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Chromosomal basic of heredity

Modul no. 1: Animal Genetics

Dr hab. Ewa Wójcik, University professor

Siedlce University of Natural Sciences and Humanities, Faculty of Agrobioengineering and Animal Husbandry, Institute of Animal Science and Fisheries

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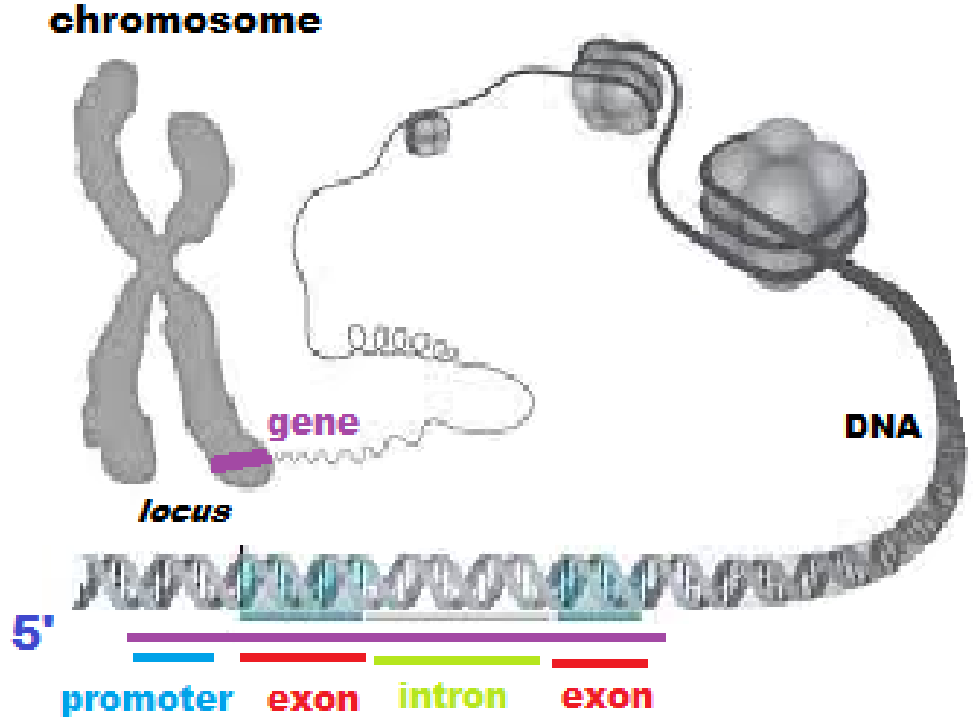
Gene

- The basic unit of heredity.
- Occupies a precise location (*locus*) in the chromosome.
- A linear series of nucleotides.
- 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, inside the mitochondria and chloroplasts (in plants).
- It consists of a regulatory and structural part.



