# Concept of biology:

- Patterns of inheritance
  - To be able to repeat these observations, ways how the biology works.
- Mendel: Experimenting with thousands of garden peas (vegetable) => fundamentals of genetics.

# Mendelian Genetics

MENDEL'S PEAS EXPERIMENTS

↓

NO IDEA ABOUT DNA, CHROMOSOMES

↓

SET MODERN GENETICS

* transmission of genes from parents → offspring

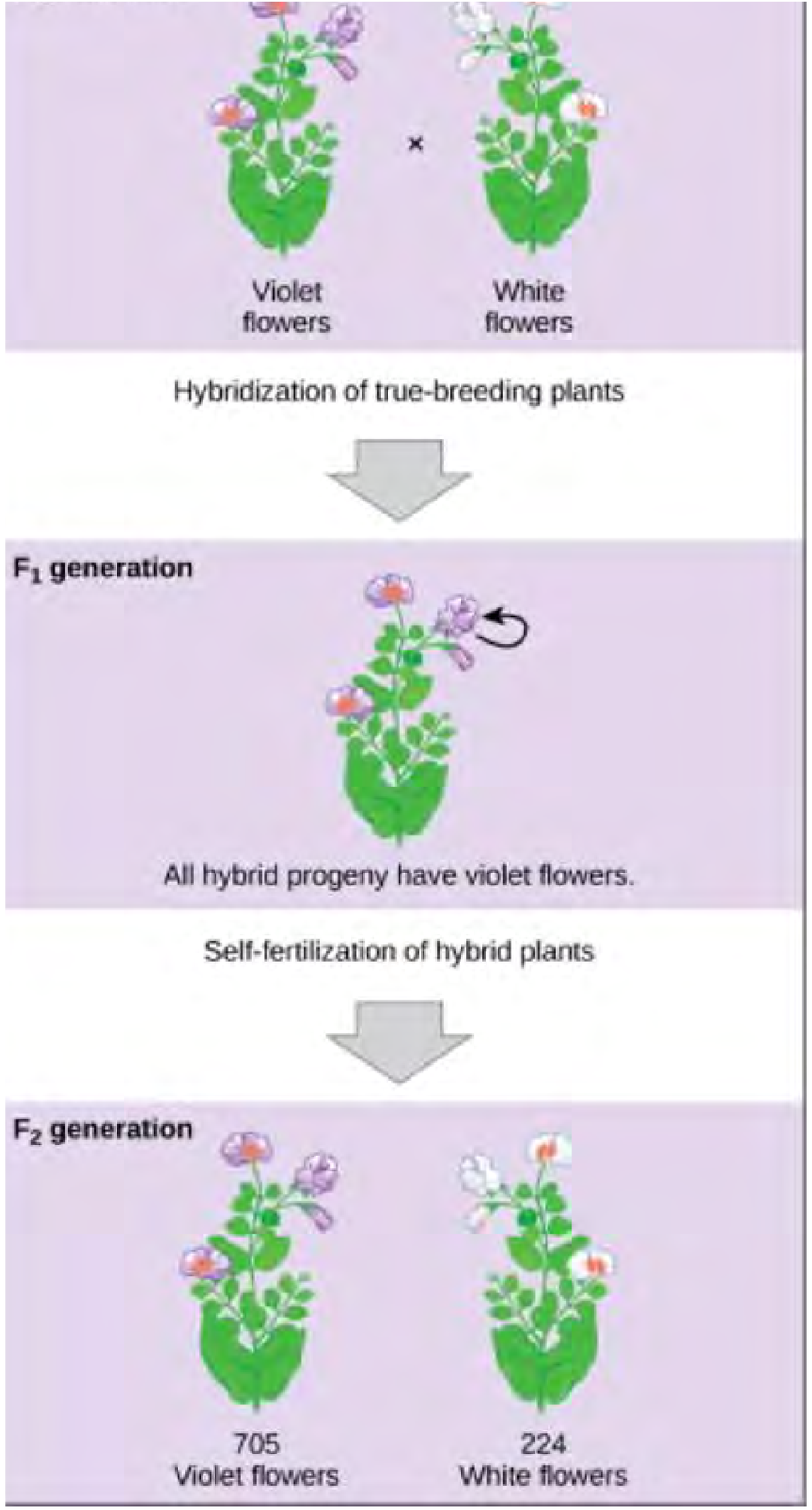
F0

↓

F1

