

Mendelian genetics

How is variation inherited from parent to offspring?

- ▶ Offspring tend to look similar to their parents
- ▶ How are traits passed from parent to offspring?



Most observed variation is continuous

- ▶ Height, shape, behaviour
- ▶ Discrete traits were known, but most variation is complex
- ▶ Blending inheritance seemed most reasonable¹
- ▶ Offspring an average of their parents



¹Halliburton R. (2004). Introduction to population genetics. Pearson/Prentice Hall.

²Image: Luna Rose, CC BY-SA 4.0 (image cropped).

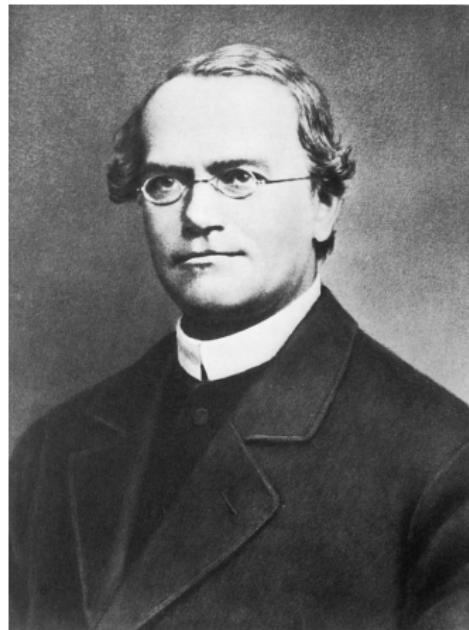
Most observed variation is continuous

- ▶ If offspring are averages of parents, why is there variation?
- ▶ What is the mechanism by which traits are passed from parents to offspring?
- ▶ Unknown to Darwin or his contemporaries



¹Image: Luna Rose, CC BY-SA 4.0 (image modified).

How are traits passed from parents to offspring?



- ▶ Interested in the question of heredity¹
- ▶ Austrian monastery ca 1857
- ▶ Peas as a **model system**
 - ▶ Easy to grow and maintain
 - ▶ Short generation time
 - ▶ Produced many offspring
 - ▶ Control mating and parentage

Gregor Mendel

¹Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 320.

²Image: Public Domain

Pea plant



¹Image: Public Domain

Pea plants have discrete characteristics

Characteristics of pea plants Gregor Mendel used in his inheritance experiments						
Seeds		Flower colour	Pod		Stem	
form	cotyledons		form	colour	position of inflorescences	size
round roundish		yellow			yellow	
wrinkled		green			green	

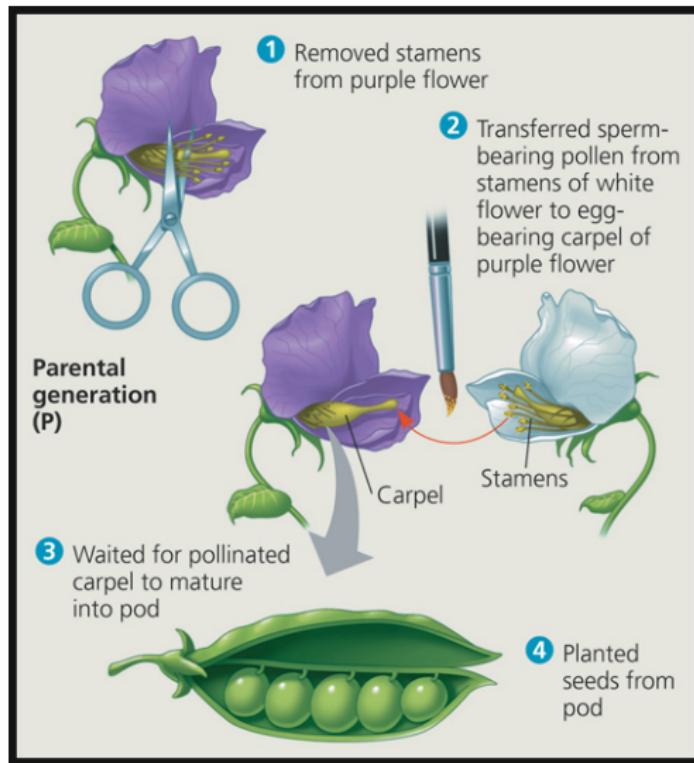
Mendel could record characteristics of each plant

¹Image: Public Domain

Experimenting with pea plant characteristics

- ▶ Consider a characteristic like flower colour (purple or white)
- ▶ Start with parents that are *true breeding*
 - ▶ If both parents have purple flowers, then offspring have purple flowers
 - ▶ If both parents have white flowers, then offspring have white flowers
- ▶ What happens when you mate (i.e., 'cross') a purple flower plant with a white flower plant?

Controlled experiment on pea plant flower colour



- Mendel controlled plant mating
- Knew parents of each offspring
- Offspring of purple and white flowered plants?

¹Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 321.

