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Class: 10th

Subject: Biology

Chapter 15: Inheritance

Important MCQs:

1. The branch of biology that deals with the study of inheritance is:

(a) Cytology

(b) Genetics

(c) Anatomy

(d) Embryology

2. Inheritance is the transmission of _____ from parents to offspring.

(a) Hormones

(b) Traits

(c) Energy



(d) Blood

3. Which of the following is an example of an inheritable trait in humans?

(a) Tattoo

(b) Language

(c) Eye colour

(d) Dressing style

4. Genes are transferred from parents to offspring through:

(a) Muscles

(b) Organs

(c) Chromosomes

(d) Hormones


5. The functional units of inheritance are called:

(a) Nuclei

(b) Genes

(c) Alleles

(d) Cells



6. Each human body cell contains how many chromosomes in total?

(a) 44

(b) 23

(c) 46

(d) 48



7. The number of homologous chromosome pairs in humans is:

(a) 46

(b) 22

(c) 24

(d) 23

8. Chromosomes are made of:

(a) RNA

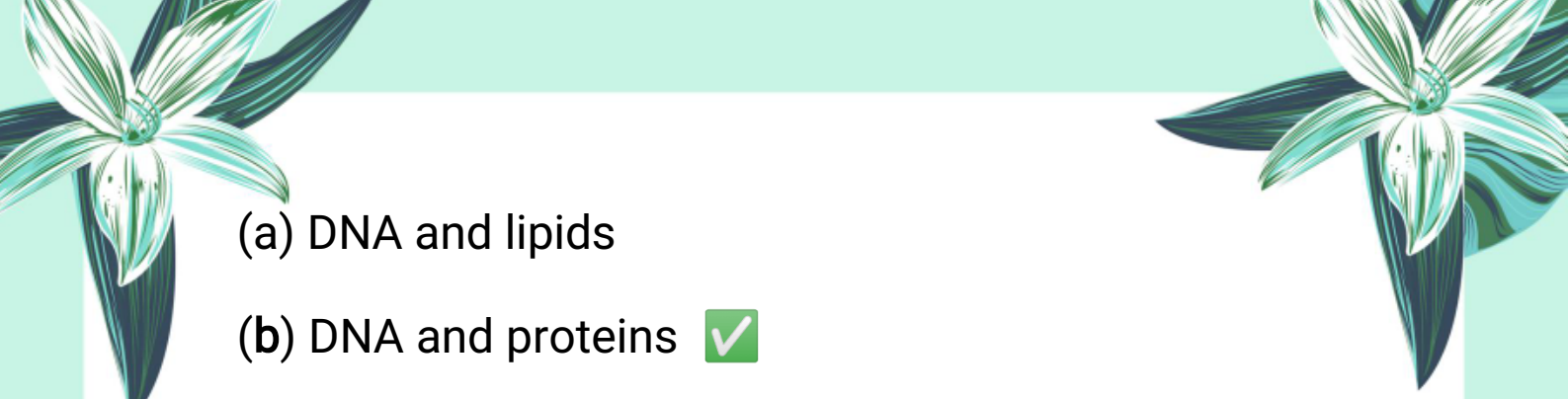
(b) Chromatin

(c) Nucleolus

(d) Lipids

9. Chromatin is mainly composed of:



- 
- (a) DNA and lipids
 - (b) DNA and proteins
 - (c) RNA and enzymes
 - (d) Carbohydrates and fats



10. The basic structural units of chromatin are called:

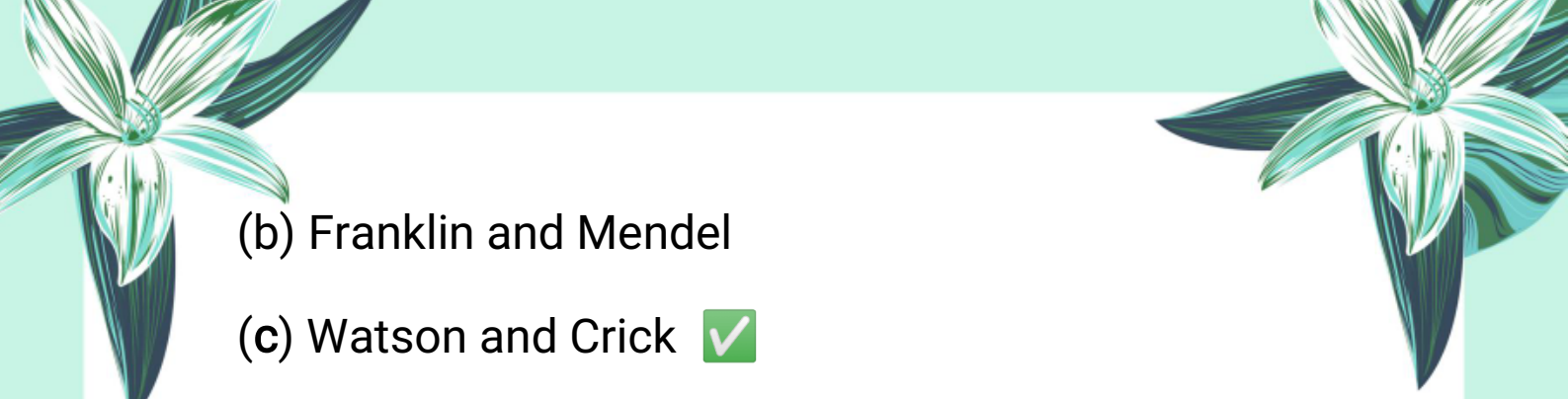
- (a) Ribosomes
- (b) Centromeres
- (c) Nucleosomes
- (d) Mitochondria

11. The "beads on a string" appearance in DNA is formed due to:


- (a) Genes
- (b) Codons
- (c) Nucleosomes
- (d) Replication forks

12. The structure of DNA was proposed by:

- (a) Darwin and Wallace
- 

- 
- (b) Franklin and Mendel
 - (c) Watson and Crick
 - (d) Lamarck and Morgan

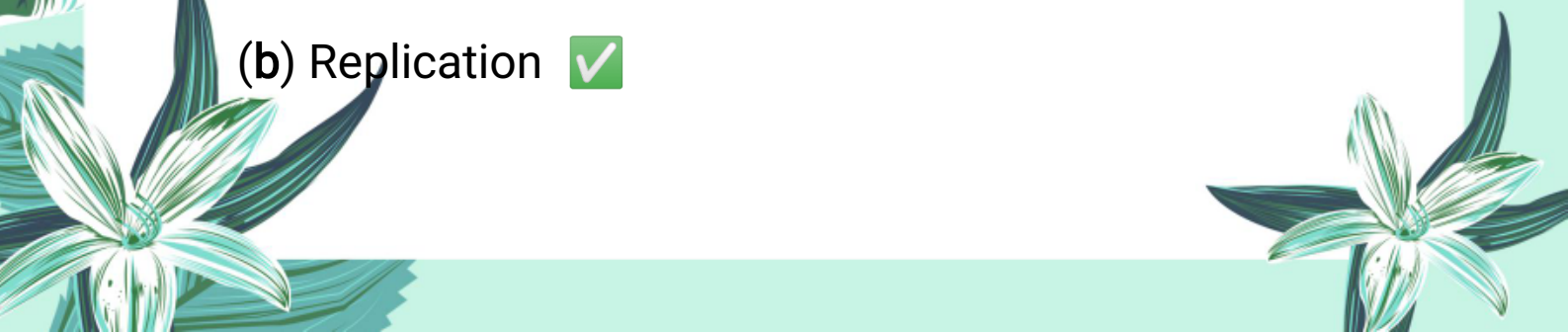
13. In DNA, adenine always pairs with:

- 
- (a) Cytosine
 - (b) Guanine
 - (c) Thymine
 - (d) Uracil

14. How many hydrogen bonds are present between cytosine and guanine?

- (a) One
- (b) Two
- (c) Three
- (d) Four

15. The process of copying DNA before cell division is called:

- (a) Transcription
 - (b) Replication
- 



(c) Translation

(d) Mutation

16. The process of copying genetic code from DNA to mRNA is:



(a) Replication

(b) Translation

(c) Transcription

(d) Duplication

17. The process by which mRNA is translated into a protein is called:

(a) Replication

(b) Transcription

(c) Mutation

(d) Translation

18. The different forms of a gene are known as:

(a) Chromosomes

(b) Loci

(c) Alleles





(d) Mutants

19. The genotype with two identical alleles is called:

(a) Heterozygous

(b) Homozygous

(c) Dominant

(d) Recessive

20. In heterozygous condition, the allele which is expressed is called:

(a) Mutant

(b) Recessive

(c) Dominant

(d) Codominant

21. Who is known as the father of genetics?

(a) Charles Darwin

(b) Gregor Mendel


(c) Watson

(d) Lamarck



22. Mendel conducted his experiments on which plant?

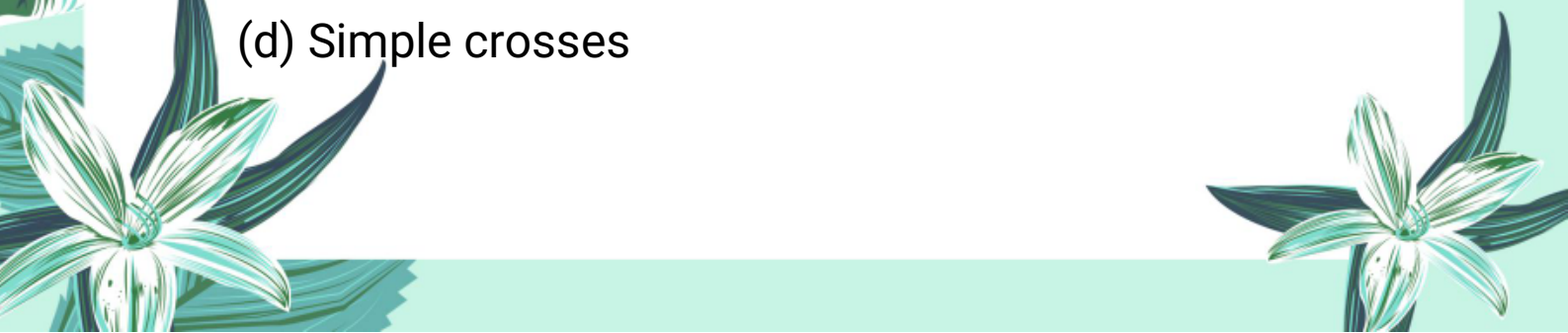
- (a) Tomato
- (b) Wheat
- (c) Pea plant
- (d) Rose

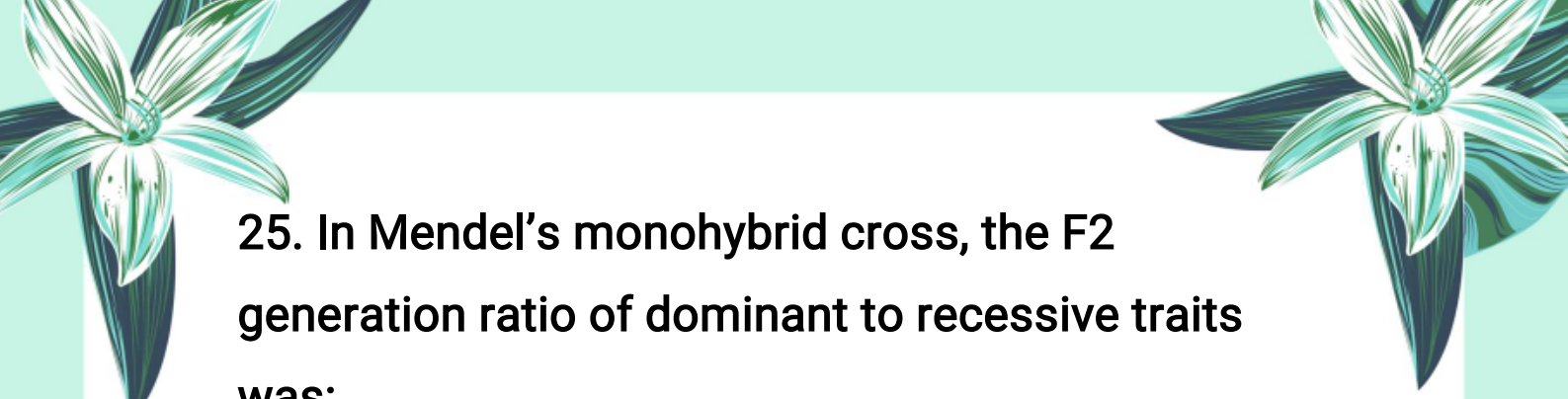


23. Which one of the following was not a reason for Mendel choosing the pea plant?

- (a) It had contrasting traits
- (b) It had a long life cycle
- (c) It allowed self-pollination
- (d) It allowed cross-pollination


24. The crosses in which only one trait is studied at a time are called:

- (a) Hybrid crosses
 - (b) Monohybrid crosses
 - (c) Dihybrid crosses
 - (d) Simple crosses
- 



