A. Definition of Terms

GENETICS

is the study of how the characteristics of organisms are passed from parents to offspring and how they are inherited.

GENOME

is a complete set of chromosomes inherited as a unit from one parent. It also refer to the collection of DNA molecules that is characteristics of an organism as its genome.

DNA REPLICATION

is a process by which double stranded DNA molecules are duplicated. The process of DNA replication is based on the complementary nature of the strands that make up duplex DNA molecules.

TRANSCRIPTION

is the process that produces an RNA molecule using one strand of DNA as a template. The RNA itself is called a transcript. Transcription is the transfer of the genetic information from DNA to RNA.

TRANSLATION

Translation, the transfer of information from RNA to protein. The second step, translation, involves the transfer of the information from mRNA into the amino acid sequence of polypeptide.

GENE EXPRESSION

Gene expression is the process of using genetic information. The expression of genetic information occurs in two steps: transcription and translation.

MITOSIS

Mitosis is the process of nuclear division that produces two identical daughter nuclei, each with the same chromosome number as the parent cell.

MEIOSIS

Meiosis is the process of nuclear division that reduces the chromosome number from diploid to haploid and produces four different nuclei.

MONOHYBRID CROSS

A monohybrid cross is cross involving a single pair of contrasting traits that illustrates the principle of dominance and segregation.

DIHYBRID CROSS

A dihybrid cross is a cross involving two pairs of contrasting traits that illustrates the principle of independent assortment.

DOMINANT TRAIT

A dominant trait is the trait that is expressed when its allele is present in either the homozygous or heterozygous condition.

RECESSIVE TRAIT

A recessive trait is the trait that is expressed only when its allele is present in the homozygous condition; the recessive allele is not present in the heterozygote.

HOMOZYGOUS

Homozygous an individual that has two identical alleles of a gene.

HETEROZYGOUS

Heterozygous an individual that has two different alleles of a gene.

GENOTYPE

Genotype the genetic constitution of an organism.

PHENOTYPE

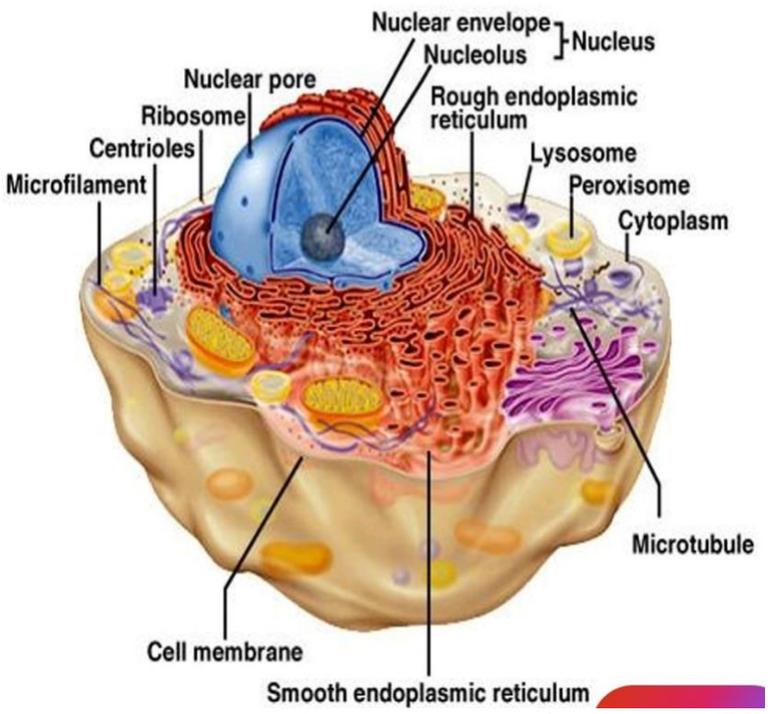
Phenotype the observable characteristics of an organism.

PEDIGREE

Pedigrees are diagrams used to track inheritance of traits in human families.

B. Identify the cell structure and it's major function.

FIGURE 1.



Nucleus – contains the chromosomes / genetic material.

Nuclear envelope – double membrane surrounding the nucleus.

Nuclear pore – allows passage of molecules between nucleus and cytoplasm.

Nucleolus – site of ribosome assembly.

Rough endoplasmic reticulum – studded with ribosomes; protein synthesis and processing.

Smooth endoplasmic reticulum – lipid synthesis and detoxification.

Ribosome – site of protein synthesis (translation).

Lysosome – digests macromolecules and cellular debris.

