Name:_____ Class:_____ Date:_____

Chapter 02 - Cells and Cell Division

True / False

1. Mitotic divisions reduce the number of chromosomes found in daughter cells.
    a. True
    b. False
ANSWER: False

2. Cytokinesis usually occurs just prior to mitosis.
    a. True
    b. False
ANSWER: False

3. Autosomal chromosome pairs are identical, whereas the sex chromosome pair in males is not.
    a. True
    b. False
ANSWER: True

4. Crossing over is partially responsible for our genetic diversity.
    a. True
    b. False
ANSWER: True

5. Random assortment occurs between chromatids of homologous chromosome pairs.
    a. True
    b. False
ANSWER: False

6. A polar body, once formed, has no further function and dies.
    a. True
    b. False
ANSWER: True

7. One treatment for Gaucher disease is enzyme replacement therapy.
    a. True
    b. False
ANSWER: True

8. Primary oocytes and spermatogonia are both haploid cells.
    a. True
    b. False
ANSWER: False

9. The four macromolecules making up our cells allow for the same structure and function across all cells in the body.
    a. True
    b. False

ANSWER: False

10. Mitosis is a process that is unique to humans.
    a. True
    b. False

ANSWER: False

Multiple Choice

11. The process of meiosis results in ____.
    a. the production of four identical cells
    b. no change in the chromosome number from parental cells
    c. a doubling of the chromosome number
    d. a reduction in the chromosome number
    e. two diploid cells

ANSWER: d

12. In the cell cycle, the G1 phase represents ____.
    a. the stage of DNA synthesis
    b. splitting of the chromosomes into chromatids
    c. a period of growth
    d. the stage of actual cell division
    e. the stage just prior to meiosis

ANSWER: c

13. Ribosomes are organelles that are involved in ____.
    a. plasma membrane selectivity
    b. cellular energy production
    c. protein synthesis
    d. transport of materials
    e. DNA replication

ANSWER: c

14. Which genetic diseases involve defects in DNA repair that affect cell division?
    a. Gaucher disease and Werner syndrome
    b. Kearns-Sayre syndrome and progeria
    c. progeria and Gaucher disease
    d. Gaucher disease and cystic fibrosis
    e. progeria and Werner syndrome

ANSWER: e

15. Autosomes represent ____.
    a. all chromosomes including the sex chromosomes
    b. the half of the chromosomes inherited from one parent

c. all chromosomes other than the sex chromosomes
d. chromosome pairs with unlike members
e. those chromosomes found only in gametes

ANSWER: c

16. During meiosis in an organism where $2n = 8$, how many chromatids will be present in a cell at the beginning of meiosis II?
a. 2
b. 4
c. 6
d. 8
e. 12

ANSWER: d

17. The Hayflick limit describes ____.
a. the size limit to which a cell can grow
b. the number of divisions a cultured cell can undergo
c. the largest number of chromosomes an organism can possess
d. the most cells an organism can have
e. how rapidly DNA replication can occur

ANSWER: b

18. In meiosis, homologous chromosomes separate in ____.
a. metaphase I
b. anaphase I
c. metaphase II
d. anaphase II
e. telophase

ANSWER: b

19. A cell that cannot form spindle fibers cannot ____.
a. engage in energy production
b. exchange gases across the plasma membrane
c. perform mitosis nor meiosis
d. perform DNA replication
e. engage in protein synthesis

ANSWER: c

20. A cell in G_0 state ____.
a. is actively growing before cell division begins
b. has a cleavage furrow and the cytoplasm is beginning to divide
c. is actively replicating chromosomes
d. is in cytokinesis

e. has entered a resting stage and is not actively dividing

ANSWER: e

21. A centromere is least likely to ____.
    a. divide in anaphase of mitosis
    b. connect sister chromatids
    c. attach chromosomes to spindle fibers
    d. cross over during prophase I of meiosis
    e. be a component of DNA

ANSWER: d

22. The underlying problem in Gaucher disease is ____.
    a. the spontaneous breakdown of red blood cells
    b. the accumulation of fat in white blood cells
    c. the breakdown of the myelin sheath around nerves
    d. a hypertrophied spleen
    e. the lack of critical liver enzymes

