Gartner & Hiatt: Color Textbook of Histology, 3rd Edition

Test Bank

Chapter 3 – Nucleus

MULTIPLE CHOICE

1. A 2-month old infant is brought to the physician's office to be examined, and the physician notices that he has flaccid muscles, a smaller head than usual, a large tongue, and a short nose and broad face. The parents say that the baby is very quiet and hardly ever cries. The pediatrician suspects aneuploidy. The baby probably has which of the following chromosomal configurations?

a. monosomy
b. trisomy
c. normal diploid complement
d. haploid complement
e. tetraploid complement

Explanation:
The answer is b. The baby most probably has trisomy 21 (Down syndrome), in which chromosome 21 is present instead of two chromosomes, one from the mother and the other from the father. During meiosis, nondisjunction occurs, so that one cell has the extra chromosome 21 and the other cell is monosomic—that is, it is missing chromosome 21.

2. A patient with a chromosomal complement of XXY has

a. trisomy of the autosomes
b. Turner's syndrome
c. monosomy of the sex chromosomes
d. Klinefelter syndrome
e. a female phenotype

Explanation:
The answer is d. The patient has Klinefelter syndrome and exhibits a male phenotype. Since there are three sex chromosomes, this is not a monosomy nor is it trisomy of the autosomes. Turner's syndrome is exhibited by females who lack the second X chromosome.

3. A patient with a chromosomal complement of XO has

a. trisomy of the sex chromosomes
b. Turner's syndrome
c. monosomy of the autosomes

d. Klinefelter syndrome
e. a male phenotype

Explanation:
The answer is b. Patients with Turner's syndrome are females who lack the second X chromosomes; therefore, they are monosomal for the sex chromosomes but not for the autosomes. Turner's syndrome is a male phenotype with an extra X chromosome.

4. A patient with a chromosomal complement of XXX has

a. a male phenotype
b. a female phenotype
c. a very short life span
d. a higher IQ than his/her siblings
e. trisomy of autosomes

Explanation:
The answer is b. The patient is a female who has the triple X syndrome; thus she has an extra sex chromosome rather than trisomy of the autosomes. These patients usually have a lower IQ than their siblings but have a normal life span and can give birth to children with a normal chromosomal complement.

5. During a routine examination of a 3-year-old child, the pediatrician notes that the color of the pupil is white and that the child is cross-eyed. She asks the child's father if there are any cases of retinoblastoma in the family, and when the answer is in the affirmative she calls in a pediatric ophthalmologist. The ophthalmologist knows that retinoblastoma is due to the mutation of the Rb gene (retinoblastoma gene) and that it is a recessive trait. Retinoblastoma can metastasize to the brain via the

a. optic nerve
b. superior division of the oculomotor nerve
c. trochlear nerve
d. abducent nerve
e. inferior division of the oculomotor nerve

Explanation:
The answer is a. The retina is attached to the brain via the optic nerve, and malignant cells can use the optic nerve as a passageway to the brain. The superior and inferior divisions of the oculomotor nerve, the trochlear nerve, and the abducent nerve all innervate the external muscles of the eye and do not contact the retina.

6. During a routine examination of a 3-year-old child, the pediatrician notes that the color of the pupil is white and that the child is cross-eyed. She asks the child's father if there are any cases of retinoblastoma in the family, and when the answer is in the affirmative she calls in a pediatric ophthalmologist. The ophthalmologist knows that retinoblastoma

is due to the mutation of the Rb gene (retinoblastoma gene) and that it is a recessive trait. Not all cases of retinoblastoma have a familial component. In the sporadic form of retinoblastoma, the child's normal genetic complement does not predispose the child to have retinoblastoma. If this child had the sporadic form of retinoblastoma, then

a. one copy of the Rb gene mutated
b. both copies of the Rb gene mutated
c. the patient's future children will most probably will have one mutated Rb gene
d. the patient's future children will most probably have two mutated Rb genes
e. the mutated Rb gene is known as a protooncogene

Explanation:
The answer is b. Because retinoblastoma is a recessive trait, both copies of the Rb gene would have mutated. The normal gene, which codes for the Rb protein, is known as a protooncogene, whereas its mutated form is known as an oncogene. Because the mutations did not occur in the gametes, the patient's future children will not have any mutated Rb genes.

