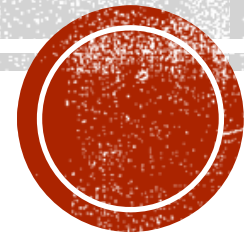


TOPIC 1: MENDELIAN GENETICS



TOPIC 1 LEARNING TARGETS

- Use basic genetics vocabulary (**genotype, phenotype, heterozygous**, etc.)
- Describe Mendel's **experiments and his laws**.
- Use **Punnett squares** for basic monohybrid crosses.



BASIC GENETICS VOCABULARY

- Genetics
- Gene
- Heredity
- Trait
- Allele
- Dominant trait
- Recessive trait
- Phenotype
- Genotype
- Homozygous
- Heterozygous



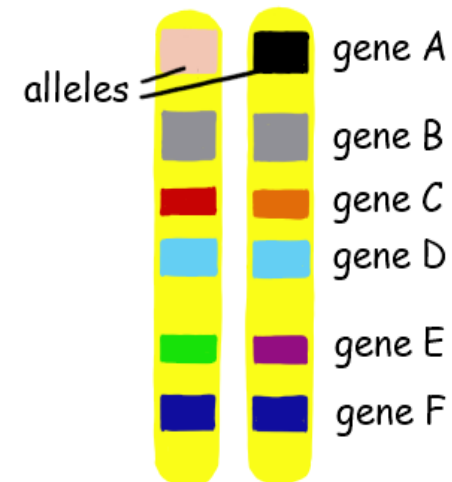
WHAT IS GENETICS?

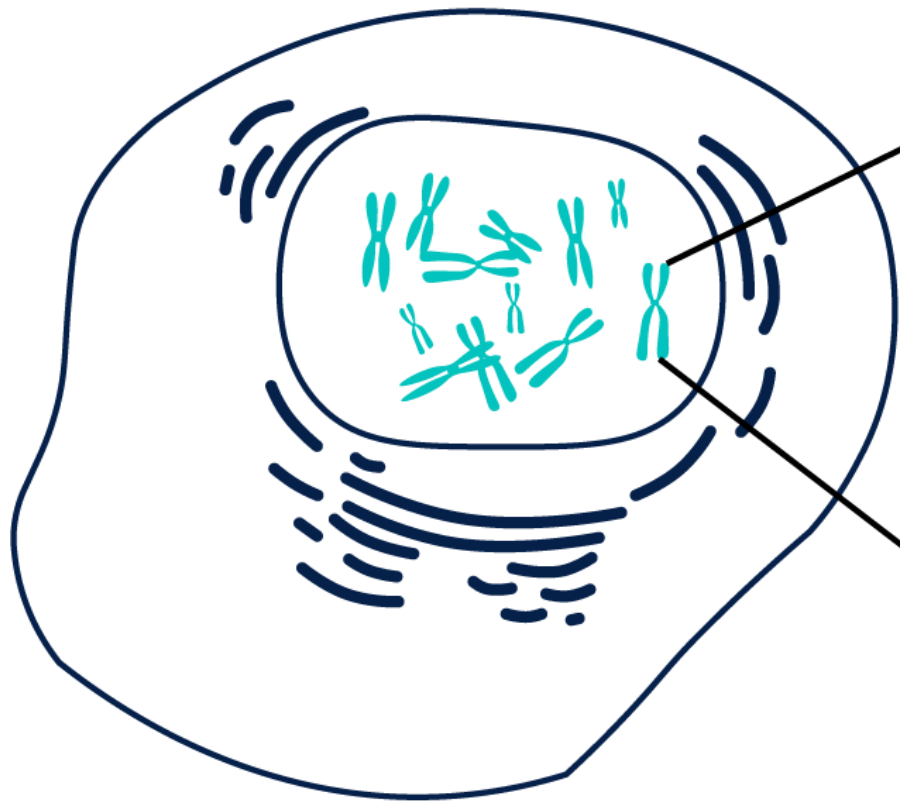
The **study of how traits are inherited** through the interaction of genes.



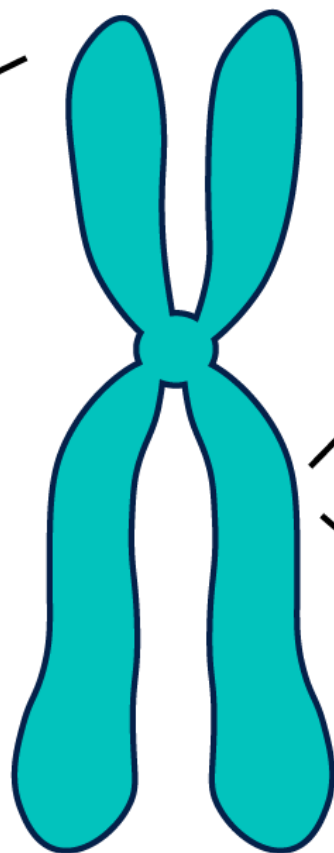
WHAT IS A GENE?

