

Study Guide 11 & 12

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

- 1) The receptors for a group of signaling molecules known as growth factors are often 1) _____
- A) ligand-gated ion channels.
 - B) G protein-coupled receptors.
 - C) neurotransmitters.
 - D) receptor tyrosine kinases.
 - E) cyclic AMP.

The following questions are based on the figure below:



- 2) In the figure, the dots in the space between the two structures represent which of the following? 2) _____
- A) receptor molecules
 - B) neurotransmitters
 - C) pheromones
 - D) signal transducers
 - E) hormones
- 3) Which of the following is true for the signaling system in an animal cell that lacks the ability to produce GTP? 3) _____
- A) It would use ATP instead of GTP to activate and inactivate the G protein on the cytoplasmic side of the plasma membrane.
 - B) It would employ a transduction pathway directly from an external messenger.
 - C) It could activate only the epinephrine system.
 - D) It would not be able to activate and inactivate the G protein on the cytoplasmic side of the plasma membrane.
 - E) It would be able to carry out reception and transduction but would not be able to respond to a signal.
- 4) Where do apoptotic signals come from? 4) _____
- A) the nucleus only
 - B) mitochondrial protein leakage only
 - C) the ER only
 - D) ligand binding only
 - E) all of the above

- 5) Which of the following is the best explanation for the fact that most transduction pathways have multiple steps? 5) _____
- A) Each individual step can remove excess phosphate groups from the cytoplasm.
 - B) Most of the steps were already in place because they are steps in other pathways.
 - C) Each step can be activated by several G proteins simultaneously.
 - D) Multiple steps in a pathway require the least amount of ATP.
 - E) Multiple steps provide for greater possible amplification of a signal.
- 6) Which of the following is a likely explanation of why natural selection favored the evolution of signals for sexual reproduction? 6) _____
- A) Multicellular eukaryotes required signals that were responded to by multiple organ systems.
 - B) Cells of several kinds of mating types needed to sort themselves to allow self-recognition.
 - C) Rooted plants required chemical diffusible signals that could travel throughout the organism.
 - D) Even in the simplest organisms, sexual reproduction required several coordinated responses by cells.
 - E) Hormones required a mechanism for introducing changes in their target tissues.
- 7) A drug designed to inhibit the response of cells to testosterone would almost certainly result in which of the following? 7) _____
- A) an increase in receptor tyrosine kinase activity
 - B) lower cytoplasmic levels of cAMP
 - C) a decrease in transcriptional activity of certain genes
 - D) a decrease in G protein activity
 - E) an increase in cytosolic calcium concentration
- 8) Why is apoptosis potentially threatening to the healthy "neighbors" of a dying cell? 8) _____
- A) Released cellular energy would interfere with the neighbors' energy budget.
 - B) Neighboring cells would activate immunological responses.
 - C) Lysosomal enzymes exiting the dying cell would damage surrounding cells.
 - D) Cell death would usually spread from one cell to the next via paracrine signals.
 - E) Bits of membrane from the dying cell could merge with neighbors and bring in foreign receptors.
- 9) Which of the following statements is true of signal molecules? 9) _____
- A) Toxins such as those that cause botulism and cholera interfere with the ability of activated G proteins to hydrolyze GTP to GDP, resulting in phosphodiesterase activity in the absence of an appropriate signal molecule.
 - B) Protein kinase A activation is one possible result of signal molecules binding to G protein-coupled receptors.
 - C) When signal molecules first bind to receptor tyrosine kinases, the receptors phosphorylate a number of nearby molecules.
 - D) In most cases, signal molecules interact with the cell at the plasma membrane and then enter the cell and eventually the nucleus.
 - E) In response to some G protein-mediated signals, a special type of lipid molecule associated with the plasma membrane is cleaved to form IP₃ and calcium.

