

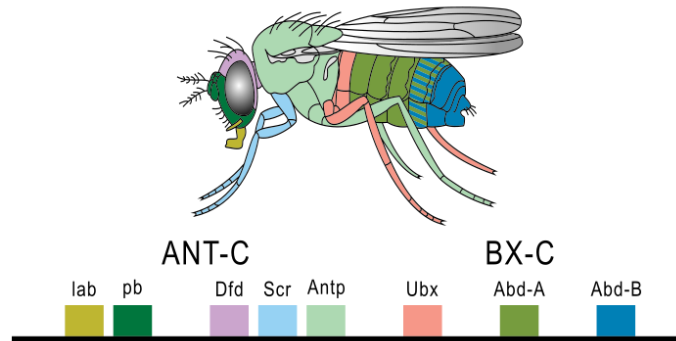
Multiple Choice Review – Cell Cycle

Use the following options to answer questions #1-3:

- I. G_0
- II. G_1
- III. G_2
- IV. S
- V. Mitosis
- VI. Cytokinesis

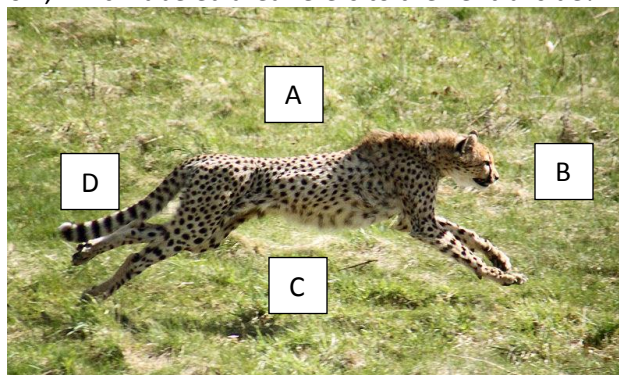
1. The cell cycle is divided into several distinct sub phases. Which sub phases occur during interphase?
 - a. I, II, and III
 - b. II, III, and IV
 - c. I, II, III, and IV
 - d. V and VI
2. Similarly to interphase, the mitotic phase includes different sub phases, including which of the following?
 - a. V
 - b. IV, V, and VI
 - c. V and VI
 - d. I, V, and VI
3. The cell cycle is regulated by several factors. Cell cycle checkpoints exist during which of the following processes?
 - a. I, II, and III
 - b. V and VI
 - c. II, III, and IV
 - d. II, III, and V
4. A sample of human cells is suspended in a nutrient solution overnight. The next day, the scientist observes that the cells have undergone high rates of division. Why does this lead her to suspect that the cells are cancerous?
 - a. Cancer cells do not exhibit density dependent inhibition.
 - b. Cancer cells do not require growth factors.
 - c. Cancer cells do not exhibit anchorage dependence.
 - d. Cancer cells ignore typical cell cycle checkpoints.
5. The sexual life cycle creates genetic variation in a population. Which of the following is not a source of genetic variation?
 - a. Independent assortment of chromosomes
 - b. Random fertilization
 - c. Separation of homologs
 - d. Crossing over

6. The image below shows eight Hox genes of the fruit fly. Why is it not surprising that the Antp gene and the Scr gene are located next to each other?



Source: <http://en.wikipedia.org/wiki/File:Hoxgenesoffruitfly.svg>

- Homeobox genes are often organized on the chromosome in the same anterior-posterior order as on the organism.
 - Scr and Antp code for structures that are connected so it would be hard to separate them.
 - The bicoid protein ensures that leg genes are always connected to thorax genes.
 - Both genes code for the abdomen.
7. Cell-based regenerative therapy refers to treating a disease or condition by extracting unspecialized cells and directing them to differentiate into specific types of cells and tissues. What types of cells are required for this type of therapy?
- Stem cells
 - Meristematic cells
 - Mitotic cells
 - Homeotic cells
8. The cheetah is a feline native to Africa. It is known as the fastest land animal, able to reach speeds of up to 75 mph and to accelerate from 0 to 62 mph in just three seconds. On the picture of the cheetah below, which labeled area refers to the ventral side?