7. Which RNA synthesis is catalyzed by RNA polymerase II?

a. tRNA
b. rRNA that codes for the large ribosomal subunit
c. rRNA that codes for the small ribosomal subunit
d. mRNA
e. tRNA that carries the start codon

Explanation:
The answer is d. RNA polymerase II catalyzes the synthesis of messenger RNA (mRNA). The synthesis of all tRNA is catalyzed by RNA polymerase III, whereas all rRNA synthesis is catalyzed by RNA polymerase I.

8. Chiasmata formation

a. occurs during metaphase II
b. results in the exchange of genetic material between nonhomologous chromosomes
c. occurs during the pachytene phase
d. results in nondisjunction
e. results in the formation of the synaptonemal complex

Explanation:
The answer is c. Chiasmata formation occurs during the pachytene phase of prophase I of the first meoitic event. Homologous pairs of chromosomes lined up during the zygotene phase of prophase I, forming the synaptonemal complex, thus permitting crossing over to occur during the pachytene phase so that there could be a random exchange of genetic

material that contributes to a more diverse gene pool. Nondisjunction occurs when the homologous pairs of chromosomes separate during anaphase I.

9. During meiosis some chromosomes do not separate from each other. This is called

a. diplotene
b. nondisjunction
c. diakinesis
d. zygotene
e. leptotene

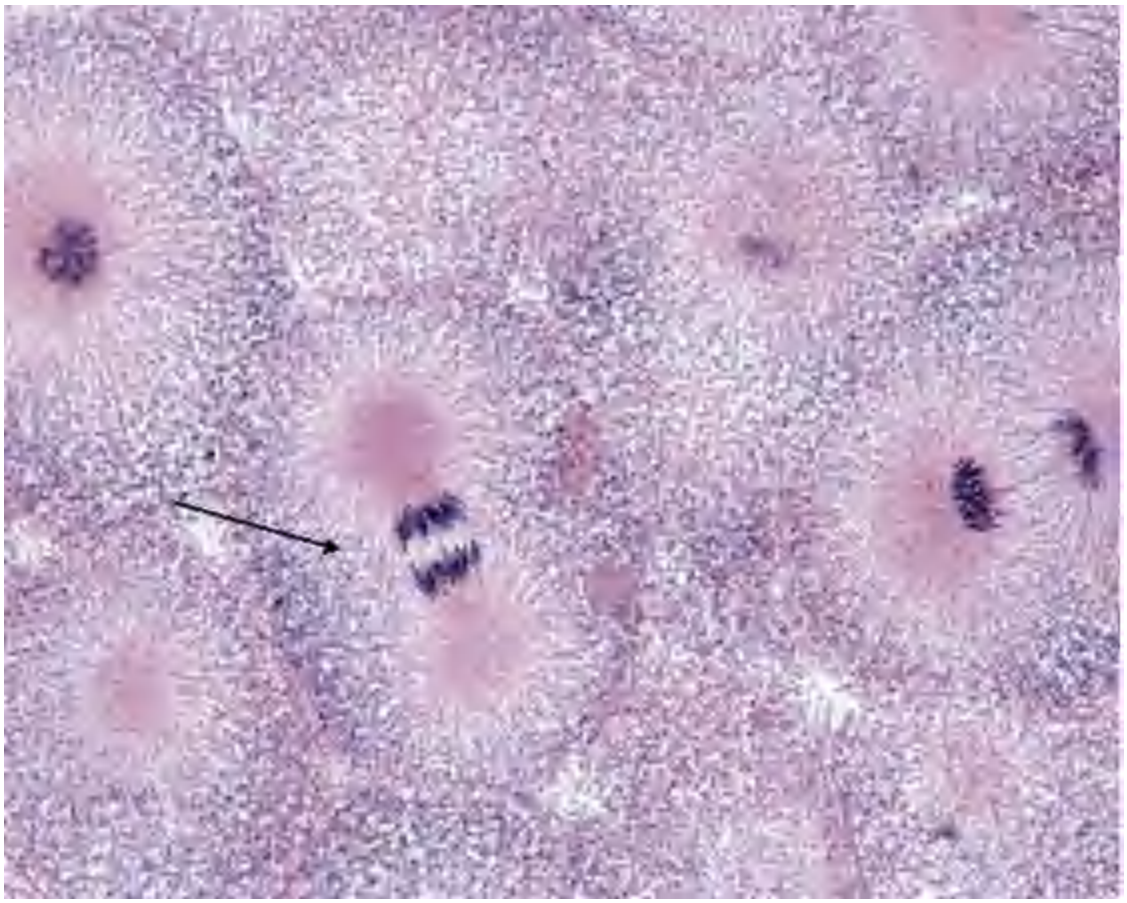
Explanation:
The answer is b. During anaphase I of meiosis, the homologous chromosomes may remain attached to each other and the two newly formed cells will have unequal chromosomal numbers. This process is known as nondisjunction. Diplotene, zygotene, diakinesis, and leptotene are phases of prophase I of the first meiotic division.