25. In Mendel's monohybrid cross, the F₂ generation ratio of dominant to recessive traits was:

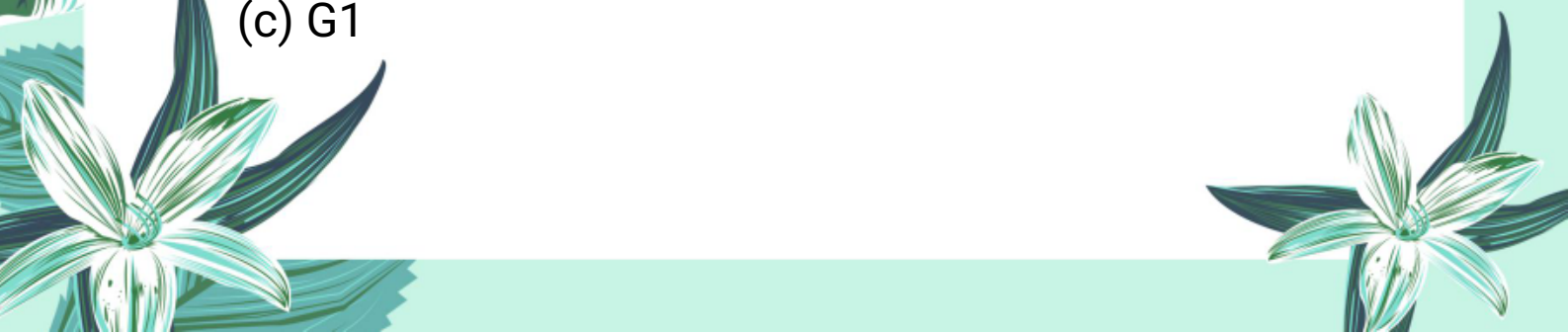
- (a) 1:1
- (b) 2:1
- (c) 3:1
- (d) 9:3:3:1



26. According to the law of segregation, how many alleles does each gamete receive from a gene pair?

- (a) 2
- (b) 4
- (c) 1
- (d) None

27. The parental generation in Mendel's experiments is represented by:

- (a) F₁
 - (b) F₂
 - (c) G₁
- 

(d) P1

28. Which one of the following best explains the Law of Independent Assortment?

(a) Genes always link together

(b) Alleles from different gene pairs segregate independently

(c) Dominant genes never separate

(d) Gametes carry all alleles

29. The phenotype ratio in Mendel's dihybrid cross (F₂ generation) was:

(a) 1:2:1

(b) 3:1

(c) 9:3:3:1

(d) 4:4

30. In Mendel's dihybrid cross, which combination was not seen in the F₁ generation?

(a) Round yellow

(b) Round green



(c) Wrinkled yellow

(d) Wrinkled green

31. Which of the following statements best describes co-dominance?



(a) One allele is completely dominant over the other

(b) Both alleles remain inactive

(c) Both alleles express equally without dominance



(d) Alleles blend to form a new trait

32. The AB blood group in humans is an example of:

(a) Incomplete dominance

(b) Multiple alleles

(c) Co-dominance

(d) Recessive trait

33. In incomplete dominance, the heterozygous phenotype is:

(a) Identical to one of the parents





(b) A mixture of both parental traits

(c) Recessive only

(d) Completely dominant

34. In Four O' Clock plants, when red (RR) is crossed with white (rr), the F1 flowers are:



(a) Red

(b) White

(c) Pink

(d) Yellow

35. The phenotypic ratio in F2 generation of incomplete dominance is:

(a) 9:3:3:1

(b) 3:1

(c) 1:2:1

(d) 2:1

36. Which of the following is not a source of variation in sexually reproducing organisms?

(a) Mutation





(b) Fertilization

(c) Gene flow

(d) Cloning

37. Variations produced through crossing over occur during:



(a) Mitosis

(b) Meiosis

(c) Fertilization

(d) Replication

38. The movement of genes from one population to another is called:

(a) Genetic drift

(b) Gene flow

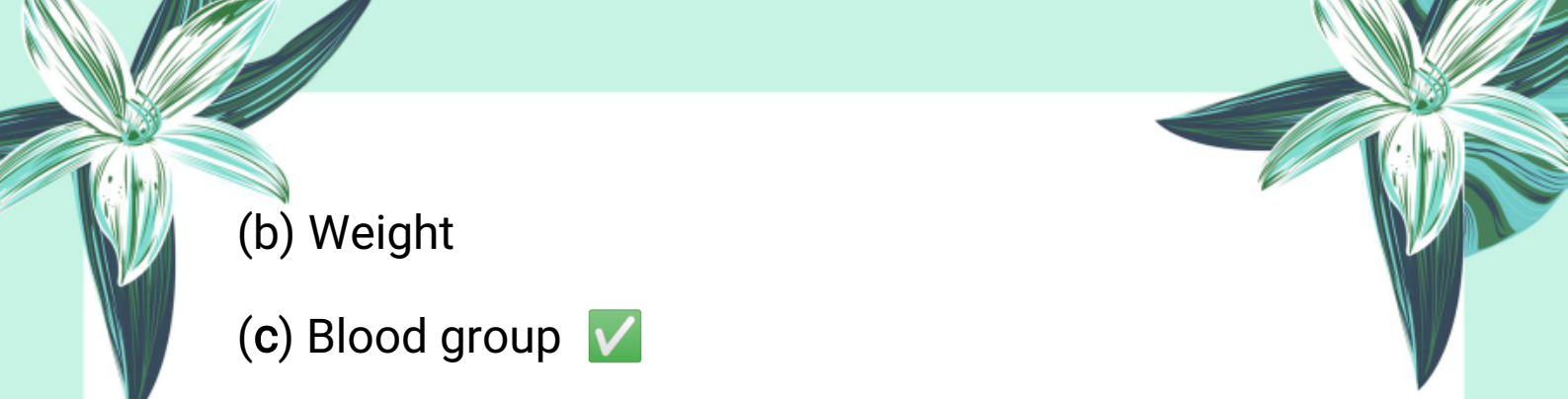
(c) Mutation

(d) Evolution


39. Which of the following is an example of discontinuous variation?




(a) Height

- 
- (b) Weight
 - (c) Blood group
 - (d) Intelligence

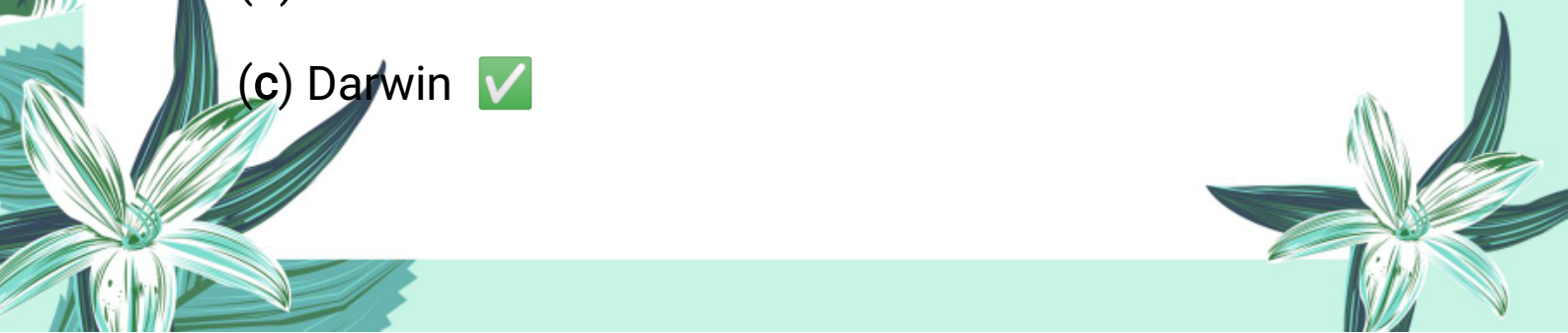
40. Continuous variations are usually:

- 
- (a) Controlled by a single gene
 - (b) Not heritable
 - (c) Affected by many genes and environment
 - (d) Random and unimportant

41. The term organic evolution refers to:

- 
- (a) The change in an individual's body
 - (b) The change in population traits over generations
 - (c) The lifespan of an organism
 - (d) Natural disasters

42. Who proposed the Theory of Natural Selection?

- 
- (a) Mendel
 - (b) Watson
 - (c) Darwin



(d) Lamarck

43. Darwin's book On the Origin of Species was published in:

(a) 1838

(b) 1842

(c) 1859

(d) 1882

44. The evolutionary fitness of an organism means:

(a) Its ability to fight predators

(b) Its strength

(c) Its ability to survive and reproduce

(d) Its intelligence

45. In natural selection, favourable traits are:

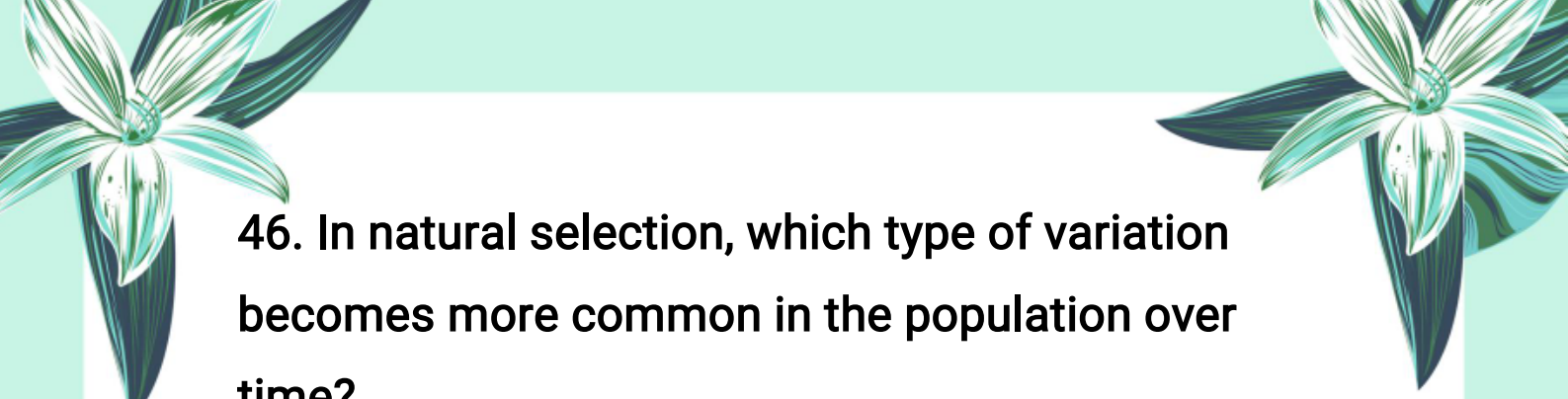
(a) Passed to next generations

(b) Mutated quickly

(c) Removed from the population


(d) Always harmful





46. In natural selection, which type of variation becomes more common in the population over time?

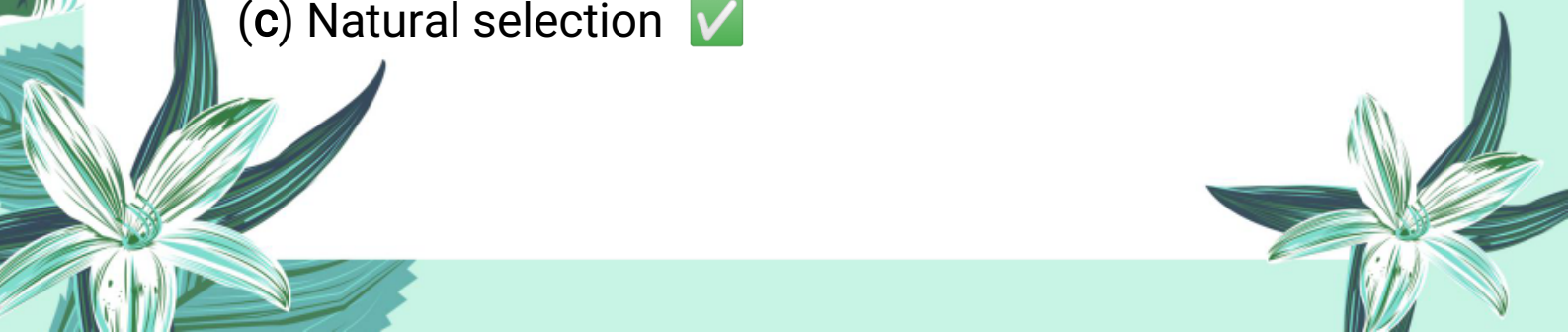
- (a) Harmful variation
- (b) Neutral variation
- (c) Favourable variation
- (d) Rare variation