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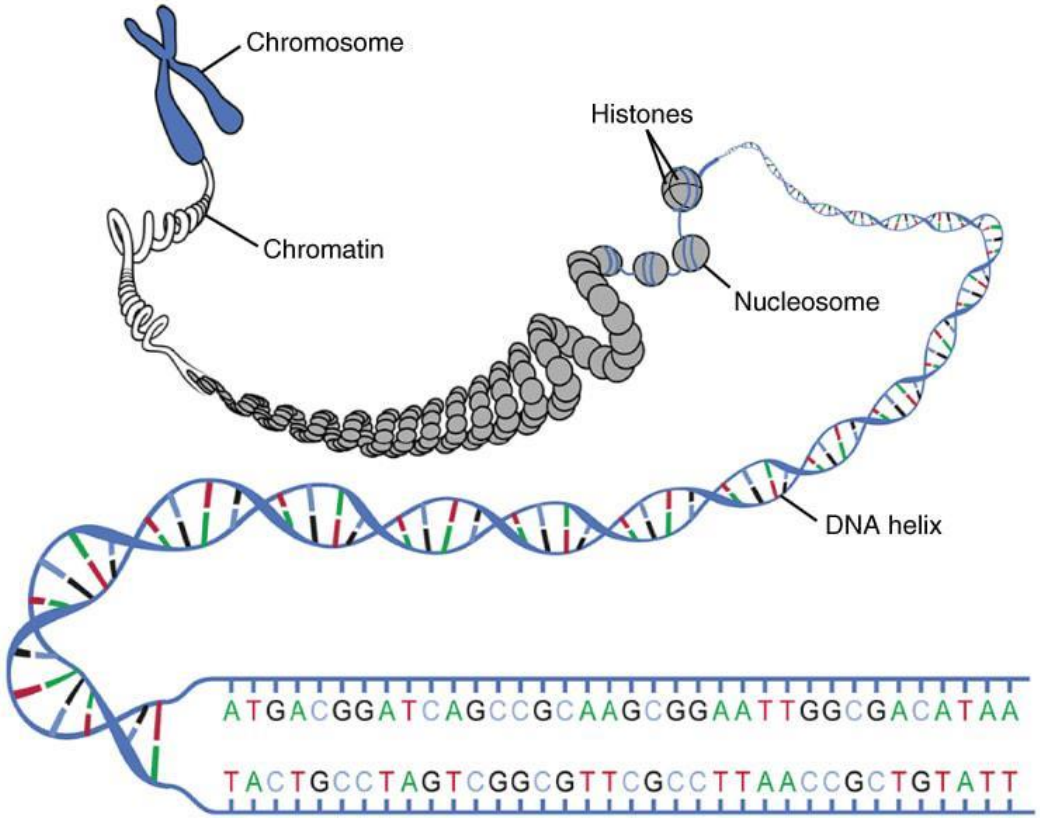
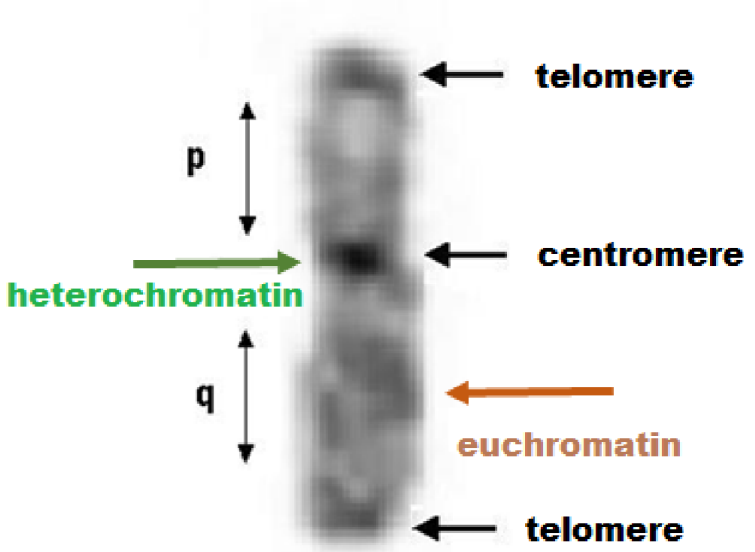
Chromosome

The structure of the cell nucleus that consists of DNA, RNA, histone and non-histone proteins.