- The **material that controls the traits** that are expressed in an organism.
- Genes come in pairs and offspring inherit one copy of each gene from each parent.





Cell



Chromosome



DNA



Gene



WHAT IS HEREDITY?

The **passing of traits** from parent to offspring



WHAT IS A TRAIT?

- Ways of looking, thinking, or being
- Types of traits
 - **Dominant** (Topic 1)
 - **Recessive** (Topic 1)
 - Polygenic (Topic 2)
 - Sex-linked (Topic 2)
 - Autosomal (Topic 3)



THINK-PAIR-SHARE

- For the next minute, **quietly** make a list of as many **human traits** as possible on a half sheet of paper.
- Example: Eye color
- For the next minute, with your neighbor, talk about your list and come up with **2 unusual human traits**.



HUMAN TRAITS



Baldness
Hair Wave
Hairline



Cleft Chin
Dimples
Face Shape
Freckles



Ear Lobe
Ear length



Eyelashes
Eyesight
Color Blindness
Mongolian eye fold



Nose width
Roman Nose



Bent pinkie
Crossing of thumbs
Handedness
Hitchhiker's thumb
Mid-digital hair
Number of fingers
Thumb Up
Vulcan Fingers
Webbed fingers



Lips
Tongue Roll



Body Hair
Human Height

Skin Color



Blood Type
Blood pressure rate
Rh factor in blood



WHAT IS AN ALLELE?

Different forms of a trait that a gene may have



WHAT IS A DOMINANT TRAIT?

- A trait that **covers over, or dominates**, another form of that trait
- Trait that **always shows up**, even when only one of the two alleles is in the dominant form
- Shown by a **capital letter**



WHAT IS A RECESSIVE TRAIT?

- A trait that is **covered over, or dominated**, by another form of that trait and seems to disappear
- **Hidden** when the other copy of the gene contains the dominant allele
- Shows up only when there is no dominant allele present
- Shown with a **lowercase letter**



Straight thumb (T)



Hitchhiker's thumb (t)



Straight thumb—dominant—chromosome 17



Unattached earlobe (E)



Attached earlobe (e)



Unattached Earlobe—dominant—chromosome 21



Long second toe (T)



Short second toe (t)



Long second toe—dominant—chromosome 20







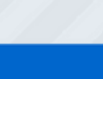




DOMINANT OR RECESSIVE?

- For the next minute, with your same neighbor, talk about your list and come up with **a dominant and recessive trait** for each item on your list.
- Example: **Eye color**. Brown eyes (B) vs. blue eyes (b)



HUMAN TRAITS	DOMINANT TRAIT	RECESSIVE TRAIT
 Baldness	Presence	Absence
 Hair Wave	Wavy	Not wavy
 Hairline	Widow's Peak	Straight
 Cleft Chin	Yes	No
 Dimples	Yes	No
 Face Shape	Oval	Round
 Freckles	Yes	No
 Ear Lobe	Free earlobes	Attached earlobes
 Ear length	Long	Short
Eyelashes	Long	Short
Eyesight	Near-sighted	Perfect/normal eyesight
Color Blindness	Not	Yes
Mongolian eye fold	Yes	No
Nose width	Broad nose	Narrow nose
Roman Nose	Roman nose	No prominent bridge















 Bent pinkie	Bendy	Straight
 Crossing of thumbs	Left thumb over right thumb	Right thumb over left thumb
 Handedness	Right-handed	Left-handed
 Hitchhiker's thumb	No	Yes
 Mid-digital hair	Yes	No
 Number of fingers	Six fingers	Five fingers - normal
 Thumb Up	Right thumb-up	Left thumb-up
 Vulcan Fingers	Vulcan	Earthling
 Webbed fingers	Webbed	Normal
Lips	Broad	Thin
Tongue Roll	Yes	No
Body Hair	Abundant	Little
Human Height	Dwarfism	Normal growth
Skin Color		
Blood Type	A/B/AB Blood types*	O blood type
Blood pressure rate	High	Low
Rh factor in blood	Rh+	Rh-
	<i>*these are codominant traits</i>	

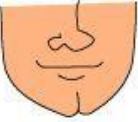












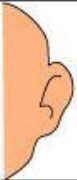
More on this at www.interactive-biology.com



INVESTIGATE THE CLASS

- For the next minute, on that same paper **identify** whether or not you have the **dominant or recessive trait** for each of the following items on this list.
- **Your information** will be combined with the rest of the class.