Peroxisome – oxidizes fatty acids and detoxifies.

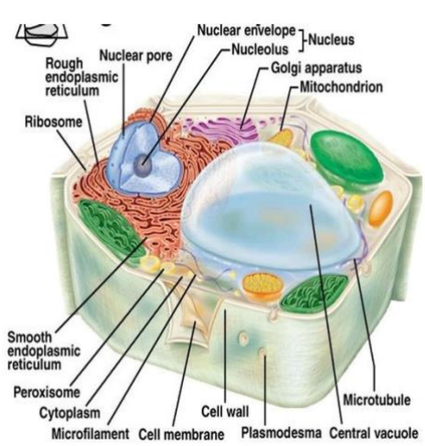
Cell membrane (plasma membrane) – selective barrier.

Centrioles – organize the mitotic spindle.

Microtubule / Microfilament – components of the cytoskeleton; cell shape and movement.

Cytoplasm – the cellular contents outside the nucleus.

FIGURE 2.



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Golgi apparatus – modifies, sorts, and packages proteins.

Mitochondrion – produces ATP (cellular respiration).

Cytoplasm – the cellular contents outside the nucleus.

Peroxisome – oxidizes fatty acids and detoxifies.

Cell membrane (plasma membrane) – selective barrier.

Microtubule / Microfilament – components of the cytoskeleton; cell shape and movement.

Cell wall (plant cells) – rigid outer layer.

Central vacuole (plant cells) – storage and turgor.

Plasmodesma (plant cells) – cytoplasmic channels between adjacent cells.

Explain

LEVELS OF GENETIC ANALYSIS

Genetics can be studied at three main levels: classical genetics, molecular genetics, and population genetics.

- Classical genetics analyzes the outcomes of crosses between different strains of organisms and tracks the transmission of genes and chromosomes from one generation to the next.

- Molecular genetics focuses on the molecular makeup of the genetic material (DNA) and how genes are expressed.

- Population genetics studies genes at the level of an entire population of organisms by assessing the variability among individuals in a group.

CELL CYCLES

The series of events that take place in a cell leading to its division and duplication; includes interphase (G_1, S, G_2) and the mitotic (M) phase.

SIGNIFICANCE OF CELL DIVISION

Cell division is essential for growth, repair, and reproduction; it ensures that each daughter cell receives a complete set of genetic material.

DISCUSS THE SIGNIFICANCE OF THE PACHYNEMA STAGE WHERE GENETIC CROSSING OVER OCCURS

Pachynema (pachytene) is the stage of meiotic prophase I in which homologous chromosomes are fully synapsed and crossing over (genetic recombination) occurs, visible as chiasmata.

GIVE COMPARISONS BETWEEN MITOSIS AND MEIOSIS

Mitosis produces two identical diploid daughter cells; meiosis produces four genetically different haploid cells. Mitosis maintains chromosome number; meiosis halves it. Crossing over and independent assortment occur only in meiosis.

PRINCIPLES OF DOMINANCE

One allele may conceal the presence of another.

PRINCIP LE OF SEGREGATION

Alleles of a gene segregate from each other during gamete formation so that each gamete receives only one allele.

PRINCIPLE OF INDEPENDENT ASSORTMENT

Dihybrid crosses: the principle of independent assortment.” Alleles of different genes assort independently of one another during gamete formation.

INCOPLETE DOMINANCE

Incomplete dominance occurs when the heterozygote shows a phenotype that is intermediate between the two homozygous phenotypes.

CODOMINANCE

Codominance occurs when both alleles are fully expressed in the heterozygote, so that the phenotype of the heterozygote shows the traits of both alleles.

MULTIPLE ALLELES

Multiple alleles means that more than two alleles of a gene exist in the population.

LETHAL GENES

Lethal genes are genes whose mutant alleles cause the death of the organism that carries them

ONE GENE, ONE PROTEIN

The one gene–one protein (originally one gene–one enzyme) concept states that each gene encodes a single polypeptide (or enzyme).

MUTATION AND THEIR EFFECT ON GENE FUNCTION

Mutation is the process of changing genetic information. Mutations alter the nucleotide sequence of a gene and can change or abolish the function of the gene product.

SEX-INFLUENCED TRAITS

Sex-influenced traits are traits whose expression is influenced by the sex of the individual.

INCOMPLETE PENETRANCE

Incomplete penetrance occurs when not all individuals who have a particular genotype show the expected phenotype.

EXPRESSIVITY

Expressivity is the degree or intensity with which a particular genotype is expressed in the phenotype.

