

## Genealogy and Coefficient of Consanguinity, Exercises

### GENEALOGY

Establishing the genealogy of an individual X, consists of identifying the individuals who share part of their genetic inheritance with X, because they are ancestors, collaterals or descendants (collaterals: brothers, half-brothers, cousins, uncles, nephews, etc ...).

Representation : there are several ways of representing genealogies, in addition to the usual method used in human genetics, and these may be more convenient when one is studying *Drosophila* for example (see below).

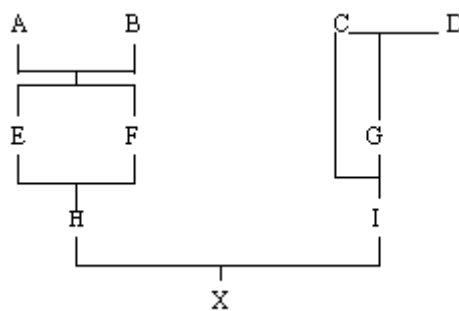


Figure 3

A and B are the parents of E and F, who are in turn the parents of H. C and D are the parents of G. C and his/her offspring, G, are the parents of I, who, mated with H, gives X.

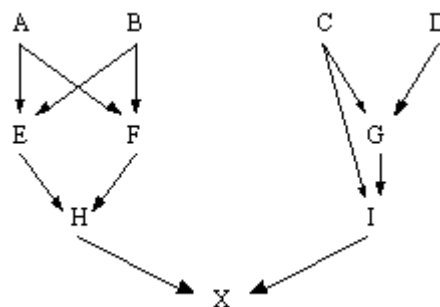


Figure 4

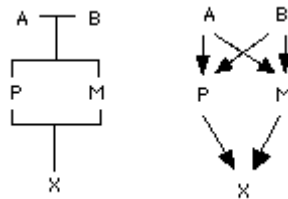
This genealogy indicated by arrows is based on the fact that every arrow starts at the ancestor and leads to the offspring. In general, each individual is crossed by two arrows. If only one parents is shared, then only one arrow is shown in the genealogy.

### COEFFICIENT OF CONSANGUINITY

To calculate  $F_X$ , what we have to do is:

- Identify the parents of X (father and mother).
- Identify all the individuals in the genealogical tree that are common ancestors of the father and mother of X and who are the only individuals who can have transmitted two identical alleles to X.
- An individual will be considered to be a common ancestor if, starting from one of the two parents of X are going back up the hereditary path from the supposed common ancestor, it is then possible to come back down again to the second parent of X without breaking the sequential line of parenthood.
- In fact, each sequential line of parenthood describes the Mendelian transmission of genes, and this means that it can never pass more than once through the same individual, nor change direction anywhere except in the only common ancestor that it contains.
- Two lines of parenthood are different if the ordered sequences of the individuals that compose them differ, even if in only one place.
- Several different lines of parenthood can pass through the same common ancestor.

**Example 1:** Brother - sister cross



**Figure 5**

The parents of X (father and mother) are P and M.

A is a shared ancestor since P ---- A ---- M. P-A-M is a line of parenthood with two links of parenthood. Here  $p + m = 2$ .

B is also a shared ancestor, since P ---- B ---- M. P-B-M is a line of parenthood with two parenthood links. Here  $p + m = 2$ .

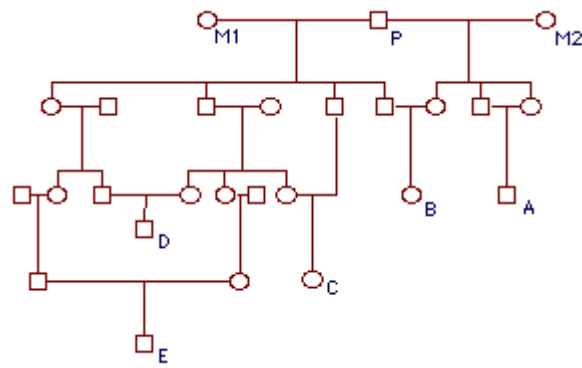
therefore,  $F_X = \frac{1}{2} (1/2)^{p+m-1} (1 + F_{\text{Common ancestor}})$  gives here:

$$F_X = ((1/2)^3 (1 + F_A)) + ((1/2)^3 (1 + F_B))$$

Note: If, in a genealogy, it is not possible to find out whether a common ancestor is also consanguine, by convention it is assumed that (s)he is not. This is applied to A and B, and so,  $F_A = 0$  and  $F_B = 0$

$$\rightarrow F_X = (1/2)^3 + (1/2)^3 = 2 (1/2)^3 = 1/4$$

**Some examples:** Calculation of the coefficients of consanguinity of individuals derived from various types of crosses (the common ancestors are not related to each other).



**Figure 6**

Individual A :  
 Line of parenthood  
 Descendant of a brother—sister cross,  
 2 lines of parenthood.  
 $FA = 1/4$



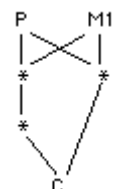
**Figure 7**

Individual B :  
 Descendant of a cross between half-siblings,  
 Only one line of parenthood.



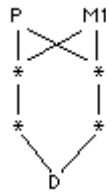
**Figure 8**

Individual C :  
 Descendant of an uncle — niece cross,  
 2 lines of parenthood.  
 $FC = 1/8$



**Figure 9**

Individual D :  
 Descendant of a cross between first cousins  
 2 lines of parenthood  
 $FD = 1/16$



**Figure 10**

Individual E :

Descendant of a cross of cousins derived from first cousins,  
2 lines of parenthood.

FE = 1/64



**Figure 4**

### Contributor(s)

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