

Gregor Mendel: A Study in Scientific Ethics

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Overview

- Gregor Mendel
- Overview of Genetics
- Mendel's Experimental Work
- Mendel's Discovery
- Rediscovery of Mendel's Work
- Questioning Mendel's Data
 - Skeptics
 - Supporters
- Conclusion

Gregor Mendel

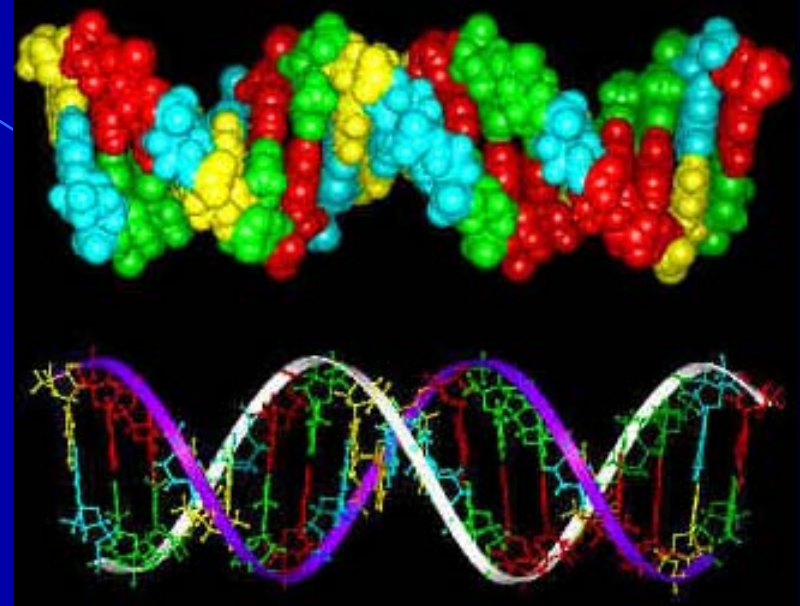
- Born 1822 in Austria
- Ordained as priest in 1847
- Studied Natural Science and Physics 1851-1853
- Undertook investigations in hybridization of plants as an abbot in 1856
- Developed a model for inheritance of genes



Gregor Mendel
(1822-1884)

Genetics

- Gene: basic unit of inheritance
- Two genes(or alleles) for each characteristic: one from father and one from mother
- Genes of two types: dominant or recessive
- Genotype: genetic makeup
- Phenotype: physical manifestation



DNA Helix

	a	a
A	Aa	Aa
A	Aa	Aa

Monohybrid Cross

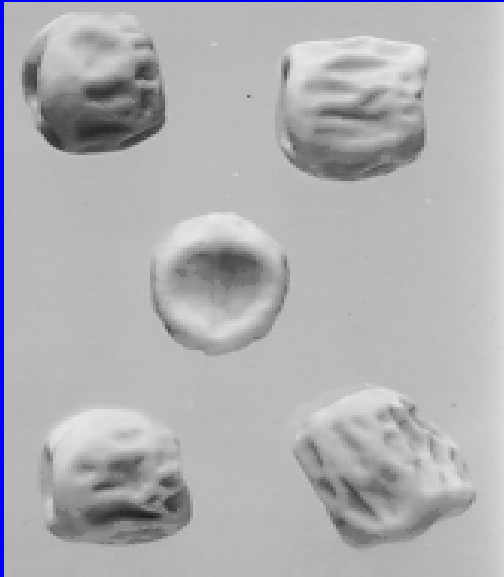
Experimental Work

- Selected pea plant for its numerous inheritable characteristics/shape of its flower
- Traced these characteristics(phenotypes) through several generations
- Inferring information about genotypes



