

## **IB Biology A**

### Curriculum Guide for Unit 5: Genetics

#### **Essential Ideas:**

- Every living organism inherits a blueprint for life from its parents.
- Chromosomes carry genes in a linear sequence that is shared by members of a species.
- Alleles segregate during meiosis allowing new combinations to be formed by the fusion of gametes.
- The inheritance of genes follows patterns.
- Biologists have developed techniques for artificial manipulation of DNA, cells and organisms.

#### **Understandings:**

- A gene is a heritable factor that consists of a length of DNA and influences a specific characteristic.
- A gene occupies a specific position on a chromosome.
- The various specific forms of a gene are alleles.
- New alleles are formed by mutation.
- Prokaryotes have one chromosome consisting of a circular DNA molecule.
- In a eukaryote species there are different chromosomes that carry different genes.
- Homologous chromosomes carry the same sequence of genes but not necessarily the same alleles of those genes.
- Diploid nuclei have pairs of homologous chromosomes.
- Haploid nuclei have one chromosome of each pair.
- The number of chromosomes is a characteristic feature of members of a species.
- A karyogram shows the chromosomes of an organism in homologous pair of decreasing length.
- Sex is determined by sex chromosomes and autosomes are chromosomes that do not determine sex.
- One diploid nucleus divides by meiosis to produce four haploid nuclei.
- The halving of the chromosome number allows a sexual life cycle with fusion of gametes.
- DNA is replicated before meiosis so that all chromosomes consist of two sister chromatids.
- The early stages of meiosis involve pairing of homologous chromosomes and crossing over followed by condensation.
- Separation of pairs of homologous chromosomes in the first division of meiosis halves the chromosome number.
- Crossing over and random orientation promotes genetic variation.
- Fusion of gametes from different parents promotes genetic variation.
- Mendel discovered the principles of inheritance with experiments in which large numbers of pea plants were crossed.
- Gametes are haploid so contain only one allele of each gene.

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- The two alleles of each gene separate into different haploid daughter nuclei during meiosis.
- Fusion of gametes results in diploid zygotes with two alleles of each gene that may be the same allele or different alleles.
- Dominant alleles mask the effects of recessive alleles but co-dominant alleles have joint effects.
- Many genetic diseases in humans are due to recessive alleles of autosomal genes, although some genetic diseases are due to dominant or co-dominant alleles.
- Some genetic diseases are sex-linked. The pattern of inheritance is different with sex-linked genes due to their location on sex chromosomes.
- Many genetic diseases have been identified in humans but most are very rare.
- Radiation and mutagenic chemicals increase the mutation rate and can cause genetic disease and cancer.
- Genetic modification is carried out by gene transfer between species.
- Clones are groups of genetically identical organisms, derived from a single original parent cell.

#### **Applications and skills:**

- Application: Use of karyogram to deduce sex and diagnose Down syndrome in humans.
- Application: Non-disjunction can cause Down syndrome and other chromosome abnormalities.
- Application: Inheritance of ABO blood groups.
- Application: Red-green color blindness and hemophilia as examples of sex-linked inheritance.
- Skill: Construction of Punnett grids for predicting the outcomes of monohybrid genetic crosses.
- Skill: Analysis of pedigree charts to deduce the pattern of inheritance of genetic diseases.