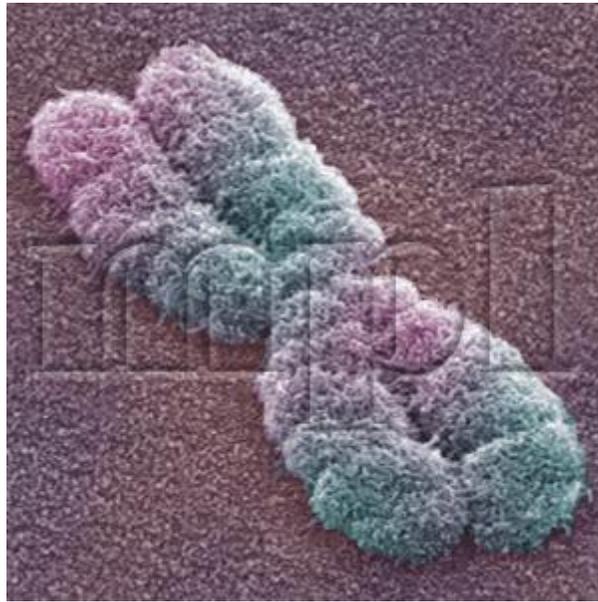


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# CHROMOSOMES AND DNA



**DR. A. G. ARIJO**

**THIS INCLUDE**

*QUICK REVIEW  
PRACTICE SHEETS  
ANSWER KEYS*

**Walter Fleming**

Scientists who first named chromosomes as colorful bodies. Later on it was found that chromosomes are colorless.

**CHROMOSOMES**

Thread like structures in nucleus. They are of four types

**HOMOLOGOUS CHROMOSOMES**

Sets of two chromosomes that make up a matched pair in a diploid cell are called homologous chromosomes. Homologous chromosomes are of same length, Centromere position and possess genes for same characters.

**HETEROLOGOUS CHROMOSOMES**

A pair of chromosomes that are dissimilar

**HOMOGAMOUS**

Because a human female has XX shape of chromosomes, therefore all the gametes produced by her will have X shape of chromosomes, as she produces similar type of gametes, so the condition is homogamous. ***A human mother is homogamous***

**HETEROGAMOUS**

Because a human male has XY shape of chromosomes, therefore he will produce two types of gametes (sperms). In one gamete he will send X chromosome and in other gamete he will send Y chromosome. Because two different types of gametes are formed, therefore this condition is called heterogamous.

***A human father is heterogamous***

**HOMOZYGOUS**

A zygote in which both chromosomes sent by mother and father are identical e.g. XX chromosomes of a female child

**HETEROZYGOUS**

A zygote in which both chromosomes sent by mother and father are dissimilar e.g. XY chromosomes in male child

***Metacentric Chromosomes:*** When centromere is found exactly in the middle of the chromatids, the chromosome is said to be metacentric

***Su-metacentric Chromosomes:*** When centromere is found slightly above the middle point of the chromatids, the chromosome is said to be sub-metacentric

***Telocentric Chromosomes:*** When the position of centromere leaves three quarters of the chromatid, the chromosome is said to be Telocentric.

***Acrocentric Chromosomes:*** When the centromere is exactly at the end point of chromatid, the chromosome is said to be Acrocentric.

**HAPLOID NUMBER**

Half number of chromosomes. This number is found in the gametes. e.g 23 chromosomes in egg and same number in sperm

**DIPLOID NUMBER**

The double number of chromosomes.  
e.g. 46 chromosomes of a human

**CHROMATIN NETWORK**

The un-arranged chromosomes in nucleus is called chromatin network. It breaks up during cell division

**CENTROMERE**

A point where the arms of a chromosome meet

**KINETOCHORE**

Same as above

**CHROMATIDS**

The two arms of chromosomes

**Chromonema**

The chromosomes which is seen as extremely thin thread is called chromonema

**Chromomeres**

When a chromosome appears in beaded form, it is called chromomere

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**WALDYER**

Scientist who discovered chromosomes

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The double number of chromosomes.  
e.g. 46 chromosomes of a human

**CHROMATIN NETWORK**

The un-arranged chromosomes in nucleus is called chromatin network. It breaks up during cell

