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Heredity in classical genetics - mendelism

Modul no. 1: Animal Genetics

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Experiment - aim and methods

„The experiments to be discussed here were prompted by artificial fertilization of ornamental plants in order to obtain new colour variants. The striking regularity with which the same hybrid forms kept returning after fertilization among the same species gave rise to further experiments to follow the development of hybrids in their offspring.“ (Mendel, 1866)

Method:

- Selected experimental organism (self-pollination, fecundity, simple traits)
- Selected suitable traits > 7 (different traits)
- Selected pea varieties > trait stability (pure lines)
- Cross/hybridized the following varieties with each other
- Recorded their numbers and evaluated them mathematically

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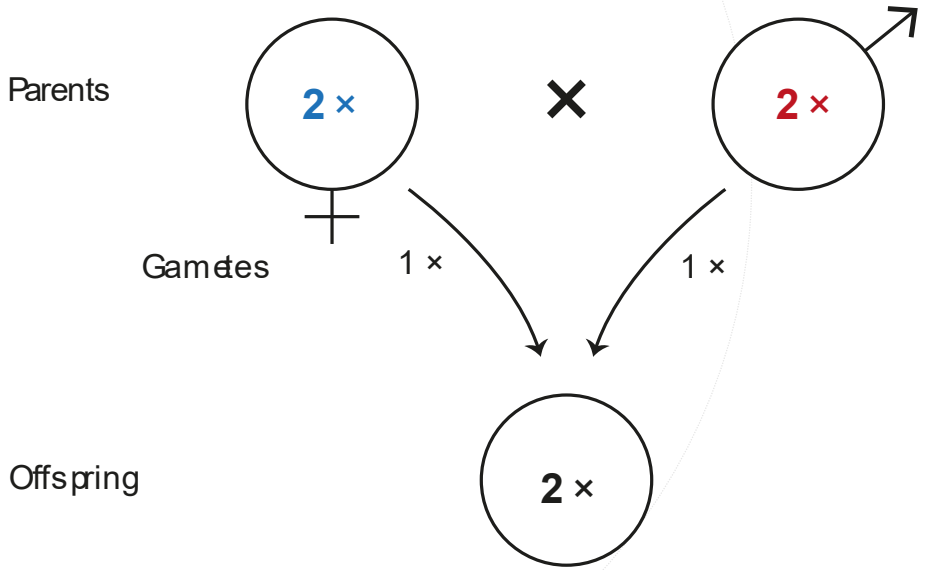
Heredity is related to sexual reproduction

- Mendel performed reproductive sex on plants -> fused male sex cells with female sex cells
- He started from the basic principle of reproduction:



Logical assumption: parents and offspring are the same in terms of the amount of hereditary information. Therefore, **the gametes must have half the amount of hereditary information.**

- What is inherited must be discrete elements - die Elementen -> each individual has 2 elements

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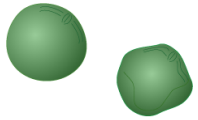
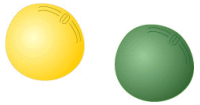
Seven pairs of contrasting traits in pea