Dominant Gene		Recessive Gene	
Cleft Chin		No Cleft	
Widow's Peak		No Widow's Peak	
Dimples		No Dimples	
Brown/Black Hair		Blonde Hair	
Freckles		No Freckles	
Brown Eyes		Gray/Blue Eyes	
Free Earlobe		Attached Earlobe	

Dominant Gene		Recessive Gene	
Cleft Chin		No Cleft	
Widow's Peak		No Widow's Peak	
Dimples		No Dimples	
Brown/Black Hair		Blonde Hair	
Freckles		No Freckles	
Brown Eyes		Gray/Blue Eyes	
Free Earlobe		Attached Earlobe	

What can we conclude from our data?





WHAT IS A PHENOTYPE?

- Outward **physical appearance and behavior** of an organism
- Example: **Eye color** → Brown, blue, dark brown, green, hazel, etc.



WHAT IS A GENOTYPE?

- The **genetic makeup** of an organism
- Example: Dominant allele (D), recessive allele (d)
- Identified as one of two compositions: **homozygous** or **heterozygous**



WHAT DOES **HOMOZYGOUS** MEAN?

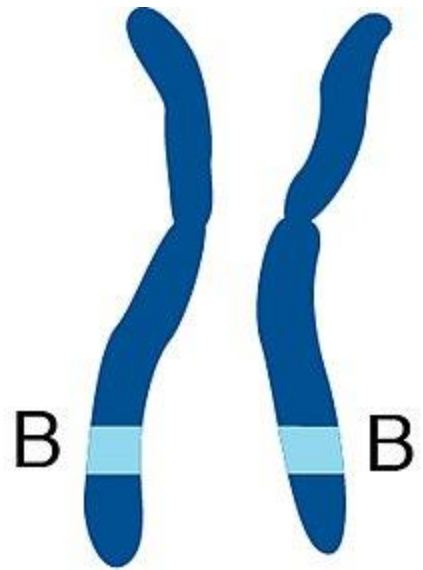
- Both alleles (forms of the gene) are the **same**
- When offspring inherit **two dominant genes**, (one dominant gene from each parent) they are said to be homozygous dominant
- When offspring inherit **two recessive genes**, (one recessive gene from each parent) they are said to be homozygous recessive



WHAT DOES HETEROZYGOUS MEAN?

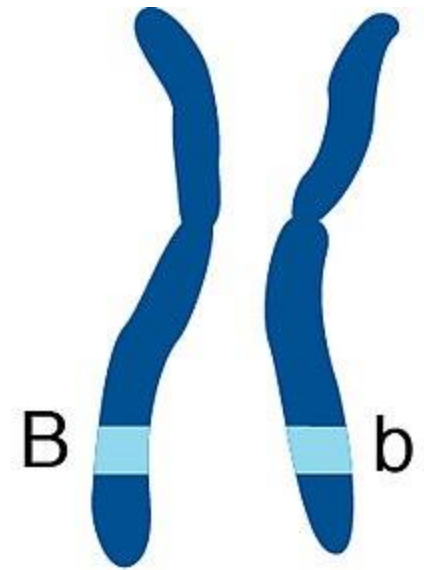
- When alleles occur in **different** forms
- When offspring inherit **one dominant gene and one recessive gene**, they are said to be heterozygous
- Since the dominant gene will be expressed, they are said to be heterozygous dominant