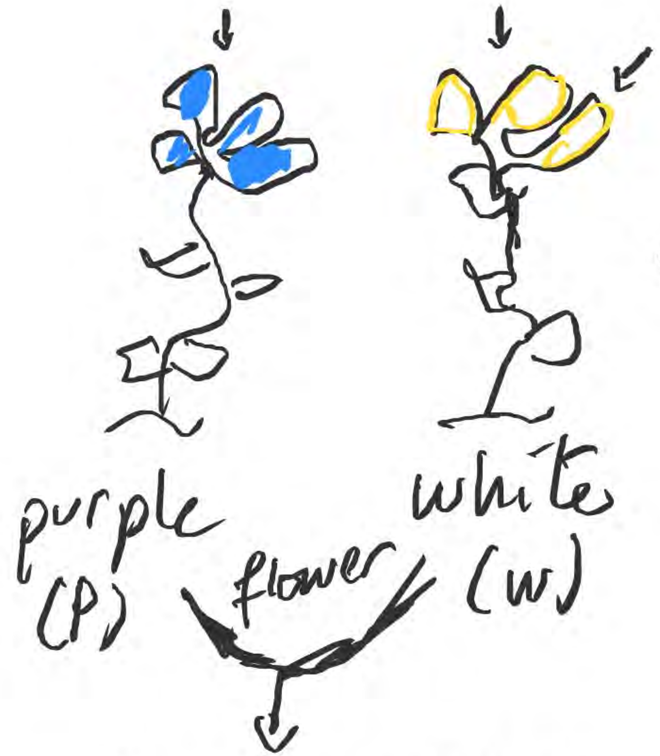
↓

F2 ..... etc...


Violet flowers
×
White flowers
Hybridization of true-breeding plants
F1 generation
All hybrid progeny have violet flowers.
Self-fertilization of hybrid plants
F2 generation
705
Violet flowers
224
White flowers

# Mendel's mechanism of study:

P




F1

hybrid progeny

(100% P)

100% purple flowers

F2


white ⊕ purple (P+W)

Parent

F1 100% purple (only P)

(hybrids)