47. In the dark-coloured mouse example, which colour of mouse survived after several generations?

- (a) Light
- (b) Medium
- (c) Dark
- (d) All

48. The dark moths in industrial England became more common due to:

- (a) Migration
 - (b) Artificial selection
 - (c) Natural selection
- 



(d) Mutation only

49. Artificial selection means:

(a) Natural reproduction between wild species

(b) Random breeding in natural habitats

(c) Human-controlled breeding for desirable traits



(d) Breeding for survival only

50. In artificial selection, specially bred animals are called:

(a) Cultivars

(b) Species

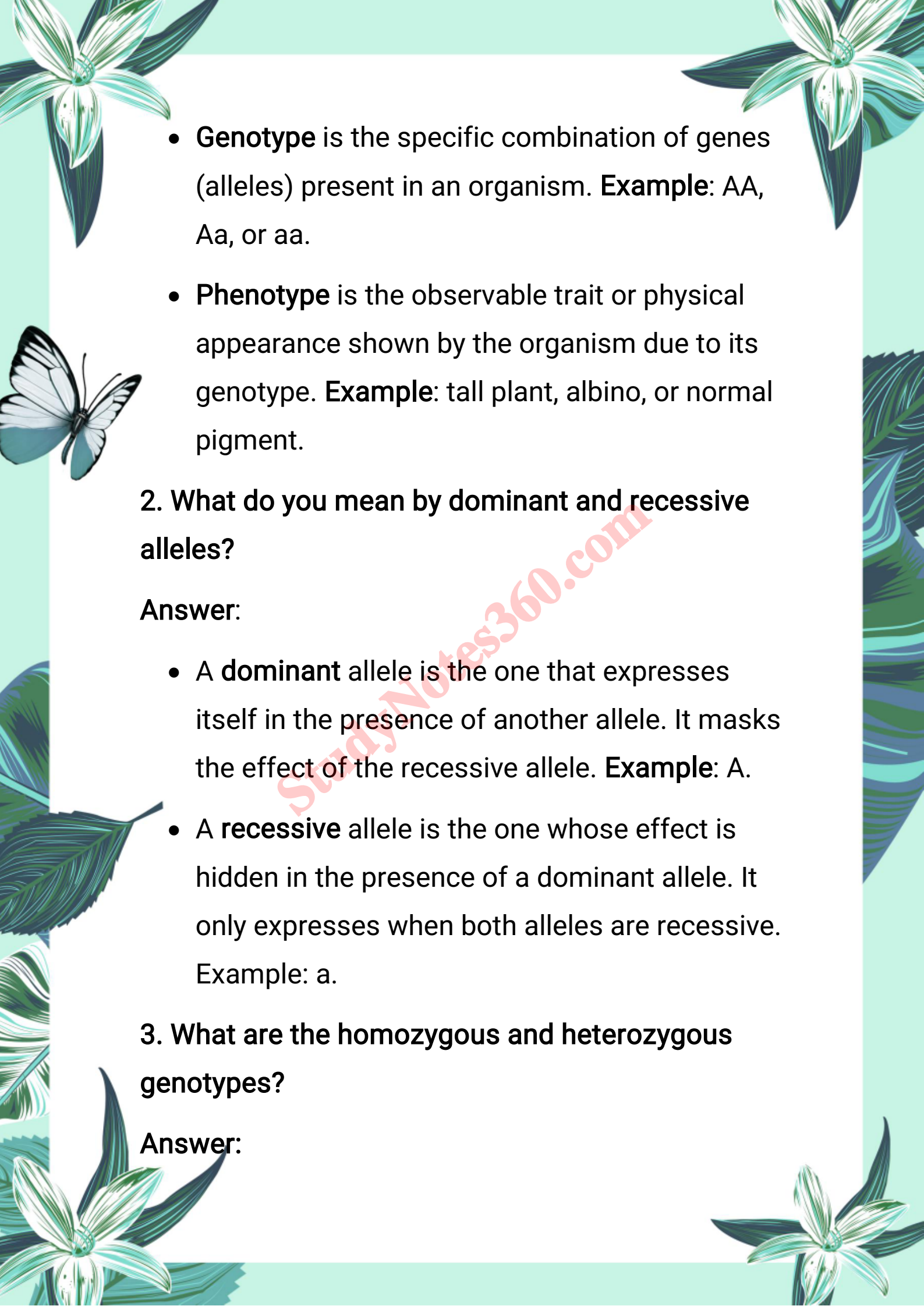
(c) Breeds

(d) Classes

Exercise Short Questions:

1. Define genotype and phenotype.

Answer:

- 
- The page is decorated with various botanical and natural illustrations. In the top left and top right corners, there are stylized flowers with five petals and long, narrow leaves. On the left side, there is a butterfly with white wings and black markings. On the right side, there are large, detailed leaves with prominent veins. At the bottom left and bottom right, there are more stylized flowers and leaves. The background is a light teal color.
- **Genotype** is the specific combination of genes (alleles) present in an organism. **Example:** AA, Aa, or aa.
 - **Phenotype** is the observable trait or physical appearance shown by the organism due to its genotype. **Example:** tall plant, albino, or normal pigment.



2. What do you mean by dominant and recessive alleles?

Answer:

- A **dominant allele** is the one that expresses itself in the presence of another allele. It masks the effect of the recessive allele. **Example:** A.
- A **recessive allele** is the one whose effect is hidden in the presence of a dominant allele. It only expresses when both alleles are recessive. **Example:** a.

3. What are the homozygous and heterozygous genotypes?



Answer:

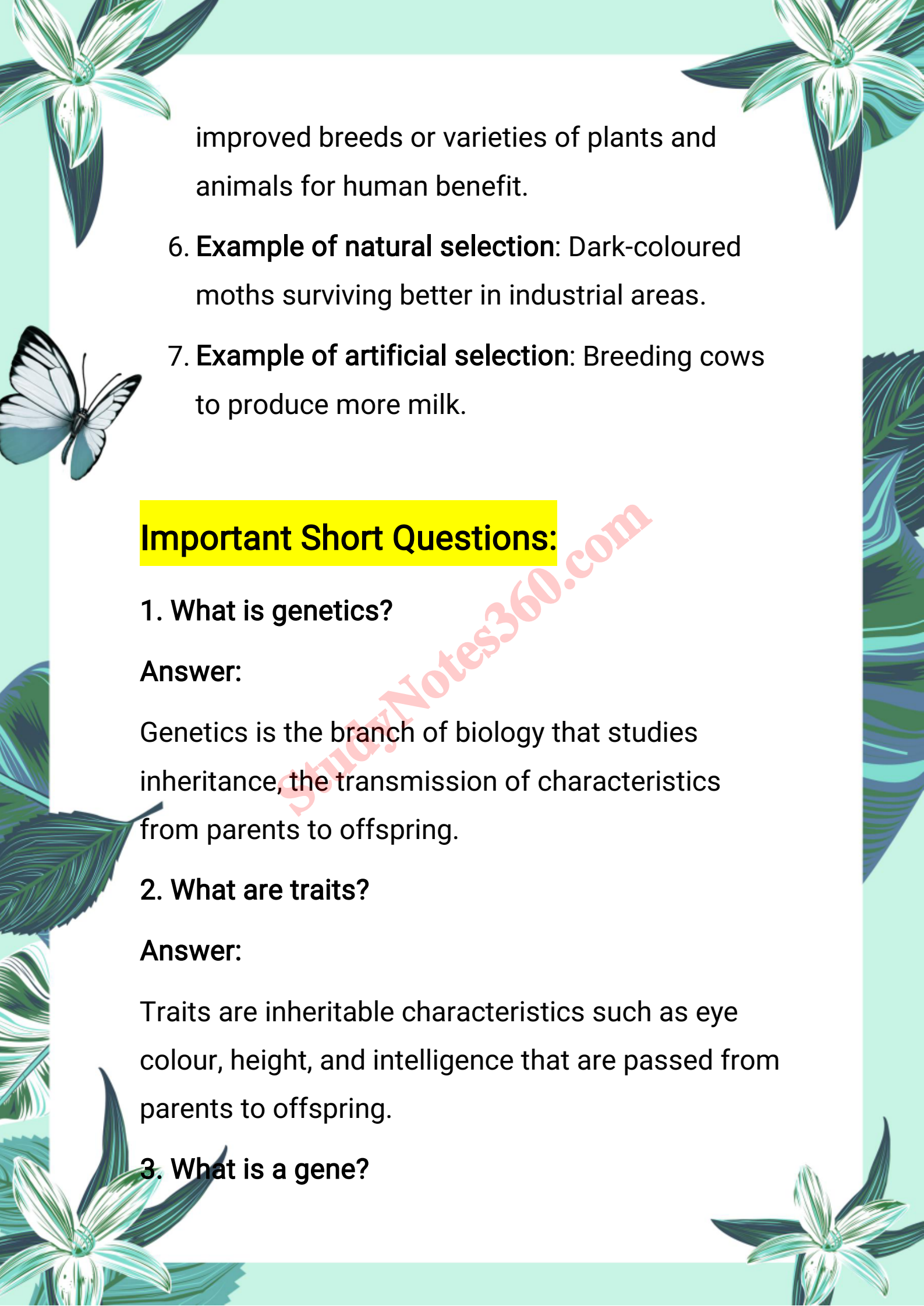
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- A homozygous genotype has two identical alleles of a gene. **Example:** AA or aa.
 - A heterozygous genotype has two different alleles of a gene. **Example:** Aa.



4. Differentiate between Natural and Artificial Selection

Answer:

1. **Natural selection** is a process that occurs naturally in the environment, without any human involvement. In contrast, artificial selection is done intentionally by humans.
 2. In **natural selection**, organisms with favourable traits survive and reproduce better in their environment.
 3. In **artificial selection**, humans select organisms with desirable traits and breed them to produce offspring with the same traits.
 4. **Natural selection** helps organisms adapt to their environment over generations.
 5. **Artificial selection** leads to the production of
- 
- 

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improved breeds or varieties of plants and animals for human benefit.

6. **Example of natural selection:** Dark-coloured moths surviving better in industrial areas.

7. **Example of artificial selection:** Breeding cows to produce more milk.

Important Short Questions:

1. What is genetics?

Answer:

Genetics is the branch of biology that studies inheritance, the transmission of characteristics from parents to offspring.

2. What are traits?

Answer:

Traits are inheritable characteristics such as eye colour, height, and intelligence that are passed from parents to offspring.

3. What is a gene?



Answer:

A gene is a unit of inheritance made of DNA that contains instructions for the synthesis of a specific protein.

4. What is meant by inheritance?



Answer:

Inheritance means the transfer of traits from parents to their offspring through genes.

5. What are chromosomes made of?

Answer:

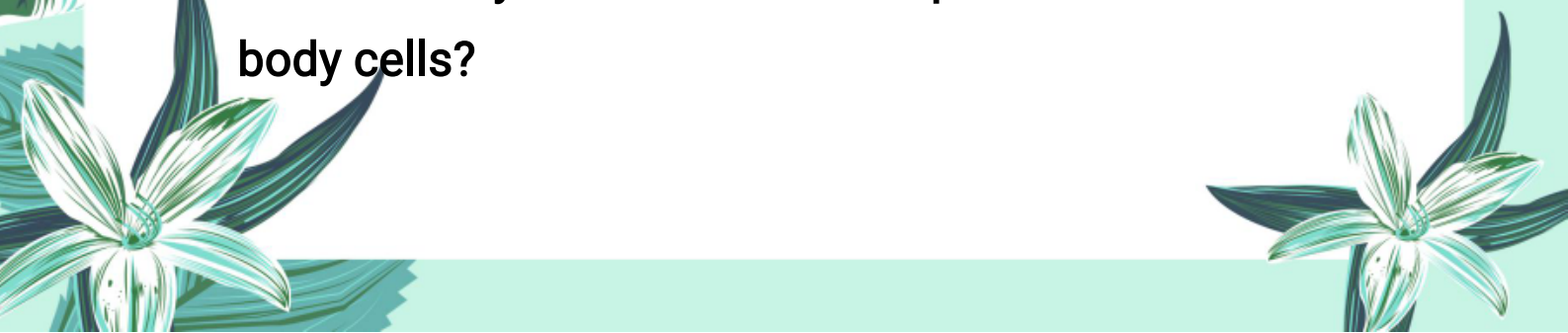
Chromosomes are made of chromatin, a complex of DNA and proteins (mainly histones).

6. What are homologous chromosomes?

Answer:

Homologous chromosomes are pairs of chromosomes in body cells that carry the same genes at the same locations.

7. How many chromosomes are present in human body cells?





Answer:

Human body cells contain 46 chromosomes or 23 pairs of homologous chromosomes.

8. What is the Watson-Crick model of DNA?



Answer:

According to the Watson-Crick model, DNA is a double helix made of two strands with a sugar-phosphate backbone and nitrogenous base pairs (A-T, C-G).