**Karyotyping**

Study of chromosomes is called karyotyping

**Nucleosome**

In long molecule of DNA, when eight Histone(s) make a junk, it is called Nucleosome

**Heterochromatin**

Highly condensed portions of the chromatin is called heterochromatin

**Euchromatin**

Part of chromosome which remain permanently condensed and its DNA is never expressed is called Euchromatin

***Chemical composition of Chromosomes:***

Chromosomes are made from three different chemicals

1. DNA (30-40%)
2. RNA (1-10%)
3. Histone protein (50-65%)

**Walter Sutton**

Scientist who proposed "Chromosome Theory"

**F. Griffith**

Scientist who conducted experiments on Streptococcus pneumonia bacteria to prove that DNA is heredity material

**S type bacteria**

Strain of bacteria which cause Pneumonia

**R type bacteria**

Strain which do not cause Pneumonia

**Avery, Macleod and McCarty**

Scientists who discovered re-conducted F. Griffith's experiment and proved that he was correct

**Hershey & chase**

Scientists who labeled the head and DNA of virus and found that DNA has property to transfer heredity characters to next generation

**Mathew Meselsn & Frank Stahl**

Scientists who in 1958 tested the DNA model described by Watson & Crick in

**Archibald Garrod**

Scientist who found that Alkaptonuria is a heredity disease

**Alkaptonuria**

A genetic disease in which homogentisic acid (amino acid) is not broken and is excreted in urine. When this amino acid is excreted with urine, its color turns black

**Genome**

Sum total of genes present in 23 pairs of chromosomes is called genome

**What is Mutation?**

Mutation may be defined as alteration in the form and function of gene. Some times mistakes occur during DNA replication and protein synthesis. These mistakes become responsible for alteration in the structure of a gene which result into mutation.

**(1) Point mutation:**

It is a kind of mutation in which a particular base sequence of nitrogen bases in a gene is altered. This kind of mutation is responsible to bring abnormalities e.g. Sickle cell anemia

**Total mutation**

It is a type of protein in which entire sequence of nitrogen bases in a gene are altered, therefore the effect of gene is completely disturbed. The total mutation is more dangerous than point mutation

**Spontaneous mutation**

It is a natural type of mutation, which takes place all of sudden.

**Induced Mutation**

It is artificial type of mutation which any genetic scientist can bring through artificial methods.

**Transcription**

Transcription may be defined as a step in which DNA produce a molecule of mRNA when RNA polymerase binds with DNA. The synthesis of mRNA is purposeful. It carries the coded messages of DNA to ribosomes where proteins are synthesized.

**Sickle cell anemia**

Sickle Cell Anemia is a genetic disorder of the blood. Sickle-cell anemia is caused by a defective gene that produces an abnormal form of hemoglobin.

The main symptom of this disease is

- (1) Frequent and severe infections
- (2) Damage to major organs
- (3) Pain in the back, chest, abdomen, and extremities.
- (4) Pain and swelling in the hands and feet, and enlargement of the abdomen and heart.

**Phenylketonuria**

Phenylketonuria is a rare hereditary disease in newborns in which the enzyme that processes the amino acid phenylalanine is defective or missing. In case of missing of this enzyme, accumulation of phenylalanine takes place in an affected child's blood shortly after birth. If not treated within the first few weeks of life, PKU can cause mental retardation and other serious neurological problems. When a strict diet that limits phenylalanine is begun early and is carefully maintained, affected children can develop normally.

**PRACTICE SHEET**

1. The chromosomes were first named by -----
  - (a) Mendel
  - (b) Waldier
  - (c) Walther Fleming
  - (d) None
2. The Diploid number of chromosomes in Ferns is
  - (a) 500
  - (b) 400
  - (c) 300
  - (d) 200
3. Chromosomes which are structurally and functionally similar are said
  - (a) Autosomes
  - (b) Heterosomes
  - (c) Nullisomes
  - (d) None
4. The study of chromosomes is called
  - (a) Karyograph
  - (b) Karyotyping
  - (c) Both
  - (d) None
5. The protein in the centromere is called
  - (a) Kinetochore
  - (b) Khromonemat
  - (c) Both a&b
  - (d) Nonr
6. Chromosomes have 30-40 %DNA, 50-65 % Proteins and -----RNA
  - (a) 1-10
  - (b) 1011
  - (c) 1-12
  - (d) 1-13
7. If a strand of DNA from single chromosomes is made straight, it will be ----- meter long
  - (a) 7
  - (b) 8
  - (c) 9
  - (d) 10