ANSWER: b

23. Which biomolecule is most associated with the structure and function of cell membranes?
    a. Polysaccharides
    b. steroids
    c. DNA
    d. phospholipids
    e. ATP

ANSWER: d

24. Proteins function ____.
    a. as energy carriers
    b. as the ‘backbone’ of the DNA molecule
    c. as component parts of enzymes
    d. in energy storage within the cell nucleus
    e. in transmission of genetic information

ANSWER: c

25. Ribosomes are most closely associated with ____.
    a. the Golgi complex
    b. lysosomes
    c. mitochondria
    d. smooth endoplasmic reticulum
    e. the cytoplasm and rough endoplasmic reticulum

ANSWER: e

26. In meiosis, cells become haploid ____.

a. at the end of telophase I
b. during metaphase I
c. during anaphase I
d. at the beginning of metaphase II
e. at the end of prophase II

ANSWER: a

27. In meiosis of oogenesis, how many mature eggs result?
a. one
b. two
c. three
d. four
e. five

ANSWER: a

28. During spermatogenesis in meiosis II, ____ form(s).
a. primary spermatocytes
b. secondary spermatocytes
c. spermatids
d. mature sperm
e. a zygote

ANSWER: c

29. A rare genetic disorder called Gaucher disease may strike as many as one in 450 people of ____ descent.
a. Middle Eastern
b. Western European
c. African American
d. British
e. Eastern European

ANSWER: e

30. Macromolecules including sugars, glycogen, and starches composed of sugar monomers linked and cross-linked together are known as ____.
a. carbohydrates
b. lipids
c. proteins
d. fatty acids
e. nucleic acids

ANSWER: a

31. Carbohydrates ____.
a. act as energy sources for cells
b. include fats and oils
c. are made of nucleic acids

d. act as protein builders
e. are also called steroids

ANSWER: a

32. Large cellular polymers assembled by chemically linking monomers together are called ____.
a. carbohydrates
b. lipids
c. proteins
d. nucleic acids
e. macromolecules

ANSWER: e

Completion

33. There are _____ autosomes present in a human sperm cell.
ANSWER: 22
twenty-two
twenty two

34. The chromosomal structure that anchors the spindle fiber to the chromosome is known as the _____.
ANSWER: centromere

35. In mitosis, chromatids separate and move to the center of the cell during _____.
ANSWER: metaphase

36. In meiosis, sister chromatids separate and move to opposite poles of the spindle during _____.
ANSWER: anaphase II

37. In cell division, toward the end of nuclear division, the cytoplasm divides by a process called _____ to produce two identical cells.
ANSWER: cytokinesis

38. The only cytoplasmic organelles in animal cells aside from nuclei that contain DNA are _____.
ANSWER: mitochondria

39. The series of flattened sacs and associated vesicles in the cytoplasm of a cell is the _____.
ANSWER: Golgi complex

40. Cells are largely constructed from four classes of large molecules called _____.
ANSWER: macromolecules

41. The condition in which each chromosome is represented twice as a member of a homologous pair is called _____.
ANSWER: diploid
2*n*

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42. _____ is a symptom of Gaucher disease (indicate any one).
ANSWER: Brittle bones
Fatigue
Painful abdomen
Tender abdomen
Enlarged spleen
Enlarged liver

43. _____ is used to diagnose and treat genetic disorders.
ANSWER: Genetic testing
Genetic counseling

44. Lipids are a class of cellular macromolecules that are _____ in water.
ANSWER: insoluble

45. In both progeria and Werner syndrome, cells are switched from a growth to a maintenance mode, halting _____.
ANSWER: divisions
cell divisions

46. Identical gene loci are located on _____.
ANSWER: homologous chromosomes
homologues

47. The two types of nucleic acids are _____ and _____.
ANSWER: DNA; RNA
RNA; DNA

48. There are two cellular domains: the _____ and the _____.
ANSWER: plasma membrane; cytoplasm
cytoplasm; plasma membrane

49. The three parts of interphase, in order, are _____, _____, and _____.
ANSWER: G1; S; G2

50. Sister chromatids are joined by a common centromere and each carries identical _____.
ANSWER: genetic information
genes

Essay

51. Describe the two ways in which meiosis produces new combinations of genes.
ANSWER: Random assortment of maternal and paternal chromosomes during cell division is the first way that meiosis produces new combinations of genes. In each pair of chromosomes, one copy was inherited from each parent. Random combinations of parental chromosomes arise in metaphase I when the maternal and paternal members of each pair line up at random with respect to all the other pairs. In other words, the arrangement of any chromosomal pair can be maternal:paternal or paternal:maternal. As a result, cells produced in meiosis I are

much more likely to receive a *combination* of maternal and paternal chromosomes than they are to receive a complete set of maternal chromosomes or a complete set of paternal chromosomes.