Pea Plant

Characteristics Studied



Shape of ripe seeds

Color of Ripe seeds



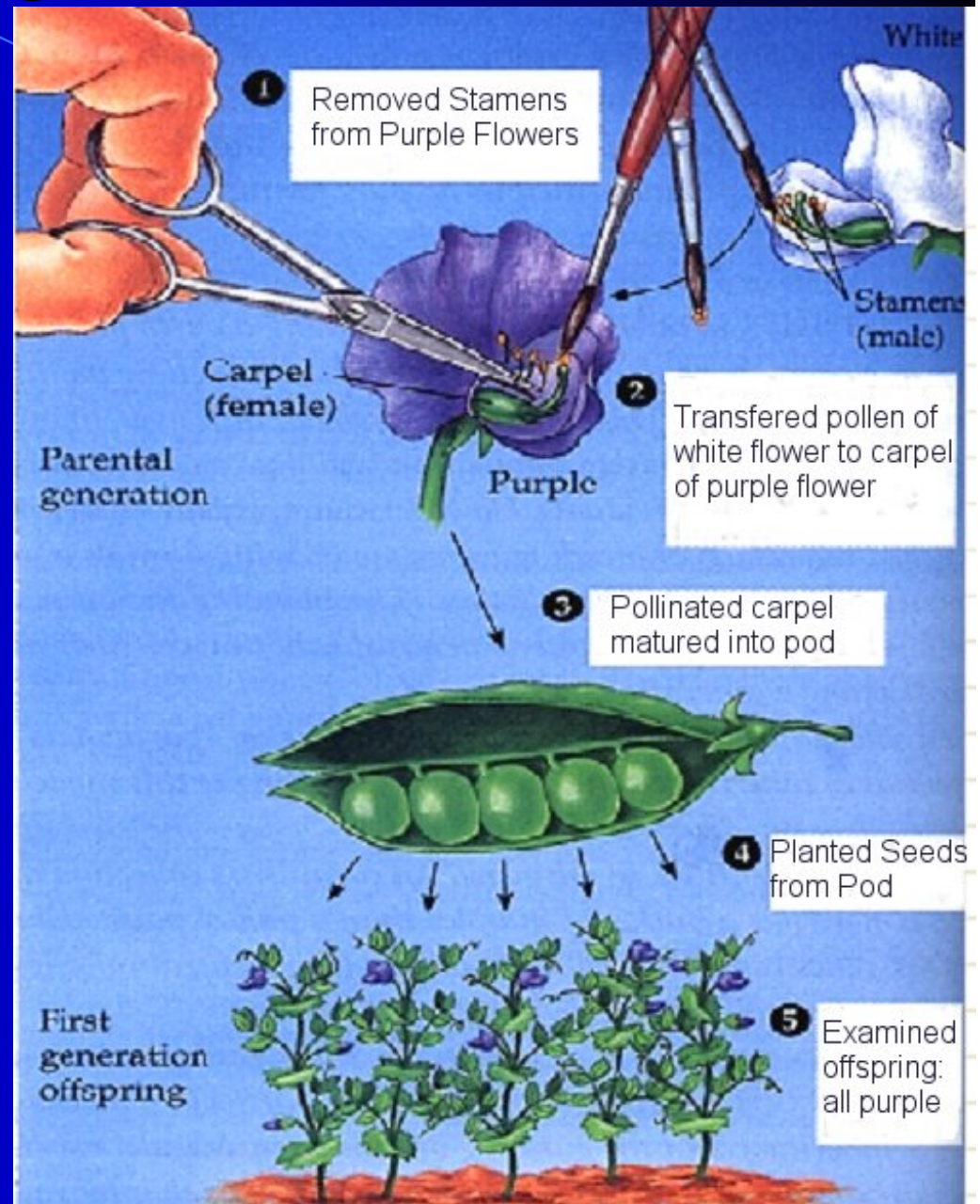
Shape of Pods

Height of Mature Plant



Regulating Conditions

- Used brushes to pollinate flowers
- Covered flowers to prevent natural fertilization
- Covered pods from being eaten
- Allowed plants to grow in controlled conditions

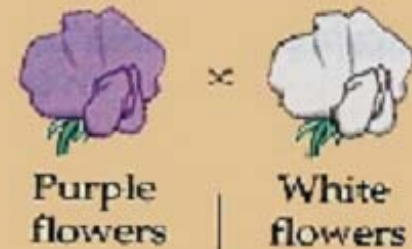


Example

- Used purple and white flowers (in P)
- Found (F1) had all purple flowers
- Generation (F2) had purple and white flowers in ratio 3:1

The Monohybrid Cross

P GENERATION
(true-breeding
parents)



F₁ GENERATION
(hybrids)



All plants had
purple flowers

F₂ GENERATION
Ratio 3:1



705 plants
had purple
flowers

224 plants
had white
flowers

Mendel's Discovery

- Established mathematical model for inheritance pattern of pea characteristics
- Brought experimental/quantitative approach to genetics
- Devised the law of segregation
- Brought ideas of independent assortment, co-dominance to the field of genetics
- Explained heredity in purely genetic terms

Rediscovery of Mendel

- Collected data and formulated theory for 28,000 pea plants
- Published results with theory in 1853-1854, 1866
- Mendel's work was ignored for a number of years
- Hugo de Vries (1848-1935) devised theory of inheritance of characteristics and uncovered Mendel while searching literature in 1900.

Why the neglect?

- Published in 1864, not referenced until 1900
- Inaccessibility of paper in journal *Verhandlungen des naturforschenden Vereines in Brünn*
- Nineteenth century biologists considered heredity to be related to development and didn't need to be explained on its own
- Mendel explained heredity by genetics but never went into the significance of his work

Questioning of Data

- Professor of Genetics R.A. Fisher (1890-1962) studied Mendel's publications extensively and reported that Mendel had falsified his data based on χ^2 analysis (1936)
- Fisher reported that Mendel's results were better than statistics even if data matched theory exactly
- Example: Flip coin 1000 times:
 - Obtaining 500 heads and 500 tails is most probable but still very unlikely

Supporters of Mendel

- Fisher's work grew much criticism because many took it very seriously
- Supporters felt that accusing a lucky man of cheating was preposterous
- Some felt that Fisher's methods were questionable and there was no proof that Mendel's data was fabricated

Conclusion

- Did Mendel falsify data?
 - Some say yes, some say no
 - We may never know
- Did Mendel manipulate data?
 - Most likely Mendel trimmed highly deviant values suspecting that they involved pollen contamination and/or other accidents
 - Since Mendel had very little knowledge of statistics, he didn't know that some variation was normal and expected

Ethical Issues

- It is likely that an investigator's bias may in some way skew the data
- "Good Science" sets experimental conditions to counteract bias.
- Statistical methods provide a way to gauge to gauge whether or not "good science" is being conducted
- Mendel most likely didn't know that he was doing anything "wrong" by throwing out some data.

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