7. Chromosomal basis of heredity

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The basic unit of heredity is a gene. A unit that occupies a precise location (called locus) in the chromosome. It has a linear series of nucleotides. A gene acts as a storage unit of genetic information responsible for replication, mutation, and expression. It is found in the chromosome or outside the cell nucleus, for example inside the mitochondria and chloroplasts (in plants). A gene consists of a regulatory and structural part.
A chromosome is the structure of the cell nucleus that consists of DNA, RNA, histone and non-histone proteins.
The specific packing of the chromatin in the chromosome allows in the metaphase stage to perform various staining techniques that will show us the anatomical features of these chromosomes, e.g. euchromatin, heterochromatin, location of adenine-thymine pairs and location of guanine-cytosine pairs
In 1902 Sutton and Boveri correlated Mendel's theory of heredity with the behavior of chromosomes during mitosis and meiosis.
The main conclusions are as follows:

- genes are located on the chromosomes,
- chromosomes come in pairs - one comes from the mother and the other from the father.

The chromosome theory of heredity according to Boveri and Sutton tego nie mowi

- homologous chromosomes are separated during meiosis
- after meiosis, the germ cells contain one of the homologous chromosomes,
- genes are inherited according to the laws of Mendel,
- in the fertilisation process, the number of diploid chromosomes and alleles is restored.

The chromosome theory of heredity according to Morgan (1919)

- In the year 1919 the chromosome theory of heredity was invented by Morgan. In previous findings he came to the following conclusion:
- Genes are located in the chromosomes,
- A gene occupies a specific place on a chromosome (locus),
- Genes in chromosomes are arranged linearly.
- Genes are duplicated (replicated). They go through a replication process.
- Alleles of the same gene are on homologous chromosomes at exactly the same locus.
- Alleles of different genes occupy different positions.
- Genes on the same chromosome form a group of linked genes.
- There are as many linkage groups as there are pairs of chromosomes in an organism.

Notes:
For example, a goose with 80 chromosomes, has 40 pairs, so it has 40 linkage groups.

Only those genes that lie on different chromosomes and are unlinked are independently inherited. Between homologous chromosomes, their fragments may be exchanged, which results in the exchange of genetic information (genes) (crossing-over). Crossing-over frequency between genes is directly proportional to the distance between them. The bigger the distance between the genes, the higher the probability of this process occurring. The location of genes on a chromosome can be determined based on the crossing-over frequency.

INHERITANCE OF LINKED TRAITS

The map distance is expressed as the ratio of the number of recombinants to the total number of offspring and this fraction is multiplied by 100%. The mapping unit is the centimorgan.

If the traits are linked with each other, that means the genes have a common location on the same chromosome, then by crossing two genotypes - one individual with a homozygous system and an individual with a homozygous recessive system - the gametes that will be formed will be AB dominant and AB recessive gametes.

After the fusion of these two gametes, we have a heterozygous individual, but the dominant genes are on one chromosome and the recessive genes are on the other chromosome in this individual

The resulting heterozygous individual creates only 2 types of gametes: gametes consisting of dominant genes and gametes consisting of recessive genes

After the merging of such gametes, we form homozygous, heterozygous systems - where the heterozygous 2 dominant genes are on the same chromosome and the recessive genes are on the other chromosome and we have one homozygous recessive system

Thank you for your attention!