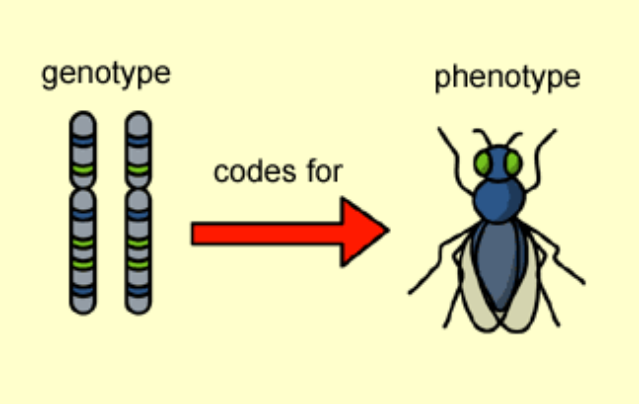
HEREDITY & VARIAITON



DR. A. G. ARIJO

This include

Quick review
Practice sheets
Answer key

Factor: A particle or unit in the organism which is responsible for the inheritance and expression of a particular character.

Gene: A gene is a particular segment of a DNA molecule which determines the inheritance and expression of a particular character.

Alleles or Allelomorphs: Two or more alternative forms of a gene are called alleles or allelomorphs. For example in pea, the gene for producing seed shape may occur in two alternative forms: round (R) and wrinkled (r). Round and wrinkled forms of the gene are alleles of each other. Alleles occupy same locus on homologous chromosomes.

Dominant: Of the two alternating forms (allomorphs) of a trait, the one which appears in the F_1 hybrid is called the dominant trait (Dominant Allele).

Recessive: Of the two alternating allomorphs of a trait, one which is suppressed (does not appear) in the F_1 hybrid is called the recessive trait (recessive allele).

Genotype: The genetic make-up of an individual (which he/she inherits from the parents) is called the genotype, e.g., the genotype of pure round seeded parent will be RR.

Phenotype : The external (morphological) appearance of an individual for any trait or traits is called the phenotype, e.g. for seeds, round shape or wrinkled shape is the phenotype.

Homozygous : An individual possessing (receiving from parents) identical alleles for a trait is said to be homozygous or pure for that trait, e.g. plant with RR alleles is homozygous for the seed shape. A homozygous always breeds true for that trait.

Heterozygous : An individual receiving dissimilar alleles for a trait is said to be heterozygous or impure for that trait, e.g. a plant with Rr alleles is heterozygous for the seed shape. Heterozygous is also called a **hybrid**.

Parent generations : The parents used for the first cross represent the parent (or P1) generation.

F_1 generation : The progeny produced from a cross between two parents (P1) is called **First Filial** or **F_1 generation**.

Inbreeding : When the individuals of a progeny (e.g. F_1 generation) are allowed to cross with each other, it is called inbreeding.

F_2 generation : The progeny resulting from self hybridization or inbreeding of F_1 individuals is called **Second Filial** or **F_2** generation.

Monohybrid cross : The cross between two parents differing in a single pair of contrasting characters is called monohybrid cross and the F_1offspring as the **hybrid**(heterozygous for one trait only).

Monohybrid ratio : The phenotypic ratio of 3 dominants : 1 recessive obtained in the F_2 generation from the monohybrid cross is called **monohybrid ratio**.

Dihybrids cross: The cross between two parents in which two pairs of contrasting characters are studied simultaneously for the inheritance pattern. The F_1 offspring is described as dihybrid or double heterozygous (i.e. with dissimilar alleles for two characters).

Dihybrid ratio: The phenotypic ratio obtained in the F_2 generation from a dihybrid cross is called dihybrid ratio. In Mendelian experiments, this ratio is 9:3:3:1.

Homologues or Homologous chromosomes: The morphologically similar looking chromosomes in a diploid cell (one chromosome coming from the male parent and the other from the female parent) are called homologous chromosomes. They have identical gene loci bearing alleles.