8. The DNA duplex is coiled after every -----nucleotides
- (a) 200
  - (b) 230
  - (c) 240
  - (d) 250
9. The un-condensed part of chromosome is called
- (a) Super coil
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  - (c) Euchromatin**
  - (d) None
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- (a) Walter Sutton
  - (b) Sir Walter
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- (a) F. Griffith
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- (a) Watson
  - (b) Crick
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13. In DNA both poly nucleotide strands have -----distance
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  - (b) 22A
  - (c) 23A
  - (d) None
14. In one of the following genetic disorder, the urine turns black due to lack of enzymes which break the Homogentistic acid
- (a) Alkaptonuria**
  - (b) Hemophilia
  - (c) Both a&b
  - (d) None
15. Sum of the total genes in any organisms are termed as
- (a) Gene pool
  - (b) Gene drift
  - (c) Genome**
  - (d) All
16. One gene one enzyme hypothesis was suggested by Beadle & Tatum
- (a) True**
  - (b) False
17. Human cell contain more than 40 different type soft RNA molecules
- (a) True**

- (b) False
18. During protein synthesis, the production of mRNA is termed as  
**(a) Transcription**  
(b) Translation  
(c) Transformation  
(d) All
19. Synthesis of polypeptide protein is expression of gene, and it is termed as  
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20. Each reaction is controlled by a single gene explains hypothesis given by Beadle & Tatum. The hypothesis is named as  
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**(b) One gene one enzyme hypothesis**  
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21. Visible change in the structure of chromosomes is known as  
(a) Gene mutation  
**(b) Chromosomal Aberrations**  
(c) Deletion  
(d) Duplication
22. Missing of a small segment of chromosomes along with genes is called  
**(a) Deletion**  
(b) Duplication  
(c) Both a&b  
(d) None
23. If a chromosome receives extra piece of chromosome, the condition will be called  
(a) Deletion  
**(b) Duplication**  
(c) Chromosome mutation  
(d) All of above
24. Some times, a block of genes that went to other chromosomes, can come back to its original chromosomes. This condition is termed as  
(a) Deletion  
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**(c) Inversion**  
(d) All
25. Transfer of segment of chromosomes to a non-homologous chromosome is called  
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26. A kind of gene mutation in which only limited number of its nucleotide is mutated, that is called

(a) **Point mutation**

(b) Specific mutation

(c) Total mutation

(d) All

27. Any physical or chemical agents that brings about mutations in genes are called

(a) Mutation

(b) **Mutagen**

(c) Mutate

(d) All

28. Ionizing radiation (X-rays etc) affect the DNA

(a) Directly

(b) Indirectly

(c) If first affect water molecules than DNA

(d) **Both a&c**

(29) The chemical mutagens are mostly responsible for mis-pairing of nitrogen bases of DNA