Crossing over is the second way meiosis generates new combinations of genes. This process involves the physical exchange of parts between non-sister chromatids. Members of a chromosome pair carry identical genes but may carry different versions of those genes (alleles). For example, a chromosome may carry a gene for eye color. One copy of the chromosome may carry an allele for blue eyes, while the other carries an allele for brown eyes. The exchange of chromosome parts during crossing over creates new combinations of alleles inherited from each parent.

52. Compare and contrast the events and results of oogenesis and spermatogenesis.

ANSWER: In males, the production of sperm, known as spermatogenesis, occurs in the testes. Cells called spermatogonia line the tubules of the testes and divide by mitosis from puberty until death, producing daughter cells called spermatocytes. Spermatocytes undergo meiosis, and the four haploid cells that result are called spermatids. Each spermatid develops into a mature sperm. The tubules within the testes contain many spermatocytes, and large numbers of sperm are always in production.

In females, the production of gametes is called oogenesis and takes place in the ovaries.
Cells in the ovary known as oogonia begin mitosis early in embryonic development and finish a few weeks later. During meiosis I, one cell, destined to become the female gamete, receives about 95% of the cytoplasm and is called a secondary oocyte. The larger cell becomes the functional gamete (the ovum) and the nonfunctional, smaller cells are known as a polar bodies. If the secondary oocyte is fertilized, meiosis II is completed quickly and the haploid nuclei of the ovum and sperm fuse to produce a diploid zygote.

53. Should the cost of treatment for a genetic disorder be an important consideration for insurance companies when deciding whether or not to cover the treatment? Justify your reasoning.

ANSWER: Answers will vary. One argument may be that insurance companies have to make decisions based on the best use of their available resources and that it would not be ethical, for example, to spend $1,000,000 a year for any one patient's treatment when it might be possible to help hundreds or thousands of people with that same money.

Alternatively, one could argue that a dollar value cannot be placed on life. The cost of treatment for a person should not, in any way, come down to money. The purpose of medical insurance is to take care of people, no matter what the cost. By accepting premium payments from their clients, insurance companies are agreeing to cover the patient and that it should not matter how much that treatment costs.

54. List the four macromolecules that make up cells and give a brief description of the structure and function of each.

ANSWER: Carbohydrates include small, water-soluble sugars and large polymers made of sugars. In the cell, carbohydrates have three important functions: They are structural components of cells; they act as energy sources for the cell; and, in combination with proteins on the surface, they give cells a molecular identity.

Lipids are a structurally and functionally diverse class of biological molecules partially defined by their insolubility in water. Lipids have many functions: They are structural components of membranes, some serve as energy reserves, while others act as hormones and vitamins. Lipids are classified into three major groups: fats and oils, phospholipids, and steroids. The phospholipids play important roles in the structure and function of the cell membrane.

Proteins are the most functionally diverse class of macromolecules. Proteins are polymers, made up of one or more chains of subunits, called amino acids. The varied structures of proteins are reflected in their diversity of functions.

Nucleic acids are polymers made from nucleotide subunits. Nucleotides themselves have important functions in energy transfer, but nucleic acids are the storehouses of genetic information in the cell. The information is encoded in the nucleotide sequence.

55. Explain the structure and function of the cell nucleus. Include the terms nuclear envelope, nucleoli, chromatin, chromosomes, autosomes, and sex chromosomes.

ANSWER: The largest organelle is the nucleus. It is enclosed by a double membrane called the nuclear envelope. Within the nucleus, dense regions known as nucleoli synthesize ribosomes. Dark strands of chromatin are seen throughout the nucleus. As a cell prepares to divide, the chromatin condenses to form the chromosomes. In humans, there are 23 pairs of chromosomes (46 chromosomes) in most cells Certain cells, such as sperm and eggs, carry only one copy of each chromosome and have 23 unpaired chromosomes. Human males have one pair of chromosomes that are not completely matched. Members of this pair are known as sex chromosomes. There are two types of human sex chromosomes: X and Y. Males carry an X chromosome and a Y chromosome, and females carry two X chromosomes. All other chromosomes are known as autosomes.