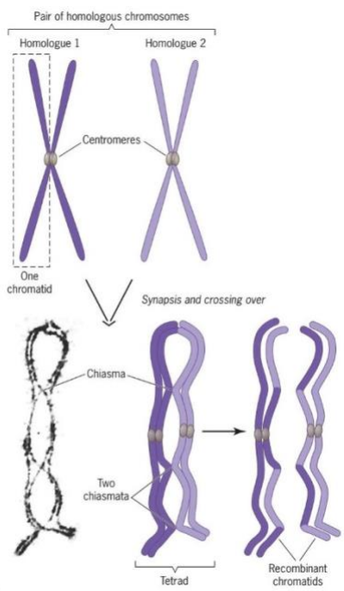
GENE INTERACTIONS

Gene interactions occur when the phenotype depends on the interaction of alleles at different loci (for example, epistasis).

PLEIOTROPY

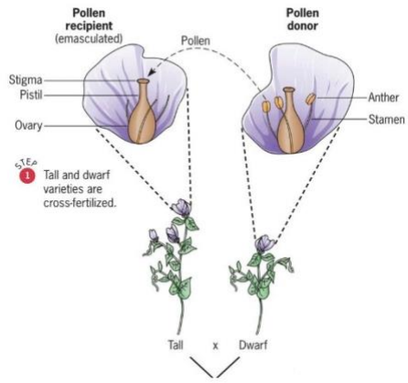
Pleiotropy is the phenomenon in which a single gene influences multiple phenotypic traits.

C. Discuss the Figure.

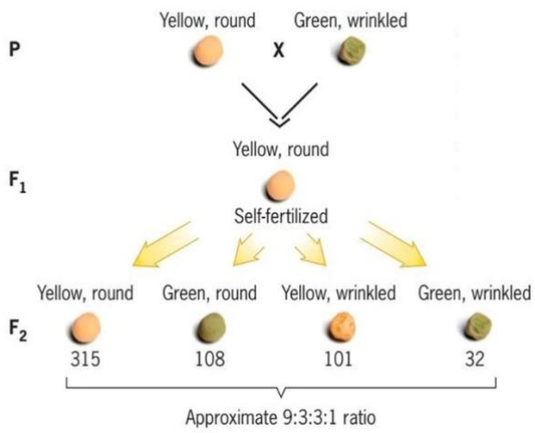


1.

1. Figure of homologous chromosomes, synapsis, crossing over, chiasmata, tetrad, recombinant chromatids. This illustrates the process of crossing over during meiotic prophase1 (pachynema). Homologous chromosomes pair (synapsis), form a tetrad, and exchange segments at chiasmata, producing recombinant chromatids.



2. This figure shows how Mendel performed controlled crosses. He removed the anthers from one flower (the pollen recipient) so it could not self-pollinate, then transferred pollen from a tall plant to a dwarf plant (or vice versa). This careful technique produced the F_1 generation and allowed him to discover the principles of dominance and segregation.



3. This figure illustrates Mendel's famous dihybrid cross. He crossed plants with yellow-round seeds to plants with green-wrinkled seeds. All the F_1 plants had yellow-round seeds. When these F_1 plants were self-fertilized, the F_2 generation produced four types of seeds in the approximate ratio 9 yellow-round : 3 green-round : 3 yellow-wrinkled : 1 green-wrinkled. This 9:3:3:1 ratio proved that the two traits are inherited independently of each other (the Principle of Independent Assortment).

4.

	F_2 Phenotype	Observed Number	Expected Number	$\frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$
Mendel's dihybrid cross	Yellow, round	315	313	0.01
	Green, round	108	104	0.15
	Yellow, wrinkled	101	104	0.09
	Green, wrinkled	32	35	0.26
	Total:	**556**	**556**	**0.51 = χ^2**

4. This figure shows the chi-square test applied to Mendel's dihybrid data. The observed numbers of the four seed types are compared with the numbers expected from a 9:3:3:1 ratio. The calculated chi-square value is only 0.51, which is very low. This means the difference between observed and expected results is not significant, so the data strongly support the idea that the two genes assort independently.

5. This figure shows the relationship between genes and proteins. Each gene (Gene A, Gene B, Gene C, and Gene D) is transcribed and translated into its own specific polypeptide (Polypeptide A, B, C, and D). These different polypeptides then work together to produce the various aspects of the organism's phenotype. The figure illustrates the classic "one gene–one polypeptide" concept.

5.