- 10) The receptors for a group of signaling molecules known as growth factors are often 10) _____
A) cyclic AMP.
B) receptor tyrosine kinases.
C) neurotransmitters.
D) G protein-coupled receptors.
E) ligand-gated ion channels.
- 11) Which of the following is a correct association? 11) _____
A) phosphodiesterase activity and the removal of phosphate groups
B) GTPase activity and hydrolysis of GTP to GDP
C) phosphorylase activity and the catabolism of glucose
D) adenylyl cyclase activity and the conversion of cAMP to AMP
E) kinase activity and the addition of a tyrosine
- 12) Sutherland discovered that epinephrine signals 12) _____
A) a decrease in levels of cAMP as a result of bypassing the plasma membrane.
B) elevation of cytosolic concentrations of cyclic AMP.
C) interactions directly with glycogen phosphorylase.
D) lower blood glucose by binding to liver cells.
E) interactions with insulin inside muscle cells.
- 13) Protein phosphorylation is commonly involved with all of the following *except* 13) _____
A) activation of G protein-coupled receptors.
B) regulation of transcription by extracellular signaling molecules.
C) enzyme activation.
D) activation of protein kinase molecules.
E) activation of receptor tyrosine kinases.
- 14) Phosphorylation cascades involving a series of protein kinases are useful for cellular signal transduction because 14) _____
A) they amplify the original signal manyfold.
B) they counter the harmful effects of phosphatases.
C) they always lead to the same cellular response.
D) they are species specific.
E) the number of molecules used is small and fixed.
- 15) Because most receptors are membrane proteins, which of the following is usually true? 15) _____
A) They open and close in response to protein signals.
B) They are only attached to one membrane surface: exterior or interior.
C) They lead to changes in intracellular ion concentration.
D) They preferentially bind with lipid or glycolipid signal molecules.
E) They change their conformation after binding with signal polypeptides.
- 16) One of the major categories of receptors in the plasma membrane reacts by forming dimers, adding phosphate groups, and then activating relay proteins. Which type does this? 16) _____
A) receptor tyrosine kinases
B) G protein-coupled receptors
C) ligand-gated ion channels
D) steroid receptors

- 17) What explains the increased concentration of Ca^{++} in the ER? 17) _____
- A) Calcium cannot enter the plasma membrane through ion channels.
 - B) Calcium levels in the blood or other body fluids are extremely low.
 - C) The Ca ions are recycled from other molecules in the ER.
 - D) Calcium ions are actively imported from the cytoplasm into the ER.
 - E) Calcium concentration is kept low in the cytoplasm because of its high usage level.
- 18) Adenylyl cyclase has the opposite effect of which of the following? 18) _____
- A) protein kinase
 - B) phosphodiesterase
 - C) GTPase
 - D) protein phosphatase
 - E) phosphorylase
- 19) GTPase activity is involved in the regulation of signal transduction because it 19) _____
- A) hydrolyzes GTP binding to G protein.
 - B) converts cGMP to GTP.
 - C) decreases the amount of G protein in the membrane.
 - D) increases the available concentration of phosphate.
 - E) phosphorylates protein kinases.
- 20) Consider this pathway: epinephrine \rightarrow G protein-coupled receptor \rightarrow G protein \rightarrow adenylyl cyclase \rightarrow cAMP. Identify the second messenger. 20) _____
- A) G protein
 - B) G protein-coupled receptor
 - C) cAMP
 - D) GTP
 - E) adenylyl cyclase
- 21) Which of the following is the best explanation for the fact that most transduction pathways have multiple steps? 21) _____
- A) Multiple steps in a pathway require the least amount of ATP.
 - B) Multiple steps provide for greater possible amplification of a signal.
 - C) Each step can be activated by several G proteins simultaneously.
 - D) Each individual step can remove excess phosphate groups from the cytoplasm.
 - E) Most of the steps were already in place because they are steps in other pathways.
- 22) Which observation suggested to Sutherland the involvement of a second messenger in epinephrine's effect on liver cells? 22) _____
- A) Enzymatic activity was proportional to the amount of calcium added to a cell-free extract.
 - B) Glycogen breakdown was observed when epinephrine and glycogen phosphorylase were combined.
 - C) Glycogen breakdown was observed only when epinephrine was administered to intact cells.
 - D) Receptor studies indicated that epinephrine was a ligand.
 - E) Epinephrine was known to have different effects on different types of cells.

The following information applies to the questions below.

Several organisms, primarily protists, have what are called intermediate mitotic organization.

- 23) What is the most probable hypothesis about these intermediate forms of cell division? 23) _____
- A) They rely on totally different proteins for the processes they undergo.
 - B) They represent a form of cell reproduction which must have evolved completely separately from those of other organisms.
 - C) They show some but not all of the evolutionary steps toward complete mitosis.
 - D) They demonstrate that these species are not closely related to any of the other protists and may well be a different kingdom.
 - E) They may be more closely related to plant forms that also have unusual mitosis.
- 24) The drug cytochalasin B blocks the function of actin. Which of the following aspects of the cell cycle would be most disrupted by cytochalasin B? 24) _____
- A) cell elongation during anaphase
 - B) spindle formation
 - C) cleavage furrow formation and cytokinesis
 - D) spindle attachment to kinetochores
 - E) DNA synthesis
- 25) A particular cell has half as much DNA as some other cells in a mitotically active tissue. The cell in question is most likely in 25) _____
- A) metaphase.
 - B) G₂.
 - C) anaphase.
 - D) G₁.
 - E) prophase.
- 26) Proteins that are involved in the regulation of the cell cycle, and that show fluctuations in concentration during the cell cycle, are called 26) _____
- A) ATPases.
 - B) kinetochores.
 - C) proton pumps.
 - D) cyclins.
 - E) kinases.
- 27) Which of the following best describes how chromosomes move toward the poles of the spindle during mitosis? 27) _____
- A) Nonkinetochore spindle fibers serve to push chromosomes in the direction of the poles.
 - B) The chromosomes are "reeled in" by the contraction of spindle microtubules, motor proteins of the kinetochores move the chromosomes along the spindle microtubules, and nonkinetochore spindle fibers serve to push chromosomes in the direction of the poles.
 - C) Motor proteins of the kinetochores move the chromosomes along the spindle microtubules.
 - D) The chromosomes are "reeled in" by the contraction of spindle microtubules, and motor proteins of the kinetochores move the chromosomes along the spindle microtubules.
 - E) The chromosomes are "reeled in" by the contraction of spindle microtubules.