56. Briefly summarize the four phases of mitosis and cytokinesis.

ANSWER: Prophase: Chromosomes become visible as threadlike structures. As they continue to condense, they are seen as double structures, with sister chromatids joined at a single centromere.
Metaphase: Chromosomes become aligned at equator of cell.
Anaphase: Centromeres divide, and chromosomes move toward opposite poles.
Telophase: Chromosomes decondense; nuclear membrane forms.

Cytokinesis--Cleavage furrow gradually tightens and the cell eventually divides in two, distributing organelles to the daughter cells.

57. Define interphase and describe its three stages.

ANSWER: Before cells can divide, they must grow to the size of the parental cell. Growth takes place during the first stage of interphase, the G1 stage. G1 begins immediately after division; during this stage, many cytoplasmic components, including organelles, membranes, and ribosomes, are made. G1 is followed by the S (synthesis) phase, during which a copy of each chromosome is made. A period known as G2 takes place before the cell is ready to begin a new round of division.

58. Some cells retain the capacity to divide throughout their life cycle, whereas others do not divide in adulthood. Give one example of each type.

ANSWER: Cells in bone marrow continually move through the cell cycle, producing about 2 million red blood cells each second.

Skin cells constantly divide to replace dead cells that are sloughed off the surface of the body.

Many cells in the nervous system leave the cell cycle, enter G0, and do not divide in adulthood.

59. Explain the major difference between daughter cells formed by mitosis and those formed by meiosis. What occurs when two daughter cells formed during meiosis fuse?

ANSWER: In mitosis, each daughter cell receives two copies of each chromosome. Cells with two copies of each chromosome are diploid (2*n*) and have 46 chromosomes. In meiosis, members of a chromosome pair separate from each other, and each daughter cell receives a haploid (*n*) set of 23 chromosomes. These haploid cells form gametes (sperm and egg). Fusion of two haploid gametes in fertilization restores the chromosome number to the diploid number of 46, providing a full set of genetic information to the fertilized egg.

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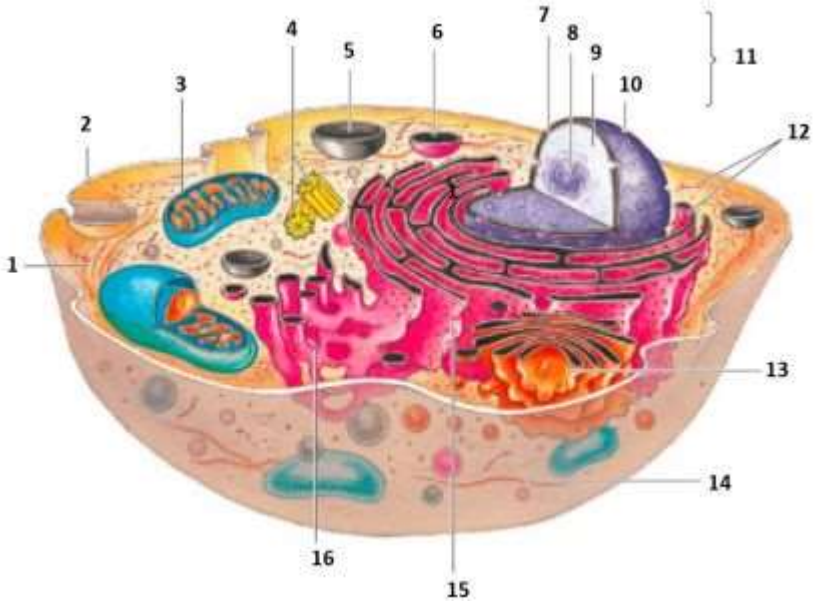
Figure 2-1



60. All cells are fundamentally similar at a structural level. Using the accompanying diagram of a generalized human cell, name as many of the numbered labels as you can to illustrate this idea.

ANSWER: All cells have a plasma membrane, cytoplasm, membranous organelles, and a membrane-bound nucleus (see labeling below). All cells' shapes, internal organizations, and functions are under genetic control.