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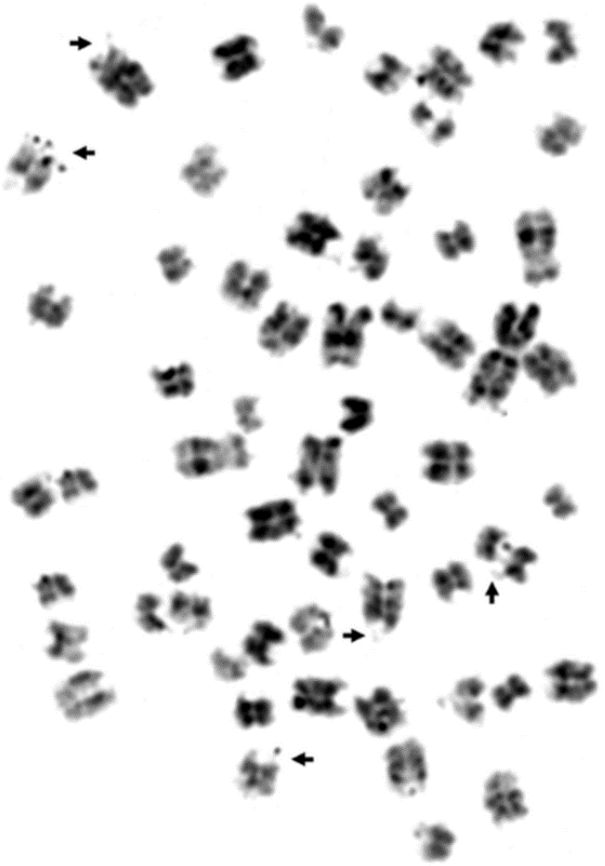
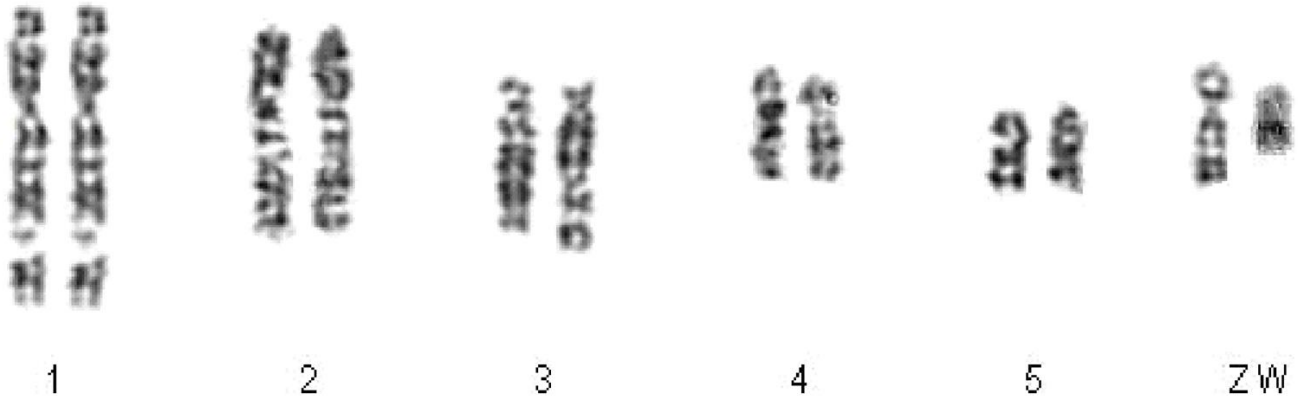
The chromosome theory of heredity according to Boveri and Sutton (1902)