Only hybrids and cross them together

F2

purple 3/4 (75%) ⊕

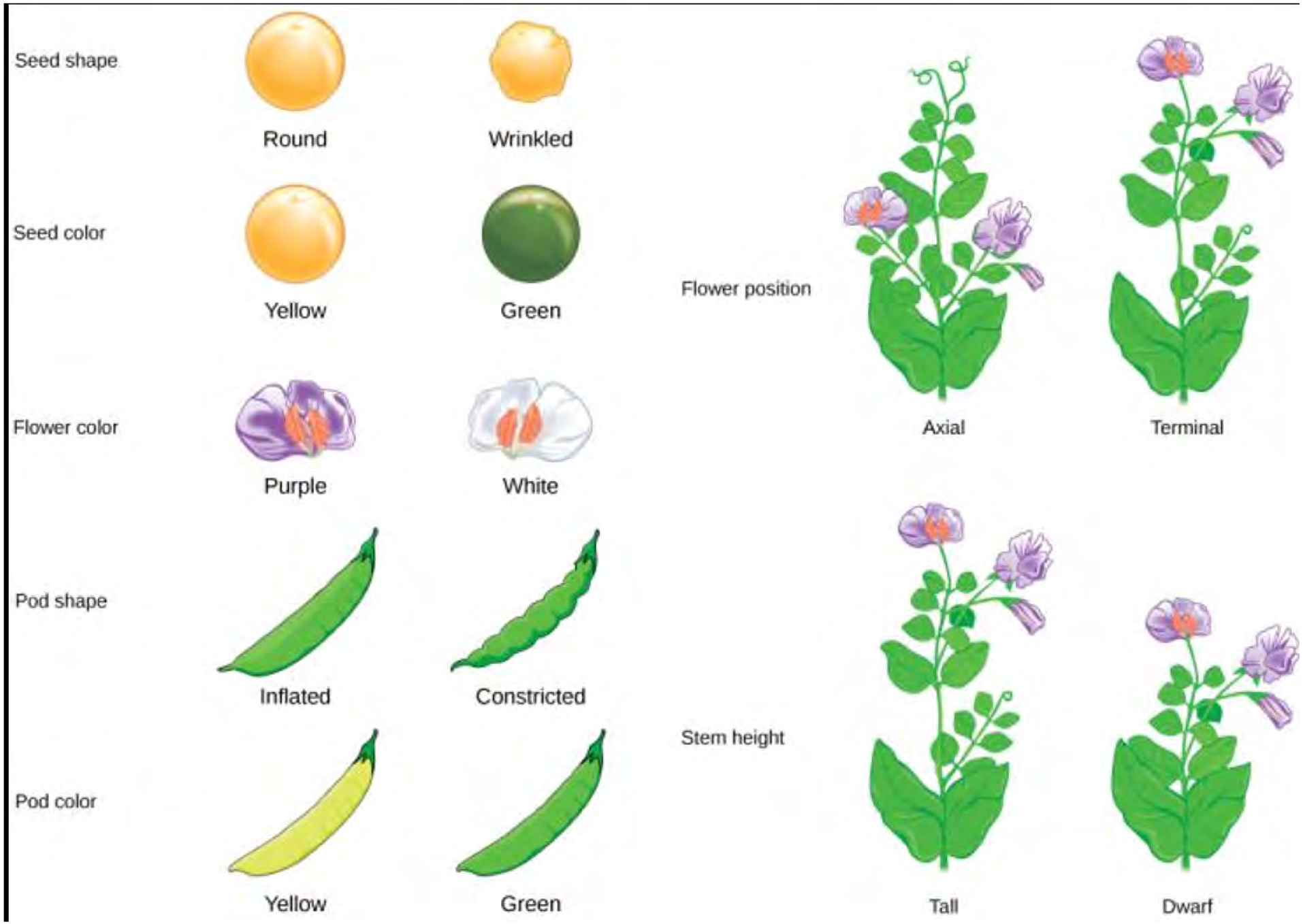
white 1/4 (25%)

# PEA PLANT EXPERIMENTS

Peas ▪ "fortunate choice": MANY VARIATIONS IN PEAS.

VARIATIONS IN PEAS: tall plant, short, round, wrinkled...

- Quick generation time. P → F1 → F2 → F3 ... (generate data very quick) – "short" time –
- Produce many offspring (great for statistics!) : P → F1 → F2 .... Fn, n → ∞ (P, F1, F2, F1)
- Capable of self-fertilization / self-pollination.


Seed shape
Round
Wrinkled
Seed color
Yellow
Green
Flower color
Purple
White
Pod shape
Inflated
Constricted
Pod color
Yellow
Green
Flower position
Axial
Terminal
Stem height
Tall
Dwarf

# MENDEL: 7 variables:

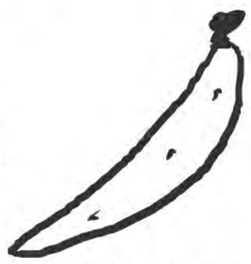
① Seed shape:  

Round wrinkled

② Seed color:  

