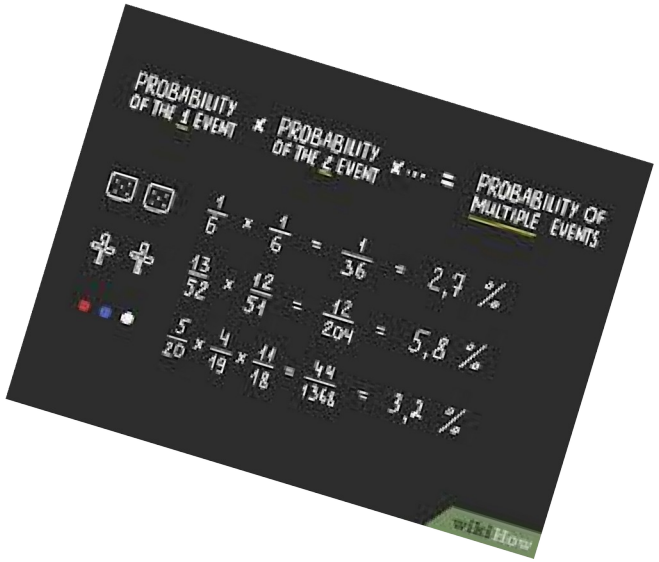
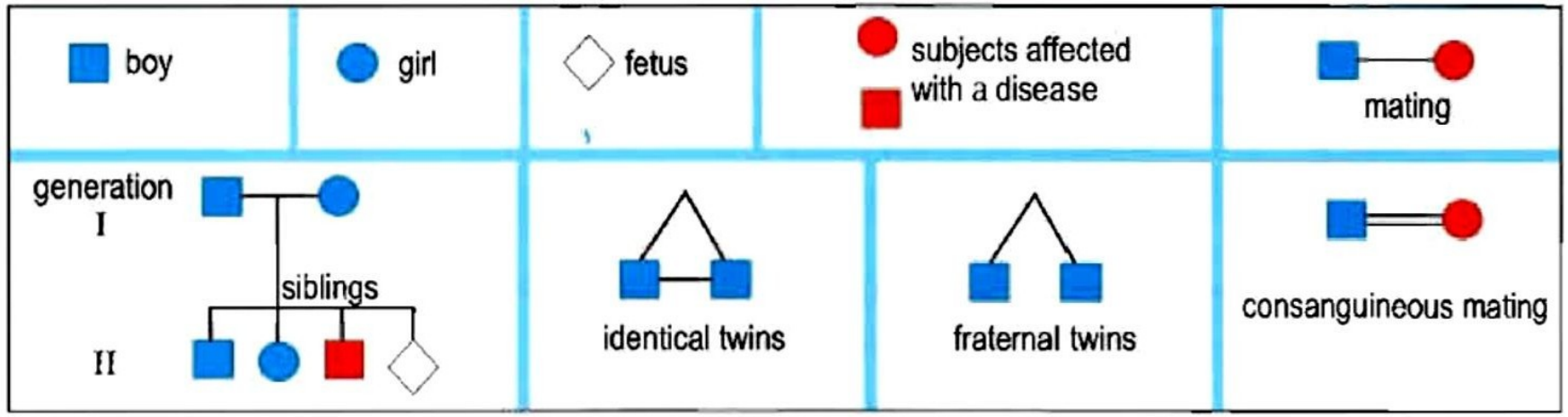
Chapter 5 Human genetics



Pedigree analysis part 1: dominant and recessive

Most of the experimental methods performed on animals to elucidate the mode of transmission of hereditary traits cannot be applied to humans for ethical reasons. Moreover, the smaller number of the descendants of a couple and the time separating two generations make the statistical analysis more difficult.

Therefore, in order to understand the patterns of inheritance of human genetic abnormalities, scientists use probability and statistical methods more than experimental ones, such as the analysis of pedigrees that are established from known phenotypes. Nowadays, modern techniques used in prenatal diagnosis, permit detection and prediction of genetic diseases.