9. What is DNA replication?

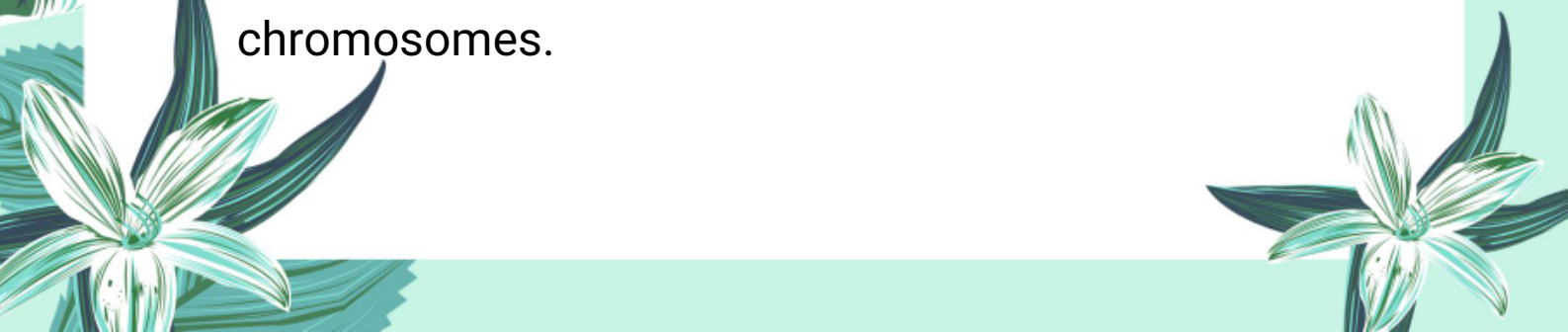
Answer:

DNA replication is the process of copying DNA before cell division, producing two identical DNA molecules.

10. What are alleles?

Answer:

Alleles are alternate forms of a gene that occupy the same position (locus) on homologous chromosomes.





11. Who was Gregor Mendel?

Answer:

Gregor Mendel was an Austrian monk who developed the fundamental principles of genetics.



12. Which plant did Mendel use for his experiments?

Answer:

Mendel used the pea plant (*Pisum sativum*) for his genetic experiments.

13. Why did Mendel select the pea plant for experiments?

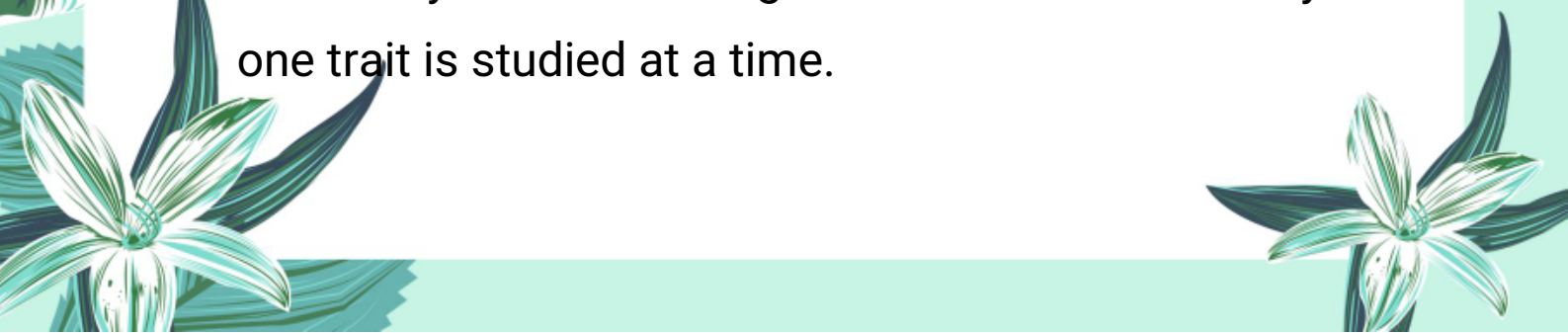
Answer:

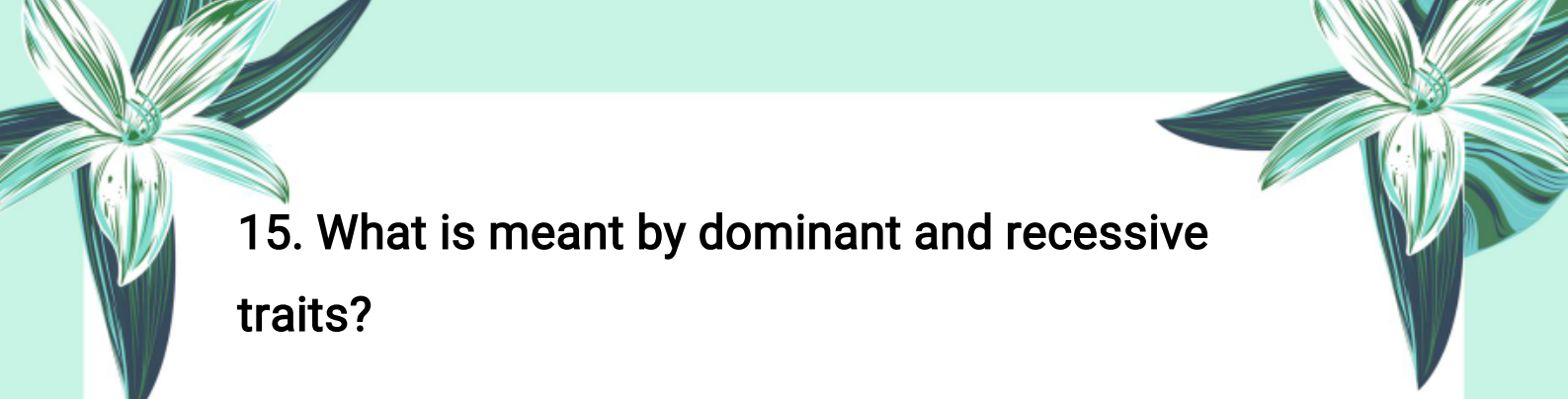
Because pea plant had contrasting traits, was self-fertilizing, cross-fertilization was possible, and it had a short life cycle.

14. What is a monohybrid cross?

Answer:

A monohybrid cross is a genetic cross in which only one trait is studied at a time.





15. What is meant by dominant and recessive traits?

Answer:

A dominant trait is the one that appears in offspring, while a recessive trait is the one that is hidden or masked.



16. What is Mendel's Law of Segregation?

Answer:

It states that during gamete formation, the two alleles of a gene pair separate, and each gamete receives only one allele.

17. What is the 3:1 ratio observed by Mendel?

Answer:

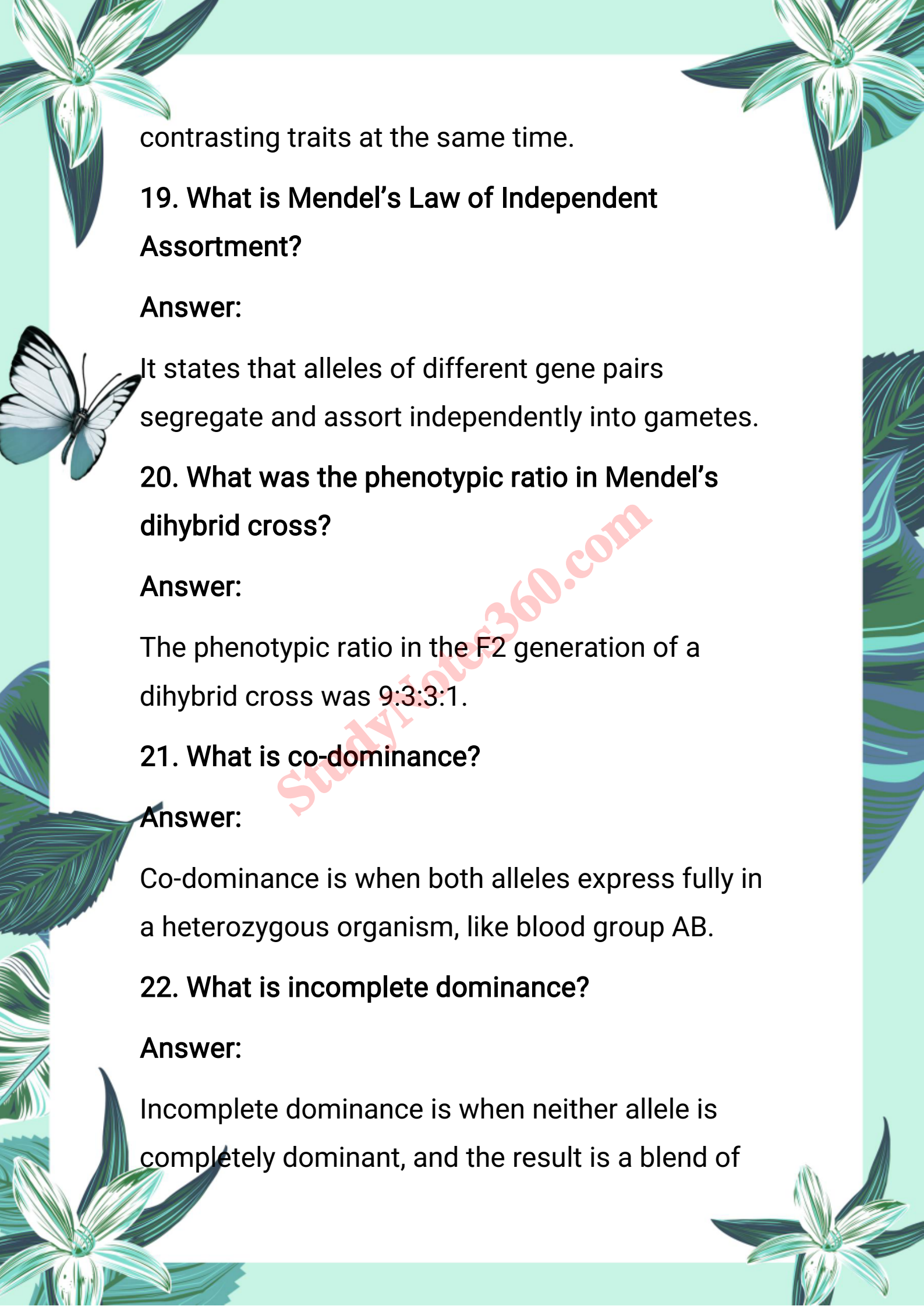
It is the phenotypic ratio in F₂ generation when dominant and recessive traits reappear in a monohybrid cross.

18. What is a dihybrid cross?

Answer:

A dihybrid cross studies the inheritance of two



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contrasting traits at the same time.

19. What is Mendel's Law of Independent Assortment?

Answer:

It states that alleles of different gene pairs segregate and assort independently into gametes.

20. What was the phenotypic ratio in Mendel's dihybrid cross?

Answer:

The phenotypic ratio in the F₂ generation of a dihybrid cross was 9:3:3:1.

21. What is co-dominance?

Answer:

Co-dominance is when both alleles express fully in a heterozygous organism, like blood group AB.

22. What is incomplete dominance?

Answer:

Incomplete dominance is when neither allele is completely dominant, and the result is a blend of



traits, e.g., pink flowers in Four o' Clock plant.

23. What is the phenotype ratio in incomplete dominance of Four o' Clock plant (F2 generation)?

Answer:

The ratio is 1 red : 2 pink : 1 white.



24. Give an example of co-dominance in humans.

Answer:

AB blood group is an example of co-dominance in humans.

25. Define variation.

Answer:

Variation means differences in traits among individuals of the same species.

26. What are two main types of variations?


Answer:

Discontinuous variations and Continuous variations.

27. What is meant by discontinuous variation?

Answer:






It shows distinct traits, e.g., blood groups, and is controlled by a single gene pair.

28. What is meant by continuous variation?

Answer:



It shows a range of traits, e.g., height, and is controlled by many genes and affected by environment.


29. Who proposed the theory of natural selection?

Answer:

Charles Darwin proposed it in 1838.

30. What is meant by natural selection?

Answer:



Natural selection is the process in which favourable variations are passed to next generations and unfavourable ones are eliminated.

31. Who first expressed the term "artificial selection"?

Answer:



The term "artificial selection" was first expressed by






Abu Rayhan Biruni in the 11th century.

32. What is artificial selection?

Answer:



Artificial selection is the intentional breeding between individuals to produce desirable traits in animals or plants.