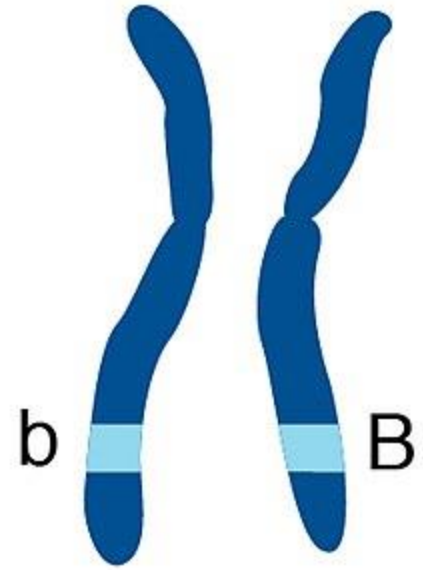


Homozygous

BB



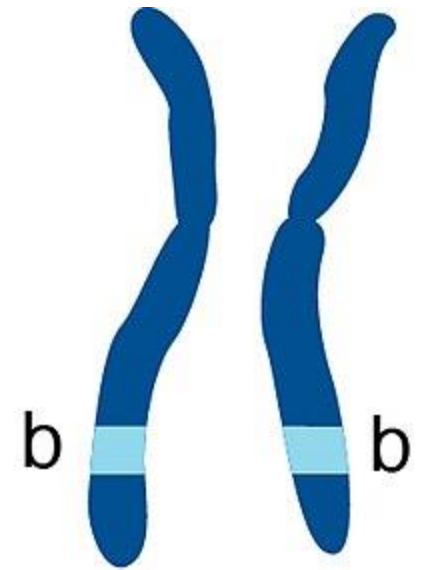
Bb



bB



Heterozygous



Homozygous

bb

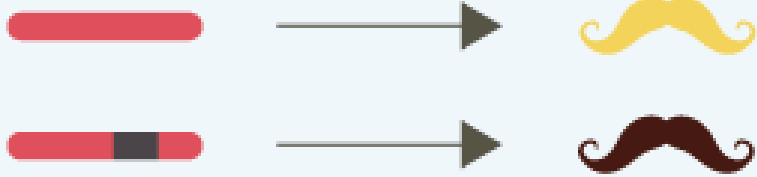


POLYGENIC INHERITANCE

- **Not every trait** is controlled by a single gene with two alleles
- Genes can be **spread across different locations** on chromosomes
- This produces **many different combinations** and mixes
- **Example: Eye color, skin color, hair color**

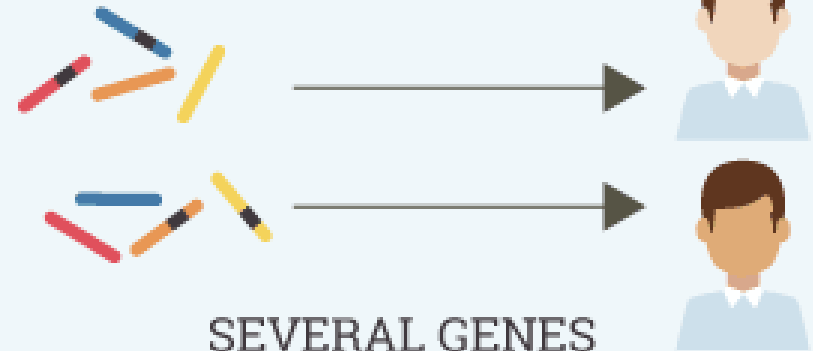


MONOGENIC



ONE GENE

POLYGENIC



SEVERAL GENES



BASIC GENETICS VOCABULARY

- Genetics
- Gene
- Heredity
- Trait
- Allele
- Dominant trait
- Recessive trait
- Phenotype
- Genotype
- Homozygous
- Heterozygous



BASIC GENETICS VOCABULARY

- Genetics
- Gene
- Heredity
- Trait
- Allele
- Dominant trait
- Recessive trait
- Phenotype
- Genotype
- Homozygous
- Heterozygous



TOPIC 1 LEARNING TARGETS

- ✓ Use basic genetics vocabulary (**genotype, phenotype, heterozygous**, etc.)
- Describe Mendel's **experiments and his laws**.
- Use **Punnett squares** for basic monohybrid crosses.



VEGETABLE COMPARISON

- What **kind of traits** might be in these vegetables?
- What **similarities** are there?
- What **differences** are there?

