Subject: Biology

Grade: 12

Section: LS

Teacher: Dr. Abdallah Nassour

Unit: Reproduction and Genetics

Chapter 5: Human genetics

Document 2: Autosomal diseases

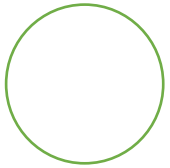
Objectives

- Determine the biological identity of an individual:.
- By shed lighting on the assortments of alleles or by a proteinogram.
- Notice the mechanism of mutations consists of Substitution, deletion and insertion of one or more nucleotides.
- Distinguish between the punctual mutation and long term mutation.

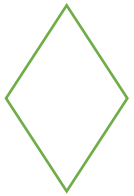
How to construct a Pedigree?

Normal Boy

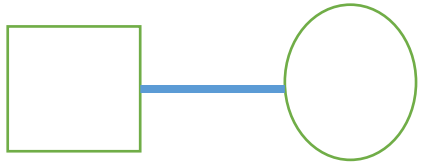
Affected boy



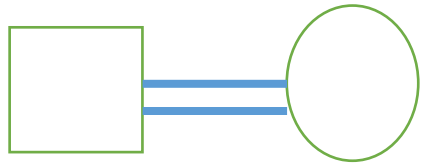
Normal Girl



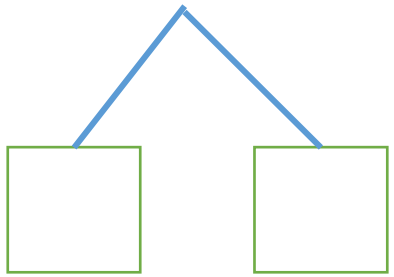
Fetus



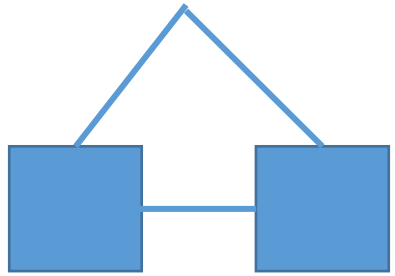
Husband and Wife
Or Mating



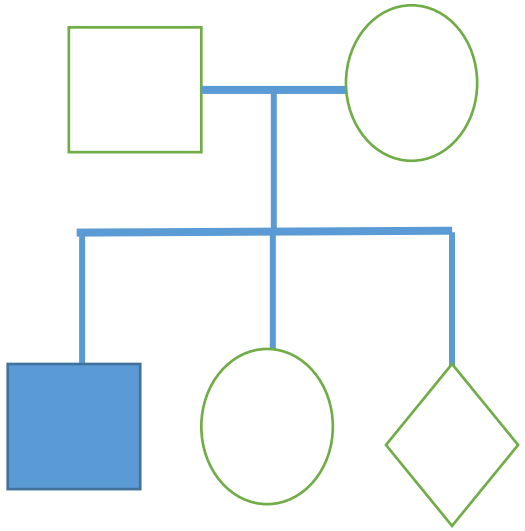
consanguineous Mating



Fraternal twins



Identical twins



Siblings or children

Normal parents can have children with hereditary diseases, regardless of their sex.