- 28) A plant-derived protein known as colchicine can be used to poison cells by blocking the formation of the spindle. Which of the following would result if colchicine is added to a sample of cells in G₂?
- A) The cells would be unable to begin M and stay in G₂.
 - B) The cells would immediately die.
 - C) Each resultant daughter cell would also be unable to form a spindle.
 - D) The chromosomes would segregate but in a disorderly pattern.
 - E) The chromosomes would coil and shorten but have no spindle to which to attach.

28) _____

The following questions are based on Figure 12.3.

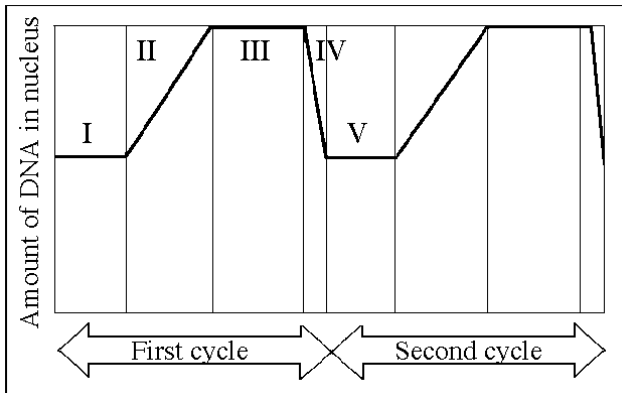


Figure 12.3

- 29) At which of the numbered regions would you expect to find cells at metaphase?

- A) I and IV
- B) II only
- C) III only
- D) IV only
- E) V only

29) _____

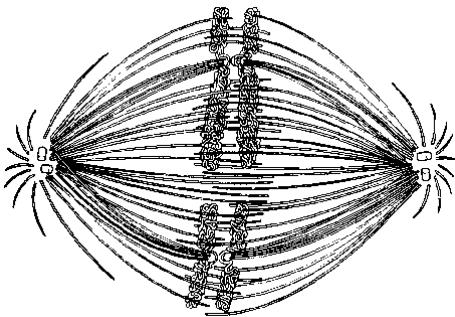


Figure 12.2

- 30) If the cell whose nuclear material is shown in Figure 12.2 continues toward completion of mitosis, which of the following events would occur next?

- A) cell membrane synthesis
- B) nuclear envelope breakdown
- C) spindle fiber formation
- D) synthesis of chromatids
- E) formation of telophase nuclei

30) _____

- 31) The decline of MPF activity at the end of mitosis is due to
- A) synthesis of DNA.
 - B) the destruction of the protein kinase Cdk.
 - C) the degradation of cyclin.
 - D) the accumulation of cyclin.
 - E) decreased synthesis of Cdk.

31) _____

- 32) The centromere is a region in which
- A) metaphase chromosomes become aligned at the metaphase plate.
 - B) chromatids remain attached to one another until anaphase.
 - C) chromosomes are grouped during telophase.
 - D) the nucleus is located prior to mitosis.
 - E) new spindle microtubules form at either end.

32) _____

- 33) During which phase of mitosis do the chromatids become chromosomes?
- A) cytokinesis
 - B) anaphase
 - C) prophase
 - D) metaphase
 - E) telophase

33) _____

The following questions are based on Figure 12.3.

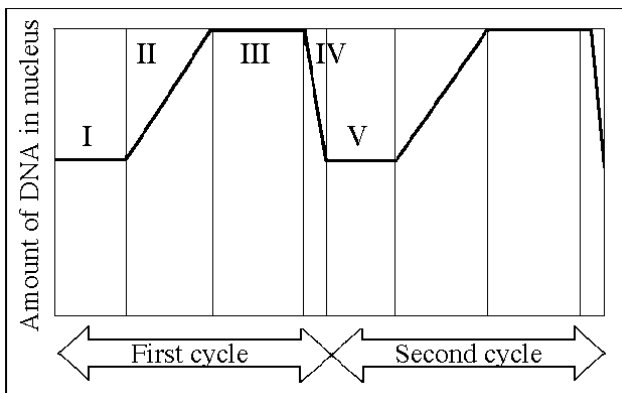


Figure 12.3

- 34) Which number represents DNA synthesis?
- A) I
 - B) II
 - C) III
 - D) IV
 - E) V
- 35) In the cells of some organisms, mitosis occurs without cytokinesis. This will result in
- A) destruction of chromosomes.
 - B) cells that are unusually small.
 - C) cells with more than one nucleus.
 - D) cells lacking nuclei.
 - E) cell cycles lacking an S phase.

