Lecture 1 For B.Sc Part III Students

Genetics

Introduction → Genetics is the study of heredity. Heredity is a biological process whereby a parent passes certain genes onto their children or offspring.

Every child inherits genes from both of their biological parents and these genes, in turn express specific traits. Some of these traits may be Physical for example hair and eye colour etc.

: on the other hand some genes may also carry the risk of certain diseases and disorders that may be passed on from parents to their offsprings

Genes in the cell — The genetic information lies within the cell nucleus of each living cell in the body. The information may be considered to be retained in a book for example. Part of this book with genetic information comes from the father while the other pair comes from the mother.

Chromosomes —

The genes lies within the chromosomes. Humans have 23 pairs of these as small thread like structures in nucleus of their cells. 23 or half of the total 46 comes from the mother while the other 23 comes from the father.

The chromosomes are therefore the genes, are made up of the chemical substance called DNA (De oxy ribose nucleic acid). The chromosomes are very long thin strands of DNA coiled up tightly.

At one point de along their length, each chromosome has constriction, called the centromere. The centromere divides the chromosomes into two arms, a long and a short arm.

Chromosomes are numbered from 1 to 22 and these are common for both sexes and called autosomes. There are two chromosomes that have been given the letters X and Y and termed as sex chromosomes. The X chromosomes is much larger than the Y chromosome

Chemical bases

The genes are further made up of unique codes of chemical bases comprising of A, T, C and G (Adenine thymine, cytosine and guanine) These chemical bases make up combinations with Permutations and combinations.

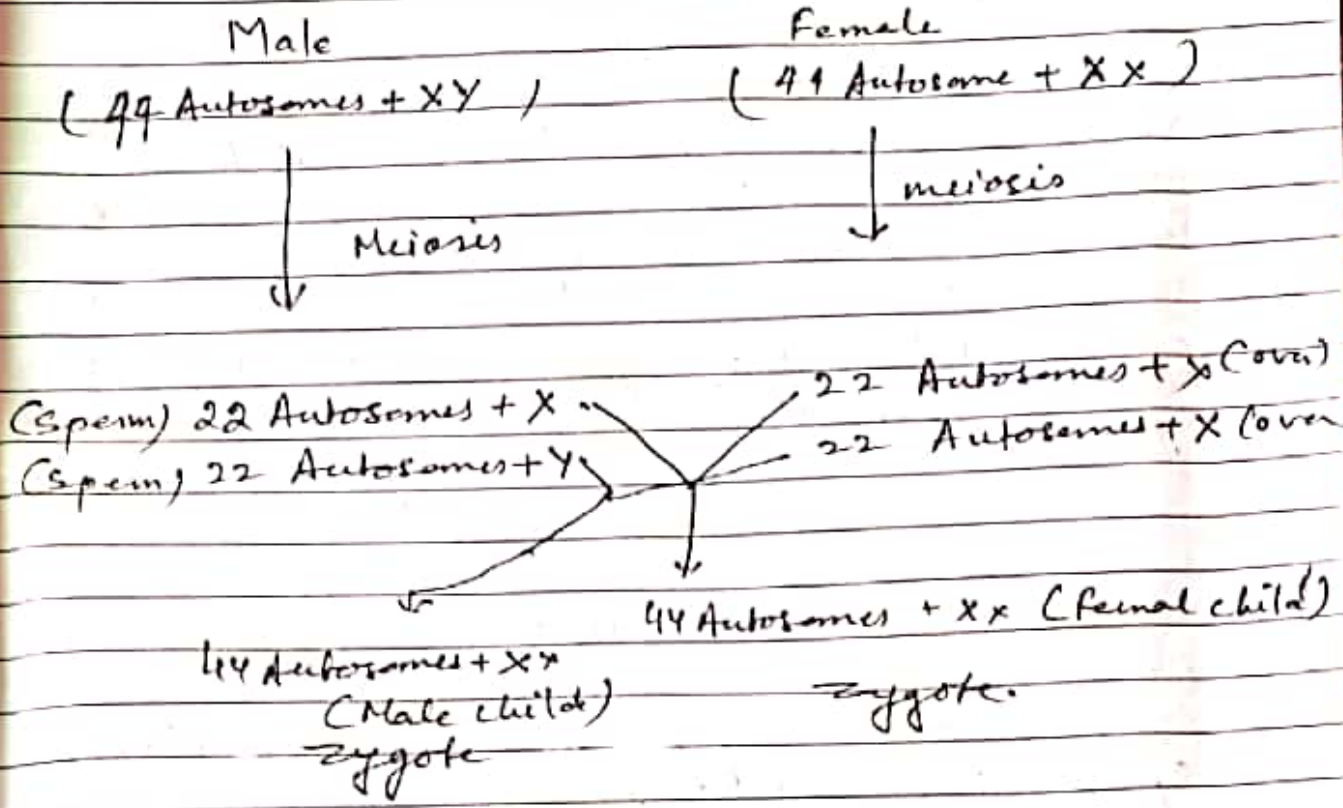
These chemical bases are part of DNA. which acts as the blueprints that cells of the body when and how to grow mature and perform various functions. With age the genes may be affected and may develop faults and damages due to environmental and endogeneous toxins.