33. What are the outcomes of artificial selection in agriculture?

Answer:

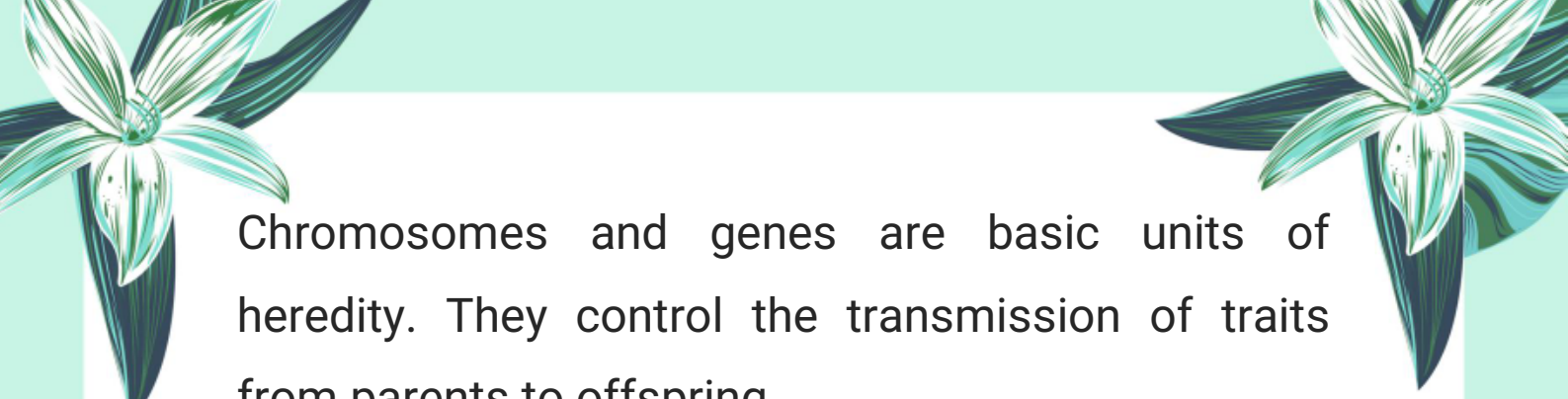
It has produced improved breeds of animals (like cow, hen, sheep) and better plant varieties for fruits, vegetables, and cereals.

Important Long Questions:

☀ Q1: What are chromosomes and genes? Describe their structure and function.


❖ Introduction:





Chromosomes and genes are basic units of heredity. They control the transmission of traits from parents to offspring.

◆ **Chromosomes**



Definition: Chromosomes are thread-like structures found in the nucleus of cells. They carry genetic material (DNA).

Number in Humans: 23 pairs (total 46 chromosomes).

Made of:

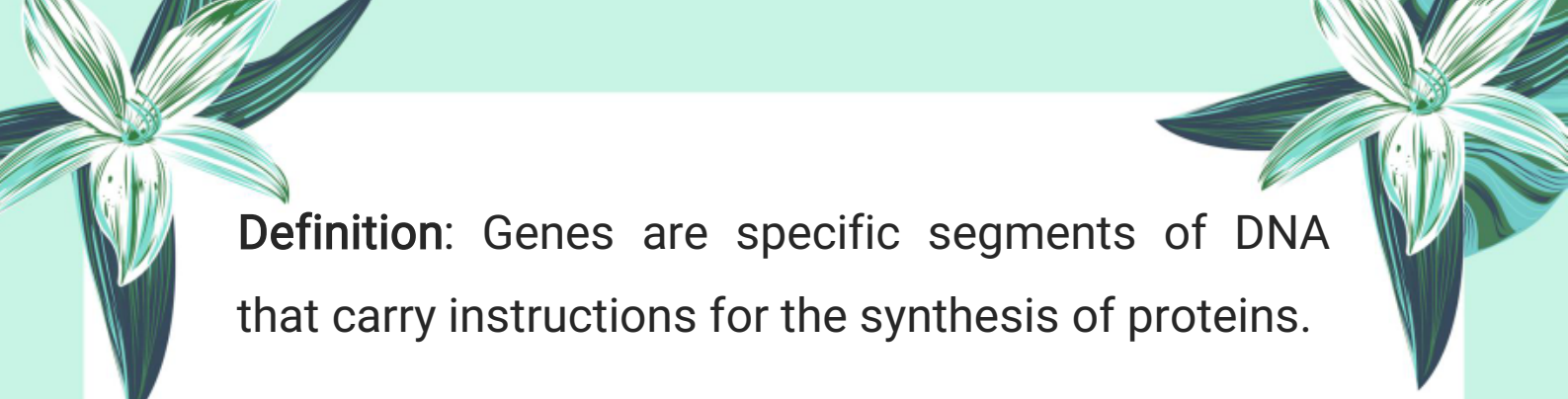
- DNA
- Histone proteins

Structure:

- Chromatin is the relaxed form of chromosomes.
- DNA wraps around histone proteins to form nucleosomes (like "beads on a string").
- During cell division, chromatin condenses to form chromosomes.

◆ **Genes**






Definition: Genes are specific segments of DNA that carry instructions for the synthesis of proteins.

Function: Genes control traits such as eye colour, height, etc.

Location: Found on chromosomes.



Pairs: Genes occur in pairs, one on each homologous chromosome.

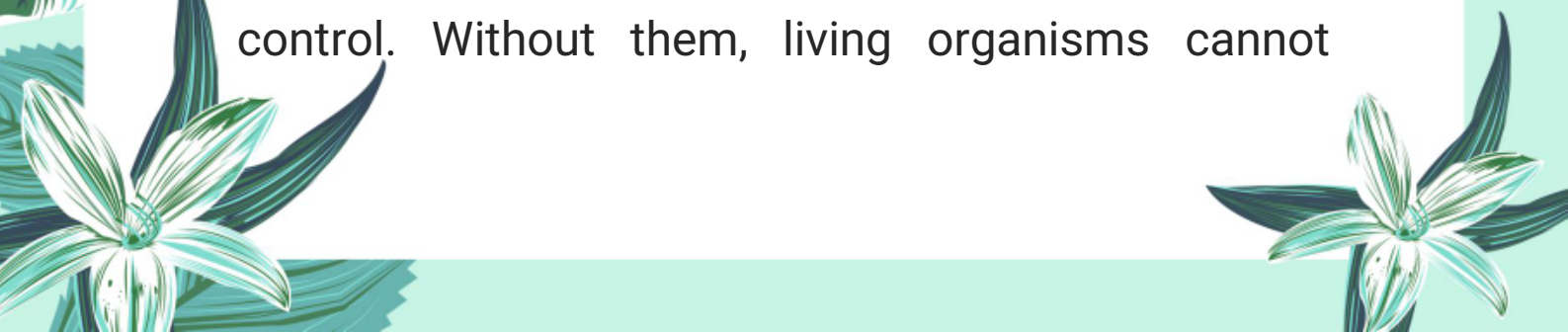
Locus: The specific location of a gene on a chromosome is called locus (plural: loci).

◆ **Function of Genes and Chromosomes**

- Store hereditary information.
- Guide protein synthesis by determining amino acid sequences.
- Control all cellular activities and characteristics of organisms.

 **Summary:**

Genes and chromosomes are essential for inheritance, protein synthesis, and overall cellular control. Without them, living organisms cannot






maintain or pass on traits.

☀ Q2: Explain the Watson-Crick model of DNA and the process of DNA replication.

❖ Introduction:



DNA is the genetic material of all living organisms. Its structure was explained by James Watson and Francis Crick in 1953.

◆ **Watson-Crick Model of DNA**

- DNA is made of two polynucleotide strands.
- These strands are twisted to form a double helix.

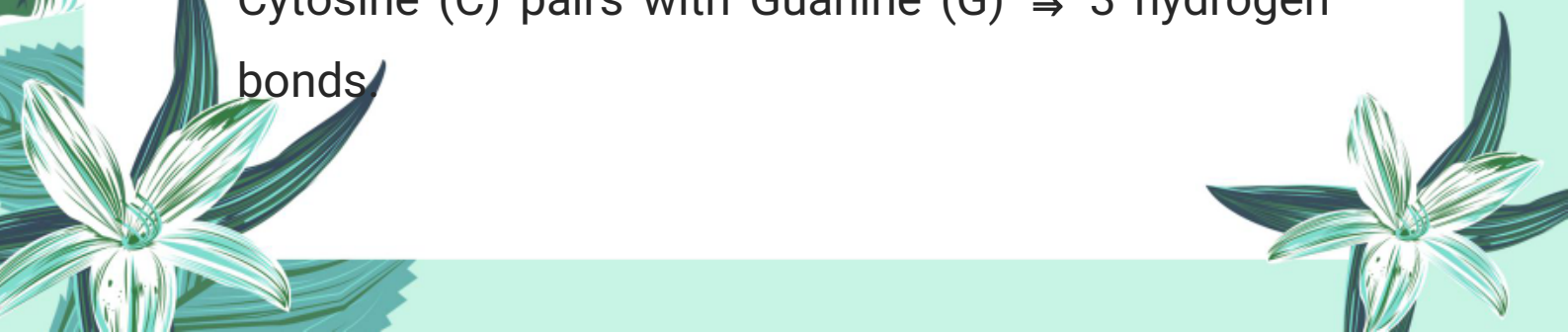
Each strand has:

- A sugar-phosphate backbone on the outside.
- Nitrogenous bases (A, T, G, C) on the inside.

◆ **Base Pairing Rules**

Adenine (A) pairs with Thymine (T) \Rightarrow 2 hydrogen bonds.

Cytosine (C) pairs with Guanine (G) \Rightarrow 3 hydrogen bonds.






This pairing is specific and complementary.

◆ **DNA Replication**

Takes place before cell division (during interphase).

Steps involved:

- 
1. **Unwinding:** DNA double helix unwinds like a zipper.
 2. **Strand Separation:** Two strands separate.
 3. **Template Formation:** Each old strand acts as a template.
 4. **New Strand Formation:** Free nucleotides pair with the template bases.
 5. **Result:** Two identical DNA molecules are formed.

◆ **Importance of DNA Replication**

- Ensures that each daughter cell receives an exact copy of genetic information.
- Maintains genetic continuity across generations.

☀ Q3: How does DNA control protein synthesis?

Define transcription and translation.





❖ Introduction:

Proteins are essential for life. DNA controls the synthesis of proteins in cells through two main steps: transcription and translation.



◆ Protein Synthesis Overview

DNA contains instructions for the sequence of amino acids in a protein.

Two main steps:

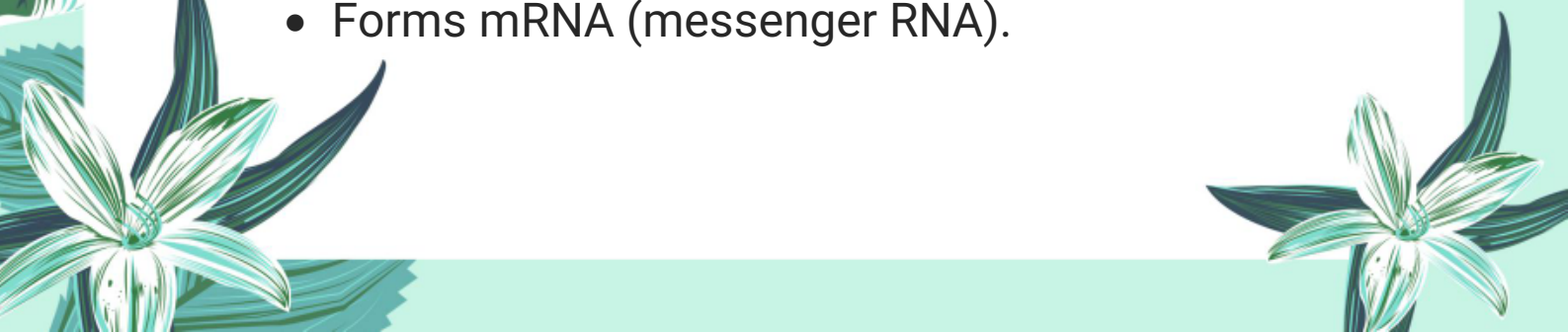
1. Transcription
2. Translation

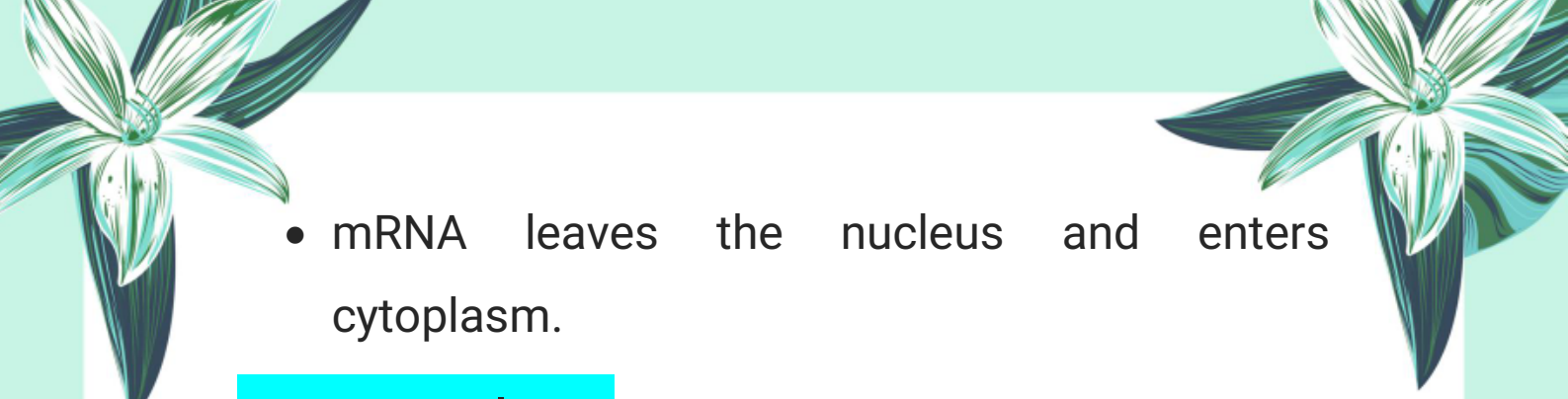
◆ 1. Transcription

Definition: The process of copying DNA sequence into mRNA.