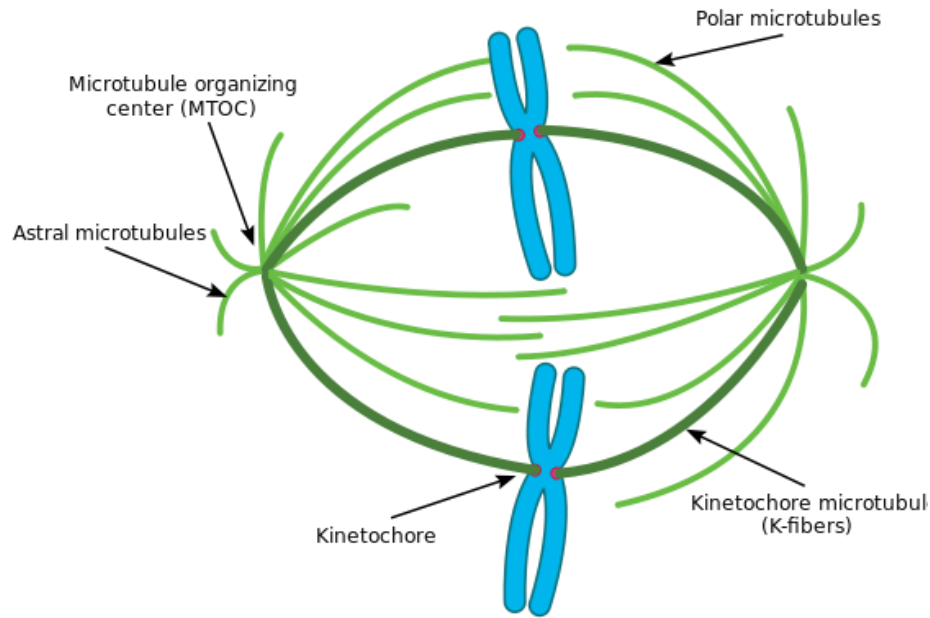


Source: [http://commons.wikimedia.org/wiki/File:Gepardjagt2_\(Acinonyx_jubatus\).jpg](http://commons.wikimedia.org/wiki/File:Gepardjagt2_(Acinonyx_jubatus).jpg)

- A
- B
- C
- D

9. Metaphase is the stage of mitosis during which the chromosomes line up along the metaphase plate in preparation of separating into two cells. Several things must occur prior to this stage in order for mitosis to be successful. Which of the following is not something that occurs before metaphase?
- a. Sister chromatids separate.
 - b. Nuclear envelope fragments.
 - c. Chromosomes become tightly coiled.
 - d. Centrosomes align on opposite sides of the cell.

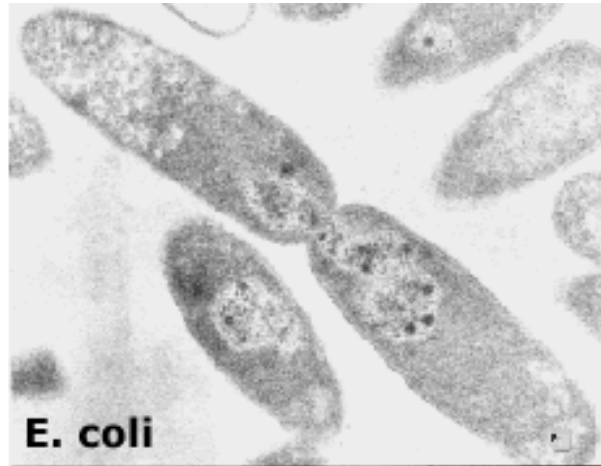
Questions #10-11 refer to the following diagram:



Source: http://commons.wikimedia.org/wiki/File:Spindle_apparatus.svg

10. The diagram shows that each kinetochore has attached to a chromosome. To what part of the chromosome is it attached?
- a. Centrosome
 - b. Asters
 - c. Centromere
 - d. Cleavage furrow
11. The mitotic spindle shown in the diagram arises during the G_2 phase, when this structure duplicates.
- a. DNA
 - b. Centrosome
 - c. Microtubule
 - d. Centromere

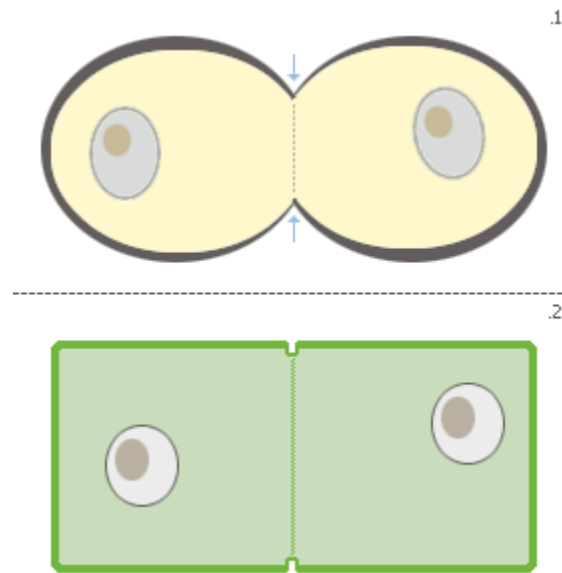
12. Crossing over is an event during meiosis that dramatically increases variation in offspring. This event occurs between what structures?
- Chiasma
 - Sister chromatids
 - Nonhomologous chromosomes
 - Nonsister chromatids
13. Two samples of animal cells are attempted to be grown in a laboratory setting. Sample #1 is placed in a suspension of nutrients while sample #2 spread on a petri dish with the same nutrients. After 24 hours, what type of cell growth will be observed in the samples?
- Sample #1 will show no growth and sample #2 will show a single layer of cells.
 - Sample #2 will show no growth and sample #1 will show a single layer of cells.
 - Sample #1 will show no growth and sample #2 will show several layers of cells.
 - Neither sample will show growth.
14. This *E. coli* cell is undergoing binary fission. Which of the following is not true concerning this process?



Source: <http://click4biology.info/c4b/2/cell2.2.htm>

- It is a type of asexual reproduction.
 - A parent cell becomes two daughter cells.
 - Offspring are genetically unique.
 - It is the method of prokaryotic reproduction.
15. Stem cells are of growing interest to scientists and the medical profession. Which of the following is not a characteristic of stem cells?
- Unspecialized
 - Able to proliferate indefinitely
 - Can specialize into any cell type
 - Grow unchecked to become tumors

Questions #16-17 refer to the following diagram:

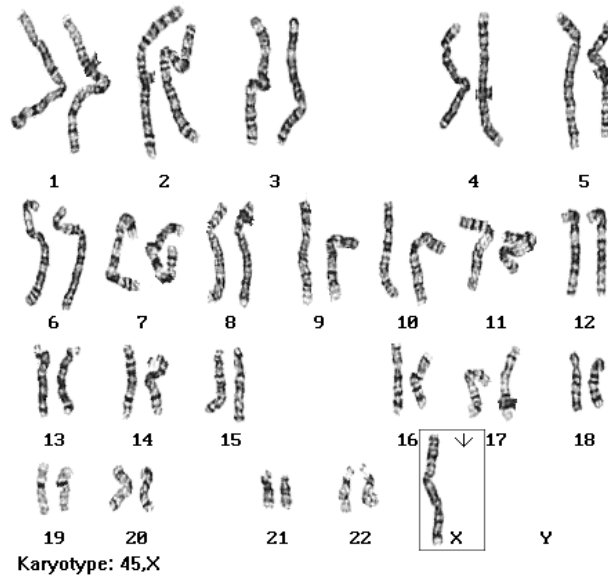


Source: <http://commons.wikimedia.org/wiki/File:Cytokinesis.png>

16. The diagram illustrates the process of cytokinesis. To what are the arrows in (1) pointing?
- Mitotic spindle
 - Site of fission
 - Cleavage furrow
 - Cell plate
17. The cells in (2) undergo cytokinesis differently than those in (1). What structure do the cells in (2) use to separate the cytoplasm?
- Aster
 - Cell plate
 - Centromere
 - Plasma membrane
18. The presence of nanos protein in a fruit fly embryo affects the posterior portion of fruit fly development. There are a variety of these types of proteins, all of which establish the anterior-posterior axis of the fly. What category of genes do these proteins fall under?
- Molecular coordinate genes
 - Hox genes
 - Homeobox genes
 - Maternal effect genes
19. Fragmentation and budding are two different types of reproduction. Which of the following statements correctly compares the two methods?
- Budding requires two organisms while fragmentation requires only one.
 - In fragmentation, a new organism is created after a piece separates from the parent. In budding, a new organism grows on the parent and then separates.
 - Fragmentation is asexual while budding is sexual.
 - Budding only produces haploid cells while fragmentation produces diploid cells.

20. Meiosis is broken down into two separate processes: meiosis I and meiosis II. Which of the following statements incorrectly pairs an event that occurs in each process?
- Meiosis I: separates homologous chromosomes
 - Meiosis II: creates haploid cells with duplicated chromosomes
 - Meiosis I: independent assortment along metaphase plate
 - Meiosis II: separates sister chromatids

Questions #21-22 refer to the following karyotype.

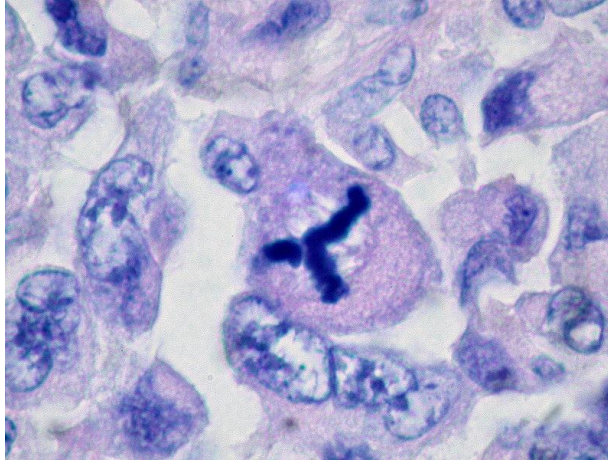


Source: <http://www.biology.iupui.edu/biocourses/N100/2k2humancsomaldisorders.html>

21. This karyotype shows Turner's syndrome in which the individual is missing a sex chromosome. By what other name can this type of defect be called?
- Polyploidy
 - Monosomy
 - Deletion
 - Haploid
22. What event would cause Turner's syndrome?
- The joining of two gametes that are each missing a sex chromosome.
 - The joining of a gamete with a somatic cell.
 - The joining of a normal gamete with a gamete missing a sex chromosome.
 - The joining of two polyploid gametes.
23. Gametes and meiosis are related in the same way as which of the following pairs?
- Meiosis: haploid
 - Chromosomes: alleles
 - Somatic cells: mitosis
 - Mitosis: Binary fission

24. There are a variety of different methods used by organisms to pass on their genes to offspring. Some methods produce genetically identical offspring while others produce unique offspring. Which of the following reproductive methods does not produce clones?
- Sexual reproduction
 - Budding
 - Binary fission
 - Fragmentation

