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THEORY OF CHROMOSOMES IN INHERITANCE

OdiljonovYusufjonFarhodjonog'li
Namangan State University,Faculty of Medicine , 1st-year student
Kakhorova Karomatkhon Sovronbaevna,
lecturer at the Department of General Medical Disciplines, Faculty of Medicine, Namangan State University

Annotation: Theory of Chromosomes in Inheritance discusses how chromosomes play a key role in passing traits from one generation to the next. Starting with early genetic studies by U.Betson and R.Punnett, it highlights Thomas Morgan's experiments with fruit flies,which revealed that genes on the same chromosome are often inherited together, a concept known as genetic linkage.Theory of Chromosomes in Inheritance also explains crossovers - the exchange of genetic material between chromosomes during meiosis - that create genetic variation. This fundational theory connects classical genetics with the chromosomal basis of inheritance, offering insight into how traits are inherited and diversified.

Keywords: Linkage group, Crossover, Non-crossover, Genetic map, Centimorgan.

In 1906,U.Bateson and R.Punnett crossbred sweet-scented pea plants anddiscovered that traits such as pollen grain shape and flower color are not independently inherited in the next generation. Instead, hybrids displayed characteristics that repeated those of the parent forms. It became clear that independent inheritance and free recombination of traits do not apply to all characterstics.Thomas Morgan and his students studied the inheritance of traits linked to genes that are not independently inherited across generation.WhileG.Mendelcounducted his experiments on pea plants, Morgan used the fruit fly Drosophila as his primary research model.Drosophila is highly suitable for experiments, as it reproduces rapidly in laboratory conditions and has only eight chromosomes. In Drosophila, the gene for gray body color (A) is dominat over the gene for black color (a). Similarly, the gene for normal wings (B) is dominat over the gene for short wings (b).

1.Linkage group- a collection of genes located on the same chromosomes that tend to be inherited together. Genes in the same linkage group are physically linked because they are close to each other on the same chromosome.

2.Crossover – the process during meiosis where homologus chromosomes exchange genetic material. This exchange leads to genetic recombination, creating new combinations of alleles in the offspring.

3.Non – crossover – refers to the gametes or cell where no crossover has occured, meaning remains the same as in the parent chromosomes. These cells carry the original combination of alleles.

4.Genetic map – a chart that shows the relative positions of genes on a chromosome based on the frequency of recombination. Genetic maps are used ton determine the distance between genes, with higher recombination rates indicating greater distances.

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5.Centimorgan (cM) is unit genetic distance used to measure the likelihood of recombination, or crossing over ,between two genes on a chromosome.Specifically, 1% centimorgan corresponds to a 1% chance that a crossover will occur between two genes during meiosis.

Problems related to crossing over and their solutions

1. In Drosophila (fruit flies),having a gray bodyis dominant over a black body, and having normal - length wings is dominant over short wings.These traits are located on an autosome.The trait of having red eyes in dominant over white eyes and is located on the X chromosome.Consider a cross between a gray-bodied,normal – winged female with red eyes (heterozygous for all traits, having inherited dominant alleles only from the father) and a black – bodied, short winged male with red eyes .What percentage of the offspring will begray - bodied,short – winged males with red eyes, given that the crossover rate is 17%.?

EXPLANATION: Gray body (G) is dominant over Black body (g). Normal wings (N) is dominant over Short wings (n). Red eyes (XR) is dominant over White eyes (X w) and they are located in the sex chromosomes.

Parent Genotypes: Female: Gg, Nn,X w X w (gray -bodied, normal-winged, wihte-eyed) .Male:gg, nn, X R,Y (black-bodied, short – winged, red-eyed).

FEMALE /MALE	g,n,X^R	g,n,Y
G,N,X^W	20.75% Gg,Nn,X^R X^W	20.75% Gg,Nn,X^W Y
g,n,X^W	20.75% gg,nn,X^R X^W	20.75% gg,nn,X^W Y
G,n,X^W	4.25% Gg,nn,X^R X^W	4.25% Gg,nn,X^W Y
g,N,X^W	4.25% gg,Nn,X^R X^W	4.25% gg,Nn,X^W Y

The colours in the table are used to make it easier to read the information and distinguish the probabilities for each gene pair.Here's what each colour represents:BLUE represents the non-crossover percentages.GREENrepresentes organisms that have undergone crossover. Red organism that asked about in the problem so,gray-bodied, short-winged, male Drosophila fly and the percentage of crossing over 4.25% .ANSWER is 4.25%

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