Where it happens: In the nucleus.

Process:

- DNA unzips.
 - RNA nucleotides pair with DNA template.
 - Forms mRNA (messenger RNA).
- 


- 
- mRNA leaves the nucleus and enters cytoplasm.

◆ 2. Translation

Definition: The process of converting mRNA code into a protein.

Where it happens: At the ribosome.

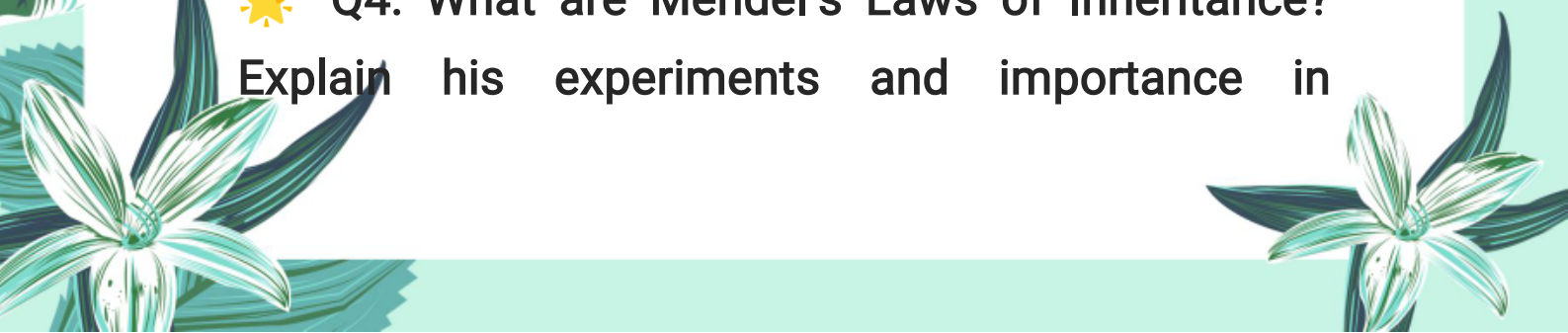
Process:

- 
- Ribosome reads mRNA codons (three-letter codes).
 - Each codon codes for a specific amino acid.
 - tRNA (transfer RNA) brings amino acids.
 - Amino acids are joined to form a protein.

◆ Gene and Trait Relationship

- A gene is a DNA segment that codes for one protein.
- Each protein controls a specific trait in the organism.

☀ **Q4: What are Mendel's Laws of Inheritance?**
Explain his experiments and importance in



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genetics.

❖ Introduction:

Mendel's Laws of Inheritance form the foundation of classical genetics. Gregor Mendel, an Austrian monk, performed experiments on pea plants and discovered how traits are inherited from one generation to the next.

◆ Mendel's Contributions:

- He studied traits like flower color, plant height, seed shape, etc.
- Mendel proposed that "special factors" (now called genes) control traits.
- He conducted experiments on 28,000 pea plants (*Pisum sativum*).

◆ Selection of Pea Plant:

Mendel selected pea plant due to:

- Easily distinguishable traits (like tall/dwarf, round/wrinkled).
- Ability of both self and cross-pollination.

- Short life cycle for faster results.

- ◆ **Methodology:**

- He conducted monohybrid (one trait) and dihybrid (two traits) crosses.
- Used true-breeding plants to begin experiments.
- Applied statistical analysis on results to form laws.

- ◆ **Importance:**

- First to explain inheritance through predictable patterns.
- Laid foundation for genetics and understanding of dominant and recessive traits.

- 📁 **Summary:**

Mendel's work became the cornerstone of modern genetics. His laws explain how traits pass from one generation to another, and are still used in genetics research today.

🌟 **Q5: Explain Mendel's Law of Segregation with an example.**



❖ **Definition:**

Mendel's Law of Segregation states that:

"Each organism carries two alleles for each trait, which separate during gamete formation so that each gamete receives only one allele."



◆ **Experiment:**

Trait Studied: Seed shape

Crossed:

Round-seeded plant (RR) × Wrinkled-seeded plant (rr)

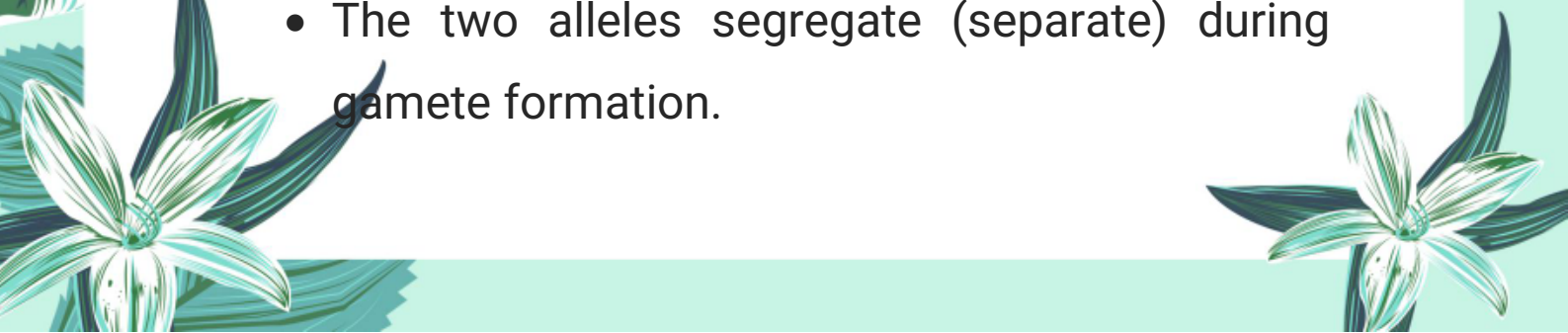
F1 Generation: All round seeds (Rr) ⇒ Round is dominant.

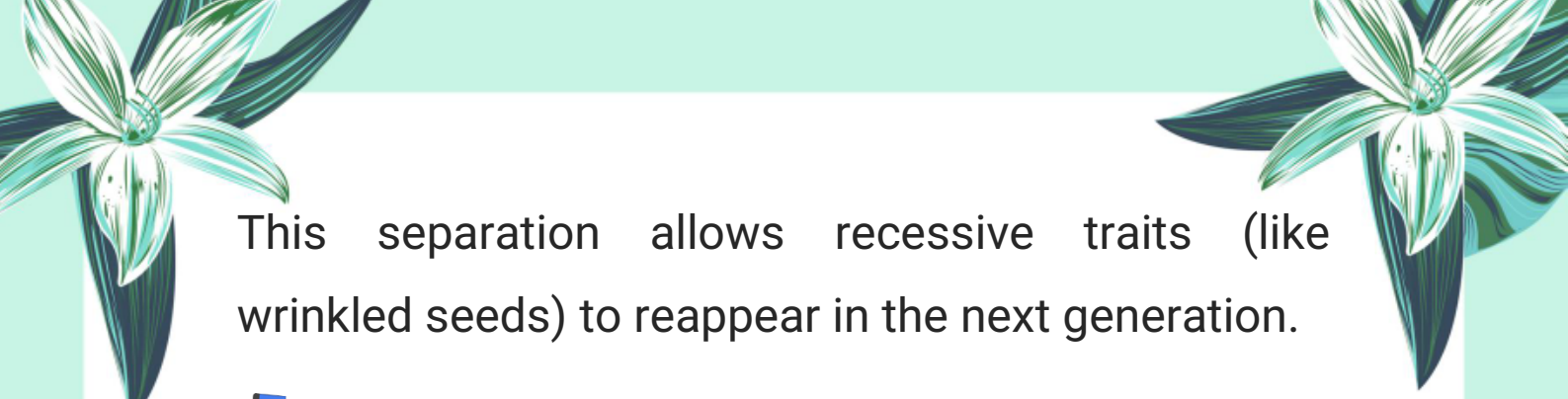
F2 Generation (Rr × Rr):

Ratio: 3 Round : 1 Wrinkled

Genotypes: 1 RR : 2 Rr : 1 rr

◆ **Explanation:**

- Each parent gives one allele to the offspring.
 - The two alleles segregate (separate) during gamete formation.
- 



This separation allows recessive traits (like wrinkled seeds) to reappear in the next generation.



 **Summary:**

The Law of Segregation shows that traits are inherited as discrete units (genes), and each parent contributes only one of the two alleles to the offspring.

☀️ **Q6: What is Mendel's Law of Independent Assortment? Explain with dihybrid cross.**

❖ **Definition:**

Mendel's Law of Independent Assortment states:

➤ "Alleles of different gene pairs separate independently during gamete formation."

◆ **Experiment:**

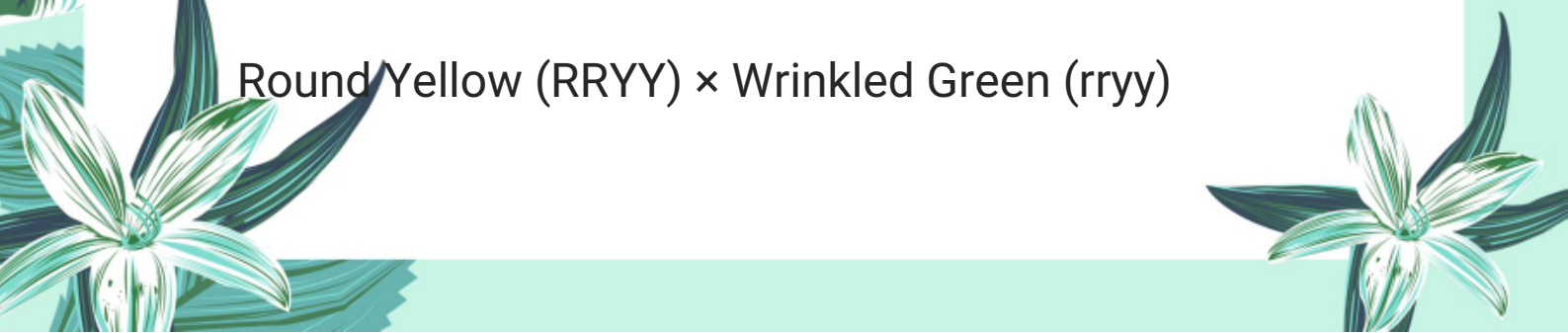
Studied two traits:

Seed shape: Round (R) vs Wrinkled (r)

Seed color: Yellow (Y) vs Green (y)

Crossed:

Round Yellow (RRYY) × Wrinkled Green (rryy)





F1 Generation: All Round Yellow (RrYy)

F2 Generation:

Four phenotypes: Round Yellow, Round Green, Wrinkled Yellow, Wrinkled Green

Phenotypic Ratio: 9:3:3:1



◆ **Explanation:**

- The alleles of seed shape (R/r) segregate independently of the seed color (Y/y).
- This means different traits are inherited separately.



Summary:

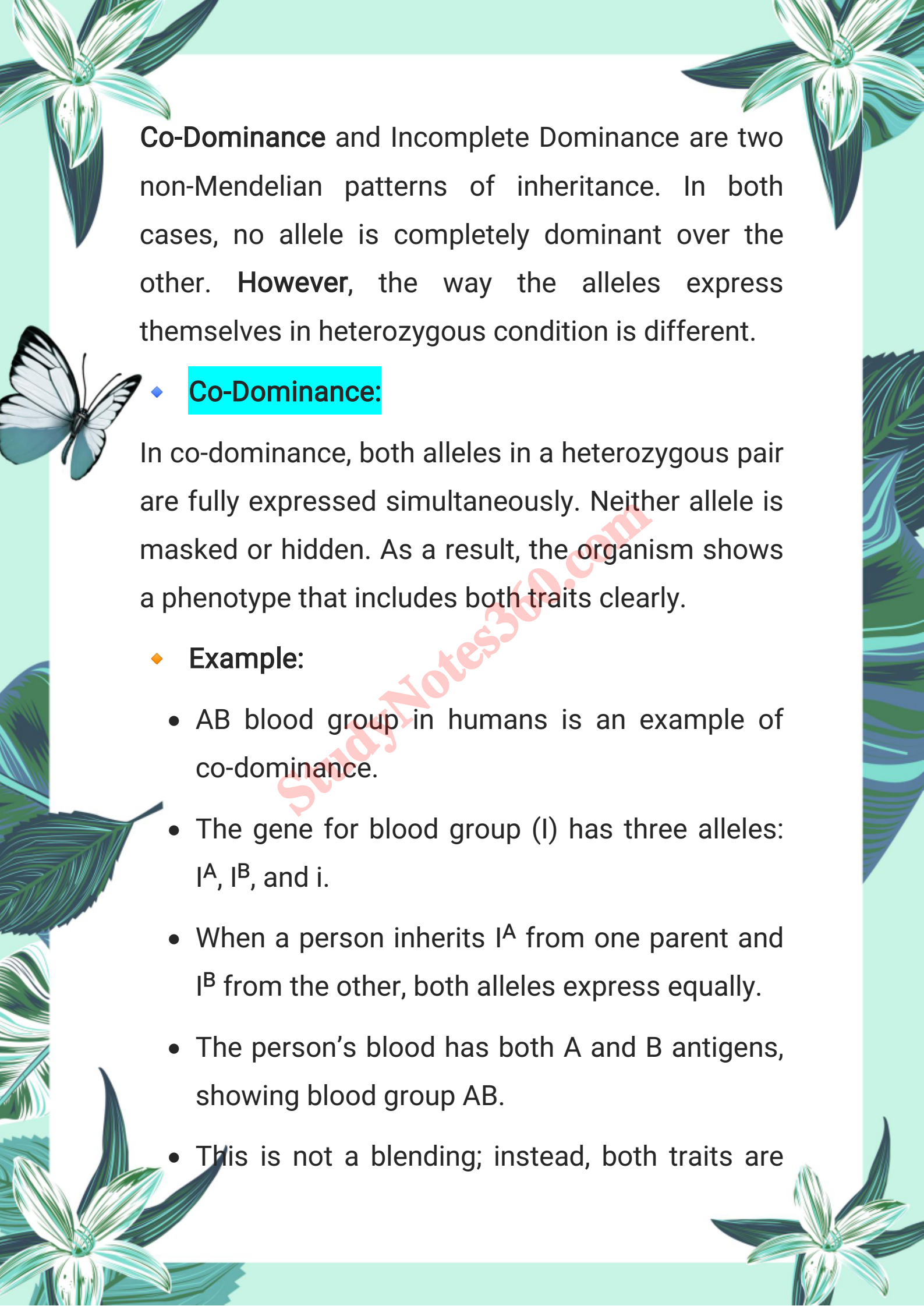
The Law of Independent Assortment explains how organisms can have new combinations of traits not seen in parents, increasing genetic diversity in populations.

