Science of Genetics

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What is Genetics?

- Genetics is the branch of biology that studies how traits are passed from parents to offspring through genes.
- Genes carry information that controls how our body looks, functions, and develops.

DNA, Genes, and Chromosomes

DNA

- DNA (Deoxyribonucleic acid) is the molecule that holds genetic information.
- DNA is made up of four bases:
  - A – Adenine
  - T – Thymine
  - G – Guanine
  - C – Cytosine

Genes

- Genes are segments of DNA.
- Each gene contains instructions to make a specific protein.
- Proteins control body structure, functions, and development.
- Each person has two copies of most genes—one from each parent.

Chromosomes

- DNA is wrapped around special proteins called histones to form chromosomes.
- Chromosomes are found in the nucleus of the cell.
- Humans have **23 pairs of chromosomes (46 in total)** in each body cell.
- Genes are located on chromosomes.

Alleles

- Alleles are different versions of the same gene.
- For example, a gene for eye color may have a brown allele or a blue allele.

Genotype and Phenotype

- **Genotype** – the genetic makeup of an organism (for example: AA, Aa, or aa).
- **Phenotype** – the physical appearance or expressed trait (for example: brown eyes or blue eyes).

Inheritance of Traits

- Traits such as eye color, blood group, and height are determined by genes.
- Genes are passed from parents to offspring through gametes (sperm and egg).
- Each parent contributes half of the genetic material to the child.

Dominant and Recessive Genes

- **Dominant genes** show their effect even if only one copy is present (for example, Aa).
- **Recessive genes** show their effect only when both copies are recessive (aa).

Mendel's Laws of Inheritance

- These laws are based on the experiments of **Gregor Mendel**.

A. Law of Segregation

- Each organism has two copies of a gene, but only one copy is passed to each offspring.

B. Law of Independent Assortment

- Genes for different traits are passed independently of each other.

Mutations

- A mutation is a change in the DNA sequence.
- Mutations can occur naturally or due to environmental factors.
- Mutations may be harmless, harmful, or beneficial.
- Some mutations can cause genetic diseases, while others create useful variation.

Inheritance Patterns

- Dominant inheritance
- Recessive inheritance
- Co-dominance
- Incomplete dominance
- Sex-linked inheritance

Importance and Applications of Genetics

- Genetics is important because it:
  - Helps in understanding inherited diseases
  - Plays a key role in personalized medicine
  - Is used in agriculture to develop better crop varieties
  - Helps in studying ancestry and evolution

- Is used in forensic science

Transgenics Analysis

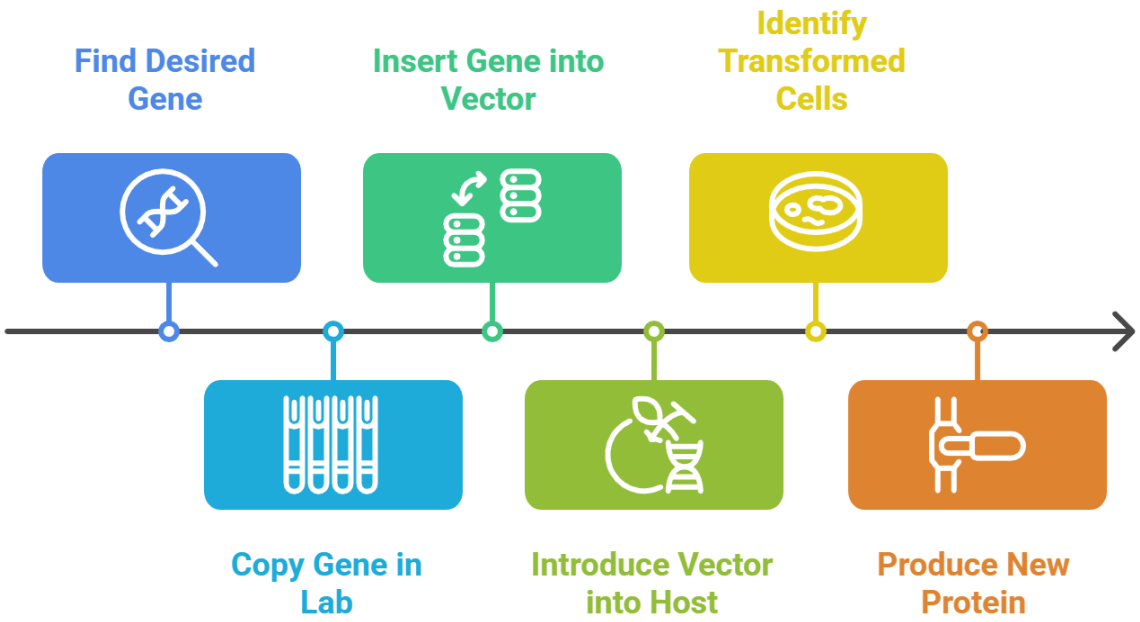
What is Transgenics?

- **Transgenics** means inserting a **foreign gene** (from another species or individual) into an organism's genome.
- This is done using genetic engineering techniques.

Why is it done?

- To give an organism a new trait or ability.
- For example, making a plant resistant to pests by adding a gene from bacteria.

Steps in Creating a Transgenic Organism:



1. **Gene Identification:**
   - Scientists find the gene that codes for a desired trait (like pest resistance in a plant).
2. **Gene Cloning:**
   - The gene is copied (cloned) in the lab.
3. **Vector Insertion:**
   - A **vector** (usually a plasmid – a small circular DNA from bacteria) is used to carry the gene into the target organism.
4. **Transformation:**
   - The vector is introduced into the host cell (bacteria, plant, or animal cell).
   - Techniques include microinjection, electroporation, or using viruses.

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