10. The binding of cyclin B to CDK1 (cyclin-dependent kinase 1) permits the cell to progress from

a. S phase into G2 phase
b. G2 phase into M phase
c. G1 phase into G2 phase
d. G1 phase into S phase
e. prometaphase into metaphase

Explanation:
The answer is b. The formation of the cyclin B-CDK1 complex allows the cell to enter the mitotic cycle—that is, progress from G2 phase into the M phase. The cell cycle cannot gofrom G1 to G2 directly; it has to go through the S phase first. Cyclins D and E are required to enter S from G1. Cyclins A and B are both required for the entry from S phase into G2 phase.

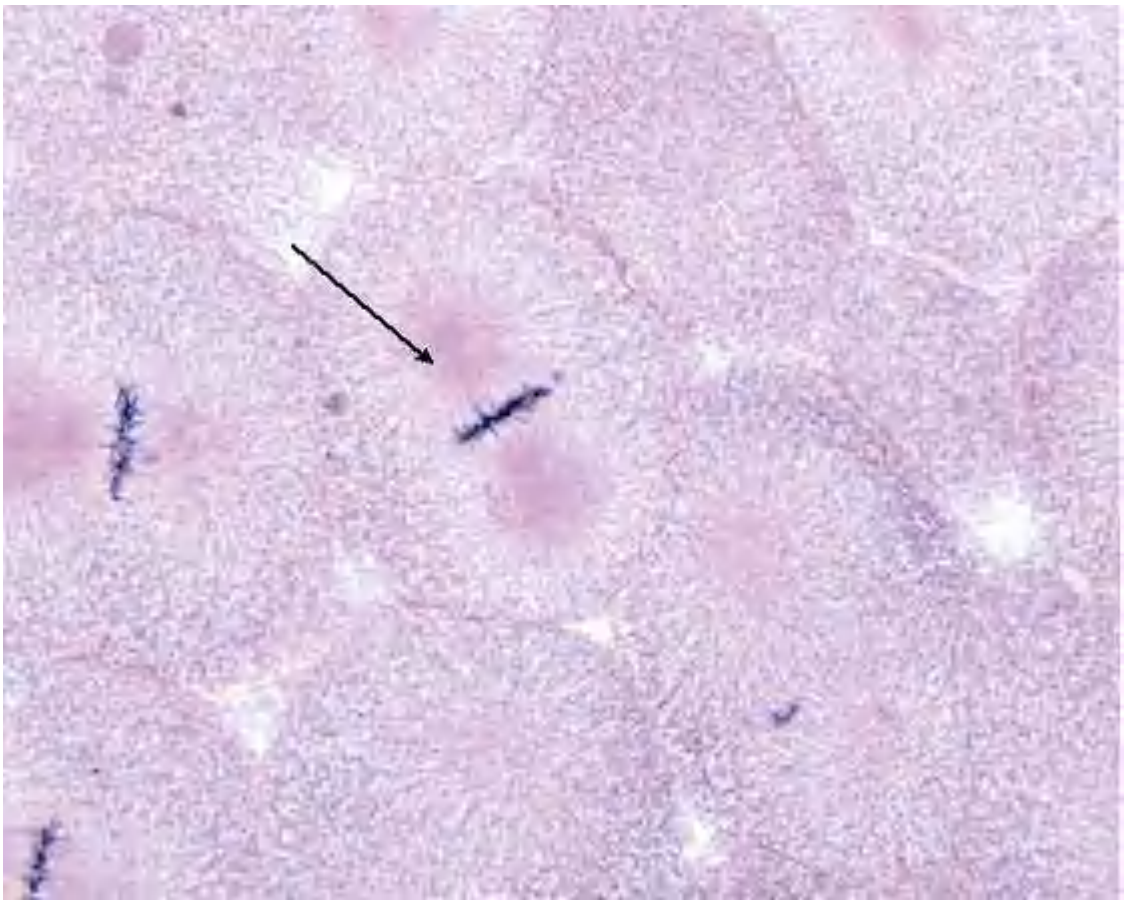
11. In Fig. Img_009, the cell at the tip of the pointer is in which of the following phases of mitosis?



a. prophase
b. prometaphase
c. metaphase
d. anaphase
e. telophase

Explanation:
The answer is d. The sister chromatids of this cell are being pulled apart to proceed toward the opposite poles of the cell; therefore, this cell is in anaphase.

