HSC Biology
Core 2 – Blueprint of Life

Focus 2

- *Gregor Mendel's experiments helped advance our knowledge of the inheritance of characteristics.*

Outline the experiments carried out by Gregor Mendel

- Mendel studied heredity.
- 1860's Gregor Mendel;
  - Formulated principles of genetics.
  - Through careful, methodical experimentation with garden peas.
    - Garden peas have short reproductive cycle.
    - Easily distinguishable characteristics.
    - Easy to grow.
- Bred each variety for 2 yrs, ensure pure breeding.
- Crossed 1 variety with another.
  - Observed result in next generation.
- Mendel examined;
  - Flower colour.
    - Purple or white.
  - Flower position.
    - Axial or terminal.
  - Seed shape.
    - Round or wrinkled.
  - Seed colour.
    - Green or yellow.
  - Pod shape.
    - Inflated or constricted.
  - Pod colour.
    - Green or yellow.
  - Stem height.
    - Tall or short.

- Mendel needed to control fertilisation.
    - Self fertilisation ensured.
        - Placed bag over flowers, made sure pollen from stamens lands on carpal of same flower
    - Cross fertilisation ensured.
        - Cutting off stamens before pollen was produced.
        - Dusting carpal with pollen from another plant.
    - Increase reliability.
        - Mendel used thousands of plants in each experiment.
- Mendel worked with true breeding plants.
    - Self fertilising plants.
        - Produced offspring identical to parents.

1. Mendel cross fertilised 2 true breeding plants for 1 characteristic.
    - **Eg.** Tall plants crossed with short plants.
        - Mendel named these parent generation (P_1).
2. Offspring produced called F_1 (1^{st} filial) generation.
3. F_1 generation self fertilised / cross fertilised to produce F_2 generation.

- Each of seven traits had;
    - Dominant factor
    - Recessive factor
    - When 2 true breeding plants crossed only **DOMINANT** factor appeared in F_1.
    - **Recessive** factor appeared in F_2 in ratio 3:1.
        - (dominant : recessive) relationship.

Describe the aspects of the experimental techniques used by Mendel that led to his success

- Mendel was successful because;
  - Used peas.
    - Easily grown.
    - Reproduced rapidly.
  - Selected easily observable characteristics.
  - Strictly controlled fertilisation process.
  - Used mathematics rigorously to analyse results.
  - Used large number of plants.
  - Studied traits that had 2 easily identified factors.
  - Lucky because each trait on separate chromosome;
    - No crossing over occurred.
  - Not sex-linked characteristics.

Describe outcomes of monohybrid crosses involving simple dominance, using Mendel's explanations

- Monohybrid crosses involve 1 factor only.
  - **Eg.** Cross may involve a true breeding (homozygous) tall with a true breeding (homozygous) short plant.
    - Produces a F_1 generation where all plants are tall.
    - Mendel explained F_1 generation trait as a **DOMINANT** factor.

  - Mendel explained observable ratios.
    - Parents: Homozygous tall, homozygous short.
    - F_1 **ALL TALL**.
    - F_2 **3 TALL : 1 SHORT**.
      - Mendalian ratio (monohybrid ratio), **3:1**.

Distinguish between homozygous and heterozygous genotypes in monohybrid crosses.

- Homozygous
  - Same.
  Eg. TT, tt
- Heterozygous
  - Different.
  Eg. Tt
- Alternate factors for same characteristics;
  - **Alleles**.
  Eg. Tall, short alleles for height. Purple, white alleles for colour.
- For each characteristic;
  - At least 2 alleles controlling phenotype.
  - Gametes from each parent contain only 1 factor.
    - When formed, pairs of factors segregate.
- Heterozygous condition, factor fully expressed;
    - Dominant.
  - Factor with no noticeable effect;
    - Recessive.

Explain the relationship between dominant and recessive genes and phenotype using examples.

- Phenotype;
  - Outward appearance of organism.
- Genotype;
  - Alleles on chromosome of organism.

  Eg. Homozygous tall plant (TT), 2 identical alleles for tall, appear tall.
- Heterozygous plant with tall phenotype;
  - Non identical alleles (Tt).
  - Tall = dominant.
  - Short = recessive (not expressed).

Outline the reasons why the importance of Mendel's work was not recognized until some time after it was published.

- Mendel began his work;
  - 1858.

  Published results;
  - 1866.

  Work undiscovered until;
  - 1900 when others performed similar experiments.
- Unclear why his original work went unnoticed.
  - Lived in isolated area.
  - Not part of an established science community.
  - Had no scientific reputation.
  - Lived at monastery, not university.
  - Presented his paper to few, insignificant people.
  - Others could not comprehend his experiment of results yielded.
    - Used maths & numbers.

Perform an investigation to construct pedigrees or family trees, trace the inheritance of selected characteristics and discuss their current use.

- Pedigree;
  - Family tree showing line of descent.
  - Trace occurrence of inherited traits in;
    - Parents & offspring.

  Through a number of generations.
- Circles represent females.
- Squares represent males.
- Line between circle & square represent a union.
- Line down represents offspring from union.
- Filled symbols represent individuals displaying studied trait.
- Valuable tools in genetic counselling.
  - Pattern of inheritance to be traced.
  - I.D. of genetic diseases.
  - Advice on probability can be made.
  - Assess genotypes from phenotypes.

Process information from secondary sources to identify and describe an example of hybridisation within a species and explain the purpose of this hybridisation.

- Hybridisation;
  - Breeding of two different types of plants OR animals.
    - **Eg.** Mule;
  - Result of union between horse & donkey.
    - Result has favourable characteristics from both parents.
    - All mules sterile, cannot produce offspring.
  - Many agricultural animals, plants result of hybridisation.
    - Offspring with desirable characteristics.

    Eg. Cross breeding cattle.

    Triticale (wheat crossed with rye).

    Zeedonk (zebra crossed with donkey).

    Liger (tiger crossed with lion).

    Wolphin (dolphin with whale).
  - Hybridisation good way of producing new plants.