- Seed shape
  - round × wrinkled



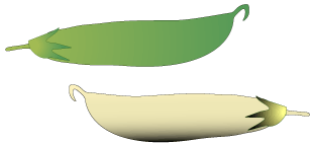
- Seed color
  - yellow × green



- Flower color
  - violet × white

- Pod shape
  - full × constricted

- Pod color
  - green × yellow



- Flower position
  - Axial × terminal

- Stem height
  - tall × dwarf

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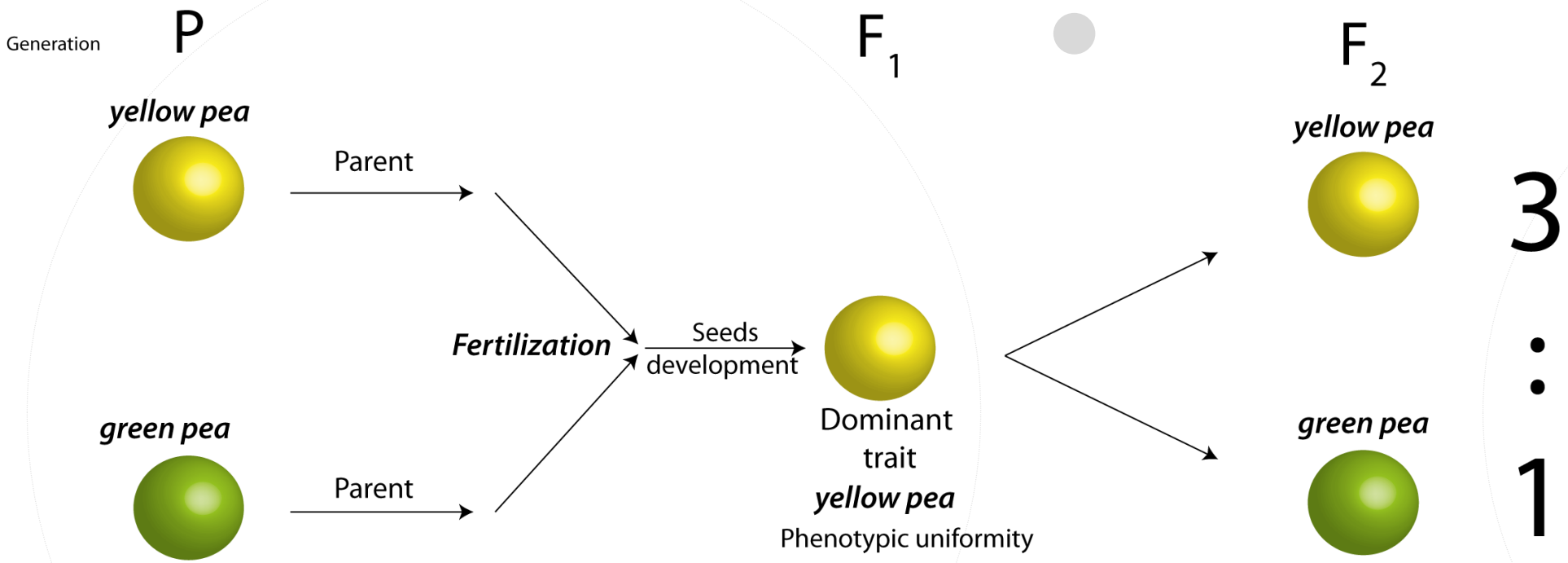
Monohybrid cross –> principle of segregation



The rules:

Dominance

Uniformity of F_1

Regularity of ratios in all seven traits

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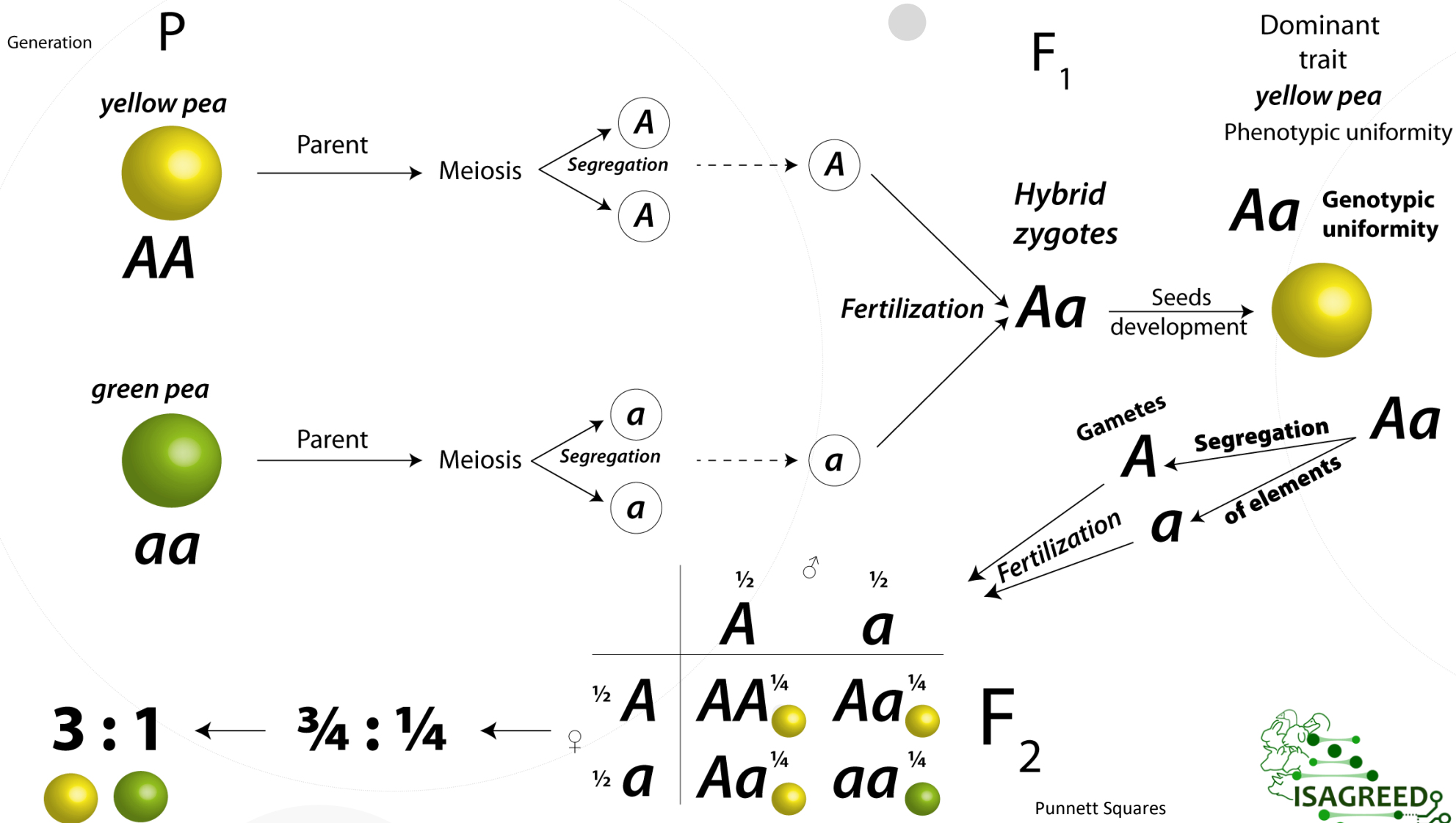
How did Mendel explain



