Inheritance

Using genetic crosses to work out the probability (ratio) of phenotypes in the offspring

Monohybrid Cross

- One gene influences the phenotype

Dihybrid Cross

- Two genes, which may or may not interact, to influence the phenotype

Monohybrid Cross - Pod colour in Peas

The allele G (green pods) is dominant to the allele g (yellow pods)

Pure-breeding green pods were crossed with pure-breeding yellow pods. Determine the ratio of phenotypes in the offspring.

Parents phenotype

Parents genotype

Gametes

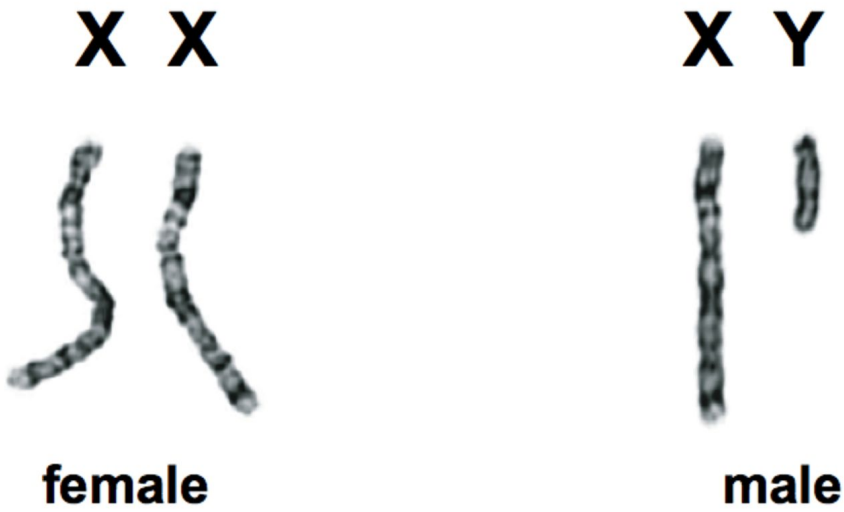
Cross

F1 genotypes

F1 phenotypes

Ratio

Monohybrid Cross - X-linked genes



X carries extra genes not found in Y

E.g. red/green cones (colour vision)
Factor VIII or IX (absence can lead to haemophilia)

Males carry only one copy of X, therefore are more likely to express the defective allele

Females are XX, chances of the defective allele being expressed are low (provided it is recessive)

Monohybrid Cross - Co-dominant allele

Both alleles equally likely to be expressed in phenotype.

Sickle-cell anaemia is caused by misfolded haemoglobin.

Hb^A - normal haemoglobin, oval RBCs
Hb^S - abnormal haemoglobin, sickle-shaped RBCs

Normal Red Blood Cell Sickle Cell

Both alleles are co-dominant.

Hb^AHb^A = 100% RBCs normal
Hb^AHb^S = 100% RBCs sickle
Hb^SHb^S = 50% RBCs normal, 50% RBCs sickle

Monohybrid Cross - Multiple allele inheritance

Blood group in humans determined by 3 alleles:

I^O I^A I^B

I^O is recessive to I^A and I^B
I^A and I^B are co-dominant

Gentoype	Phenotype (blood group)
I^AI^A	A
I^AI^O	A
I^B I^B	B
I^B I^O	B
I^AI^B	AB
I^O I^O	O

Dihybrid Cross - Pod shape and colour in peas

In peas, the allele for round seeds, **R** and yellow seeds, **G** is dominant to the allele for wrinkled seeds, **r** and green seeds, **g** respectively.

Parents: round, yellow x wrinkled, yellow

Genotype: RrGg x rrGg

Gametes: RG, Rg, rG, rg x rG, rg, rG, rg

Cross:

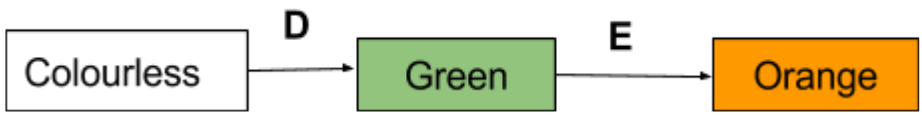
F1 genotypes:
F1 phenotypes:
Ratio:

Epistasis

The action of one gene on another can result in a change in the phenotype

Example 1: Recessive Epistasis

Wing colour in butterflies - pigment producing genes



D - colourless to green; **d** - remains white
E - green to orange; **e** - remains green

In all cases, butterflies with **dd**_ _ will have white wings:

ddEe = white; **dd**EE = white; **dd**ee = white

Example 2 - Dominant Epistasis

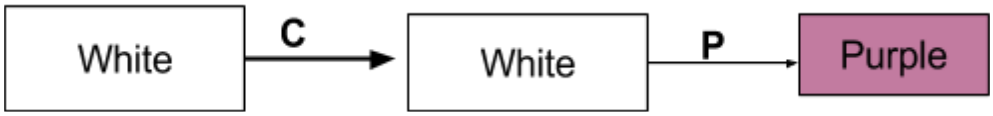
Colour of squash - pigment production

y = Enzyme I, produces green pigment
Y = Enzyme II, converts green pigment to yellow
W = produces a molecule that inhibits both enzymes
w = no effect

All squash with **_ _ W _** will be white, irrespective of the alleles in the other positions

Example 3: Complementary Epistasis

Flower colour in snapdragons - pigment production



C = enzyme, which converts a white form A to form B

c = no effect on pigment

P = enzyme which converts white into purple

p = no effect

To obtain purple flowers, the flowers must have :

C_P_ (CCPP, CcPP, CcPp)

All other flowers are white.