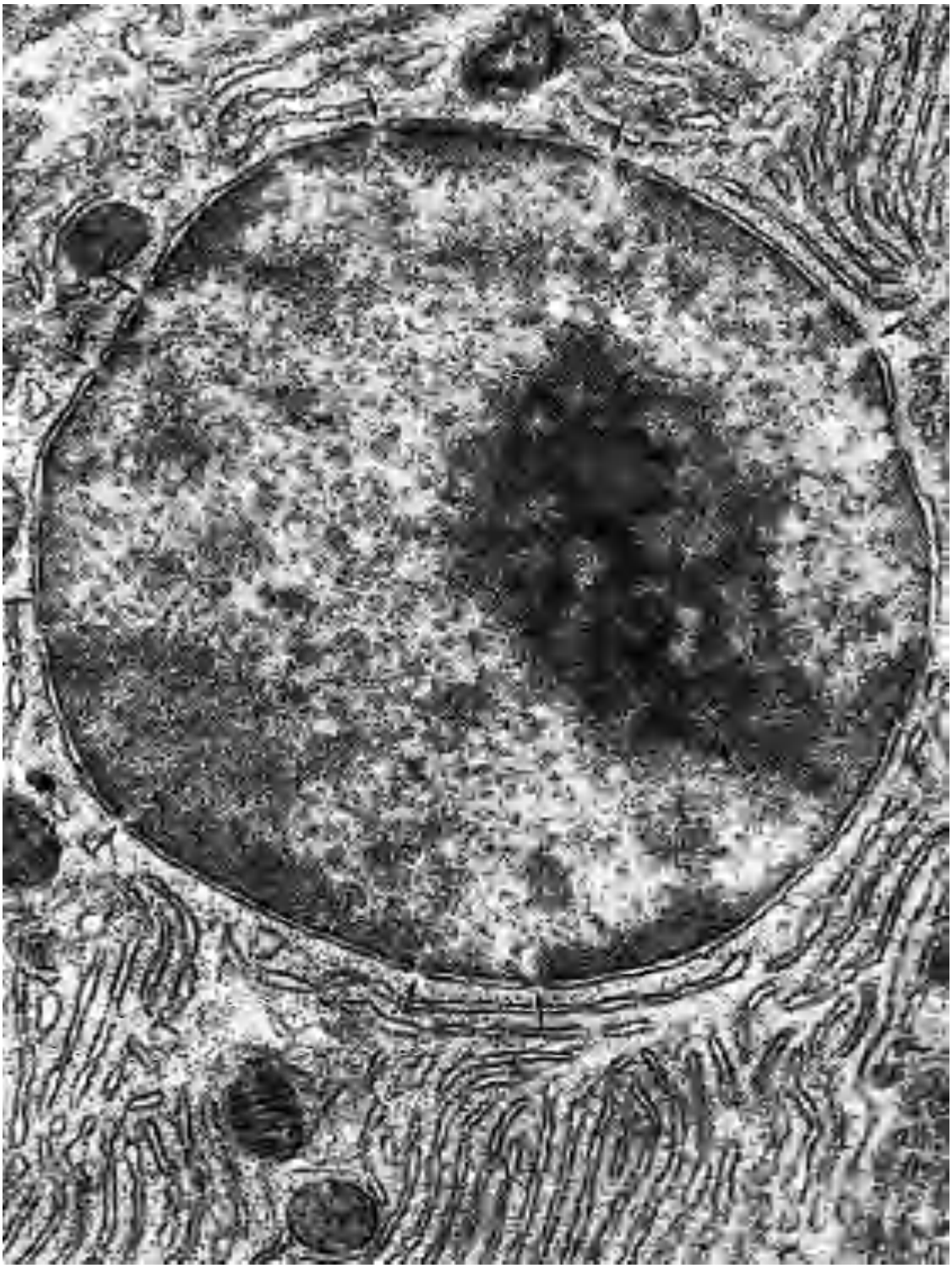
12. In Fig. Img_010, the cell at the tip of the pointer is in which of the following phases of mitosis?



a. prophase
b. prometaphase
c. metaphase
d. anaphase
e. telophase

Explanation:
The answer is c. The sister chromatids of this cell are located at the equator of the mitotic spindle (metaphase plate configuration); therefore, this cell is in metaphase. Note that the mitotic spindle microtubules are attached to the kinetochores of the sister chromatids and will pull the sister chromatids apart during anaphase of the mitotic event.

13. In the Fig. Nucleus, the cell depicted in this electron micrograph synthesize



a. short-chain lipids
b. proteins destined for the cytosol
c. cholesterol
d. proteins destined to be packaged
e. long-chain lipids

Explanation:
The answer is d. The nucleus of this cell has a high level of euchromatin and a rich supply of rough ER. Both of these characteristics indicate that this cell functions in protein synthesis. The presence of rough ER is indicative that the proteins being synthesized have to be packaged by the cell, so the newly-formed protein is not destined for the cytosol. Cholesterol and lipid synthesis requires the presence of smooth ER as well as a rich supply of mitochondria.

14. A patient with cancer possesses cells that are undergoing mitosis at a very rapid rate. The contractile rings that are formed during cytokinesis are composed of

a. thin filaments
b. intermediate filaments
c. thick filaments
d. microtubules
e. neurofilaments

Explanation:
The answer is a. Contractile rings, composed of thin (actin) filaments form around the site where the cleavage furrow forms during telophase. Just prior to complete separation of the two daughter cells, the midbody forms, which is then incorporated into one of the two cells. Intermediate filaments, thick filaments, and neurofilaments (intermediate filaments of neurons) do not participate in the formation of contractile rings. The midbody is composed of polar microtubules and a bridge of cytoplasm.