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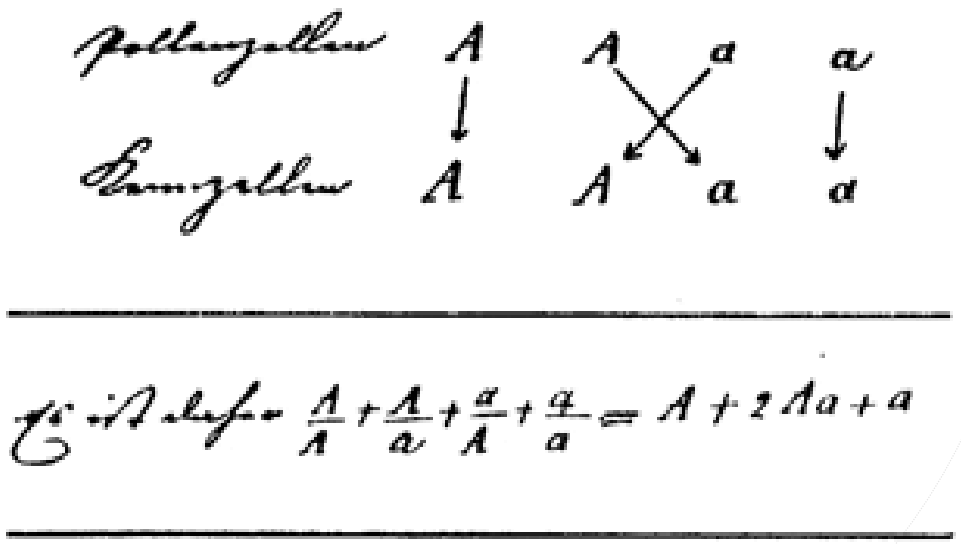
What is Mendel´s „die Elementen“

- discreteness of genetic information (not mixed, not blended, not diluted...)



Elements / Alleles
in gametes

Genotypes of offspring
- Result of combination of parental alleles
- Ratio **1 : 2 : 1**