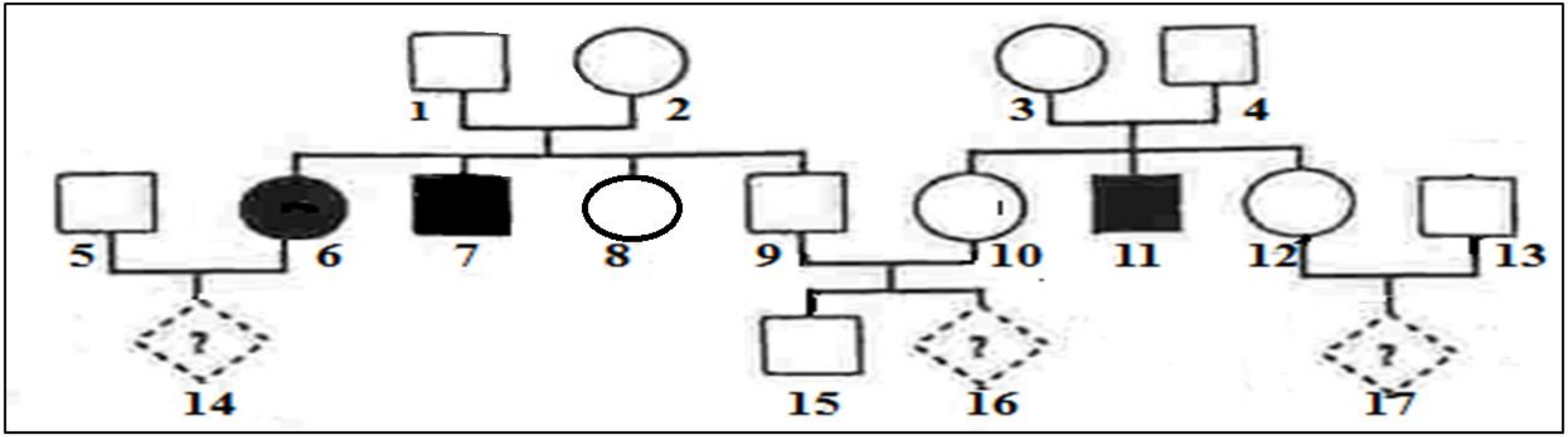
Where are the genes responsible for these diseases located?

How can we predict the risk of their occurrence in the offspring of affected families?

1 - Cystic fibrosis, a recessive disease

- Cystic fibrosis is a severe disease due to the secretion of excessively viscous mucus by mucus glands, leading to respiratory and digestive problems.
- - In the respiratory tract, the excessive mucus blocks the bronchi, causing difficulties in breathing and providing a permanent site for infection.
- In the pancreas, the secretory canaliculi and the excretory cells of the pancreas degenerate

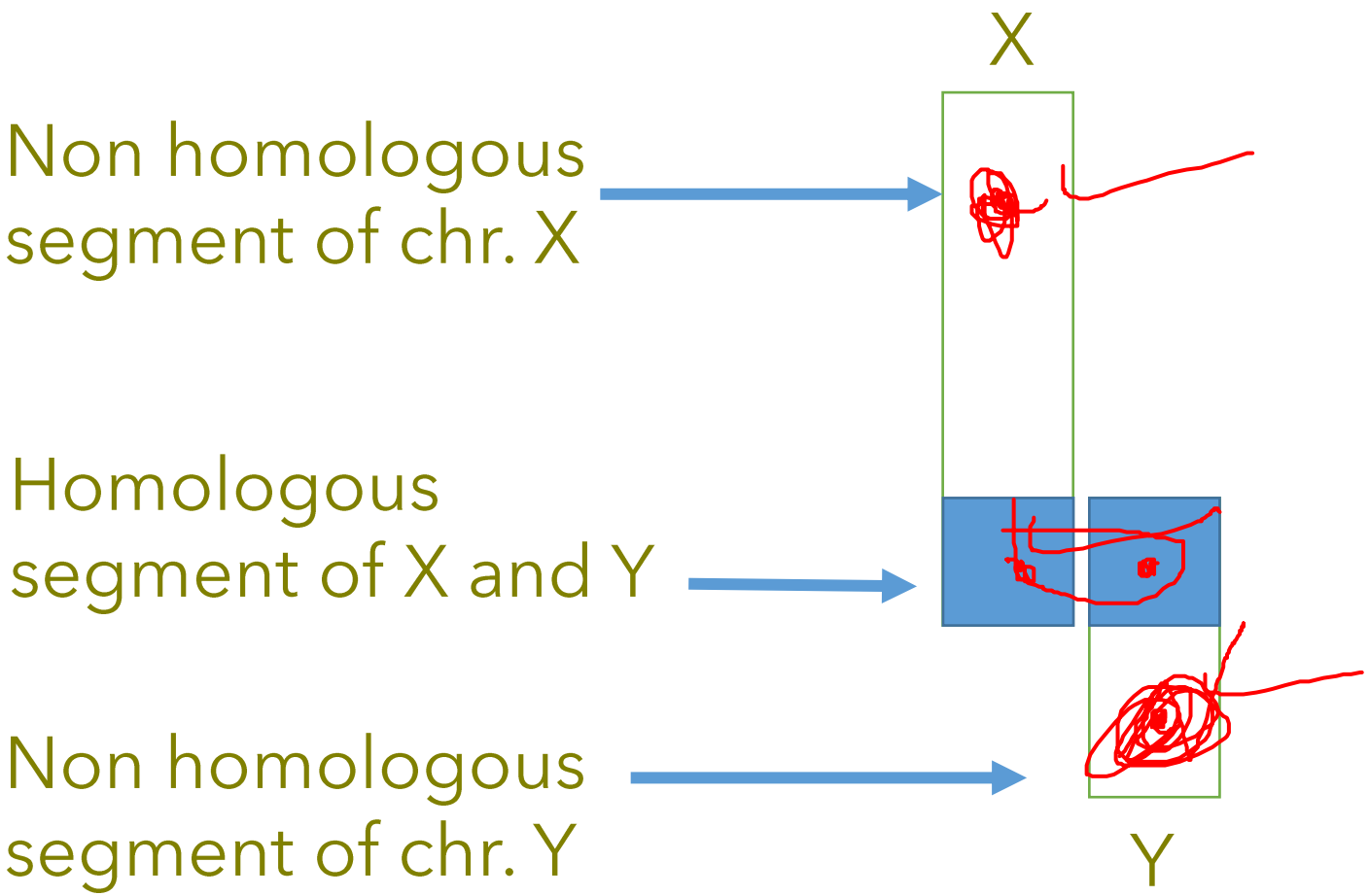
The gene for cystic fibrosis is found on the pair of autosomal chromosomes 7



