Quadrant II – Transcript and Related Materials

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Unit: 04

Module Name: Introduction to chromosome mapping and its application

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Notes

Introduction to chromosome mapping and its applications

We refer to a map when we want to go to an unfamiliar place. Maps help us not only in navigation but also in presenting information. Maps support spatial thinking by helping us to visualise the placement of objects in relation to other.

A similar concept is used in genetics to determine the position or a locus of a gene on a chromosome.

We define chromosome map as that which map shows the relative locations of genes and other important features based on the idea of linkage. Which means that closer the two genes are to each other on the chromosome, the grater probability that they will be inherited together.

Let us see little about the genes and chromosomes before learning about chromosome maps.

Arrangement of genes on chromosomes

- Many genes are located on one chromosome because the number of genes present in an organism usually exceeds the number of chromosomes.
- The genes are arranged linearly on the chromosome and they behave according to the chromosome during gametogenesis and inheritance
- All genes on a chromosome inherit together and are said to be linked with each other to form linkage groups.
- All genes in a given linkage group can be shown in a linear array.
- A circle or ring exhibits linearity as it is simply a closed line with no ends.

» Since a sequence of base pairs in DNA is linear, it is appropriate that linkage maps are also linear.

The linkage of the genes in a chromosome can be represented in the form of a chromosome map.

The major aspects of gene mapping are as follows

1. Determination of linkage groups
2. Determination of relative distance between the genes.
3. Determination of gene order

Determination of linkage groups –

One has to know the exact number of chromosomes of that species and then determine the total number of genes by undergoing hybridization experiments between wild and mutant strains.

By these techniques it can be determined how many phenotypic traits are linked and consequently their genes during the course of inheritance.

Determination of relative distance between the genes.

The linked genes do not always remain linked, but are occasionally departed from other members of their linkage groups by crossing over.

Recombination tends to occur with increasing frequency

The percentage of recombination can be used to represent a measure of distance between two genes.

The percentage of recombination between two loci is directly related to the physical distance between the loci.

1% recombination is equivalent to 1 map unit is equivalent to one map unit or 1 centimorgans cM .

By analyzing the percent recombination among the progeny of parents that are heterozygous for a number of linked genes, a genetic map can be constructed.

For example: two genes that recombine with frequency 3.5 %are said to be located 3.5map units apart.

Determining the gene order

After detrmining the relative distances between the genes of a linkage group, it becomes easy to place genes in their proper linear order.

Applications of chromosome mapping

1. Identification of genes

Identification of genes responsible for diseases such as hereditary diseases and various cancers.

It also helps in identifying useful traits in plants and animals such as disease resistance, increase in production of substances which have an economical value.

2. Forensics

It helps to identify potential suspects through DNA evidence.

Absolve those who were wrongly convicted by providing DNA evidence.

Settle doubts of paternity and other family relations.

3. Molecular medicine

Improve upon gene therapy which may include alteration of genes to treat a disease.

Design drugs to act as activators or inhibitors of function of different proteins to prevent diseases.

4. Human genome project – The international scientific research project for determining the base pairs that make up the human DNA and mapping all the genes of the human genome for physical and functional aspect.
5. Agriculture application – The knowledge of genetic maps leads to the development of better agricultural crops that are more nutritious, productive and may be better disease resistant.