Gene

A gene is a particular segment of a DNA molecule which determines the inheritance and expression of a particular character. Genes are generally found in pairs and work for same character. Some genes are only capable to control one character, whereas some strong genes may control more than one character.

Allele

Two or more alternative forms of a gene are called alleles or allelomorphs. For example in pea, the gene for producing seed shape may occur in two alternative forms: round (R) and wrinkled (r). Round and wrinkled forms of the gene are alleles of each other. Alleles occupy same locus on homologous chromosomes.

Gene pool

Gene pool may be defined as sum total of genes in population. Gene pool also consists of alleles in individuals of the population. Gene pool of various communities is different and specific. It remains same unless out breeding is not practiced. In case the individuals of population practice out breeding, than new

genes appear in coming generations, therefore there will be genetic drift in gene pool.

Genetics

"Genetics is the study and understanding of the phenomena of heredity and variation.*"* The term 'genetics' was first coined by Bateson in 1906. In Latin, it means genesis or origination of organisms.

Heredity is the transmission of characters from one generation to the next, i.e., from parents to their offspring. Because of heredity, the offspring resemble their parents. Heredity is the essence of self-reproduction. It is of self-reproduction. For example a seed of mango develops into a mango tree, or the offspring of a dog is a puppy, and that of human beings is a human being only.

Variations:

It may be defined as the visible differences between the parents and the offspring, or between two offspring of the same parents.

Law of Dominance

The law of dominance may be defined as a phenotypic appearance of strong gene in F1 generation.

According to Mendel, some genes are strong and others are weak. The body characters controlled by strong genes are called dominant characters, and body characters controlled by weak genes are called recessive characters. If strong and weak genes are crossed, the weak genes do not appear in next generation, but strong genes will appear. It means that the strong gene became dominant over weak gene.

Incomplete dominance

Incomplete dominance may be defined as a genetic method in which the dominant gene fails to show its dominancy.

Example:

When a plant with Red color of flowers was crossed with white color flower, the next generation of plants should have produced red flowers, because red is dominant character, controlled by dominant genes. But according to result, in next generation, the color of flower was neither red not while, but it was pink

Co-dominance

It may be defined as equal appearance of dominant and recessive genes in F1 generation.

Explanation:

A dominant genes appears phenotypically in F1 generation, but a recessive genes never appears in F1 generation. But in case of co-dominance, both dominant and recessive genes may appear in equal ratio in same individual

Example:

Black is a dominant character and white is a recessive character. When a dog with black color was crossed with bitch with white color. According to Mendelian genetics, the puppies must appear black. But it was observed that all puppies had black and white spots on their body in the ration of 50:50.

Law of Segregation

The **law** states that when a pair of alleles is brought together in hybrid union, the members of the allelic pair remain together without mixing, diluting or altering each other and separate or segregate from each other when the hybrid forms gametes. Thus, according to this law, when the hybrid tall **(Tt)** forms gametes, the genes **T** and **t** shall separate (segregate) and enter in different gametes. As a result, the hybrid shall form two types of gametes; those with (T) genes and an equal number with (t) gene. Since each gamete will be pure for tallness or for dwarf ness, therefore the law of dominance is also known as the **law of the purity of gametes**.

Monohybrid Ratio

The phenotypic ratio of different types of individuals occurring in the F_2 generation of the monohybrid cross is called the **monohybrid ratio**. In the Mendelian monohybrid experiments, this ratio was always 3:1(i.e., 75% is dominant and 25% is recessive).

Dihybrid Ratio

A cross between two pure, true breeding parents in which the inheritance pattern of two allelomorphic pairs is considered (studied) simultaneously is called a **dihybrid cross**. The phenotypic ratio obtained in the F_2 generation of a dihybrid cross is called the **dihybrid ratio**.

Test Cross

Test cross may be defined as a simple method given by Mendel to verify the genotype of the F_1 hybrid. Test cross is a genetic way to test the homozygosis or heterozygosis of organisms involved in crosses.