Doc.e *Symbols used to construct a pedigree. I, II... are used for generations and 1, 2, 3... for the individuals of the same generation.*

Main characteristics of a hereditary trait to be determined from pedigree analysis

Whether the studied trait is dominant or recessive

Whether the studied gene is located on an autosome or the sex chromosomes

The probability (or risk) of having offspring with a particular trait (or hereditary disease).

There are five basic patterns of Mendelian inheritance.

- autosomal recessive inheritance
- autosomal dominant inheritance
- X-linked dominant inheritance
- X-linked recessive inheritance
- Y-linked inheritance

Part 1: determine whether a certain trait is inherited in a dominant or a recessive manner

A = dominant

a = recessive

Example 1:

In this example we are going to study the transmission of the disease A in a family. To be affected, every individual must possess 2 affected alleles.

The allele of the disease is only expressed when found in 2 copies, thus if it were present with another allele it would be masked; it is recessive.

In this example we are going to study the transmission of the disease B in a family. To be normal an individual should possess two normal alleles.

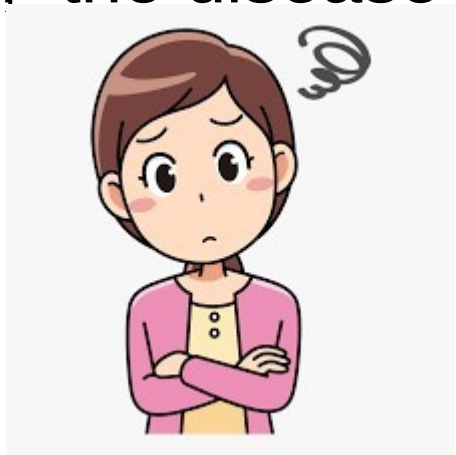
The allele of the normal phenotype is only expressed when found in 2 copies, thus if it were present with the disease allele it would be masked; it is recessive and the allele of the disease is dominant.

In this example we are going to study the transmission of the disease C. One affected allele isn’t sufficient to express the abnormal phenotype.

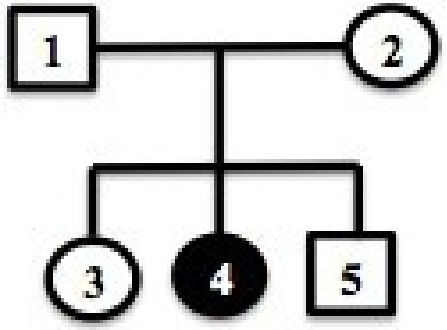
One disease allele is not enough to induce the abnormal phenotype, hence two copies are needed for expression and it is a recessive allele.

In this example we are going to study the transmission of the disease D. One affected allele is sufficient to express the abnormal phenotype

One disease allele is enough to induce the abnormal phenotype, hence it can dominate the normal allele: the disease allele is dominant.

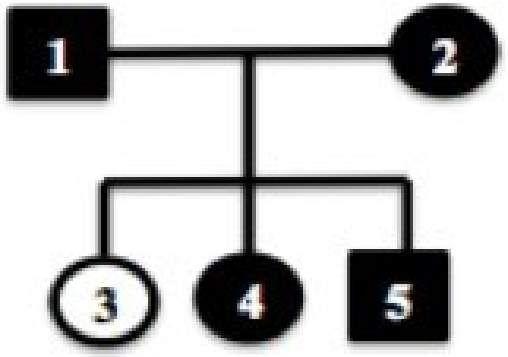


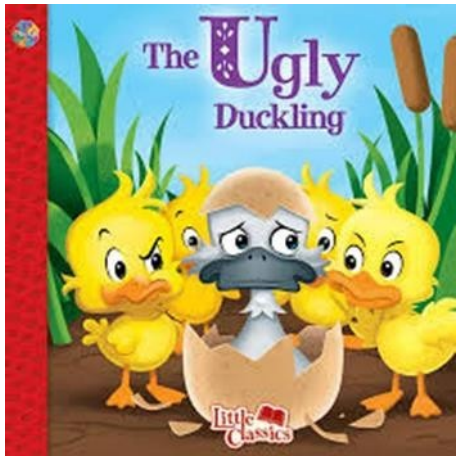
In this example we are going to study the transmission of the disease E in the following pedigree:



The disease expressed in daughter 4, but not in her parents. So one or both of the parents carried the allele of the disease and transmitted it to their daughter 4, but it was masked in them; it is recessive.