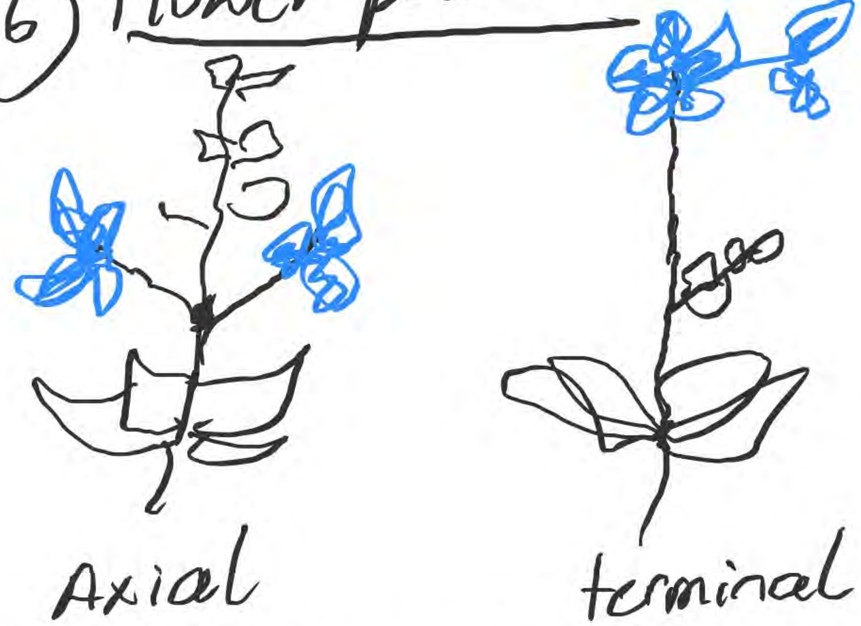
Yellow Green

③ Flower color: Purple White

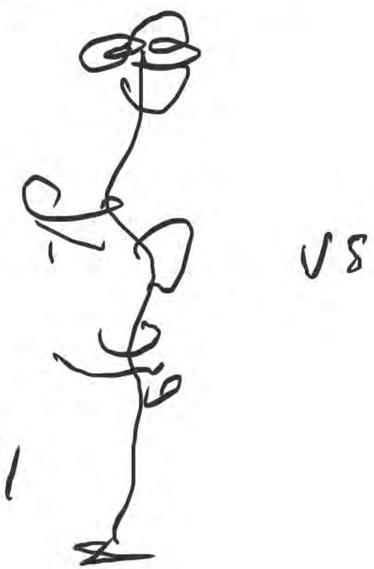
④ Pod shape  

Inflated constricted

⑤ Pod color  

⑥ Flower position: 

Axial terminal

⑦ Stem height:  vs 

Tall Dwarf

# Mendel's principles

In all cases, the careful quantification of results showed the same patterns in $F_1$ and $F_2$ progeny that led Mendel to propose:

- Parents carry 2 alleles, gametes get one (Law of segregation)

DEFINE DOMINANCE: Concept of simple dominance.

Ex: blue eyes vs brown eyes.

⇒ Explanation for the numbers obtained on generation $F_2$.

## PHENOTYPE

P

(a) Cross-fertilization

100% of yellow progeny (hybrids)

$F_1$

(b) self-fertilization

$F_2$

75% yellow progeny

25% of green progeny

## GENOTYPE

P

YY × yy

Y: dominant allele
y: recessive allele

(a) Cross-fertilization

$F_1$

100% (yellow)