Explanation:

When the F_1 hybrid is crossed with the homozygous recessive parent, it is called a **test cross.** Since, the F_1 is crossed back with one of the parents; it is also called a back cross.

Example:

In a cross of *Tall x Dwarf*, the F_1 are all *tall* (Figure is given below). Let us see what happens when this F_1 *tall* is test crossed with the homozygous recessive parent i.e. *Dwarf* with (tt) genotype.

Multiple allele

Multiple allele may be defined as a gene for a trait having three or more allele forms.

Explanation:

Generally genes have single allele, but in case of multiple allele, gene has more than three alleles which express them in multiple ways. The most popular example of multiple allele is blood groups. In human beings, there are four types of blood groups. All these groups are because of two antigens which are protein in nature. The name of antigen is **Isohemaglutinogen.**

Rh antigen

Rh is a kind of antigen which may or may not be found in human blood.

Explanation:

Before human blood research was carried out on Rhesus monkey in which an antigen was found. That antigen was named after the Rhesus monkeys. Later on, when same antigen was found in humans, the name of antigen was continued that is why this antigen is called Rh antigen.

The research on human blood has revealed that this antigen is found in 85 % population, and is absent in 15% population. A person who has this antigen will have positive blood group and a person who does not have this antigen will have negative blood group.

Erythroblastosis foetalis.

It is very interesting that the blood type of mother is negative and in her womb, the blood type of child is positive. These types are opposite to each other. In this case the child will have normal birth, but his positive Rh will stimulate mother to produce antibodies against positive antigen and these antibodies will remain in mothers' blood. When same woman will become pregnant next time, than the antibodies of mother will interfere with the Red blood cells of baby who will be born very anemic. This condition is called Erythroblastosis foetalis.

Polygenic inheritance

Polygenic inheritance may be defined as a kind of inheritance which is controlled by more than two separate pairs of genes.

Explanation:

Some body characters are very simple and may be controlled only by one pair of genes, but some body characters are complicated in nature, therefore they are controlled by at least 2 separate pairs of genes.

Pleiotropy

It may be defined as inter-related pathway where one product of necessary for the start of next reaction.

Explanation:

Pleiotropy simply means that a single gene can have multiple effects, but, each effect has its respective costs and benefits -- which can vary, even reverse, in different contexts thus, a cost in one context might be a benefit in a different one. Additionally, the capacity to respond to varying environments with varying effects is itself an adaptive trait!

Phenylketonuria

Phenylketonuria (PKU) is an inherited error of metabolism caused by a deficiency in the enzyme phenylalanine hydroxylase. Loss of this enzyme results in mental retardation, organ damage, unusual posture and can, in cases of maternal PKU, severely compromise pregnancy.

Linkage:

Tendency of genes in a chromosome to remain together is called linkage

Explanation:

There are thousand of genes which are present in chromosomes. It means that in chromosomes, many genes are linked with each other, but they may be separated from each other if and when needed.

Crossing Over:

It is defined as tendency of a block of genes which leave their place in chromosome and go to another chromosome.

Explanation:

During diplotene stage of meiosis cell division, when two homologous chromosomes link up with the help of synopsis, the genes of both chromosomes get chance to cross over.

Sex determination and sex linkage

Sex determination may be defined as a genetic phenomenon, in which the sex of off spring is decided.

Explanation:

As we know that organisms have two type of chromosomes i.e. autosome and sex chromosomes. The autosomes chromosomes have gene for the control of body characters and they don't play any part in determination of sex of off spring. Other chromosomes are called sex chromosomes which have genes for body characters and genes which also control the sex of off spring.

color-blindness

Definition:

The color blindness is a genetic disorder in which a person either cannot distinguish red from green, or see red and green differently from most people.

Explanation:

The genes for normal color are located on the XX chromosomes of female and only on the X chromosomes of male. The Y chromosome is very short, therefore it has no genes for body characters, but it has genes for sex determination.

