Mendel was also interested in examining if one trait influenced another, so he crossed two traits at one time - called a **dihybrid cross**. He looked at pea shape and colour. Round seeds were dominant to wrinkled and yellow seeds were dominant to green.

He true bred the parents - homozygous dominant for both traits with homozygous recessive for both traits. All members of the F_1 were yellow and round, but were hybrid for both traits.

Parents RRYY x rryy

Gametes

F_1 Generation

He then performed an F_2 cross.

He always got the same ratio of phenotypes ☞ 9:3:3:1
9 round-yellow to 3 round-green to 3 wrinkled-yellow to 1 wrinkled-green

Due to his results he proposed the **Law of Independent Assortment** - the inheritance of one trait does not influence the second trait. This works great with pea plants and simple organisms, but you will find that some traits do not sort independently and are actually linked.

Beyond Mendel

The inheritance of some traits don't follow Mendel's rules!

1. Incomplete Dominance - this is actually support for the Blend Theory. The colours of many plants do not seem to support Mendel's theories.

For incomplete dominance we do not use capitals and lowercase, we use a capital and capital prime (R, R')

Snapdragons and four o'clock flowers both show incomplete dominance in their flower colours. Red flowers are the result of the ability to produce red pigment. Homozygous dominant flowers are RR. Flowers that cannot produce any red pigment are white in colour and are designated R' R'. The hybrid (heterozygous) flowers are RR' and appear pink because they can make some red pigment but not a lot.

2. Co-dominance

In some cases, both alleles may be dominant and will both show up in the offspring. This happens in a number of examples:

A. Barred Poultry - in some chicken species, both black feathers and white feathers co-dominant and will be present in offspring

B. Roan Livestock - some cattle and horses can have both red hair and white hair present because neither one can dominant the other. This pattern is referred to as strawberry roan.

C. Human AB blood type - neither the A allele nor the B allele can dominant over the other.

3. Multiple Alleles - many genes have more than just two alleles possible, which leads to more combinations for genotypes and phenotypes. A good example of this is blood types in humans.

There are three different alleles for human blood, which makes six different possible genotypes and four possible phenotypes:

Phenotype (blood type)	Possible Genotypes
A	I^AI^A or I^Ai
B	I^BI^B or I^Bi
O	ii
AB	I^AI^B

Both the A and B alleles are dominant over O, but neither can dominant the other.

The only way to have O blood is to inherit a recessive allele from each parent. Before DNA testing, blood typing was often done to establish paternity.

Sample Question from old publics:

Three women gave birth to children in the same hospital at the same time. The babies are mixed up in the nursery. The hospital checked the blood types of each parent and child with the following results:

Name	Father	Mother	Baby	Type
Smith	A	B	Jane	O
Jones	AB	O	Bob	B
Olsen	A	A	Joan	AB

Who could have produced Baby Bob?
A. Either the Olsens or the Joneses
B. Either the Smiths or the Joneses
C. Only the Olsens
D. Only the Smiths

Answer: Baby Bob has B blood. His possible genotypes are I^Bi or I^BI^B He got one allele from each parent.

Of the three sets of parents, only the Olsens can be ruled out. Neither Olsen parent has a I^B allele to pass on, since they both have A blood.

The Smith Father is A, so he could be I^Ai and pass on an i allele to go with an I^B from the mother.

The Jones Mother can only pass on an i because she must be ii, but the I^B allele could come from the father because his genotype can only be I^AI^B

Correct answer is B (worth 1 point)