Yy

self-fertilization

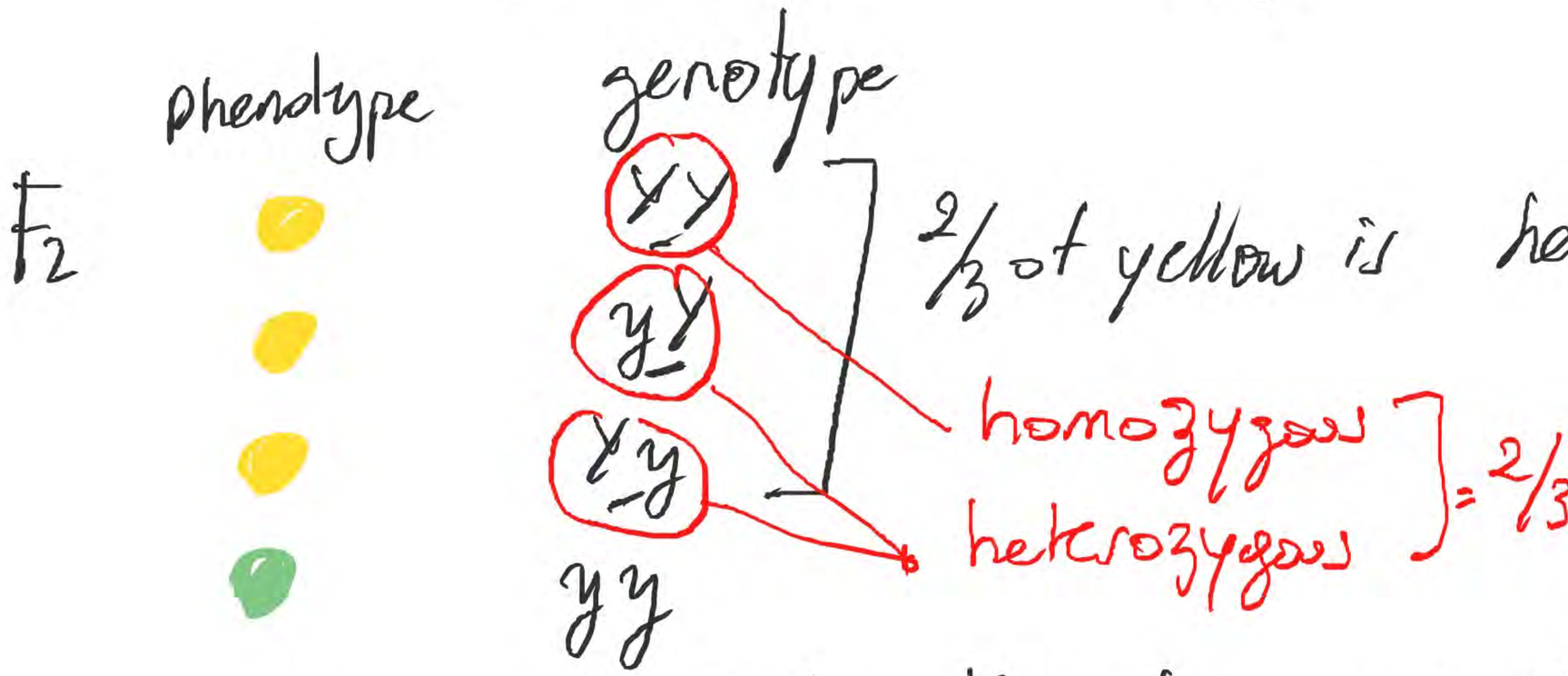
$F_2$

YY ] 25% YY
Yy ] 50% Yy
yY ]
] 75% yellow

yy ] 25% yy ] 25% Green

HYPOTHESIS: Mendel → genotypes 2 alleles. → 1 allele/gamete

if correct: $\frac{2}{3}$ of dominant-looking $F_2$s should be heterozygous.




the test cross accomplishes this by revealing "hidden" second allele.