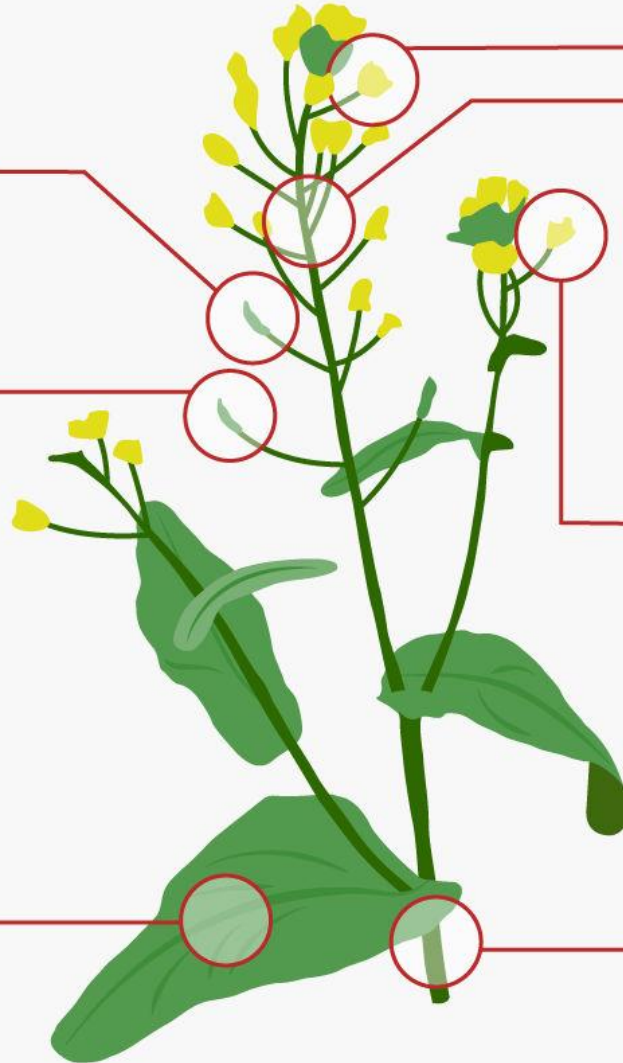


6 VEGETABLES THAT ARE ACTUALLY THE SAME PLANT

Brussels sprouts
Lateral leaf buds



Wild Mustard Plant
Brassica Oleracea



Broccoli
Flower buds/stems



Cabbage
Terminal leaf bud



Cauliflower
Flower buds



Kale
Leaves

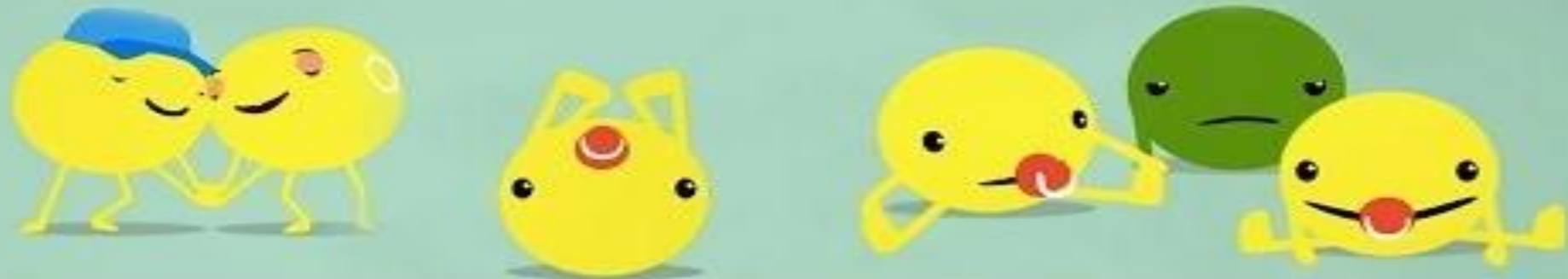


Kohlrabi
Stem





HOW MENDEL'S
PEA PLANTS
HELPED US UNDERSTAND
GENETICS



WHY THE PEA PLANTS?

Why do you think Mendel **used pea plants** in his experiment?



WHY THE PEA PLANTS? (CONT'D)

- Peas have a wide variety of **observable traits** (flower color, flower position, seed color, seed shape, pod shape, pod color, stem length)
- **Short generation times** with large number of offspring from each mating
- **Easy to control** mating between the plants