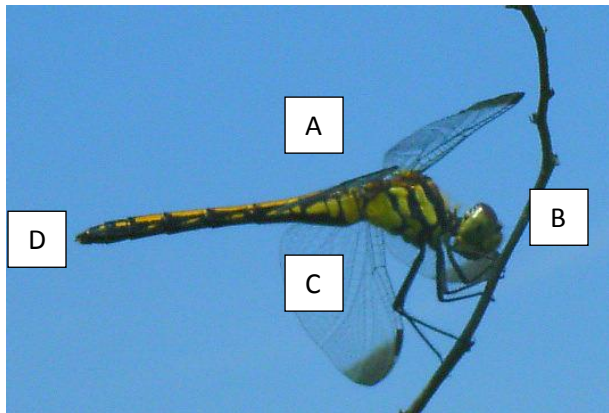
Questions #25-27 refer to the following image of a sample of cells from a breast tumor.



http://commons.wikimedia.org/wiki/File:Tripolar_Mitosis_-_breast_carcinoma.jpg

25. The abnormal cell in the middle of the picture is an example of tripolar mitosis. This results from abnormal mitotic spindles and is evidence that the tumor is malignant. The tumor began when which of the following experienced a mutation?
- Proto-oncogene
 - Promotion factor
 - Oncogene
 - Kinase
26. Noncancerous cells undergo a pathway that ultimately ends in apoptosis, programmed cell death. Cancerous cells, however, do not undergo apoptosis. They also do not follow many other regulatory processes experienced by other cells. Which of the following is not a growth process ignored by cancer cells?
- Anchorage dependence
 - Cell cycle checkpoints
 - Interphase
 - Density dependent inhibition
27. While this tumor is deemed malignant, some tumors are localized and do not harm the overall health of the organism. What term is used to describe this second type of tumor?
- Cyclin-dependent
 - Benign
 - Oncogenetic
 - Anchorage dependent

28. Kinases are proteins that maintain cell cycle checkpoints. Kinases, however, require the presence of one other molecule in order to be activated. What molecule is responsible for doing so?
- Maturation promotion factor
 - Cyclin
 - Oncogene
 - Hox gene
29. Maternal effect genes work by establishing what inside the embryo?
- Protein gradients
 - Replication patterns
 - Nutrient balance
 - Differentiation
30. Dragonflies are insects capable of flying in six different directions: up, down, forwards, backwards, left, and right. Female dragonflies lay their eggs in or near the water. The baby dragonflies, called nymphs, live in the water until they undergo metamorphosis into mature dragonflies. On the picture of the dragonfly below, which labeled area refers to the anterior side?



Source: <http://commons.wikimedia.org/wiki/File:SympetrumInfuscatum.jpg>

- A
 - B
 - C
 - D
31. In asexual reproduction, organisms do not have to spend time and energy on finding a mate. In this way, asexual reproduction is beneficial over sexual reproduction. Which statement does not describe a benefit of asexual reproduction?
- Organisms can reproduce faster.
 - All of an organism's genes are passed to offspring.
 - Energy is not spent on creating and maintaining sex cells.
 - The population can withstand environmental pressures due to the genetic variation of the individuals.

32. The cell cycle is a highly regulated process. Which of the following is not something that affects the cell cycle?
- a. S checkpoint
 - b. Density-dependent inhibition
 - c. Growth factors
 - d. Anchorage dependence
33. The picture below shows a mutant fruit fly with two pairs of wings. This occurs when a mutation in the Ubx gene causes that gene to not be expressed. What is the name given to this type of gene that controls the type of appendage on specific body segments?



Source: <http://www.pbs.org/wgbh/nova/genes/fate-nf.html>

- a. Maternal effect genes
 - b. Stem cells
 - c. Molecular coordinate genes
 - d. Hox genes
34. Skin cells are placed in a culture containing growth medium. After incubating at 37°C for 24 hours, the cells have divided to form a single layer that has spread to all borders of the culture. A scientist scrapes away a small circle of cells in the middle of the culture. If she incubates the culture again and returns in 24 hours, what will she find?
- a. The cells will divide to cover the circle as well as creating a second layer of cells in the other areas of the culture.
 - b. No change.
 - c. The cells will divide, creating a second layer of cells but avoiding the circle of missing cells.
 - d. The cells will divide just enough to cover the circle.

