF: p. 18

17. At what point in gestation does the fetus have a well-formed face with eyes that can open?
    a. 1-2 weeks after fertilization
    b. 2-3 weeks
    c. 5 weeks
    d. 8 weeks
    e. 16 weeks

    ANS: E PTS: 1 DIF: Easy REF: p. 20

18. During which trimester(s) does the most rapid fetal growth take place?
    a. first trimester
    b. second trimester
    c. third trimester
    d. There is equal fetal growth in all trimesters.
    e. It varies depending on each individual pregnancy.

    ANS: C PTS: 1 DIF: Easy REF: p. 18-19

19. At what point in development is the embryo considered a fetus?
    a. After the first month.
    b. After eight weeks.
    c. After the fourth month.
    d. After the sixth month.
    e. Just before birth.

    ANS: B PTS: 1 DIF: Moderate REF: p. 20

20. When can the mother usually feel movements of the fetus' arms and legs?
    a. within days after fertilization
    b. during the second month
    c. around the fourth month
    d. not until the third trimester
    e. only in the last two months of pregnancy

    ANS: C PTS: 1 DIF: Moderate REF: p. 20

21. When can ultrasound be used to determine the sex of a fetus?
    a. within days after implantation
    b. 1-2 weeks after fertilization
    c. at the end of the first trimester
    d. at the beginning of the second trimester
    e. not until the third trimester

    ANS: D PTS: 1 DIF: Difficult REF: p. 20

22. Which of the following is **FALSE**?
    a. Testes secrete the hormone testosterone.
    b. Testosterone promotes the development of male reproductive organs.
    c. Testosterone promotes the development of the ovary.
    d. Testosterone promotes the development of secondary male sex characteristics.
    e. The Y chromosome must be present for the secretion of testosterone.

    ANS: C PTS: 1 DIF: Easy REF: p. 21

23. Which of the following is **FALSE** about androgen insensitivity?
    a. Complete androgen insensitivity is caused by a mutation in a gene on the X chromosome.
    b. Individuals have a mutation in the androgen receptor gene.
    c. Development of individuals continues as if testosterone were absent.
    d. Individuals with this condition have an XX sex chromosome combination.
    e. Individuals with complete androgen insensitivity have the chromosome combination of a female but appear male.

    ANS: D PTS: 1 DIF: Difficult REF: p. 23-24

24. Individuals with complete androgen insensitivity
    a. menstruate after reaching puberty.
    b. are phenotypically males.
    c. often have testes present in their abdomens.
    d. usually have no problems reproducing.
    e. have a set of XX sex chromosomes.

    ANS: C PTS: 1 DIF: Difficult REF: p. 23-24

25. Gonadal sex is determined
    a. at fertilization.
    b. at birth.
    c. upon the formation of external genitalia.
    d. when the presence or absence of the *SRY* gene determines the formation of testes or ovaries.
    e. when either testosterone or estrogen is produced.

    ANS: D PTS: 1 DIF: Difficult REF: p. 21

26. The _____ will eventually form the fetus.
    a. inner cell mass of the blastocyst
    b. outer layer of cells of the blastocyst
    c. internal cavity of the blastocyst
    d. outer layer of chorion
    e. inner layer of placenta

    ANS: A PTS: 1 DIF: Easy REF: p. 18

27. The _____ is the source for embryonic stem cells.
    a. inner cell mass of the blastocyst
    b. outer layer of cells of the blastocyst
    c. internal cavity of the blastocyst
    d. outer layer of chorion
    e. inner layer of placenta

    ANS: A PTS: 1 DIF: Easy REF: p. 18

28. Sex testing in the Olympics prior to 2000 was based on
    a. testosterone levels.
    b. the presence or absence of the Y chromosome.
    c. ultrasound scanning.
    d. the presence or absence of Barr bodies.
    e. estrogen levels.

    ANS: D PTS: 1 DIF: Moderate REF: p. 25

29. Intersexuality
    a. is determined only by the number of sex chromosomes an individual possesses.
    b. is a condition in which the chromosomal and phenotypic sex of an individual match.
    c. describes a condition in which an individual's phenotype cannot be classified as either male or female.
    d. is determined only by the autosomes an individual possesses.
    e. is determined at fertilization.

ANS: C PTS: 1 DIF: Moderate REF: p. 25

30. How many Barr bodies would be found in cells from an individual with Turner syndrome?
    a. 0
    b. 1
    c. 2
    d. 3
    e. The number would vary depending on the age of the individual.

    ANS: A PTS: 1 DIF: Moderate REF: p. 25

TRUE/FALSE

1. In an ultrasound scan, the sex organs can be seen as early as 7 weeks after implantation.

   ANS: F PTS: 1 DIF: Moderate REF: p. 20

2. Development of the sex organs is influenced by the presence or absence of the hormone testosterone.

   ANS: T PTS: 1 DIF: Easy REF: p. 21

3. Chromosomal sex is determined at fertilization.

   ANS: T PTS: 1 DIF: Easy REF: p. 21

4. Complete androgen insensitivity is genetically controlled.

   ANS: T PTS: 1 DIF: Moderate REF: p. 23

5. Sperm containing the X chromosome have more DNA than sperm containing the Y chromosome and therefore glow brighter in the sperm sorting procedure.