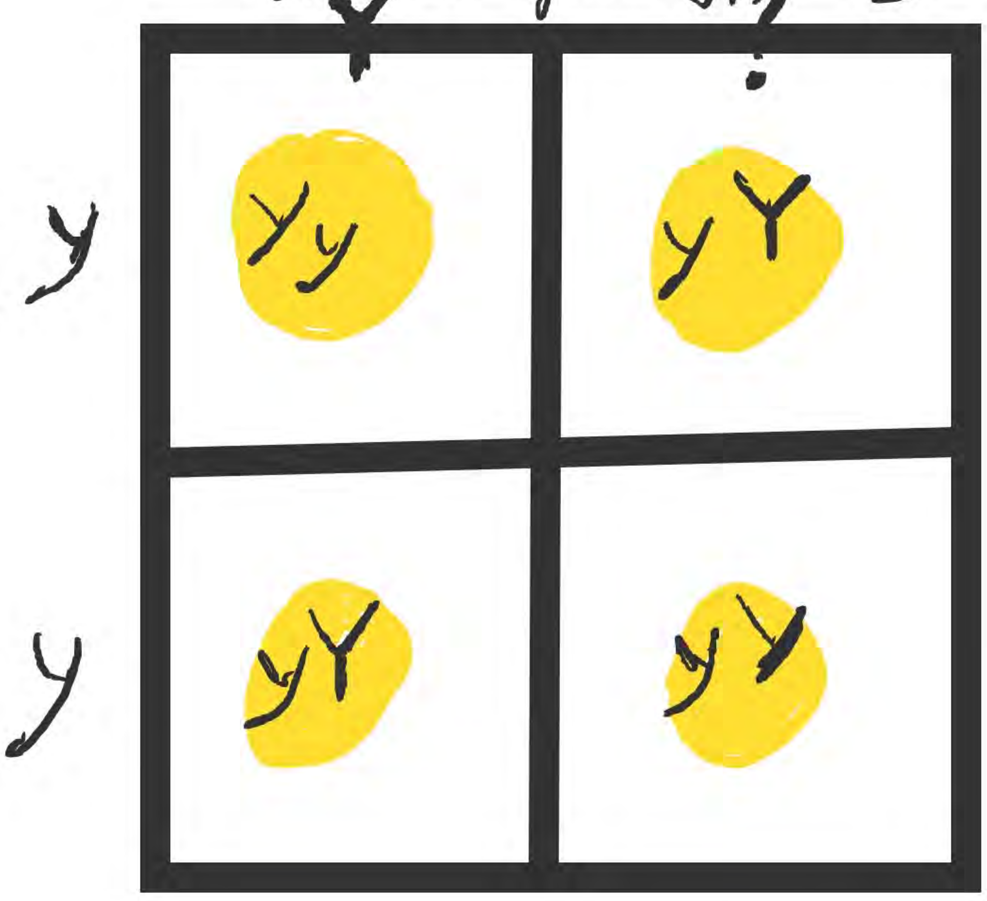
# TEST CROSS

Phenotype: Yellow
genotype: unknown



Phenotype: Green
Genotype: known (yy)

Gametes from parent of unknow genotype




can only be YY

A test cross resulting in all dominant offspring indicates the parent is HOMOZYGOUS DOMINANT

Conclusion: my yellow peas is YY.


A test cross resulting in a 1:1 ratio of yellow and green offspring indicate that the parent is HETEROZYGOUS.

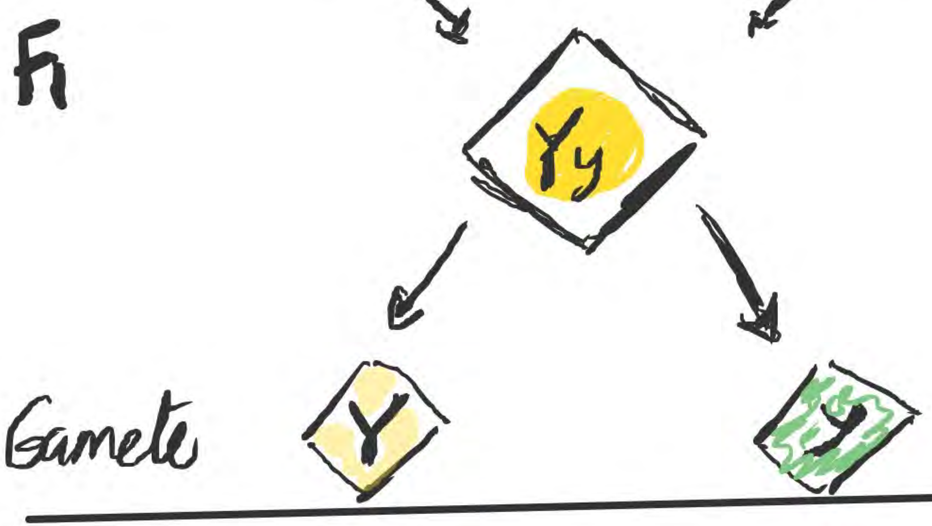
Conclusion: UNKNOWN = Y? = Yy

# MONOHYBRID CROSS (Punnett square)

P


Each homozygous parent in the P generation produces only one kind of gametes.

F1




The heterozygous F1 offspring produces 2 kinds of gametes

F2


⇒ 3:1 ratio

self-pollination of F1 offsprings produces F2 offsprings with 3:1 ratio of yellow to green seeds.

| | Genotype | ratio | Phenotype ratio |
|---|---|---|---|
| YELLOW | YY | 1 | 3 |
| | Yy | 2 | |
| GREEN | yy | 1 | 1 |