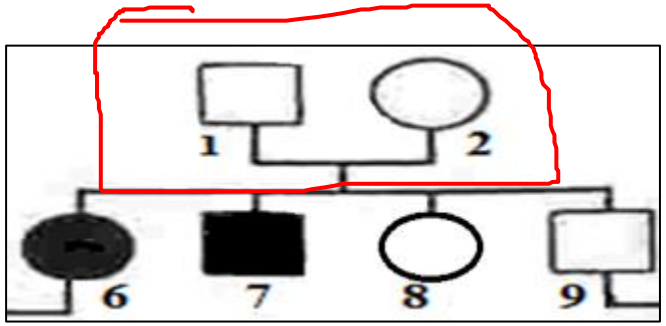
1.1 determine if the allele responsible of cystic fibrosis is dominant or recessive?

The disease allele is recessive compared to the normal allele because the normal parents (1 and 2) have affected children (6 and 7). Then the allele of the disease is present in the parents in a masked state by the normal allele (m= allele responsible for the disease; N= normal allele); N>m.

Sex chromosomes



1.2 Determine the chromosomal localization of the gene responsible for cystic fibrosis



If the allele is carried on the non-homologous segment of the chromosome Y, the disease would be transmitted from father to son, but the affected son 7 has a healthy father 1. Thus the gene is not carried on the non-homologous segment of the chromosome Y.