   ANS: T PTS: 1 DIF: Easy REF: p. 15

6. Sex selection can use sperm sorting or preimplantation genetic diagnosis.

   ANS: T PTS: 1 DIF: Easy REF: p. 15

7. In males, the development of internal and external sex organs depends on the actions of the *SRY* gene located on the Y chromosome.

   ANS: T PTS: 1 DIF: Moderate REF: p. 21

8. In females, one X chromosome out of the two becomes a Barr body.

   ANS: T PTS: 1 DIF: Easy REF: p. 24

9. An individual who is (45, X) would be phenotypically female.

   ANS: T PTS: 1 DIF: Difficult REF: p. 25

10. An individual who is (47, XXY) would be phenotypically female.

ANS: F PTS: 1 DIF: Difficult REF: p. 21

MATCHING

Match the appropriate chromosomal composition to the sex of the individual.
a. Female
b. Male

1. XX
2. XY
3. XO
4. XXY

1. ANS: A PTS: 1 DIF: Easy REF: p. 14
2. ANS: B PTS: 1 DIF: Easy REF: p. 14
3. ANS: A PTS: 1 DIF: Moderate REF: p. 14
4. ANS: B PTS: 1 DIF: Moderate REF: p. 14

Match the appropriate term with the description.
a. finger-like projections
b. large hollow ball of cells
c. attachment of embryo to uterus
d. source of embryonic stem cells
e. hCG is produced by this membrane

5. Blastocyst
6. Implantation
7. Villi
8. Inner cell mass
9. Chorion

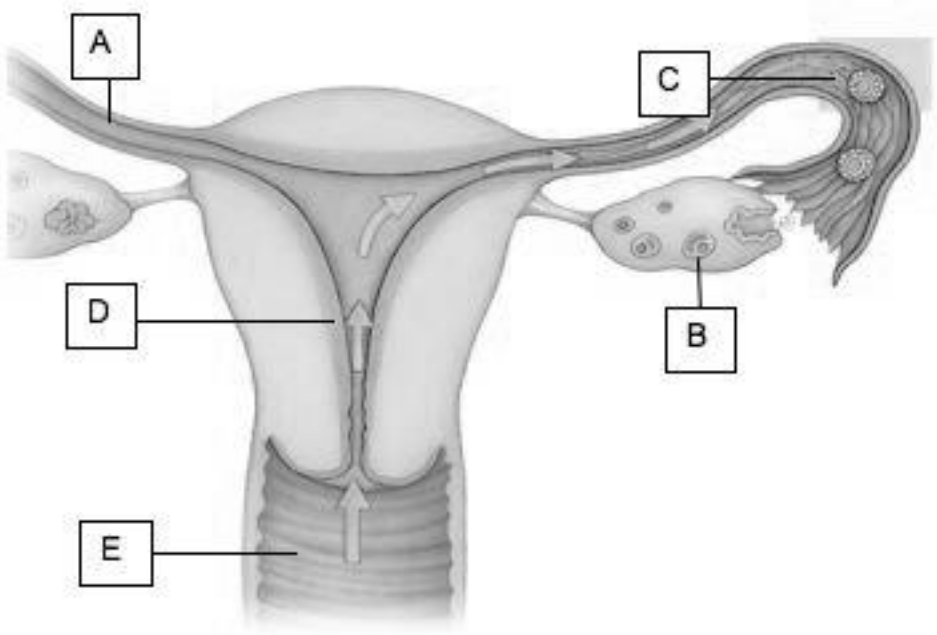
5. ANS: B PTS: 1 DIF: Easy REF: p. 18
6. ANS: C PTS: 1 DIF: Easy REF: p. 18
7. ANS: A PTS: 1 DIF: Moderate REF: p. 18
8. ANS: D PTS: 1 DIF: Moderate REF: p. 18
9. ANS: E PTS: 1 DIF: Moderate REF: p. 18

Match the description to the number of chromosomes.
a. normal number of chromosomes in humans
b. number of autosomal chromosomal pairs
c. number of chromosomes present in an individual with Kleinfelter syndrome
d. number of chromosomes present in an individual with Turner syndrome

10. 22
11. 46
12. 47
13. 45

10. ANS: B PTS: 1 DIF: Easy REF: p. 14
11. ANS: A PTS: 1 DIF: Easy REF: p. 14
12. ANS: C PTS: 1 DIF: Moderate REF: p. 25
13. ANS: D PTS: 1 DIF: Moderate REF: p. 25

Match the following descriptions with the appropriate letter.



14. sperm enter the female reproductive tract here
15. implantation will occur here
16. fertilization occurring
17. fallopian tube
18. the nonspecific gonad develops into this structure in human females

14. ANS: E PTS: 1 DIF: Moderate REF: p. 17-18
15. ANS: D PTS: 1 DIF: Moderate REF: p. 17-18
16. ANS: C PTS: 1 DIF: Moderate REF: p. 17-18
17. ANS: A PTS: 1 DIF: Moderate REF: p. 17-18
18. ANS: B PTS: 1 DIF: Moderate REF: p. 17-18

ESSAY

1. In countries like China and India, sex selection using ultrasound, amniocentesis, preimplantation genetic diagnosis, and sperm sorting has resulted in an imbalance of male and female offspring in the population. The trend has led to a gradual increase in the number of males born. How would you anticipate this sex selection could influence society in these countries? Do you think the same possibility exists in this country?