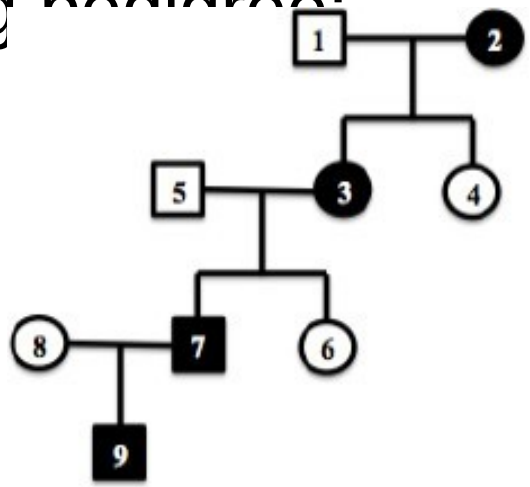
In this example we are going to study the transmission of the disease F in the following pedigree:





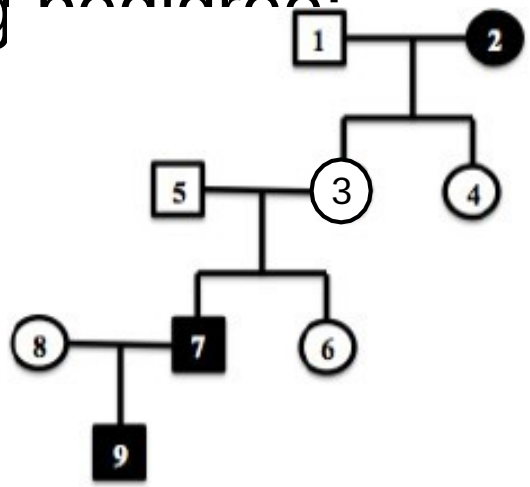
The normal allele is expressed in daughter 3, but not in her parents. So one or both of the parents carried the allele of the normal phenotype and transmitted it to their daughter 3, but it was masked in them; it is recessive and it is dominated by the disease allele. (disease dominant)

In this example we are going to study the transmission of the disease G in the following pedigree:



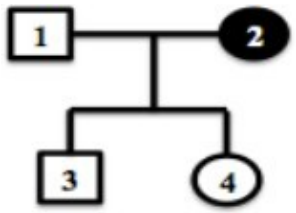
The disease allele is expressed in every generation, and every affected individual has an affected parent, so if the disease were recessive, every normal parent would have to be a carrier for the disease, and it is unlikely to have many carriers, so the disease is MOST PROBABLY coded by a dominant allele.

In this example we are going to study the transmission of the disease H in the following pedigree:



Couple 5-3 are normal, yet they have an affected son 7, thus the allele of the disease was transmitted from one or both parents, but it was masked in their phenotype, it is recessive.

In this example we are going to study the transmission of the disease I in the following pedigree:

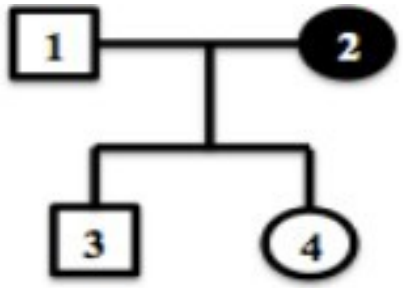


Giving the result of DNA fingerprinting for the father 1:

Alleles	Father
Normal allele	—
Mutant allele	—

The father is normal, yet the DNA analysis shows that he carries both the normal and
disease allele, thus the allele of the disease was masked , it is recessive.

In this example we are going to study the transmission of the disease J in the following pedigree:



Giving the result of DNA fingerprinting for the mother 2:

Alleles	Mother
Normal allele	—
Mutant allele	—

The mother is affected with this hereditary anomaly, yet the DNA analysis shows that she carries both the normal and disease allele, thus the allele of the disease was expressed over the normal allele (which was masked) , then the disease allele is dominant.