If the genes in XX chromosomes of female become mutant, the female will suffer from color blindness. In male only one gene located on X chromosomes has to become mutant and the male will become color blind. It means if in female, one gene becomes mutant, the other normal gene will save a female from becoming

color blind, whereas male will become color blind if the one and only gene on X chromosomes becomes mutant.

Diabetes mellitus

Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels, which result from defects in insulin secretion. Diabetes mellitus, commonly referred as diabetes, means **"sweet urine."** lead to spillage of glucose into the urine, hence the term is called sweet urine.

PRACTICE SHEET

Practice Sheet

1. The position of genes on chromosomes is called

(b) Locus
(c) Loci
(d) Position
(e) Both a&b

1. Contrast form of gene is called
(a) Allelomorphs
(b) Allele
(c) Contrast gene
(d) All

2. Some total of aggregate genes present in entire population is called

(a) Gene pool
(b) Genetic drift
(c) Gene frequency
(d) All

3. If a dominant character hides a recessive character in F1 generation, the phenomenon is called
(a) Law of Dominance
(b) Law of incomplete dominance
(c) Co-dominance
(d) None

4. Recessive genes can express them in
(a) F1 generation
(b) F2 generation
(c) F3 generation
(d) All

5. The genetic ratio of dominant and recessive in F2 is
(a) 3:1
(b) 2:1
(c) 1:2:1
(d) None

6. If heterozygous dominant is crossed with homozygous recessive, it defines
(a) Back cross
(b) Test Cross
(c) Both a&b
(d) None

7. To test homozygocity and heterpzygocity ----test is performed
(a) Test cross
(b) Back cross
(c) Both a&b

(d) None

8. When dominant and recessive traits appear in equal ration in F1 generation, it defines----------

(a) Law of dominance
(b) Law of co dominance
(c) Law of incomplete dominance
(d) None

9. Separation of a pair of genes into gametes defines

(a) Law of segregation
(b) Law of dominance
(c) Co dominance
(d) All

10. Pink flower is phenotypic expression of cross between Red & White. Is explains

(a) Dominance
(b) Co dominance
(c) Incomplete dominance
(d) All

11. Blood group AB is example of

(a) Multiple allele
(b) Co dominance
(c) Both a&b
(d) None

12. ABO grouping of blood is example of

(a) Codominance
(b) Multiple allele
(c) Polygenic inheritance
(d) All

13. One of the following is international donor

(a) O+ve
(b) O-ve
(c) Both a&b
(d) None

15 f blood group of mother differs from baby, she can produce antibodies and can cause ----------problem in next child

(a) Erythroblast foetalasis
(b) Leukemia
(c) Blood disorder
(d) All

16. Effect of a gene on non pair allele is called

(a) Epi-stasis

(b) Polygenic inheritance
(c) Both a&b
(d) None

17. When more than one set of genes control single trait, it is
(a) Double trait inheritance
(b) Polygenic inheritance
(c) Multiple varying trait
(d) Both a&c

18. One of the following is not example of polygenic inheritance in humans
(a) Skin color
(b) Height
(c) Intelligence
(d) Color blind ness

19. The multiple effect of a single gene is called
(a) Pleiotropy
(b) Epistasis
(c) Both a&b
(d) None

20. Mendel performed his famous experiments of heredity on
a) Maize b) Mirabilis c) **Garden pea** d) Bean plant

21. Mendel in his experiments considered characters
a) Five b) Three c) Six d) **Seven**

22. In a cross appearance of dominant and recessive character is known as
a) **Co-dominance** b) Incomplete dominance c) Epistasis d) None

23. If in a cross both characters equally appear then it is called
a) **Co-dominance** b) Incomplete dominance c) Interaction of gene d) Multiple allele

24. Blood group is also known as universal donor
a) Blood group A b) Blood group B c) Blood group AB d) **Blood group O**