ANS:
Answers will vary but should discuss how the modified sex ratio could affect schooling, work, marriage, etc. Answers should also point out that this is less likely to occur in the United States because there is less of a demand for male children.

PTS: 1 DIF: Moderate REF: Entire chapter

2. One technology that has been valuable for couples who have a known increased risk of passing on a genetic disease (biochemical or chromosomal) is preimplantation genetic diagnosis (PGD). Ethically, some individuals feel this is "playing God" and should not be done; others consider the method a "scientific miracle" and are grateful for the opportunity to virtually insure that they will not have a disease-stricken child. Where would you fall on this spectrum of varying opinions? What factors have you considered in forming your opinion? Now suppose that you and your spouse are interested in starting a family but find out that the female (you or your spouse) is a carrier for Hunter syndrome, a genetic disorder in which the affected infants become blind, deaf, mentally retarded, and seldom live past age 5. Does this change your opinion of using PGD to select for a healthy child? Explain.

ANS:
Answers will vary but could include discussion about religious beliefs, societal costs, personal costs, mental, physical, and emotional stress, and how having a child with a severe genetic disorder can affect all the individuals involved. Answers may also delve into usage of PGD in cases of genetic disorders of varying severity.

PTS: 1 DIF: Moderate REF: Entire chapter

SHORT ANSWER

1. The X and Y chromosomes of the human genome are termed the sex chromosomes. Explain how the sex chromosome complement for a normal female and a normal male is determined at fertilization.

ANS:
Since females only have two X chromosomes, all of their eggs will have an X chromosome. Since males have an X and a Y chromosome, half of the males' sperm will contain an X and half a Y chromosome. If the egg is fertilized with an X chromosome-containing sperm, the resulting zygote will be XX, female. If the egg is fertilized with a Y chromosome-containing sperm, the resulting zygote will be XY, male.

PTS: 1 DIF: Easy REF: p. 14

2. Distinguish between chromosomal, gonadal, and phenotypic stages of sex development for a male. When does each occur and what is the key feature of each?

ANS:
Chromosomal sex is determined at fertilization and depends on whether the zygote carries two X chromosomes or an X and a Y. At about the seventh or eighth week of pregnancy, the presence of the Y chromosome causes the nonspecific gonads to become testes. In the phenotypic stage, sometime before the 12th week, production of masculinizing hormones such as testosterone lead to the formation of male external genitals.

PTS: 1 DIF: Difficult REF: p. 21

3. Describe the genetic factors required for the development of the male internal and external sex organs. Describe the genetic factors required for the development of the female internal and external sex organs.

   ANS:
   In males, the pathway begins with the action of a gene (*SRY*) on the Y chromosome, the presence of at least one X chromosome, and expression of genes carried on the other 22 chromosomes. In females, the pathway begins with the presence of two X chromosomes, the absence of Y chromosome genes, and expression of a female-specific set of genes on the X chromosome and the other 22 chromosomes.

   PTS: 1 DIF: Moderate REF: p. 21

4. Explain why the sex ratio for humans changes over time.

   ANS:
   Although we cannot be completely certain about the numbers or the reasons, estimates indicate that more males are conceived than females. This does not mean that the sex ratio at birth reflects this imbalance. At birth the ratio is about 1:1.05 (100 females for every 105 males). As a generation ages, these numbers change. More males than females die in childhood, and when this generation reaches the age of 20, the ratio of males to females moves closer to 1:1. Beyond this age, females begin to outnumber males because men have a shorter life span than women.

   PTS: 1 DIF: Moderate REF: p. 14

PROBLEM

1. During early embryonic development, one of the X chromosomes is randomly inactivated in each cell to form a Barr body, a condensed structure near the nuclear envelope that can be used to identify the sex of the individual and/or the presence of a sex chromosome abnormality. In individuals with abnormal numbers of X chromosomes, all but one of the X chromosomes will be inactivated. What would the number of Barr bodies, sex, and syndrome (if any) be for each of the following situations?

Sex chromosomes	Number of Barr bodies	Sex	Syndrome (if any)
XX	_____	_____	_____
XY	_____	_____	_____
XXX	_____	_____	_____
XO	_____	_____	_____
XYY	_____	_____	_____
XXY	_____	_____	_____
XXXY	_____	_____	_____

ANS:

Sex chromosomes	Number of Barr bodies	Sex	Syndrome (if any)
XX	1	F	Normal female
XY	0	M	Normal male
XXX	2	F	Not listed in chapter

XO	0	F	Turner syndrome
XYY	0	M	Not listed in chapter
XXY	1	M	Kleinfelter syndrome
XXXY	2	M	Kleinfelter syndrome

PTS: 1 DIF: Difficult REF: p. 24-25