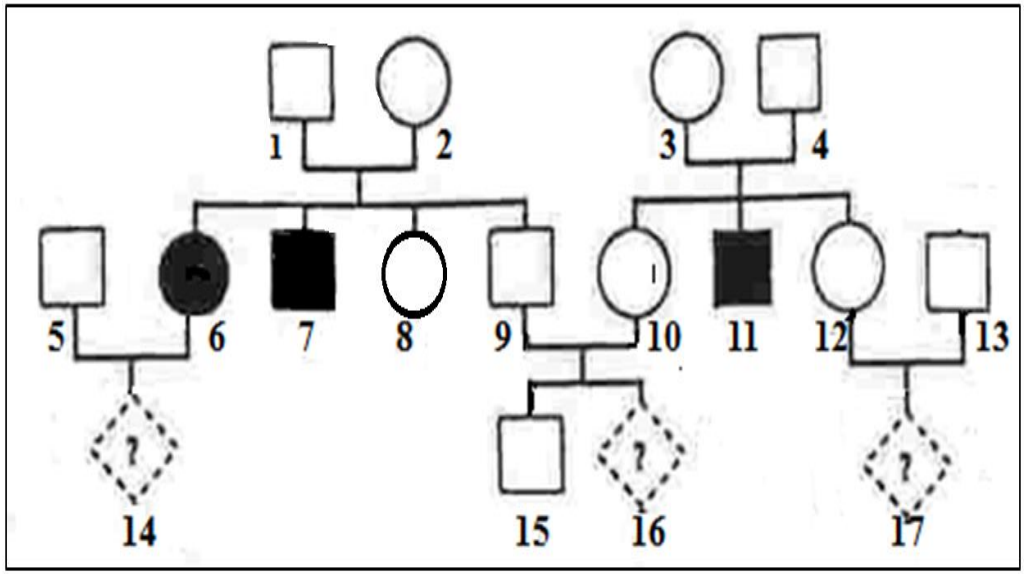
If the gene is carried by the non-homologous segment of the chromosome X, the affected girl 6 must be homozygous of genotype **Xc//Xc**; she should have inherited the affected allele from her father 1 who should be affected of genotype **Xc//Y** . But her father is normal. Thus the gene is not carried by non-homologous segment of X.

If the gene is carried by the homologous segments of X and Y, affected girl 6 should have inherited **Xc** from her father 1; the affected boy 7 should have inherited **Yc** from his father 1. Father 1 should be affected of genotype **XcYc** which is not the case (father1 is normal) . thus the gene is not carried by the homologous segments of X and Y.

Therefore, the gene is carried by an autosome.

1.3 Determine the risk for each of a couple to have an affected child

P ♂ (heter) x P♀ (heter) x P having an affected child



Couple 9-10: the parents of fetuses (16) are both healthy but their parents (grandparents of the fetus) are heterozygous Nc because they have sick children cc.

The possibility of each parent (9-10) to be heterozygous is 2/3

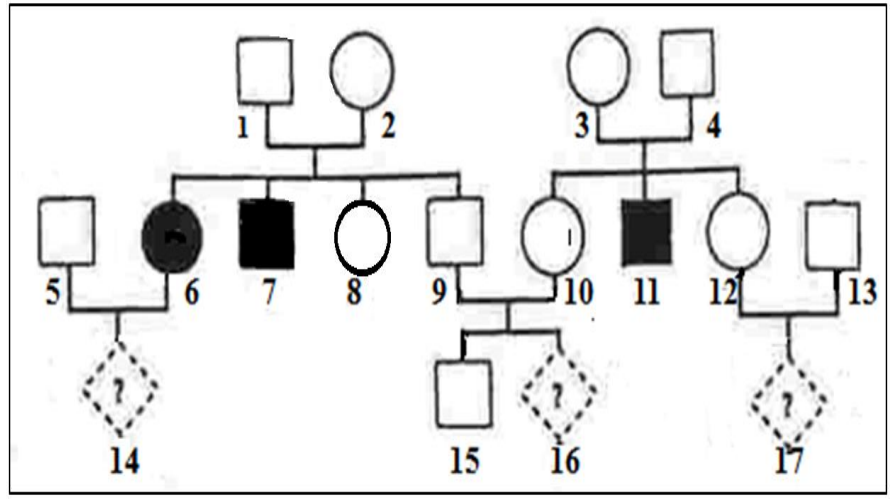
The probability of the parents of having an affected child is 1/4.

So the risk of this couple to have an affected child is:

P ♂ (heter) x P♀ (heter) x P having an affected child = 2/3 x 2/3 x 1/4 = 1/9.