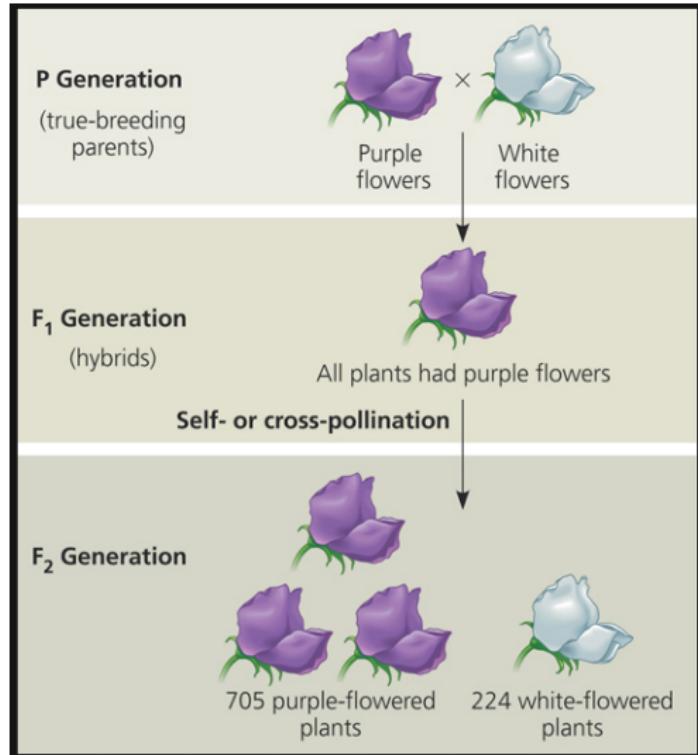
First generation of purple-white cross

All offspring are purple?!



¹Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 321.

Second generation of purple-white cross



- ▶ White flowers reappear
- ▶ Ca 3 purple to 1 white flower
- ▶ How are the purple and white traits passed from parents to offspring?

¹Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 322.

Genotypes and phenotypes

Phenotype	Genotype
Purple	PP (homozygous)
Purple	
Purple	
White	Pp (heterozygous)
	pp (homozygous)

Ratio 3 purple : 1 white Ratio 1 PP : 2 Pp : 1 pp

Phenotype: Observable trait

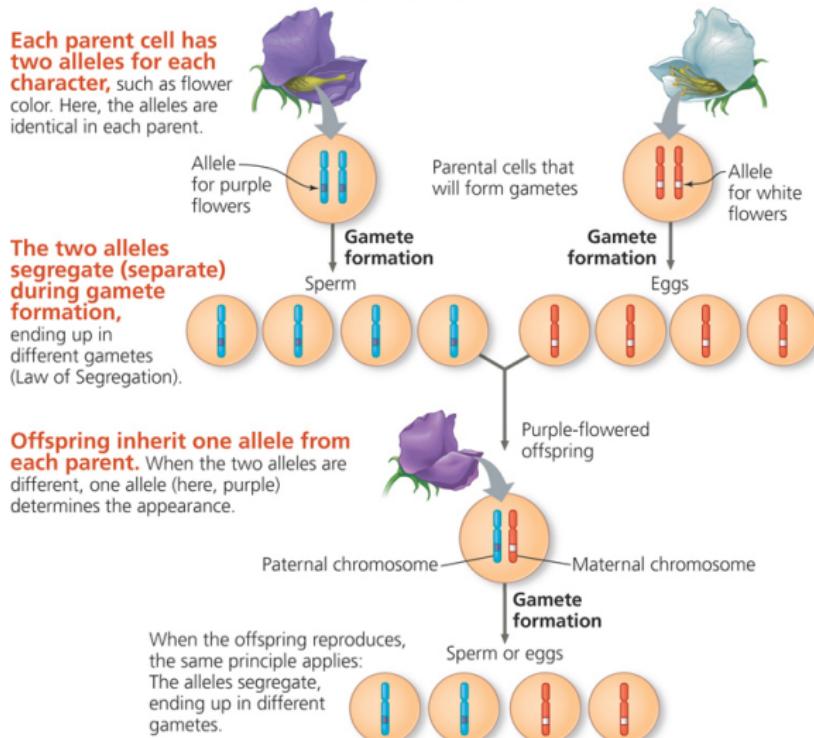
Genotype: Set of alleles

Gene: Discrete unity of hereditary information

Allele: Variant of a gene

¹Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 324.

Second generation of purple-white cross



¹Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 322.

More genetic vocabulary

- ▶ **Homozygote:** An organism with a pair of identical alleles for a gene
- ▶ **Heterozygote:** An organism with two different alleles for a gene

Four key concepts from Mendel

1. Alternative versions of a gene (i.e., *alleles*) account for variation in inherited characteristics (i.e., *phenotypes*).
2. For each characteristic, an organism inherits 1 allele from each parent.
3. If 2 alleles are different, then the dominant allele determines the phenotype.
4. The 2 alleles for a phenotype separate and end up in different gametes

¹Image: Campbell N, et al. (2021). Biology: a global approach (12th edition global). Pearson Education Limited. Page 322.