Seed shape



Round



Wrinkled

Seed color



Yellow



Green

Flower color



Purple

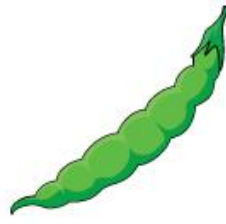


White

Pod shape

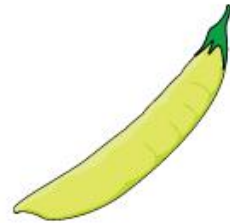


Inflated

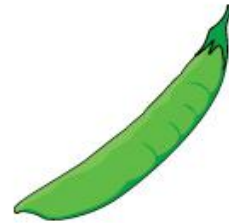


Constricted

Pod color



Yellow



Green

Flower position



Axial



Terminal

Stem height



Tall



Dwarf

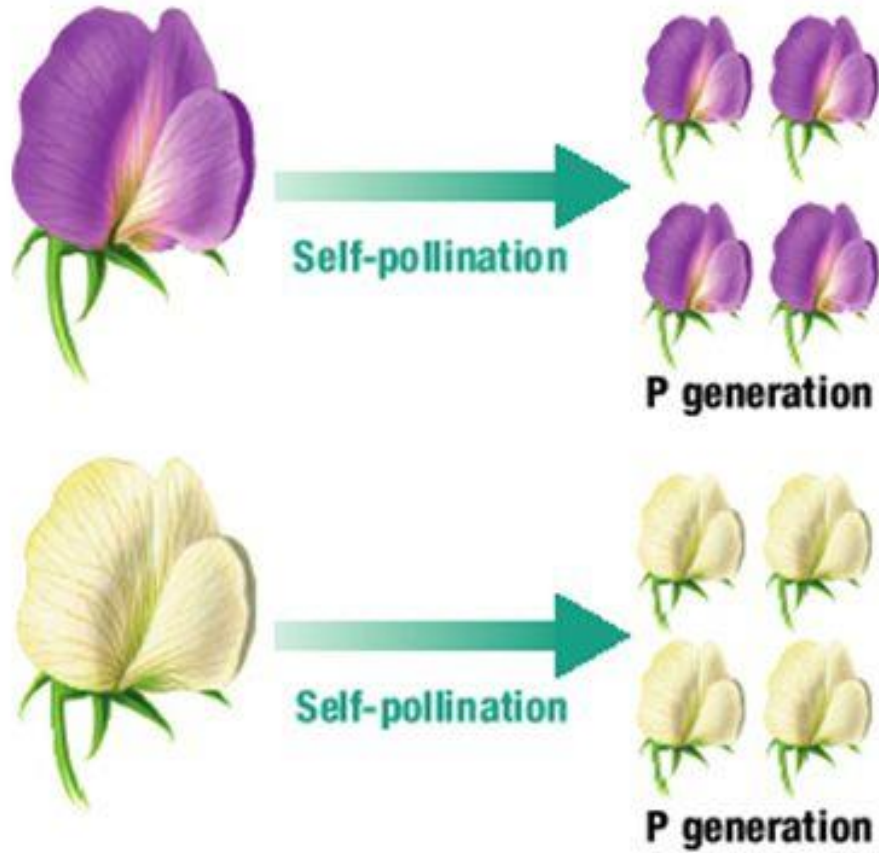


GREGOR MENDEL — FATHER OF GENETICS

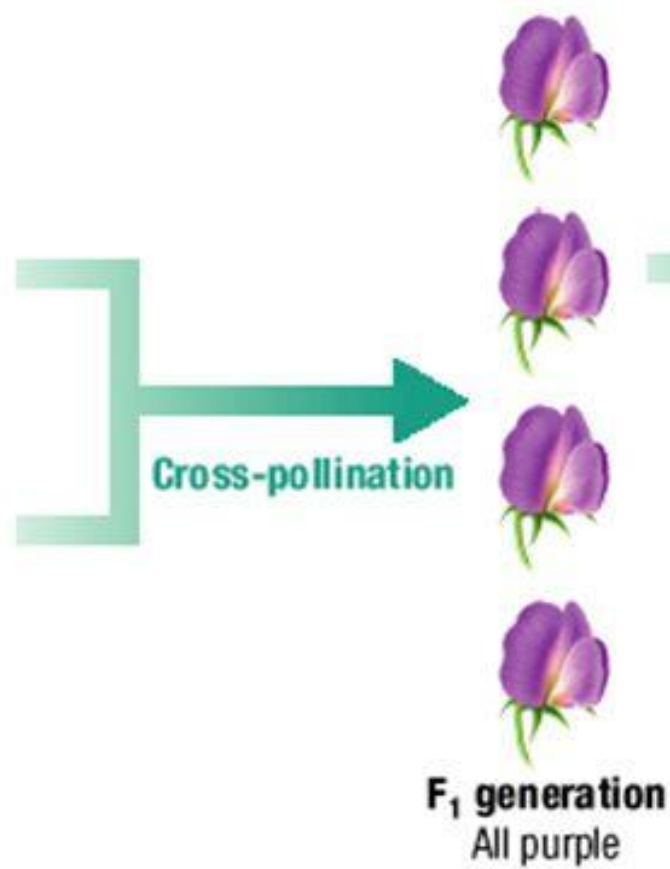
- Worked on pea plants to discover the fundamental laws of inheritance
- Deduced that **genes come in pairs** and are inherited as distinct units, one from each parent.
- Tracked the segregation of parental genes and their appearance in the offspring as **dominant or recessive traits**.
- Recognized **mathematical patterns of inheritance** from one generation to the next.