♂ ♀	N ½	C ½
N ½	NN ¼	Nc ¼
C ½	Nc ¼	cc ¼

Couple 12 - 13



the mother 12 has an affected brother, her parents are surely heterozygote. The probability to be hetero zygote is 2/3. Father 13 is of normal phenotype (with no family history) and his risk of carrying the affected allele is therefore that of heterozygous individuals in the population , which is 1/40.

In the case of heterozygous parents, the risk that the child inherits the allele c from both parents is ¼. (from the table) So the risk is therefore**:**

P ♂ (heter) x P♀ (heter) x P have an affected child = 2/3 x 1/40 x 1/4 = 1/240

Couple 5-6:

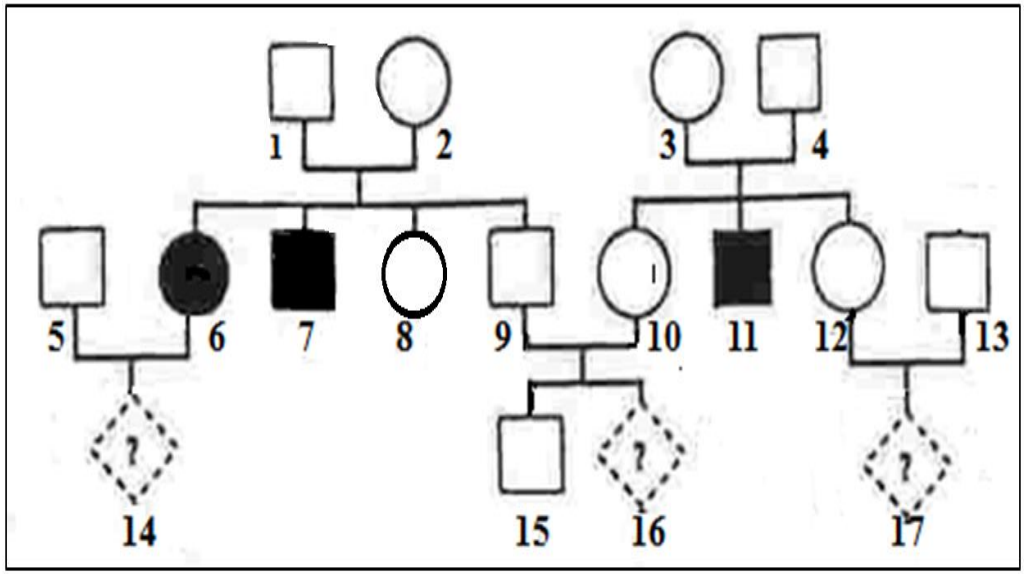
The father of the fetus is part of the population and his risk of being heterozygous is 1/40. Her mother is affected; she is surely possessed the affected gene. and the risk of having an affected child is 1/2. So the risk that the fetus will be affected is:

P ♂ (heter) x P♀ x P have an affected child = 1/40 x 1 x 1/2 = 1/80.

♂ ♀	C 1
N ½	Nc ½
C ½	Cc ½

1.4 Specify the genotypes of individuals 1, 6 and 8

1: N//c because he is phenotypically normal and the allele normal is dominant and has san affected child 7