☀ **Q8: Differentiate between Co-Dominance and Incomplete Dominance with examples.**

Answer:

◆ **Introduction:**



The page is decorated with various illustrations: a large white flower with green leaves in the top left and bottom left corners, a white butterfly with black markings on its wings on the left side, and a large green leaf on the right side. The background is a light green color.

Co-Dominance and Incomplete Dominance are two non-Mendelian patterns of inheritance. In both cases, no allele is completely dominant over the other. **However**, the way the alleles express themselves in heterozygous condition is different.

◆ **Co-Dominance:**

In co-dominance, both alleles in a heterozygous pair are fully expressed simultaneously. Neither allele is masked or hidden. As a result, the organism shows a phenotype that includes both traits clearly.


◆ **Example:**

- AB blood group in humans is an example of co-dominance.
- The gene for blood group (I) has three alleles: I^A , I^B , and i .
- When a person inherits I^A from one parent and I^B from the other, both alleles express equally.
- The person's blood has both A and B antigens, showing blood group AB.
- This is not a blending; instead, both traits are



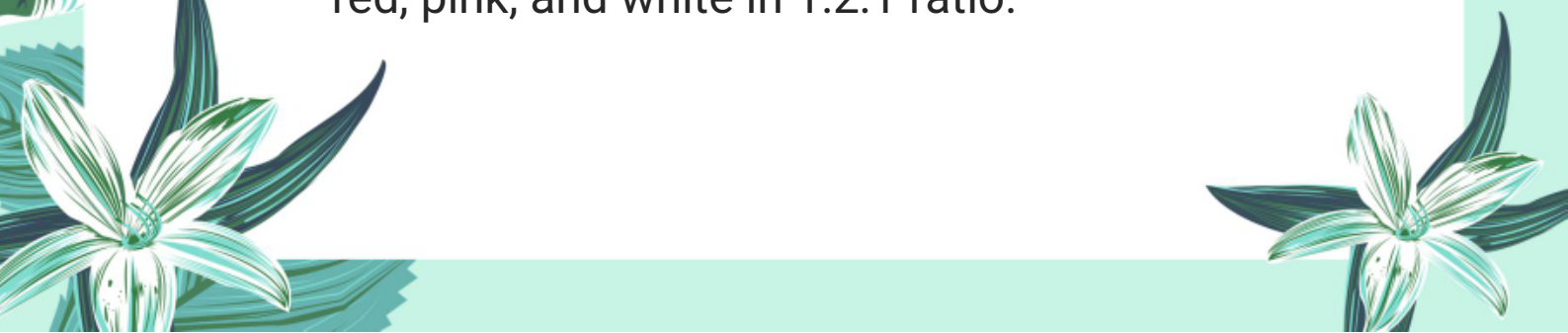
present side by side.

◆ **Incomplete Dominance:**



In incomplete dominance, neither allele in the heterozygous pair is completely dominant. As a result, the phenotype is a blend or mixture of both alleles. The heterozygous condition produces a new, intermediate trait.

◆ **Example:**

- Flower colour in Four O'clock plant (*Mirabilis jalapa*) shows incomplete dominance.
 - A red-flowered plant (RR) is crossed with a white-flowered plant (rr).
 - All the F_1 generation plants have pink flowers (Rr).
 - This pink colour is a blended expression of red and white – not separate traits like in co-dominance.
 - In F_2 generation, three types of flowers appear: red, pink, and white in 1:2:1 ratio.
- 



Summary:

- In co-dominance, both alleles show their effects side by side, like AB blood group.
- In incomplete dominance, the alleles blend their effects, producing an intermediate trait, like pink flowers.
- These patterns prove that not all genetic traits follow simple dominant-recessive rules explained by Mendel.

☀ Q9: Describe the types of variations and differentiate between discontinuous and continuous variations with examples.

❖ Definition of Variation:

- Variation refers to the differences in characteristics or traits among individuals of the same species. These differences can be:
- Visible (like height, eye color)
- Or invisible (like blood group, resistance to diseases)
- Variations are heritable, and they are essential



for evolution and biodiversity.

They arise mainly due to:

- Genetic recombination (crossing over during meiosis)
- Mutations (changes in DNA)
- Random fertilization
- Gene flow (movement of genes between populations)

◆ **Types of Variations:**


Variations can be broadly classified into two types:

 **1. Discontinuous Variations:**

Definition:

Discontinuous variations are those where individuals show distinct and separate phenotypes. There are clear-cut categories without any intermediate states.

Features:

- Controlled by a single gene or a pair of alleles
 - Not influenced by environment
- 

- Phenotypes can be easily grouped

Examples:

- Blood groups (A, B, AB, O)
- Tongue rolling ability (can roll or cannot roll)
- Earlobe type (attached or free)

Explanation:

For example, a person can have blood group A, B, AB, or O. There are no intermediate blood groups. Each type is determined by specific alleles (I^A , I^B , i) and follows a simple Mendelian pattern of inheritance.

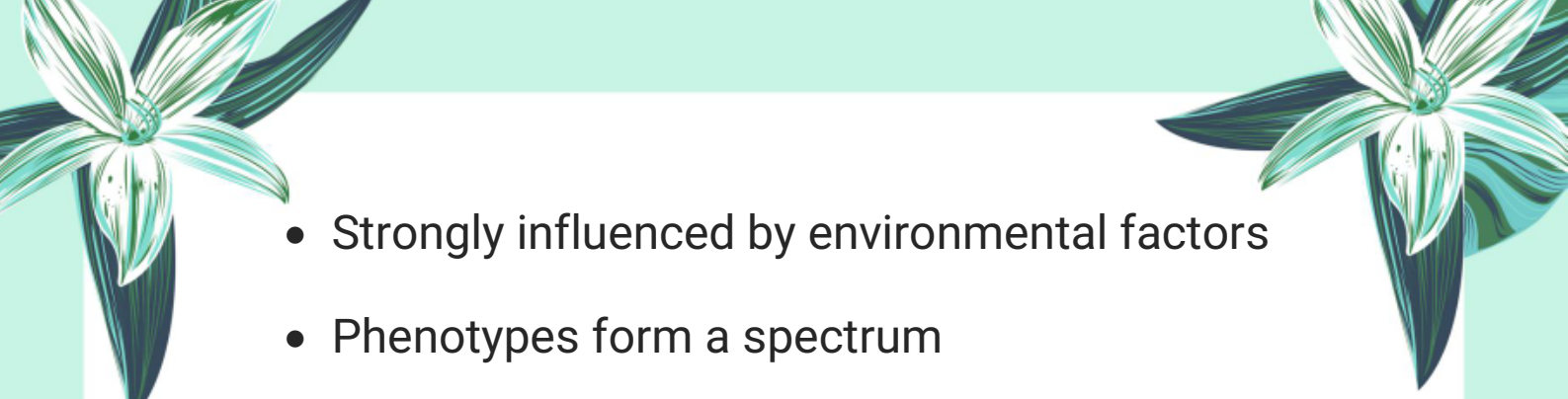
2. Continuous Variations:

Definition:


Continuous variations are those where individuals show a range of phenotypes with no distinct boundaries between them.

Features:

- Controlled by many genes (polygenic inheritance)

- 
- Strongly influenced by environmental factors
 - Phenotypes form a spectrum

Examples:

- 
- Height in humans
 - Weight
 - Intelligence
 - Skin colour

Explanation:

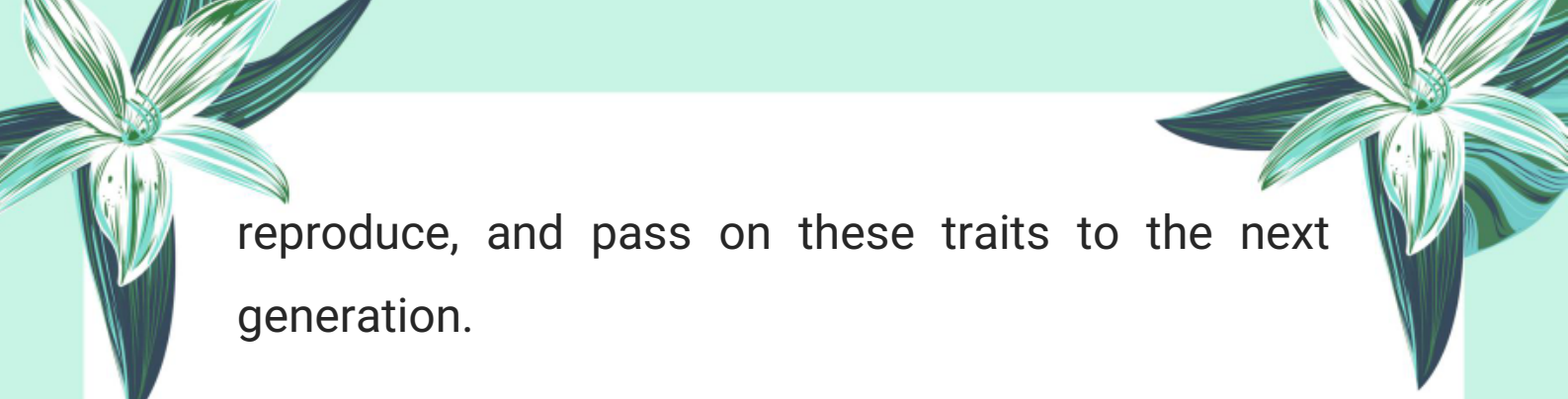
Height in a human population can vary from very short to very tall with many in-between heights. It does not fall into distinct categories and is influenced by both genetic factors and nutrition/environment.

🌟 Q10: Describe the mechanism of evolution through natural selection with suitable examples.

❖ Definition of Natural Selection:

Natural Selection is the process by which organisms with favourable traits (better adapted to their environment) are more likely to survive,





reproduce, and pass on these traits to the next generation.

This concept was proposed by Charles Darwin in 1838 and published in his book “On the Origin of Species” in 1859.



► **Struggle for Survival:**

In every population, organisms compete for limited resources such as:

- Food
- Shelter
- Water
- Mates


This competition creates a “struggle for survival”. Not all individuals survive – only those with advantageous (favourable) traits are more likely to survive.