34) _____

35) _____

- 36) Which of the following triggers the cell's passage past the G₂ checkpoint into mitosis? 36) _____
- A) Cdk
 - B) PDGF
 - C) cyclin
 - D) MPF
 - E) protein kinase
- 37) Movement of the chromosomes during anaphase would be most affected by a drug that 37) _____
- A) prevents elongation of microtubules.
 - B) reduces cyclin concentrations.
 - C) prevents shortening of microtubules.
 - D) prevents attachment of the microtubules to the kinetochore.
 - E) increases cyclin concentrations.
- 38) For a chemotherapeutic drug to be useful for treating cancer cells, which of the following is most desirable? 38) _____
- A) It interferes with rapidly dividing cells.
 - B) It interferes with cells entering G₀.
 - C) It does not alter metabolically active cells.
 - D) It only attacks cells that are density dependent.
 - E) It is safe enough to limit all apoptosis.
- 39) Which of the following describe(s) cyclin-dependent kinase (Cdk)? 39) _____
- A) Cdk is an enzyme that attaches phosphate groups to other proteins.
 - B) Cdk is inactive, or "turned off," in the presence of cyclin.
 - C) Cdk is present throughout the cell cycle and is an enzyme that attaches phosphate groups to other proteins.
 - D) Cdk is inactive, or "turned off," in the presence of cyclin and it is present throughout the cell cycle.
 - E) Cdk is present throughout the cell cycle.
- 40) Which of the following does *not* occur during mitosis? 40) _____
- A) condensation of the chromosomes
 - B) separation of the spindle poles
 - C) replication of the DNA
 - D) separation of sister chromatids
 - E) spindle formation
- 41) What is a cleavage furrow? 41) _____
- A) a groove in the plasma membrane between daughter nuclei
 - B) the space that is created between two chromatids during anaphase
 - C) the metaphase plate where chromosomes attach to the spindle
 - D) the separation of divided prokaryotes
 - E) a ring of vesicles forming a cell plate

Use the following information to answer the questions below.

The lettered circle in Figure 12.1 shows a diploid nucleus with four chromosomes. There are two pairs of homologous chromosomes, one long and the other short. One haploid set is symbolized as black and the other haploid set is gray. The chromosomes in the unlettered circle have not yet replicated. Choose the correct chromosomal conditions for the following stages.

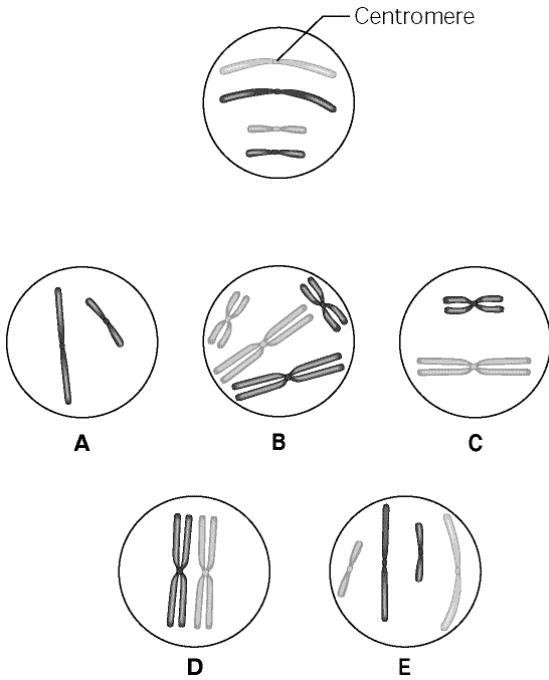


Figure 12.1

- 42) What is the correct chromosomal condition at the prometaphase of mitosis? 42) _____
 A) A B) B C) C D) D E) E
- 43) Which of the following is (are) required for motor proteins to function in the movement of chromosomes toward the poles of the mitotic spindle? 43) _____
 A) an MTOC (microtubule organizing center)
 B) ATP as an energy source
 C) a kinetochore attached to the metaphase plate
 D) intact centromeres
 E) synthesis of cohesin
- 44) The MPF protein complex turns itself off by 44) _____
 A) exiting the cell.
 B) activating a process that destroys cyclin components.
 C) binding to chromatin.
 D) activating the anaphase-promoting complex.
 E) activating an enzyme that stimulates cyclin.