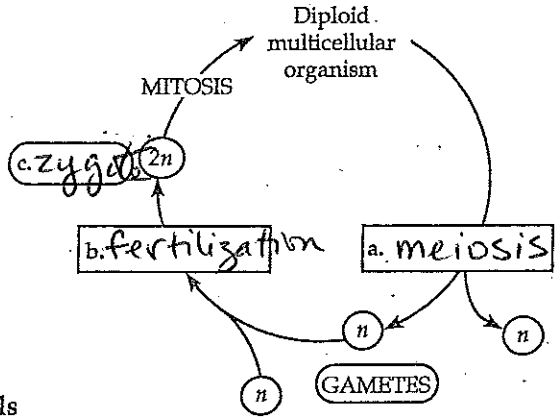
Structure Your Knowledge

1. Describe the key events of these stages of meiosis.

a. Interphase	Replication
b. Prophase I	Tetrad Formation & Crossing over
c. Metaphase I	Pairs line up on the equator
d. Anaphase I	Pairs of homologous chromosomes separate
e. Metaphase II	Chromosomes line up on the equator single file
f. Anaphase II	Chromatids Separate

INTERACTIVE QUESTION 13.2

Complete these three diagrams of sexual life cycles with the names of processes or cells.



Animals

Test Your Knowledge

FILL IN THE BLANK: *Identify the appropriate phase of the cell cycle.*

G0 1. most cells that will no longer divide are in this phase

A 2. sister chromatids separate and chromosomes move apart

P 3. mitotic spindle begins to form

C 4. cell plate forms or cleavage furrow pinches cells apart

S 5. chromosomes replicate

M 6. chromosomes line up at equatorial plane

T 7. nuclear membranes form around separated chromosomes

P 8. chromosomes become visible

PM 9. kinetochore–microtubule interactions move chromosomes to midline

G1 10. restriction point occurs in this phase

MULTIPLE CHOICE: *Choose the one best answer.*

1. One of the major differences in the cell division of prokaryotic cells compared to eukaryotic cells is that
   a. cytokinesis does not occur in prokaryotic cells.
   b. genes are not replicated on chromosomes in prokaryotic cells.
   c. the duplicated chromosomes are attached to the nuclear membrane in prokaryotic cells and are separated from each other as the membrane grows.
   d. the chromosomes do not separate along a mitotic spindle in prokaryotic cells.
   e. the chromosome number is reduced by half in eukaryotic cells but not prokaryotic cells.

2. A plant cell has 12 chromosomes at the end of mitosis. How many *chromosomes* would it have in the G_2 phase of its next cell cycle?
   a. 6
   b. 9
   c. 12
   d. 24
   e. It depends on whether it is undergoing mitosis or meiosis.

3. How many *chromatids* would this plant cell have in the G_2 phase of its cell cycle?
   a. 6
   b. 9
   c. 12
   d. 24
   e. 48

4. The longest part of the cell cycle is
   a. prophase.
   b. G_1 phase.
   c. G_2 phase.
   d. mitosis.
   e. interphase.

5. In animal cells, cytokinesis involves
   a. the separation of sister chromatids.
   b. the contraction of the contractile ring of microfilaments.
   c. depolymerization of kinetochore microtubules.
   d. a protein kinase that phosphorylates other enzymes.
   e. sliding of nonkinetochore microtubules past each other.

6. Humans have 46 chromosomes. That number of chromosomes will be found in
   a. cells in anaphase.
   b. the egg and sperm cells.
   c. the somatic cells.
   d. all the cells of the body.
   e. only cells in G_1 of interphase.

7. Sister chromatids
   a. have one-half the amount of genetic material as does the original chromosome.
   b. start to move along kinetochore microtubules toward opposite poles during telophase.
   c. each have their own kinetochore.
   d. are formed during prophase.
   e. slide past each other along nonkinetochore microtubules.

8. Which of the following would *not* be exhibited by cancer cells?
   a. changing levels of MPF concentration
   b. passage through the restriction point
   c. density-dependent inhibition
   d. metastasis
   e. mitotic phase of the cell cycle

9. Which of the following is *not* true of a cell plate?
   a. It forms at the site of the metaphase plate.
   b. It results from the fusion of microtubules.
   c. It fuses with the plasma membrane.
   d. A cell wall is laid down between its membranes.
   e. It forms during telophase in plant cells.

10. A cell that passes the restriction point in G_1 will most likely
    a. undergo chromosome duplication.
    b. have just completed cytokinesis.
    c. continue to divide only if it is a cancer cell.
    d. show a drop in MPF concentration.
    e. move into the G_0 phase.

11. The rhythmic changes in cyclin concentration in a cell cycle are due to
    a. its increased production once the restriction point is passed.
    b. the cascade of increased production once its enzyme is phosphorylated by MPF.
    c. its degradation, which is initiated by active MPF.
    d. the correlation of its production with the production of Cdk.
    e. the binding of the growth factor PDGF.

12. In a plant cell, a centrosome functions in the formation of
    a. the cell plate.
    b. kinetochores.
    c. duplicate chromosomes.
    d. centromeres.
    e. microtubules of the spindle apparatus.

13. A cell in which of the following phases would have the *least* amount of DNA?
    a. G_0
    b. G_2
    c. prophase
    d. metaphase
    e. anaphase

14. What initiates the separation of sister chromatids in anaphase?
    a. the drop in MPF concentration
    b. a rapid rise in Cdk concentration
    c. movement past the G_2 checkpoint
    d. a signal pathway initiated by the binding of a growth factor
    e. the cessation of delay signals received from unattached kinetochores

15. Cells growing in cell culture that divide and pile up on top of each other are lacking
    a. anchorage dependence.
    b. density independence.
    c. PDGF.
    d. MPF.
    e. nutrients and growth factors.