Males and Females

Women have 46 chromosomes (44 autosomes + 2 X chromosomes) in the body cells. They half of this 22 autosomes plus an X chromosome in their egg cells

Males have 46 chromosomes (44 autosomes plus an X and and Y chromosomes) in their body cells and half of these 22 autosomes plus an X or Y chromosome in their sperm cells.

Human Sex determination in Human beings



Genes and Genetics—

Each gene is a piece of genetic information. All the DNA in the cell makes up for the human genome. There are about 20,000 genes located on one of the 23 chromosome pairs found inside the nucleus. about 12,800 genes have been mapped to specific locations on each of the chromosomes. The database is a part of Human Genome Project which completed in April 2003 but the exact number of genes in the human genome is still unknown.

History of genetics— Genomics involves the study of genes, genetics, inheritance, molecular biology, biochemistry, biological statistics and incorporates the knowledge of advanced technology, computer science and mathematics.

The origin of genetics lies in the development of theories of evolution. In 1858 a research paper by Darwin and Wallace gave the concept of origin of species. They described how new species arose via evolution and how natural selection occurred to evolve new forms. They however did not know the role of genes had to play in this phenomenon.

Around the same time a person Mendel, an Austrian monk, was performing experiments on inheritance and genetics of sweet pea plant. He described the unit of heredity as a particle that does not change and it passed to offspring. Gregor Mendel is known as the father of genetics.

At this period Haeckel correctly predicted that the hereditary materials were located in the nucleus. Hiesber showed the material in the nucleus was a nucleic acid chromosomes as well carrying genetic information was also discovered around this time.

Development of the chromosomal theory of inheritance led to advent of the field of cytogenetics and chromosomal abnormalities (eg duplication, deletion, translocations, inversion) etc.

Avery, MacLeod and Mc Carty further showed that DNA not protein or RNA was the factor responsible for genetic inheritance and evolution of the bacterial strains studied by Griffith.

Then Watson and Crick determined the structure of DNA and then suggested that DNA contains genetic code. Crick discovered the 'Central Dogma of molecular biology'

various advanced technologies made their way into Knowledge base around us This included molecular biology, recombinant DNA technology and biotechnology methods.

Restriction enzymes were discovered and used to construct recombinant DNA molecules that contained foreign DNA that could be grown in abundance in bacterial strains, methods like Polymerase Chain reaction / PCR and other biotechnological methods helped in new research in the field of medicine and pharmacotherapy.

Many experimental breakthroughs like Genetic mapping, maternal inheritance, Hardy Weinberg principle of genetic equillibrium Griffiths experiment and explaination of certain riddles like Genetic code (Har Gobind Khorana) ~~Transcription~~ Transcription, Translation, Replication operon and complete mechanism of Protein synthesis in cell was discovered.

The discovery of Mendel is known as Theory of inheritance he performed his experiments in pea plant by taking pure breed of long and dwarf plant, then and crossed these plants by taking into consideration one or two characteristic feature features. They are known as Monohybrid and dihybrid cross Simultaneously. These crosses gave rise to laws of inheritance which states that

1. Law of dominance
2. Law of Segregation
3. Law of independent assortment.

According to Law of dominance among two

contrasting characters one becomes dominant and masks the other character which is known as a recessive character.

Law of Segregation states that the characters have the capacity to get separated and reappear in the next generation.

Law of independent assortment - The Dihybrid cross experiment of Mendel gave a different result in which new combination of characters arose different from the parents. This led to the formulation of law of independent assortment.

Thus it can be said that Genetics is very important part of Life Sciences which gave a lot of benefit in the field of Medicine, Agriculture, Microbiology and its application in Dairy industry and other different utilizations!

By Dr. Bibha Verma
Dept of Zoology
Maharaja college Ara