Fitness and Reproductive Success:

Fitness means an organism’s ability to:

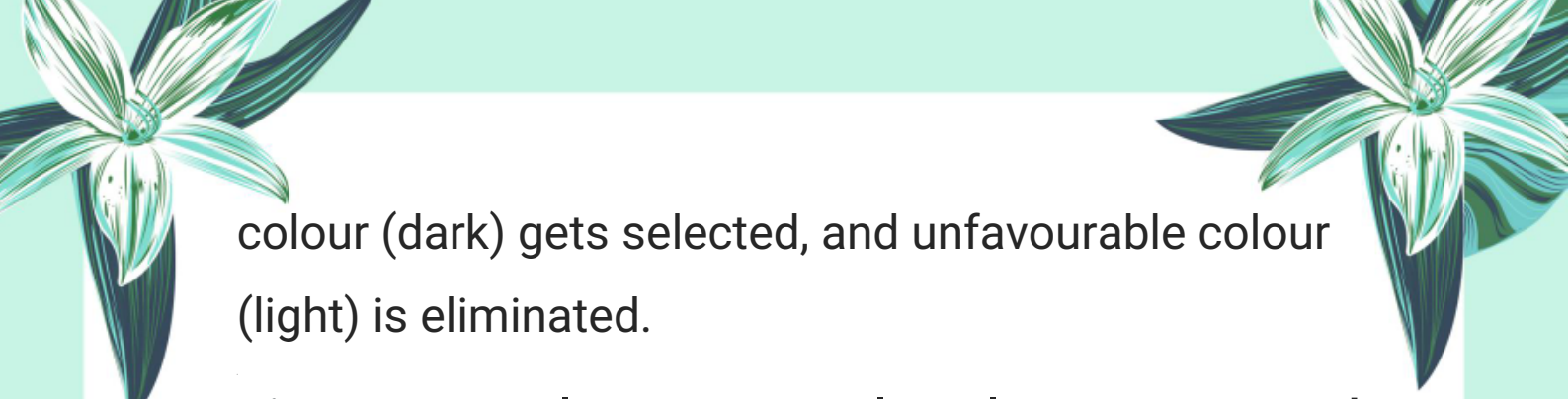
- Survive in its environment
- 

- 
- Reproduce successfully
 - Organisms with higher fitness:
 - Reproduce more
 - Pass their favourable traits to the next generation
 - **Over generations**, the favourable traits become common, and the unfavourable traits disappear.

Example 1: Natural Selection in Mice (Skin Colour)

- In a population of mice, there are light, medium, and dark coloured individuals.
- A predatory cat hunts mostly the light-coloured mice, because they are easily visible.
- Medium and dark-coloured mice survive and reproduce.
- In the next generation, more dark mice are born.
- This process continues, and dark-coloured mice become dominant in the population.


 This is natural selection – favourable skin



colour (dark) gets selected, and unfavourable colour (light) is eliminated.

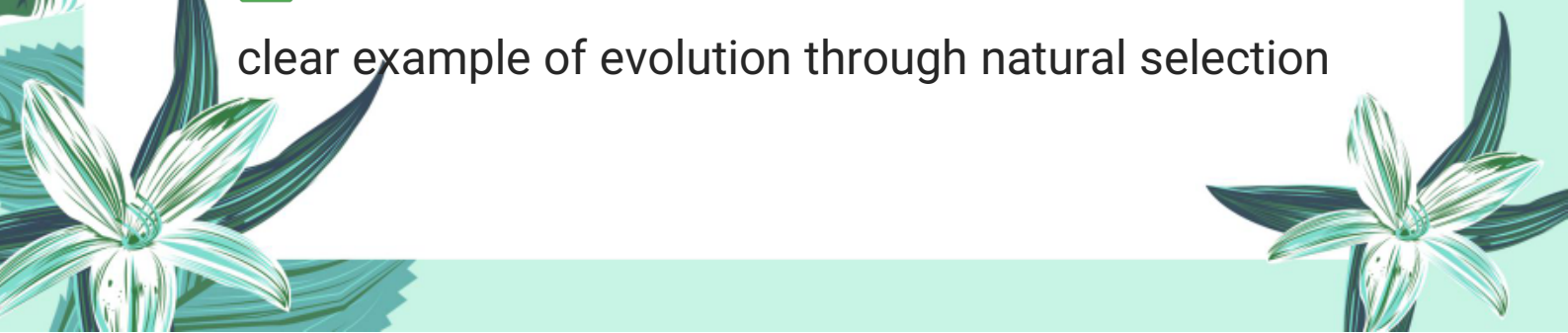


Example 2: Natural Selection in Moths (Industrial Melanism)

- 
- In 19th-century England, before industrialization, trees had light-coloured bark with white lichens.
 - White moths could easily camouflage and survive; dark moths were rare and visible to birds.
 - After industries were built, soot pollution killed lichens, and tree trunks turned dark.
 - Now, dark moths were camouflaged while white moths became more visible and were eaten by birds.
 - **As a result**, the dark moths survived and reproduced, and white moths reduced in number.



Over time, dark moths became dominant – a clear example of evolution through natural selection





based on environmental change.



 **Summary:**

Natural selection is the driving force of evolution. It ensures that:

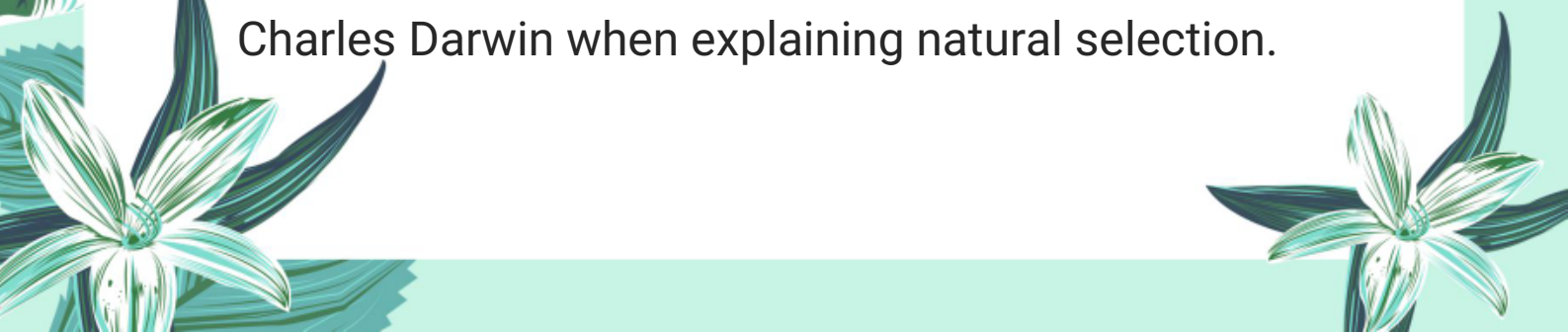
- Only advantageous traits are passed on
- Populations change over time
- Species adapt to their environment
- These changes can lead to new traits, and over a long time, even new species.

❖ **Q11: What is artificial selection? How does it differ from natural selection? Explain with examples.**

❖ **Definition and Origin:**

Artificial selection is the process in which humans intentionally breed plants or animals to enhance desired traits in future generations.

This idea was first mentioned by Abu Rayhan Biruni in the 11th century and was later discussed by Charles Darwin when explaining natural selection.





◆ **Process of Selective Breeding:**

In artificial selection:

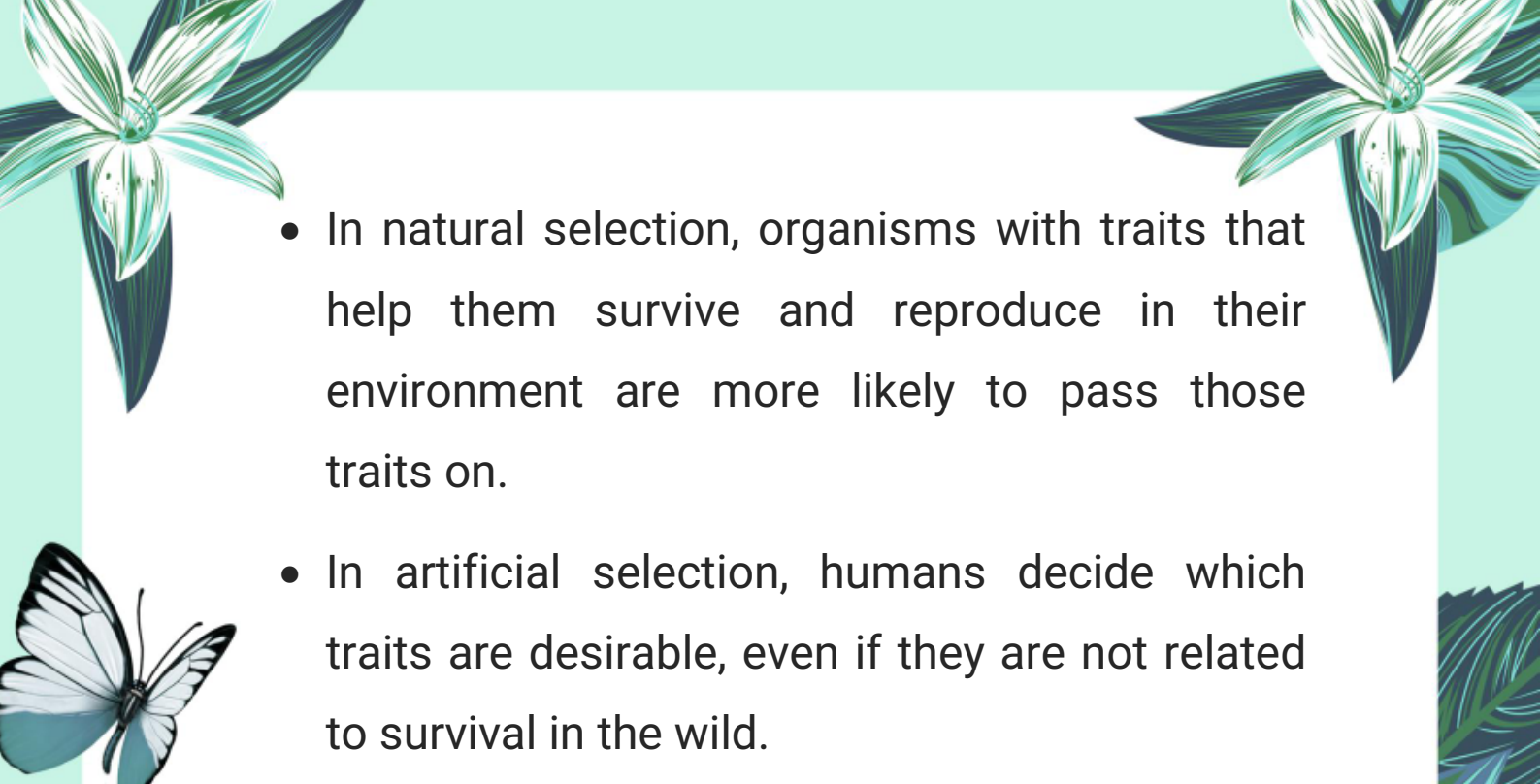
- Humans select individuals with beneficial traits (e.g. high milk production, good fruit size).
- These selected individuals are allowed to reproduce, while those with less useful traits are prevented from breeding.
- This process is repeated over generations to improve the population.

◆ **Examples:**

- **Animals:** Cows are bred to produce more milk; chickens are selected for more eggs; sheep are bred for softer wool.
- **Plants:** Wheat varieties are improved for better yield; fruits are bred for better taste, size, and resistance to disease.

◆ **Difference from Natural Selection:**

- Artificial selection is controlled by humans, while natural selection happens in nature without human interference.

- 
- In natural selection, organisms with traits that help them survive and reproduce in their environment are more likely to pass those traits on.
 - In artificial selection, humans decide which traits are desirable, even if they are not related to survival in the wild.

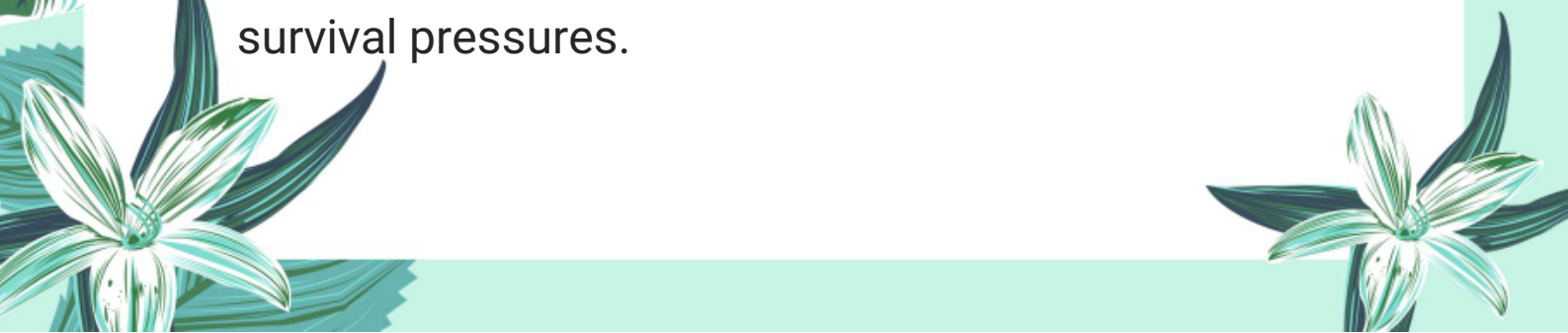
For example:

- In natural selection, a dark-coloured mouse may survive better in a dark environment because predators can't see it easily.
- In artificial selection, a cow that gives more milk is bred repeatedly, regardless of whether it would survive well in nature.



Summary:

Artificial selection is a powerful human technique to produce high-yielding or better-quality animals and plants. It is different from natural selection because it is guided by human choice, not environmental survival pressures.





Note:

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.

Author: Muhammad Asghar

Purpose: To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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