Questions #35-40 refer to the following scenario:

A scientist is working with a unique cell sample. He isolates two molecules that are always present when the cells divide. To determine the effects of the two molecules, he sets up the following experiment. In group #1, he spreads cell samples on a petri dish and adds molecule A. In group #2, he spreads cell samples on a petri dish and adds molecule B. In group #3, he spreads cell samples on a petri dish and adds molecules A and B. In group #4, he spreads cells samples on a petri dish with no added molecules. He uses a sample size of five. The results are shown in the table below.

	Cellular growth	No growth
Treatment #1		X
Treatment #2		X
Treatment #3	X	
Treatment #4		X

35. What would be the null hypothesis for this experiment?
- Molecules A and B are necessary for cellular growth.
 - Molecule B affects cellular growth while molecule A does not.
 - Molecules A and B have no effect on cellular growth.
 - Molecule A affects cellular growth while molecule B does not.
36. Explain the results.
- Molecules A and B are both growth factors for the cell.
 - Molecule A is a cell cycle checkpoint for molecule B.
 - Molecules A and B are enzymes that speed up the mitotic phase.
 - Molecule B is a metastasized version of molecule A.
37. What would have to change about treatment #1 in order to cultivate cellular growth?
- Add more molecule A.
 - Add molecule B.
 - Incubate at a higher temperature.
 - Take away molecule A.
38. Which of the following is not a variable that should have been controlled in the experiment?
- Volume of molecule A/B added
 - Temperature of petri dishes
 - Alternating periods of light and darkness
 - Duration of incubation
39. How many petri dishes are used in this experiment?
- 4
 - 5
 - 15
 - 20
40. Which group is the control group?
- Treatment #1
 - Treatment #2
 - Treatment #3
 - Treatment #4

Quantitative Review – Cell Cycle

1. The fruit fly has eight chromosomes. During the S phase of interphase, these chromosomes are duplicated. How many chromatids are present after the S phase in a fruit fly?
2. The common house cat is a diploid animal with 38 chromosomes. How many chromosomes are present in the gametes of a house cat?
3. Independent assortment leads to genetic diversity in offspring. When chromosomes assort independently, there are 2^n ways for them to line up along the metaphase plate (n = # of chromosomes). In a rabbit, a diploid animal with 44 chromosomes, how many different ways can the chromosomes line up during meiosis?
4. In a controlled laboratory setting, 14 somatic cells are prompted to undergo meiosis. How many cells will be present at the end of meiosis II?
5. Chinchillas are rodents that are native to the Andes Mountains in South America. Although they have become popular as household pets in the United States, they have specific requirements that can make them difficult to care for. Because of this, chinchillas are often found in animal shelters across the country. After interphase in a chinchilla, 128 chromatids are present. How many chromosomes do chinchillas have?
6. The sea star is an echinoderm found in marine environments. If there are 6.9×10^{10} ways for the chromosomes of a sea star to line up along the metaphase plate during meiosis, how many chromosomes does a sea star have?

ANSWER KEY

- | | |
|-------|-------------------------|
| 1. B | 25. A |
| 2. C | 26. C |
| 3. D | 27. B |
| 4. C | 28. B |
| 5. C | 29. A |
| 6. A | 30. B |
| 7. A | 31. D |
| 8. C | 32. A |
| 9. A | 33. D |
| 10. C | 34. D |
| 11. B | 35. C |
| 12. D | 36. A |
| 13. A | 37. B |
| 14. C | 38. C |
| 15. D | 39. D |
| 16. C | 40. D |
| 17. B | |
| 18. D | 1. 16 |
| 19. B | 2. 19 |
| 20. B | 3. 1.8×10^{13} |
| 21. B | 4. 56 |
| 22. C | 5. 64 |
| 23. C | 6. 36 |
| 24. A | |