- 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,





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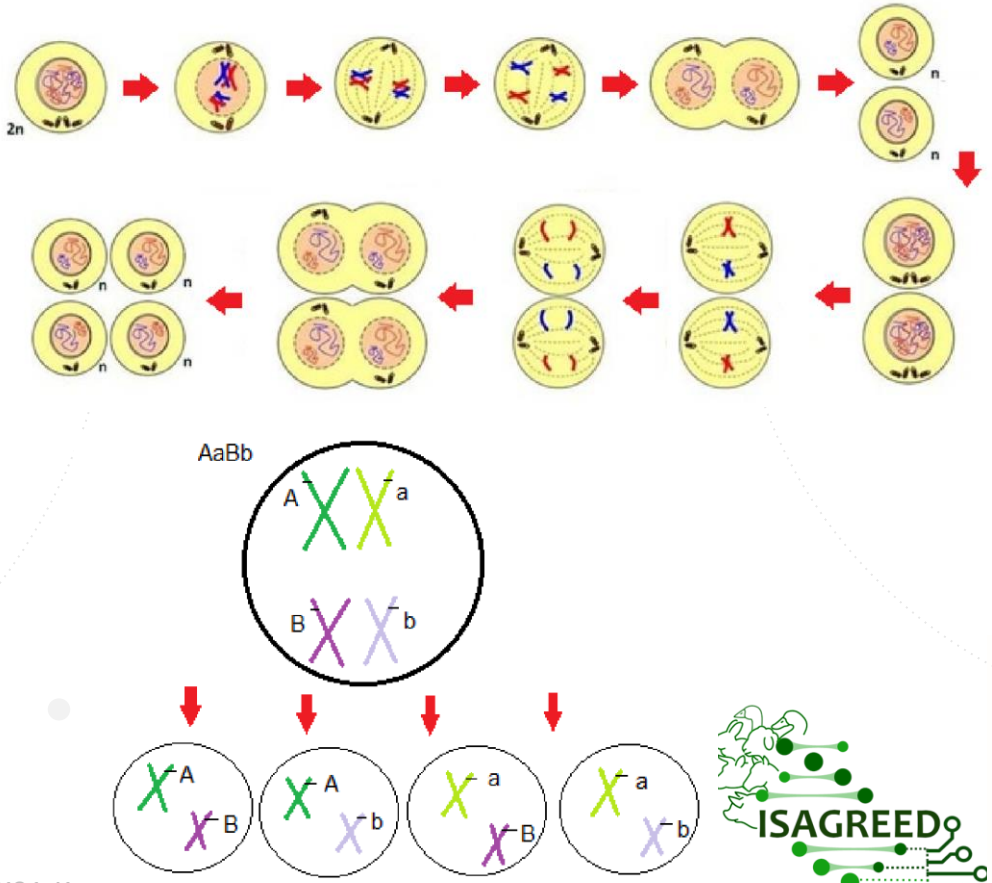
The chromosome theory of heredity according to Boveri and Sutton

Walter Sutton

Theodor Boveri

- ✓ 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.



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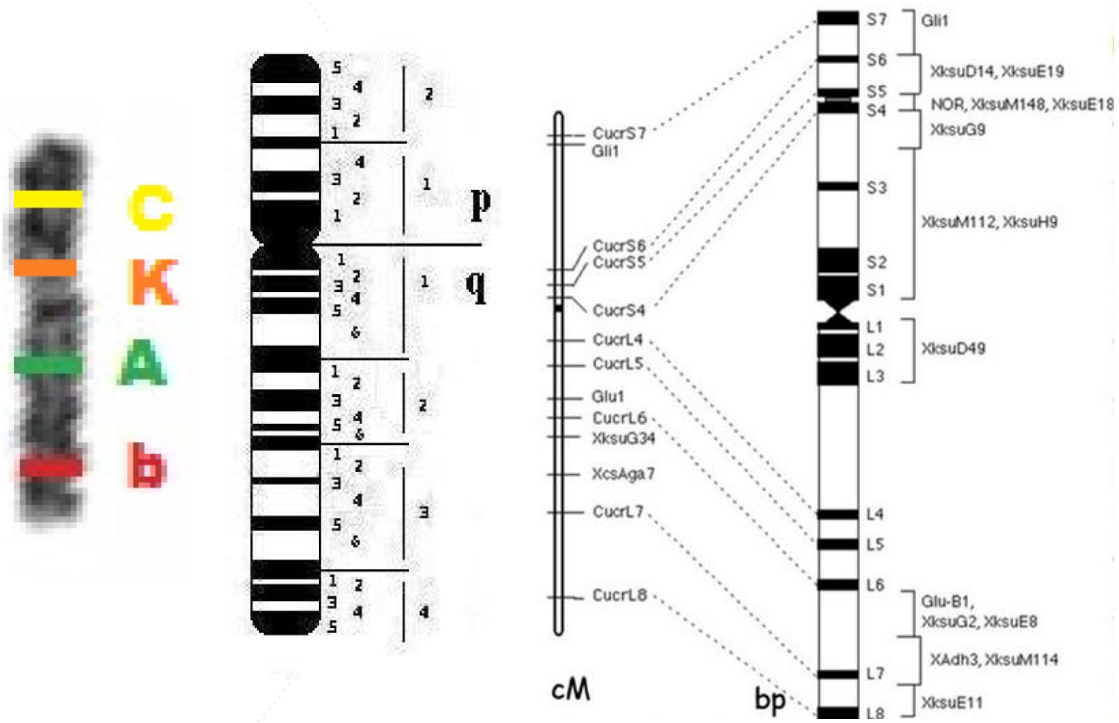
The chromosome theory of heredity according to Morgan (1919)