16. Knowledge of the cell cycle control system will be most beneficial to the area of
    a. human reproduction.
    b. plant genetics.
    c. prokaryotic growth and development.
    d. cancer prevention and treatment.
    e. prevention and treatment of cardiovascular disease.

Test Your Knowledge

MULTIPLE CHOICE: *Choose the one best answer.*

1. The restoration of the diploid chromosome number after halving in meiosis is due to
   a. synapsis.
   b. fertilization.
   c. mitosis.
   d. DNA replication.
   e. chiasmata.

2. What is a karyotype?
   a. a genotype of an individual
   b. a unique combination of chromosomes found in a gamete
   c. a blood type determination of an individual
   d. a pictorial display of an individual's chromosomes
   e. a species-specific diploid number of chromosomes

3. What are autosomes?
   a. sex chromosomes
   b. chromosomes that occur singly
   c. chromosomal abnormalities that result in genetic defects
   d. chromosomes found in mitochondria and chloroplasts
   e. none of the above

4. A synaptonemal complex would be found during
   a. prophase I of meiosis.
   b. fertilization or syngamy of gametes.
   c. metaphase II of meiosis.
   d. prophase of mitosis.
   e. anaphase I of meiosis.

5. During the first meiotic division (meiosis I),
   a. homologous chromosomes separate.
   b. the chromosome number becomes haploid.
   c. crossing over between nonsister chromatids occurs.
   d. paternal and maternal chromosomes assort randomly.
   e. all of the above occur.

6. A cell with a diploid number of 6 could produce gametes with how many different combinations of maternal and paternal chromosomes?
   a. 6 c. 12 e. 128
   b. 8 d. 64

7. The DNA content of a diploid cell is measured in the G_1 phase. After meiosis I, the DNA content of one of the two cells produced would be
   a. equal to that of the G_1 cell.
   b. twice that of the G_1 cell.
   c. one-half that of the G_1 cell.
   d. one-fourth that of the G_1 cell.
   e. impossible to estimate due to independent assortment of homologous chromosomes.

8. In most fungi and some protists,
   a. the zygote is the only haploid stage.
   b. gametes are formed by meiosis.
   c. the multicellular organism is haploid.
   d. the gametophyte generation produces gametes by mitosis.
   e. reproduction is exclusively asexual.

9. In the alternation of generations found in plants,
   a. the sporophyte generation produces spores by mitosis.
   b. the gametophyte generation produces gametes by mitosis.
   c. the zygote will develop into a sporophyte generation by meiosis.
   d. spores develop into the haploid sporophyte generation.
   e. the gametophyte generation produces spores by meiosis.

10. Which of the following is least likely to be a source of genetic variation in sexually reproducing organisms?
    a. crossing over
    b. replication of DNA during S phase before meiosis I
    c. independent assortment of chromosomes
    d. random fertilization of gametes
    e. mutation

11. Meiosis II is similar to mitosis because
    a. sister chromatids separate.
    b. homologous chromosomes separate.
    c. DNA replication precedes the division.
    d. they both take the same amount of time.
    e. haploid cells are produced.

12. Pairs of homologous chromosomes
    a. have identical DNA sequences in their genes.
    b. have genes for the same traits at the same loci.
    c. are found in gametes.
    d. separate in meiosis II.
    e. have all of the above characteristics.

13. Asexual reproduction of a diploid organism would
    a. be impossible.
    b. involve meiosis.
    c. produce identical offspring.
    d. show variation among sibling offspring.
    e. involve spores produced by meiosis.

14. In a sexually reproducing species with a diploid number of 8, how many different combinations of paternal and maternal chromosomes would be possible in the *offspring*?
    a. 8 c. 64 e. 512
    b. 16 d. 256

15. The calculation of offspring in Question 14 includes only variation resulting from
    a. crossing over.
    b. random fertilization.
    c. independent assortment of chromosomes.
    d. a, b, and c.
    e. only b and c.

16. How many *chromatids* are present in metaphase II in a cell undergoing meiosis from an organism in which $2n = 24$?
    a. 12 c. 36 e. 96
    b. 24 d. 48

17. Which of the following would *not* be considered a haploid cell?
    a. daughter cell after meiosis II
    b. gamete
    c. daughter cell after mitosis in gametophyte generation of a plant
    d. cell in prophase I
    e. cell in prophase II

18. Which of the following is *not* true of homologous chromosomes?
    a. They behave independently in mitosis.
    b. They synapse during the S phase of meiosis.
    c. They travel together to the metaphase plate in prometaphase of meiosis I.
    d. Each parent contributes one set of homologous chromosomes to an offspring.
    e. Crossing over between nonsister chromatids of homologous chromosomes is indicated by the presence of chiasmata.

19. Which of the following describes why or how recombinant chromosomes add to genetic variability?
    a. They are formed as a result of random fertilization when two sets of chromosomes combine in a zygote.
    b. They are the result of mutations that change alleles.
    c. They randomly orient during metaphase II and the nonequivalent sister chromatids separate in anaphase II.
    d. Genetic material from two parents is combined on the same chromosome.
    e. Both c and d are true.

20. A cell in G_2 before meiosis compared with one of the four cells produced by that meiotic division has
    a. twice as much DNA and twice as many chromosomes.
    b. four times as much DNA and twice as many chromosomes.
    c. four times as much DNA and four times as many chromosomes.
    d. half as much DNA but the same number of chromosomes.
    e. half as much DNA and half as many chromosomes.