



Law Of Segregation ^[1]

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Mendel Pea Plant Experiment

The Law of Segregation is based on one of the benchmark scientific experiments in genetic studies, the Mendel Pea Plant Experiment.

It was a stroke of genius considering that it was performed in the 19th century.

Of course, Mendel knew nothing about the processes behind inherited behavior, but found out the rules dictating how characteristics are passed down through the generations.

The way in which he meticulously planned his experiment to generate testable ^[3], rather than observational data, is a shining example of experimental design ^[4].

Gregory Mendel ^[5] was an Austrian monk studying at the University of Vienna. Like many pioneering scientists, his discoveries were largely ignored until long after his death.

Mendel's Initial Observations

Mendel noticed that certain characteristics appeared to be passed on from parents to offspring, in many species, and wondered why this was so. He also wanted to establish what characteristics were taken from each parent.

For the Mendel Pea Experiment he chose pea plants, because they had some measurable characteristics as well as being easy to breed and with a relatively short breeding period allowing a quick experimental turn-around.

He measured seven of these characteristics, including seed-shape, seed color, pod-color and pod-shape, each occurring in two distinctive forms.

Method

To conduct the experiment ^[6], he cross pollinated the selected pea plants by removing the anthers from one flower, to prevent self-fertilization, and dusting pollen from another plant onto the flower.

Initially, he cross-fertilized plants with the same characteristics to ensure that the plants were

true-breeding, giving a good baseline for the research.

The next stage was to cross-pollinate plants with different characteristics, such as one with green seed pods to one with yellow seed pods.

These initial plants are called the P (Parental) generation. The resulting offspring, the F1 (Filial generation) were then self pollinated to produce the F2 generation. This self-fertilization continued until the traits were established for many generations.

Mendel's Law of Segregation

In the case of pod color, the Mendel Pea Experiment showed that a cross between a green pod plant and a yellow pod plant produced only green pod plants for the F1 generation. It appeared that the yellow pod characteristic had disappeared.

However, the F2 generation threw up a surprising result; the yellow pod variant appeared in a quarter of this generation.

Clearly, some thing strange was going on and, in an inspired piece of thinking, Mendel came up with his 'Law of Segregation'.

1. There are alternative forms of genes, the units determining heritable characteristics. This is now known as an **allele**
2. An organism inherits one allele from each parent. The F1 generation inherited one green and one yellow pod allele from the parental generation.
3. A sperm or egg carries only one allele for each characteristic which pair upon fertilization.
4. When the alleles are different, one is fully expressed and the other is masked, now known as dominant and recessive genes.

The Mendel Pea Experiment and the discovery of the Law of Segregation has shaped the way that genetic research has developed and it has been shown that this law applies to all sexually reproducing organisms.

Modern Terminology

Modern geneticists always express genes as letters and numbers, with a dominant gene being a capital letter, a recessive gene a lowercase letter.

For example, the Green pod gene is 'G', the yellow gene 'g'.

Discussion - What is Happening

The F1 generation all had the Gg combination and so were all green pod variants although, importantly, all had a 50% chance of passing on the recessive g allele to the next generation.

The best way to express what happens in the F2 generation is with a type of diagram known as a Punnett Square. (Fig 1)

As the Punnett Square [7] shows, offspring with a dominant G gene will always have green pods with only the offspring containing the gg combination having yellow pods.

This is why Mendel only found that one quarter of the F2 generation had yellow pods. However, all but one quarter had at least one 'g' allele and so this would continue to be passed down through the generations.

Figure 1 - Law of Segregation

		EGG	
		B	b
SPERM	B	BB	Bb
	b	Bb	bb

Figure 1: A Punnett Square showing gene combinations and pod colors in the F2 generation. B is a dominant gene (green) and b is a recessive gene (yellow).

Summary

The Mendel Pea Experiment really was a ground-breaking piece of research. The Law of Segregation [8] is the base from which genetic science developed.

Whilst there are other processes at work, the Mendel Pea Experiment was the first to examine the processes behind heritable characteristics.

Bibliography

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[5] http://en.wikipedia.org/wiki/Gregory_mendel

[6] <https://staging.explorable.com/conducting-an-experiment>

[7] http://en.wikipedia.org/wiki/Punnett_square

[8] http://en.wikipedia.org/wiki/Mendelian_inheritance