Thomas Hunt Morgan

- Genes are located in the chromosomes.
- Genes in chromosomes are arranged linearly.
- Genes are duplicated (replicated).
- A gene occupies a specific place on a chromosome (*locus*).



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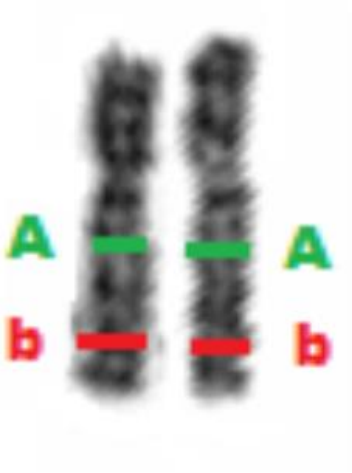
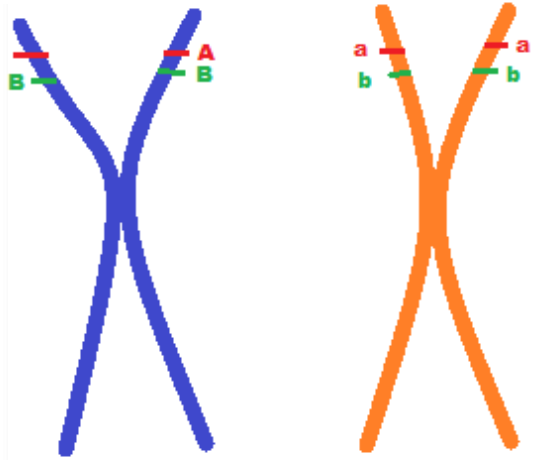
The chromosome theory of heredity according to Morgan

- Alleles of the same gene are on homologous chromosomes at exactly the same locus.
- Alleles of different genes occupy different positions.





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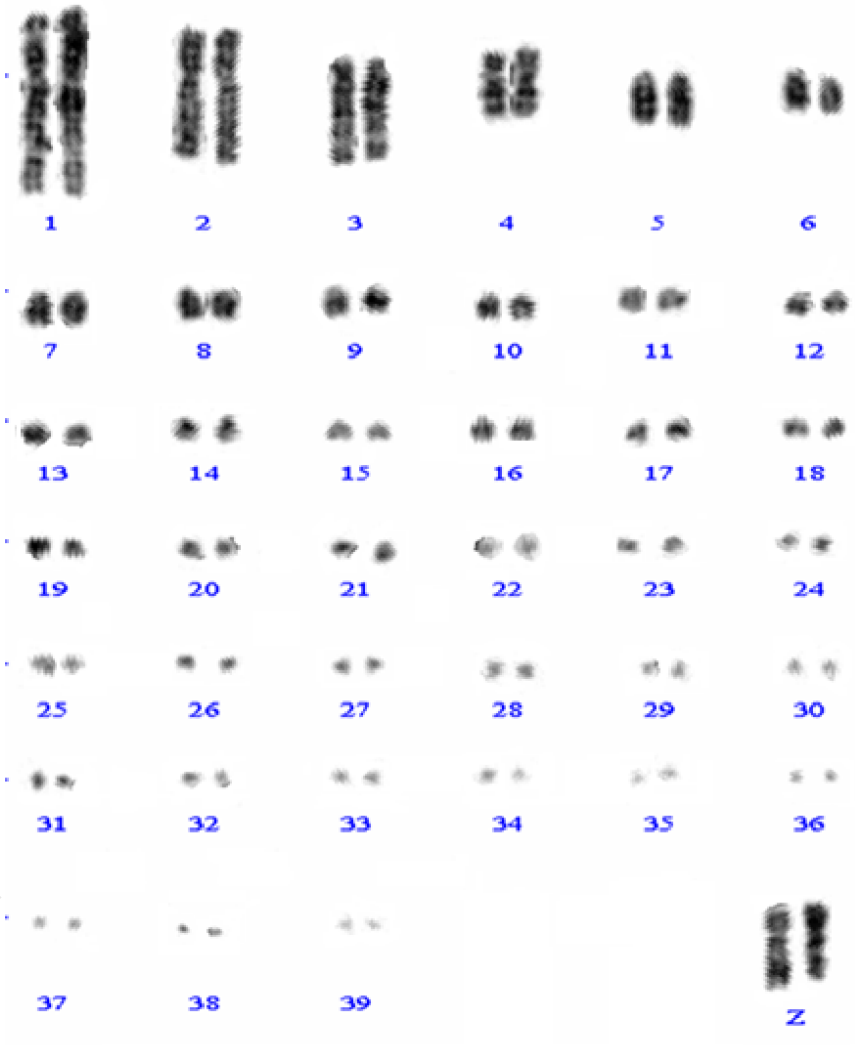
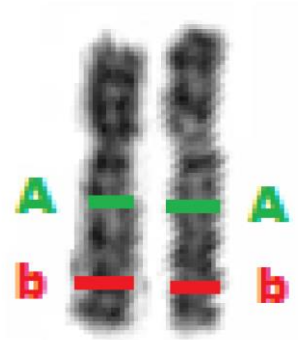
The chromosome theory of heredity according to Morgan