(a) **True**

(b) False

30. Nearly 300 amino acids are required to make normal hemoglobin

(a) **True**

(b) False

31. Hemoglobin in Sickle Cell Anemia is different only in ----amino acids

(a) **1**

(b) 2

© 3

(d) 4

32. In sickle cell anemia, -----replaces glutamic acid

(a) **Valine**

(b) Serine

© Both a&b

(e) None

33. Phnylketonuria is a genetic disorder which may interfere with the brain cells of infant (child)

(a) **True**

(b) False

34. Sickle cell anemia is more common in

(a) Americans

(b) **Africans**

© Asians

(e) None

35. The haploid number of Mosquito is

(a) 3

(b) 4

© 5

(e) 1



1. Shortest possible time for cell division may be----minutes
  - (a) **20**
  - (b) 30
  - (c) 40
  - (d) None
2. A kind of amitosis in which nucleus is divided into different sizes are called
  - (a) **Nuclear budding**
  - (b) Nuclear fragmentation
  - (c) Amitosis
  - (d) All
3. In cancer and tumor cells, the cell divided in a way that nucleus divides repeatedly and cytoplasm does not divide. That is called
4.
  - (a) **Nuclear budding**
  - (b) Nuclear fragmentation
  - (c) Amitosis
  - (d) All
5. Programmed death of cell is termed as
  - (a) Epitasis
  - (b) **Apoptosis**
  - (c) Both a&b
  - (d) None
6. Apoptosis may occur at any stage of life but it is more common during
  - (a) **Embryonic stage**
  - (b) Maturation stage
  - (c) Aging
  - (d) All of above
7. Any change in the normal number of chromosomes is called
  - (a) **Heteroploidy**
  - (b) Aneuploidy
  - (c) Polyploidy
  - (d) All
8. If an animal has more that two homologous chromosome for given trait, the condition is called
  - (a) Heteroploidy
  - (b) **Polyploidy**
  - (c) Both a&b
9. Addition or subtraction of chromosomes is termed as
  - (a) Heteroploidy
  - (b) Poly ploidy
  - (c) **Aneuploidy**
  - (d) All
10. One in every 900 births show -----syndrome
  - (a) **Down's Syndrome**
  - (b) Turners Syndrome
  - (c) Klinefelter syndrome

- (d) All
11. A person with XXY is -----  
**(a) Klinefelters syndrome**  
(b) Down's Syndrome  
(c) Both a&b  
(d) None
12. About 1 in every 5000 babies are XO. This genetic defect is termed as ----  
(a) Down's Syndrome  
**(b) Turners Syndrome**  
(c) Klinefelters syndrome  
(d) All

## MITOSIS

1. New cells can come only from preexisting cells.  
**true**  
false
2. Cell division in unicellular organisms produces two new individuals that are like the parents.  
**true**  
false
3. Binary fission does not utilize a spindle.  
**true**  
false
4. The nucleoid of a prokaryote is enclosed by a membrane.  
true  
**false**
6. Simple cell division distributes the chromosomes in such a way that each and every cell gets a full number.  
**true**  
false
7. Each species has a characteristic chromosomal number which is called the diploid number.  
**true**  
false
8. During telophase, new nuclear envelopes form around the daughter chromosomes.  
**true**  
false
9. The period of DNA synthesis when replication occurs is termed the G<sub>1</sub> stage.  
true  
**false**
10. During mitosis, the spindle forms.  
**true**  
false

12. During \_\_\_\_\_, the chromosomes attach to the spindle and align at the metaphase plate of the spindle.
- prophase
  - prometaphase**
  - metaphase
  - anaphase
13. During \_\_\_\_\_, the chromosomes attached to kinetochore fibers are aligned at the metaphase plate.
- anaphase
  - metaphase**
  - prophase
  - prometaphase
16. Meristem tissue is found in the \_\_\_\_\_ of a plant.
- roots middle
  - shoot tips**
  - stems middle
  - all of the above
17. Cell division in multicellular organisms
- is part of the growth process that produces the multicellular organism.
  - is important for renewal.
  - is important for repair.
  - all of the above.**
18. It is apparent during prophase that nuclear division is about to occur because
- the chromatin has condensed.
  - the chromosomes are visible structures.
  - both a and b.**
19. The spindle of animal cells consists of \_\_\_\_\_.
- poles
  - asters
  - fibers
  - all of the above**
20. During anaphase
- the spindle lengthens.
  - the poles become more distant from one another.
  - both a and b.**
21. Microtubules are found in
- the cytoplasm.
  - flagella.
  - centrioles.
  - all of the above.**
22. The mechanics of the cell cycle and the cause of cancer are \_\_\_\_\_ related.
- distantly
  - closely**
  - not

23. Interphase consists of the \_\_\_\_\_ stages of cellular growth and division.
- G<sub>1</sub>, M, and G<sub>2</sub>
  - G<sub>1</sub>, S, and G<sub>2</sub>**
  - M, S, and G<sub>2</sub>
  - M, S, and G<sub>1</sub>
24. During the G<sub>1</sub> stage
- the cell grows in size.
  - the cellular organelles increase in number.**
  - both a and b.
25. Mitosis is the type of nuclear division involved in
- growth of the body.
  - repair of the body.
  - both a and b.**
26. Cell division in eukaryotes involves
- nuclear division.
  - division of the cytoplasm.
  - both a and b.**
28. Cell division in multicellular organisms is important for
- growth.
  - repair.
  - both a and b.**
29. Each cell of an organism
- contains only the DNA it needs.
  - contains a full complement of DNA.**
  - depends on the cell.
30. Daughter cells as a result of mitosis have a complete copy of
- chromosomes.
  - genes.
  - both a and b.**