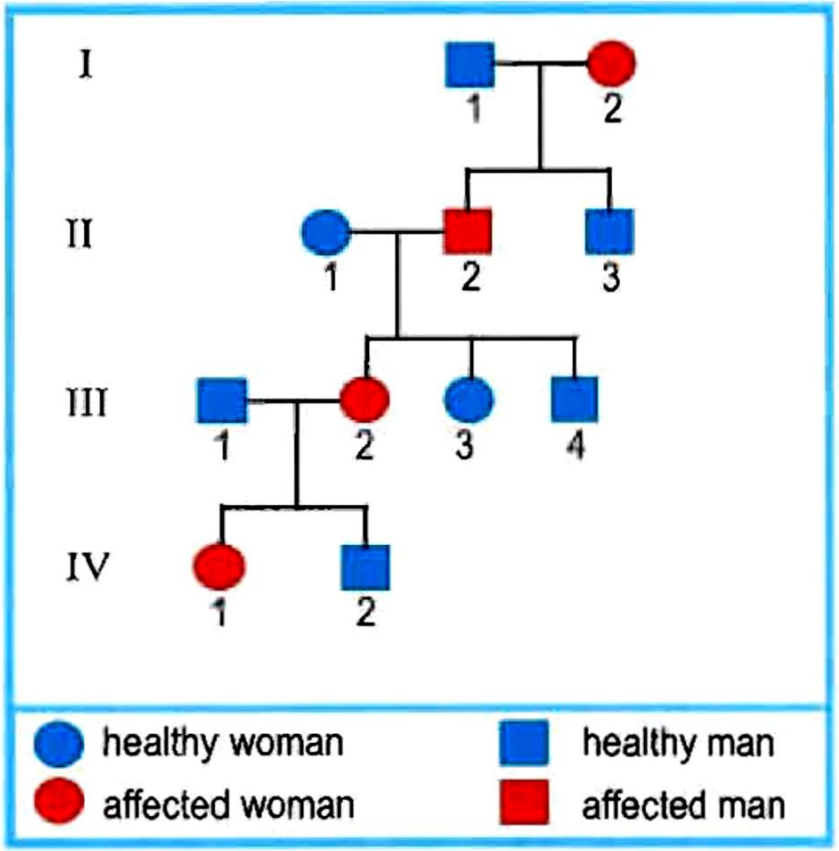
7: c//c because he is affected and the affected allele is recessive . Which is expressed only in homozygote state.

8: N//c or N//N because she is phenotypically normal and the allele normal is dominant could be expressed in homozygous or heterozygous.

2 – Huntington's Chorea, a dominant disease

Huntington's disease, also known as Huntington's chorea, is a hereditary disease that appears only in adults between 30 and 50 years old. The symptoms are uncontrolled incoherent movements and psychological troubles. This disease is due to a lesion of certain neurons of the central nervous system. It occurs with a very low frequency: 0.4 to 0.8 in 10000 individuals.

The gene for Huntington's chorea is carried by the autosomal chromosome 4.



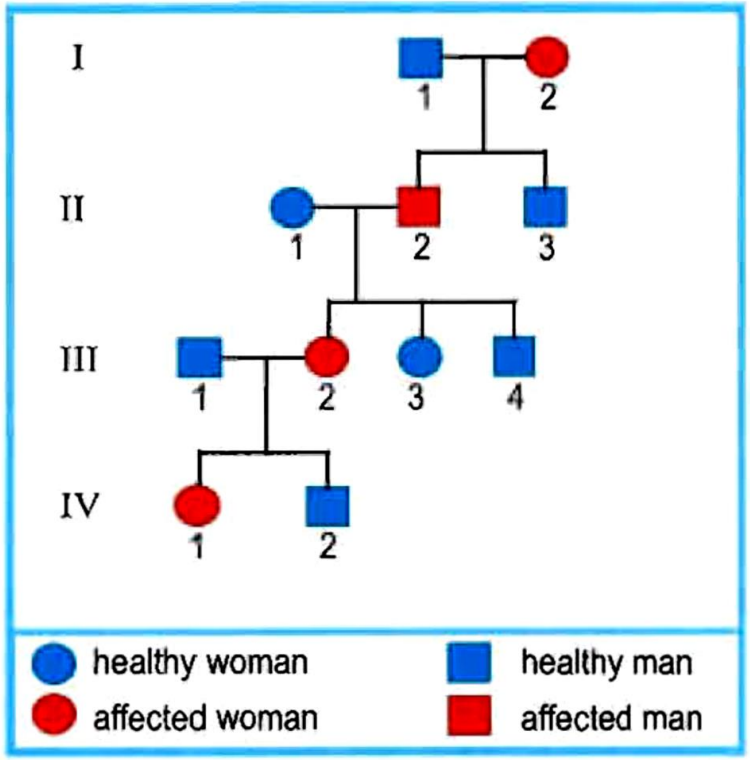
Doc.b *Inheritance of Huntington's disease.*

2.1 dominant or recessive

for autosomal dominant diseases, the affected persons have necessarily an affected parent.