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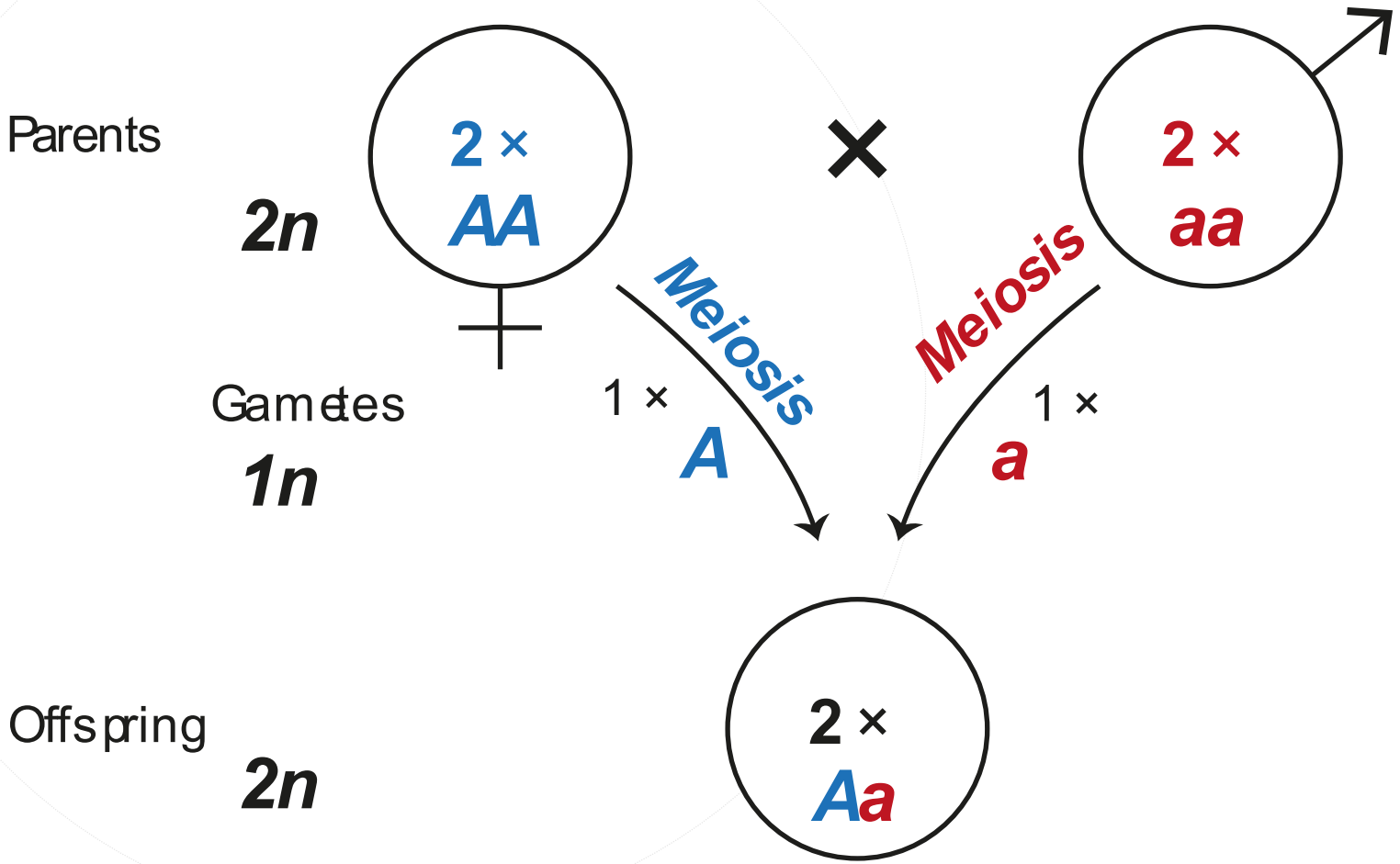

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Mendel´s first three postulates

- **Unit factors in pairs (~ genotypes)**
  - Genetic traits are controlled by unit factors existing in pairs in individual organisms
- **Dominance/recessiveness (Mendel terms)**
  - When two unlike unit factors responsible for a single traits are present in a single individual (heterozygote), one unit factor is dominant to the other, recessive.
- **Segregation**
  - During the formation of gametes, the paired unit factors separet, or segregate, randomly so that each gamete receives one or the other with equal likelihood

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Dihybrid experiment

- Mendel designed experiments in which he examined two traits simultaneously
- The experimental design is the same as the monohybrid cross