## MEIOSIS

Meiosis is more common than mitosis.

true

**false**

2. Meiosis always increases the number of chromosomes.

true

**false**

3. Exchange of genetic material is called crossing-over.

**true**

false

4. Replication of DNA is necessary between meiosis I and meiosis II.

true

**False**

6. It is apparent during prophase I that nuclear division is about to occur.

**true**

false

7. After crossing-over during prophase I, the sister chromatids of a duplicated chromosome remain identical.

true

**false**

8. There is no set way for the homologous chromosomes to align themselves at the metaphase plate of the spindle.

true

**false**

9. A zygote always has the diploid number of chromosomes.

**true**

false

10. Meiosis occurs at the same points during the life cycles of various organisms.

true

**false**

11. In animals, the adult is always haploid.

true

**false**

12. Mammals, including humans, have a life cycle that requires \_\_\_\_\_.

a. meiosis

b. mitosis

c. **both a and b**

13. In human females, meiosis is a part of \_\_\_\_\_.

a. ovulation

b. **Oogenesis**

c. neither a or b

14. Mitosis occurs in humans during

a. development of the zygote.

b. growth of a child.

- c. repair of tissue at any time.
  - d. **all of the above.**
15. In humans, meiosis
- a. occurs only in the sex organs.
  - b. produces the gametes.
  - c. **both a and b.**
16. During \_\_\_\_\_, the chromosomes of each homologous pair separate and move to opposite poles.
- a. prophase I
  - b. metaphase I
  - c. **anaphase I**
  - d. telophase I
17. If telophase I takes place, which of the following always happens?
- a. the nuclear envelope reforms
  - b. cytokinesis occurs
  - c. nucleoli appear
  - d. **both a and c**
19. Metaphase I is characterized by
- a. a fully formed spindle.
  - b. alignment of the bivalents at the metaphase plate.
  - c. **both a and b.**
20. During \_\_\_\_\_, the sister chromatids separate and therefore four daughter cells each have chromosomes with one chromatid.
- a. meiosis I
  - b. **meiosis II**
  - c. mitosis
  - d. both a and b
21. Crossing-over is an exchange of genetic material between \_\_\_\_\_ chromatids.
- a. **sister**
  - b. nonsister
  - c. neither a or b
22. When a cell is  $2n$ , the chromosomes
- a. occur singly.
  - b. **occur in pairs.**
  - c. either a or b.
24. Sexual reproduction includes
- a. gamete formation.
  - b. fusion of gametes to form a zygote.
  - c. **both a and b.**
25. In animals, meiosis
- a. **occurs during the production of gametes.**
  - b. produces spores that divide mitotically to become a haploid generation.
  - c. both a and b.
28. At the end of telophase II and cytokinesis, there are \_\_\_\_\_ haploid cells.

- a. two  
**b. four**  
 c. six
29. After synapsis during meiosis I, the homologous chromosomes \_\_\_\_\_.
- a. separate  
 b. join  
 c. diffuse  
**d. Split**
30. Meiosis occurs in
- a. animals.  
 b. plants.  
 c. fungi.  
**d. all of the above**
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2. The hyploid number of chromosomes in Ferns is
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31. Hemoglobin in Sickle Cell Anemia is different only in ----amino acids  
 (a) 1 (b) 2 (c) 3 (d) 4
32. In sickle cell anemia, -----replaces glutamic acid  
 (a) Valine (b) Serine (c) Both a&b  
 None
33. Phenylketonuria is a genetic disorder which may interfere with the brain cells of infant (child)  
 (a) True (b) False
34. Sickle cell anemia is more common in  
 (a) Americans (b) Africans (c) Asians (d) None
35. The haploid number of Mosquito is  
 (a) 3 (b) 4 (c) 5 (d) 1

QUESTION NO.	ANSWER KEY
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	C
10.	
11.	
12.	
13.	A
14.	A
15.	C
16.	A
17.	A
18.	A
19.	C
20.	B
21.	B
22.	A
23.	B
24.	C
25.	C
26.	A
27.	B
28.	D
29.	A
30.	A
31.	A
32.	A
33.	A
34.	B
35.	