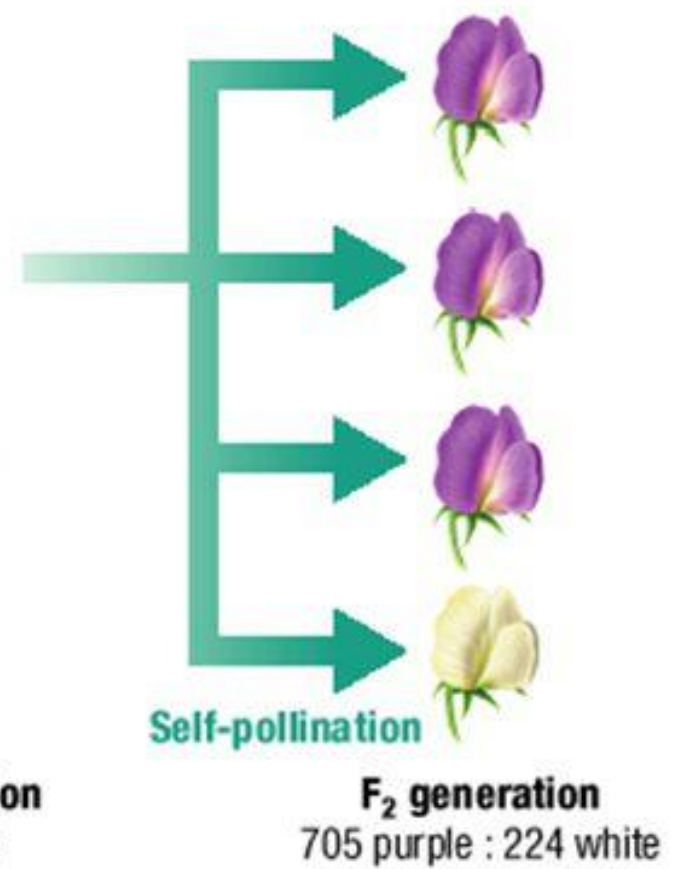
1 Producing a true-breeding P generation



2 Producing an F₁ generation



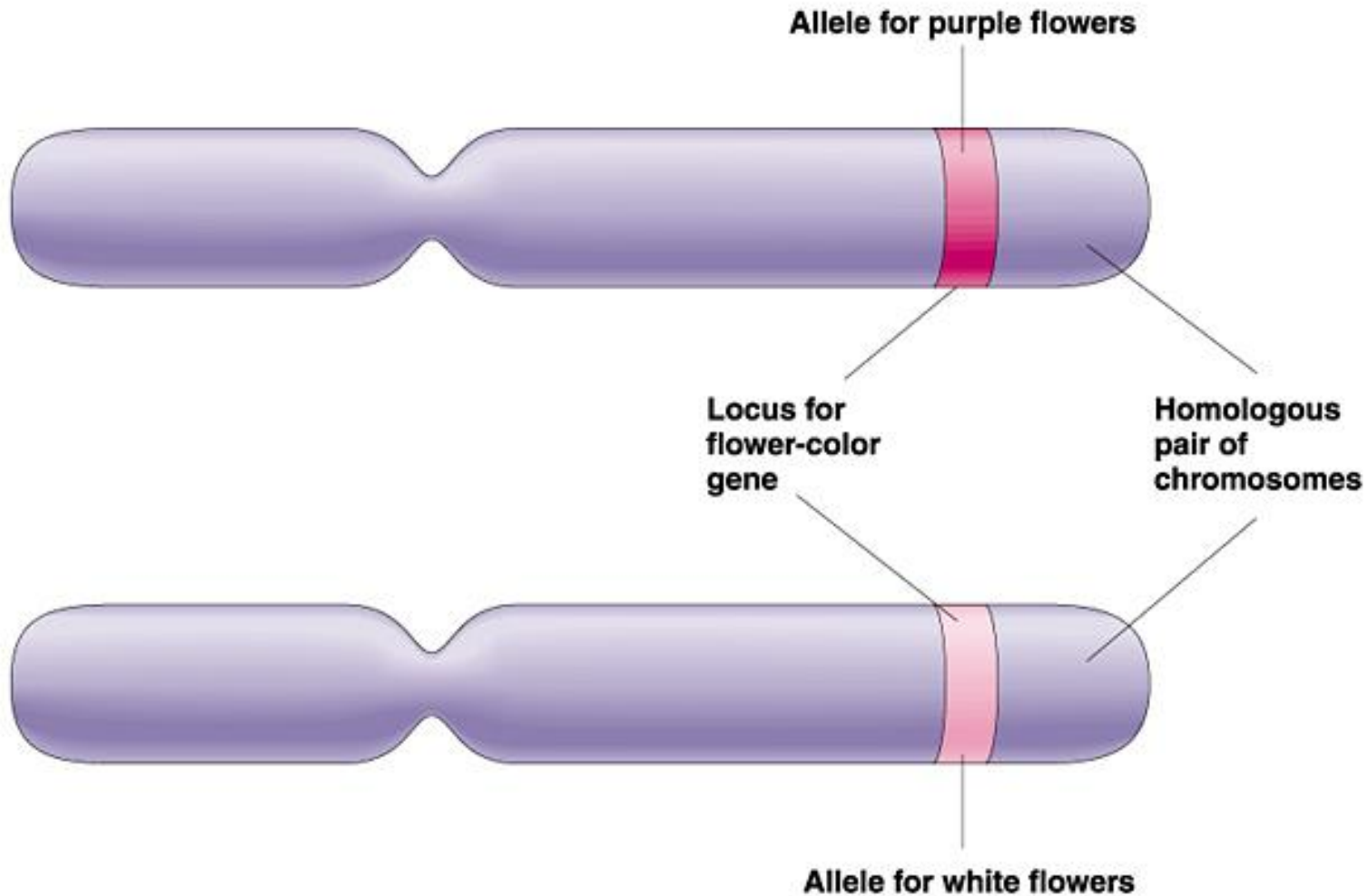
3 Producing an F₂ generation



MENDEL'S LAWS OF HEREDITY

1. The Law of Dominance
2. The Law of Segregation
3. The Law of Independent Assortment





©1999 Addison Wesley Longman, Inc.