- 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.





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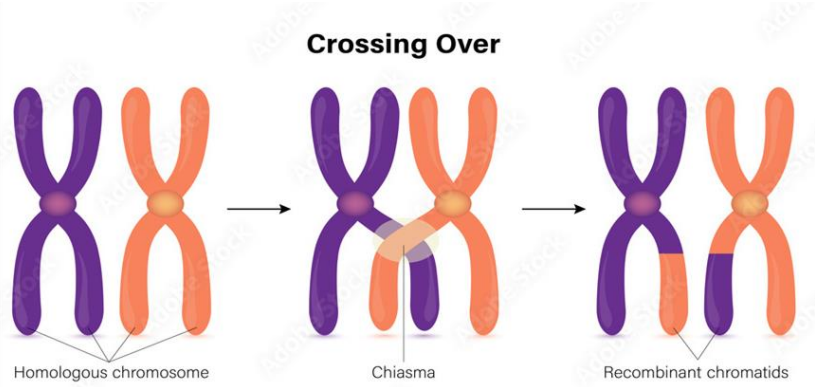
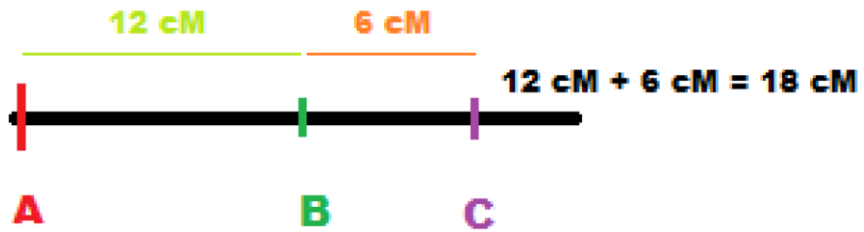
The chromosome theory of heredity according to Morgan

- 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 location of genes on a chromosome can be determined based on the crossing-over frequency.



$$\text{map distance} = \frac{\text{number of recombinants}}{\text{total number of offspring}} \times 100\%$$



