

04 - 3. Chromosomal Numbers

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© SPMM Course □ The main differences are the occurrence of synapsis (crossing over) in the prolonged prophase phase and non-separation of sister chromatids during anaphase 1, leading to reduced (half) chromosomal numbers in daughter cells. Meiosis 2 is same as a normal mitosis. 3. Chromosomal Numbers: Chromosomes are intranuclear structures containing one linear molecule of DNA. Human cells are called diploid as they have 46 chromosomes, 23 inherited from each parent; thus there are 23 'homologous' pairs of chromosomes (22 pairs of 'autosomes' and two 'sex chromosomes'). The sex chromosomes, called X and Y, are not homologous but are different in size and shape. Males have an X and a Y chromosome; females have two X chromosomes. During the mitotic division, each chromosome divides into two; this ensures that each daughter nucleus has the same number of chromosomes as its parent cell. During gametogenesis, the number of chromosomes is halved with meiosis so that after conception the number of chromosomes remains the same and not doubled. Hence, gametes are haploid cells. Chromosomes can be classified according to their size and shape, the largest being chromosome 1. The constriction in the chromosome is the centromere, which divides the chromosome into a short arm and a long arm, which are referred to as the p arm and the q arm respectively. o A metacentric chromosome has centromere right in the middle. So p and q arms are of equal length. o If it is placed at one end, it is called as an acrocentric or submetacentric where the arms are of unequal length. o If centromere is at the tail of a chromosome, it is called telocentric. With holocentric chromosomes, the entire length of the chromosome acts as the centromere. These latter two types are not seen in humans.

When cells possess chromosomal numbers different from normal diploid status, they are called aneuploid cells. Aneuploidy can occur in single numbers e.g. trisomy 21, trisomy 18, monosomy of Turner's, etc. Very rarely, the entire chromosome set will be present in more than two copies, so the individual may be triploid rather than diploid and have a chromosome number of 69. Triploidy and tetraploidy (four sets) result in spontaneous abortion. These aberrations result from the failure of chromosome or chromatids to separate ('non-disjunction') in meiosis, with one gamete receiving two copies of that chromosome and one another with no copies of the chromosome. This can produce (i) an extra chromosome, so resulting in a fetus that is 'trisomic' and has three instead of two copies of the chromosome; or (ii) no chromosome, so the fetus is 'monosomic' and has one instead of two copies of the chromosome. Nondisjunction can occur with autosomes or sex chromosomes. However, only individuals with trisomy 13, 18 and 21 survive to birth, and most children with trisomy 13 and trisomy 18 die in early childhood.

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