25. Each human being possesses pairs of chromosomes
a) 21 pairs b) 22 pairs c) **23 pairs** d) 24 pairs

25. Genes for one of the following disorder are not sex linked
(a) Color blindness
(b **tallness**
© Sickle cell anemia
(d) All of above

NUMBER	CORRECT OPTION
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PRACTICE SHHET 02

1: Which of the following is an alternate form of a gene?
(a) Allele
(b) genotype
(c) linkage
(d) phenotype

2: An individual who is heterozygous for two genes is represented:
(a) Aabb
(b) AaBb
(c) AAbb
(d) AABb

3: How many genetically different kinds gametes will an individual with genotype AAbb produce ?
(a) 1
(b) 2
(c) 3
(d) 4

4: Round seed is dominant over wrinkled seed in pea. If homozygous, round seeded peas are crossed with wrinkled seeded peas, the offspring will be:
(a) all round
(b) all wrinkled
(c) 50 % round + 50% wrinkled
(d) 75 % round + 25% wrinkled

5: If heterozygous round seeded pea plants are self-pollinated the offspring will be:
(a) 75% round
(b) 50% heterozygous
(c) 25 % aa
(d) All of the above

6: Assume that red-green colorblindness is sex-linked. A colorblind woman and a man with normal vision have a son. The son's genotype is:
(a) Aa
(b) ay
(c) Ay
(d) AxAx

7: A man and a woman, both with normal thumbs, have a son with hitchhiker's thumb. It is likely that _____ is (are) heterozygous.
(a) the son
(b) the man
(c) the woman
(d) both parents

8: A man has blood type A. His wife has blood type B. Their children can have blood type:
(a) AB
(b) A or B
(c) A or B or AB
(d) A or B or AB or O

9: Inheritance of the A,B,O blood groups is an example of:
(a) incomplete dominance
(b) linkage
(c) multiple alleles
(d) sex linkage
(e) all of the above

10: In pigeons, checkered pattern is dominant over plain pattern and red color is dominant over brown. A checkered brown female mated with a plain red male produced 2 checkered red, 2 plain red, and 1 checkered brown offspring. What are the probable genotypes of the parents ?
(a) CCRR and ccrr
(b) CcRr and CRrr
(c) CcRr and ccRR
(d) Ccrr and ccRr

Question	Answer
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PRACTICE SHEET 03

1. The different forms of a gene are called
- a. chromosomes.
- b traits.
- c genotypes.
- d alleles.

2. One parent has genotype DD and the other has dd. All of the offspring will be
- a heterozygous.
- b. homozygous.
- c dominant.
- d recessive.

3. Both parents have genotype Rr. The offspring could have genotype
- a RR or Rr.
- b. Rr only.
- c Rr or rr.
- d Rr, RR, or rr.

4. If two hybrid tall pea plants are crossed, what is the probability that the offspring will be hybrid tall?
- a. 0 percent
- b. 50 percent
- c 75 percent
- d. 100 percent

5. In the hybrid tall cross of problem 4, what is the probability that the offspring will have the tall phenotype?
- a. 25 percent
- b 50 percent
- c. 75 percent
- d 100 percent

6. If two white guinea pigs with genotype bb are crossed, what is the probability that the offspring will be white?
- a 0 percent
- b. 50 percent
- c 75 percent
- d. 100 percent

7. If a black heterozygous guinea pig is crossed with one of the white guinea pigs in question 6, what is the probability that the offspring will be white?

a 0 percent
b 50 percent
c. 75 percent
d. 100 percent

8. As a result of meiosis, the number of chromosomes

a is reduced by half in sex cells.
b stays the same in sex cells.
c is doubled in sex cells.
d is quadrupled in sex cells.

9. Which of the following statements about RNA is false?

a. RNA is a one-stranded ladder.
b RNA has a different sugar molecule from the sugar found in DNA.
c RNA contains uracil.
d RNA contains thymine.

10. The job of transfer RNA is to

a make messenger RNA.
b make DNA.
c carry amino acids.
d carry proteins.

Question	Answer
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