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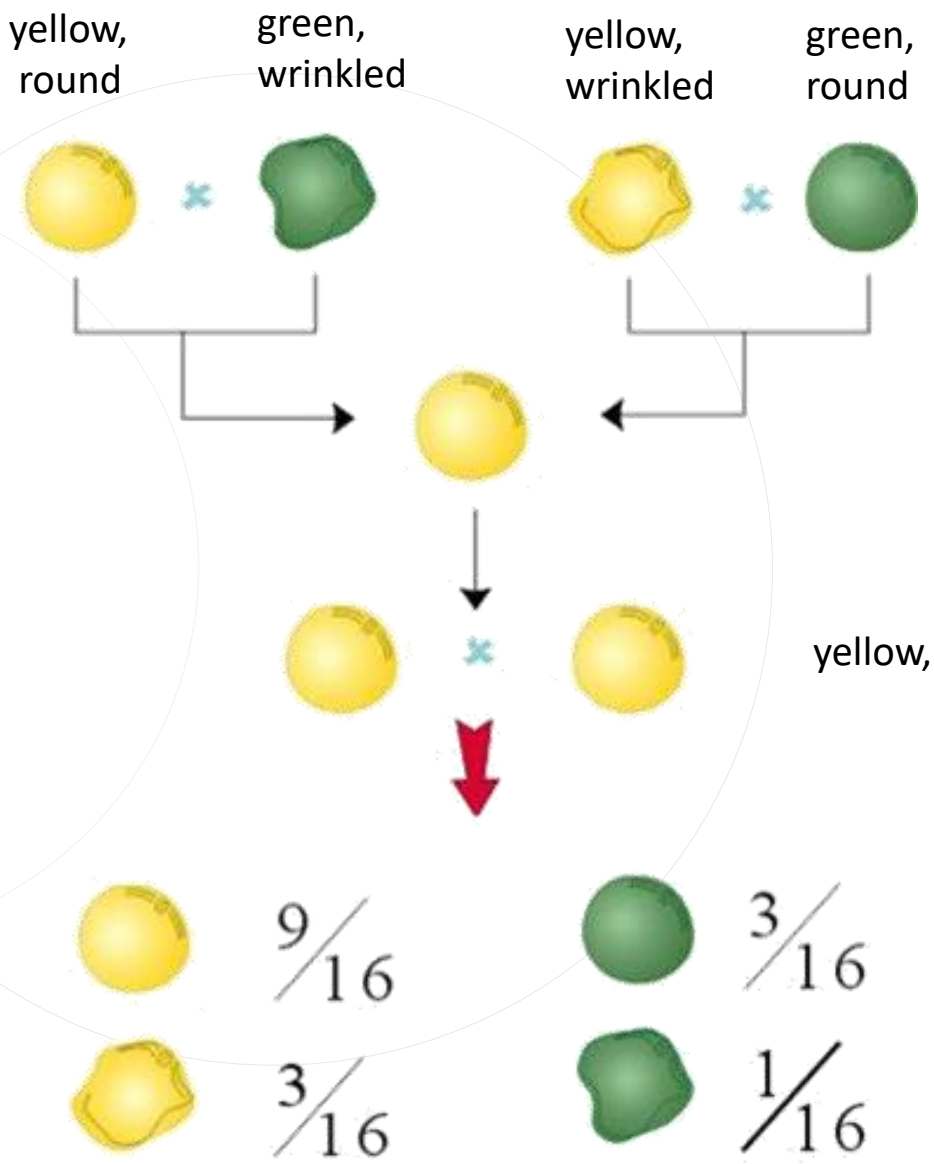
Dihybrid cross



