# Multiple Alleles: A gene with more than two alleles

### **Examples**

1) Fly eye colour is determined by multiple alleles. There are four different alleles that each code for a different eye colour ( $E^1$  = Red with is dominant to  $E^2$  = Apricot, which is dominant to  $E^3$  = Honey which is dominant to  $E^4$  = white).

a. Two flies mate and have 74 apricot colour eyed offspring and 30 honey colour eyed offspring. What are genotypes of both parent flies?

b. You are in the process of performing genetic experiments on flies in the lab when all of your flies escape. You manage to trap a couple of flies but you no longer know what genotype they are. One of the flies has red eyes, and the other has white eyes. When you mate the two flies your results show approximately half the progeny with apricot eyes, and the other half with red eyes. What are the genotypes of the two flies you were able to capture?

- 2) The gene that controls chinchilla coat colour in rabbits has 4 alleles: Agouti C > chincilla  $c^{ch}$  > Himalayan  $c^{h}$  > albino c. Agouti coat colour must have at least one C.
  - a) What are the possible genotypes for agouti colouration?
  - b) What are the possible genotypes for chinchilla colouration?
  - c) What are the possible genotypes for Himilayan colouration?
  - d) A chinchilla rabbit with the genotype  $c^{ch}c^{h}$  is crossed with a himilayan rabbit with genotype  $c^{h}c$ . What is the expected ratio of phenotypes among the offspring of this cross?

e) Some of the offspring of a chinchilla rabbit and a Himilayan rabbit are albino. What must be the genotypes of the parent rabbits?

## Incomplete and Co-Dominance

**Incomplete Dominance:** Describes a condition where there is *partial* expression of both alleles: neither of two alleles for the same gene can completely conceal the presence of the other.

## Examples

1. The Four O'clock plant has only two alleles for flower color, but has three different phenotypes: red flowered plants, white flowered plants, and pink flowered plants.

a. Show the expected offspring of a cross between two pink-flowered plants. Include genotypes, phenotypes and ratios.

b. Show the expected offspring of a cross between a red-flowered Four O'clock plant and a pink-flowered plant.

c. Show the expected offspring of a cross between a pink-flowered Four O'clock plant and a white flowered plant.

**<u>Co-Dominance</u>**: Describes a condition in which *both* alleles are fully expressed.



### Examples

1. In shorthorn cattle the  $\mathbb{C}^{\mathbb{R}}$  allele, when homozygous, produces animals with red hair and the  $\mathbb{C}^{\mathbb{W}}$  allele, when homozygous, produces cattle with white hair. An animal with a heterozygous genotype is **roan** in color, meaning its coat contains *both* red hairs and white hairs.

a. Describe the expected offspring when a breeder mates cows and bulls of the following phenotypes:

red x red white x white red x roan white x roan red x white roan x roan b. What is the probability of a pair of roan cattle producing (1) a red calf? (2) a roan calf? (3) a white calf?

2. A blue roan horse is a heterozygote in which one allele is expressed in the white hairs and the other allele is expressed in the black hairs. When both these colours are expressed, the horses coat color sometimes looks blue. If two blue roan horses are bred together, what is the chance that the colt will be white?