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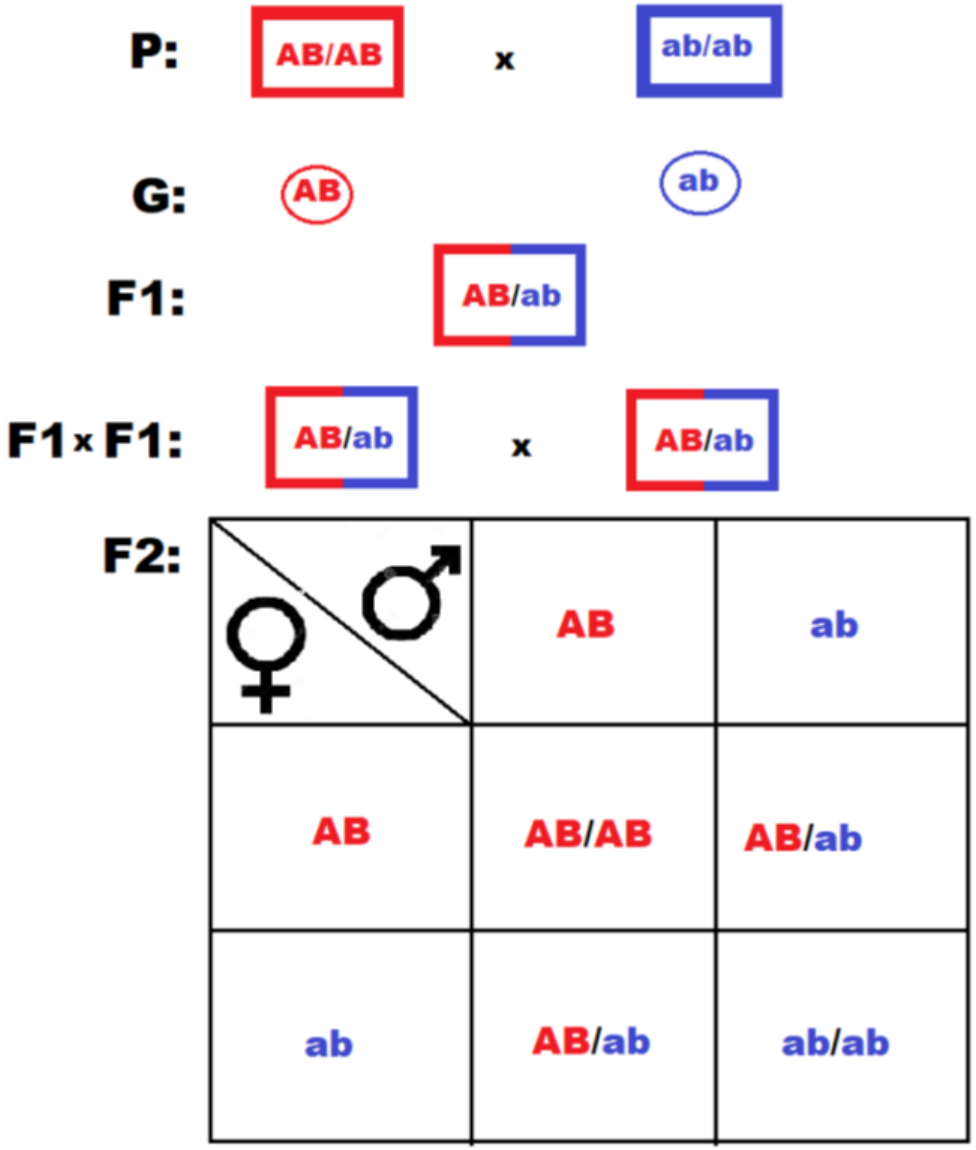
INHERITANCE OF LINKED TRAITS



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Thank you for your attention!

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Ewa Wójcik

ewa.wojcik@uph.edu.pl

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www pages

- https://www.dwieksiegi.pl/czy-ewolucja-moze-generowac-nowa-informacje.html
- http://tablicaprzyrodnika.blogspot.com/2017/10/mitoza-i-mejoza.html
- https://docplayer.pl/3570586-Genomika-mapowanie-genomow-mapy-genomiczne.html
- https://www.bajeczneobrazy.pl/obrazy-na-plotnie/crossing-over-of-chromosome-genetic-recombination-456633735

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