yellow, round > uniformity

All four combinations in ration 9 : 3 : 3 : 1

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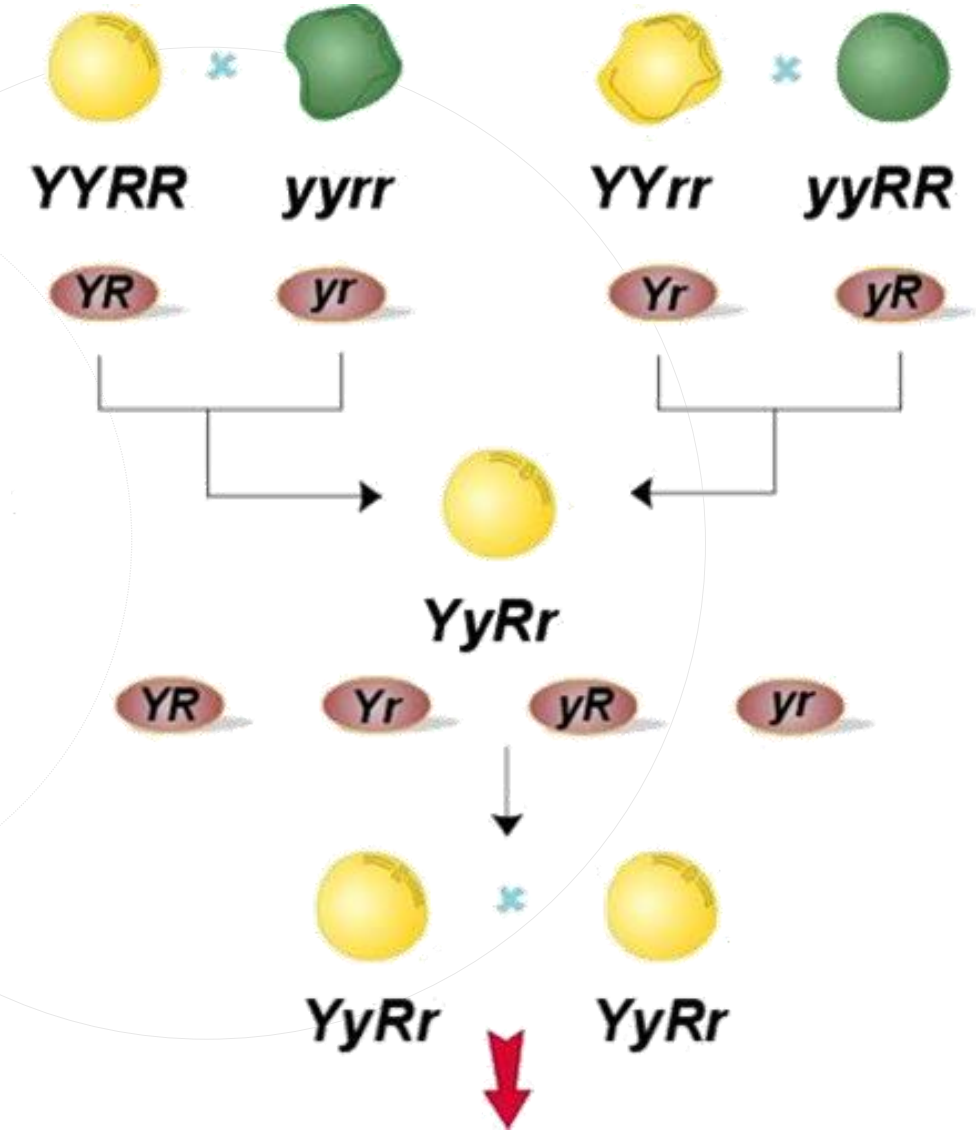
Dihybrid cross



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Results of dihybrid cross

F_2

♂ \ ♀	YR	Yr	yR	yr
YR	YYRR	YYRr	YyRR	YyRr
Yr	YYRr	YYrr	YyRr	Yyrr
yR	YyRR	YyRr	yyRR	yyRr
yr	YyRr	Yyrr	yyRr	yyrr

1/4 (rows) 1/16 (columns)

- 1/16 ***YYRR*** + 2/16 ***YYRr*** + 2/16 ***YyRR*** + 4/16 ***YyRr***
- 1/16 ***YYrr*** + 2/16 ***Yyrr***
- 1/16 ***yyRR*** + 2/16 ***yyRr***
- 1/16 ***yyrr***

Genotypic ration = 1:1:2:2:4:2:2:1:1

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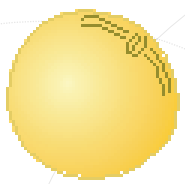
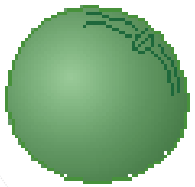
Pea numbers and phenotypic ratio in F2