2.1 Autosomal or gonosomal

If the allele is carried on the non-homologous segment of the chromosome Y, the disease would be transmitted from father to son, but the affected son II2 has a healthy father I1. Thus the gene is not carried on the non-homologous segment of the chromosome Y.



Doc.b *Inheritance of Huntington's disease.*

If the gene is carried by the non-homologous segment of the chromosome X, the normal girl III3 must be homozygous of genotype **Xn//Xn**; she should have inherited the normal allele from her father I1 who should be normal of genotype **Xn//Y** . But her father is affected. Thus the gene is not carried by non-homologous segment of X.

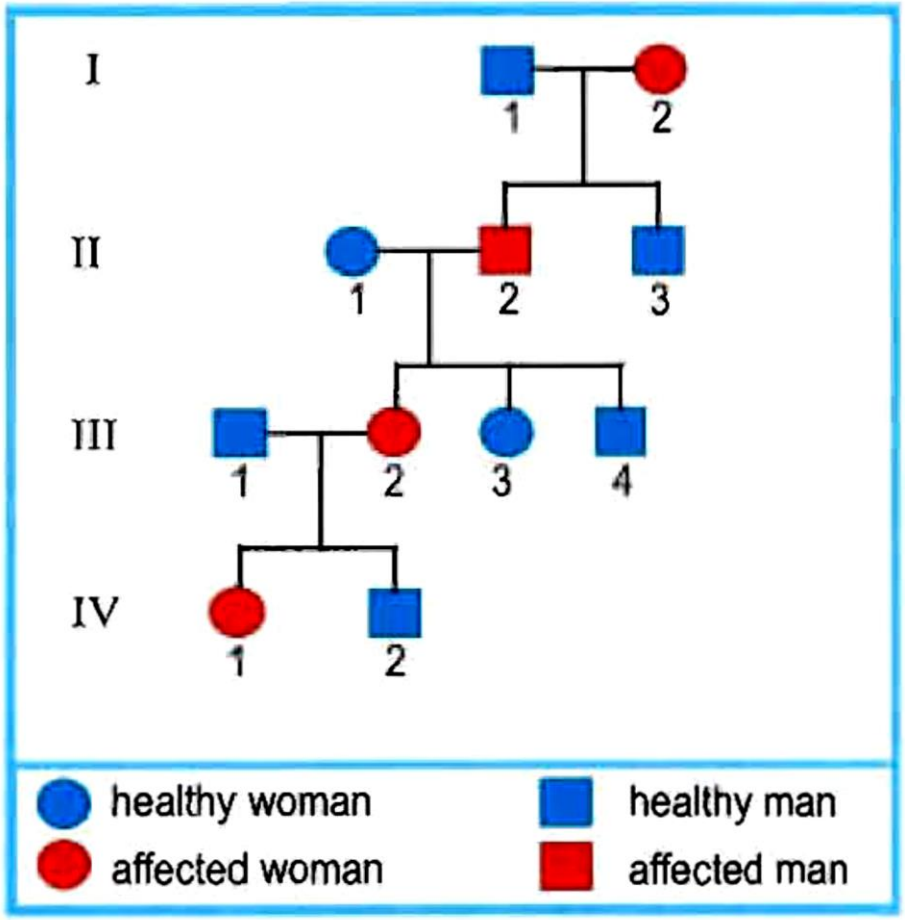
If the gene is carried by the homologous segments of X and Y, normal girl II3 should have inherited **Xn** from her father I1; the normal boy III4 should have inherited **Yn** from his father I1. Father 1 should be normal of genotype **XnYn** which is not the case (father1 is affected) . thus the gene is not carried by the homologous segments of X and Y.

Therefore, the gene is carried by an autosome.

2.3 genotypes of the family

I1: n//n because he is normal and the normal allele is recessive . Which is expressed only in homozygote state. (same for all the normal members)

I2: H//n because she is phenotypically affected and the affected allele is dominant and has son II3 normal. (same for II2, III2, IV1)



Doc.b *Inheritance of Huntington's disease.*