315	108	101	32
9/16	3/16	3/16	1/16

9 : 3 : 3 : 1

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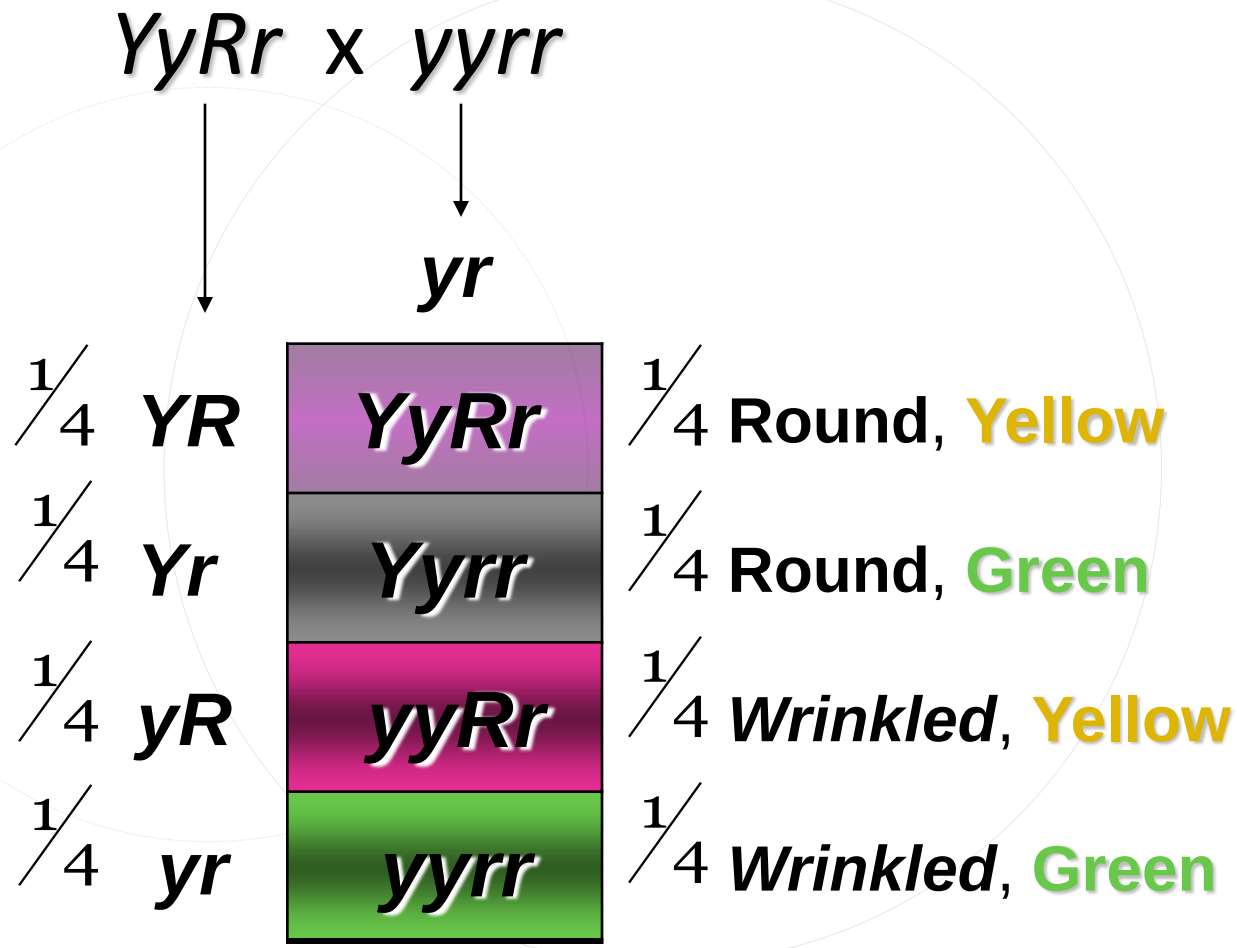
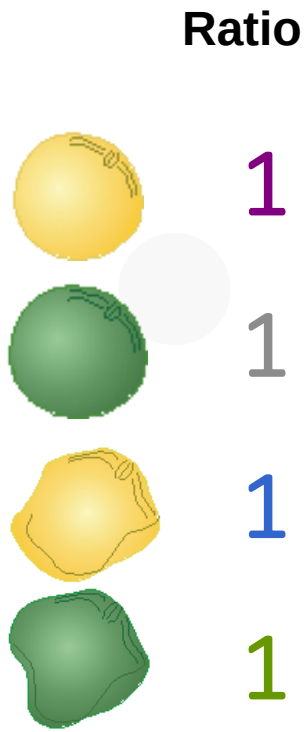
Confirmation of the hypothesis - **testcross**





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Result from a dihybrid cross: Independent assortment

- **Rule of independent assortment**
  - During gamete formation, segregation of pairs of unit factors assort independently of each other (alleles of one allelic pair is independent of segregation of alleles of the other allelic pair)

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Main conclusion resulted from Mendel´s experiments

- **What is inherited are not traits, but discrete genetic information (elements, traits, genes)**

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Thank you for your attention!

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