LAW OF DOMINANCE

Alleles can be either **dominant or recessive**.

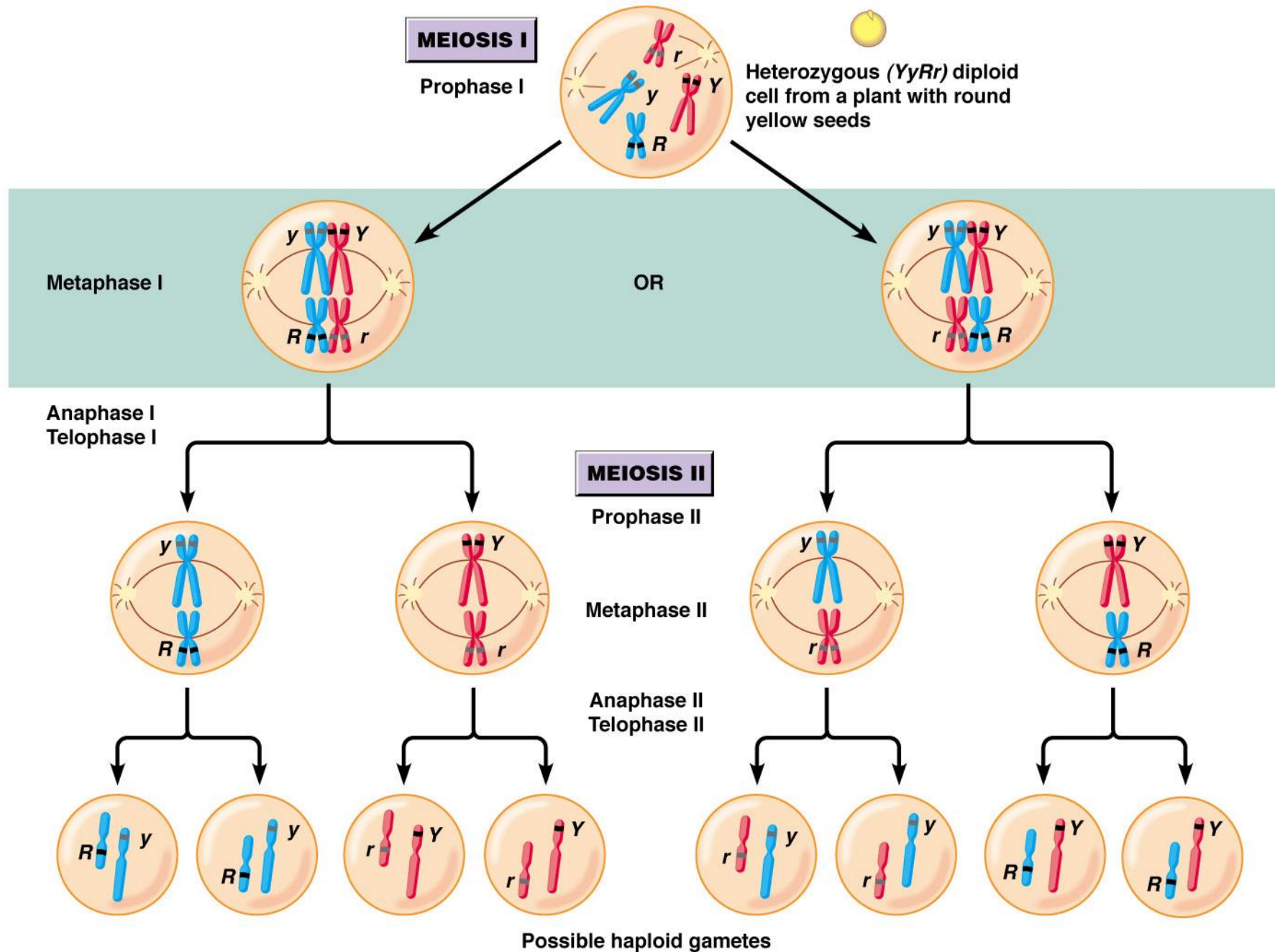
An organism with alternate forms of a gene will always **express the form that is dominant**.

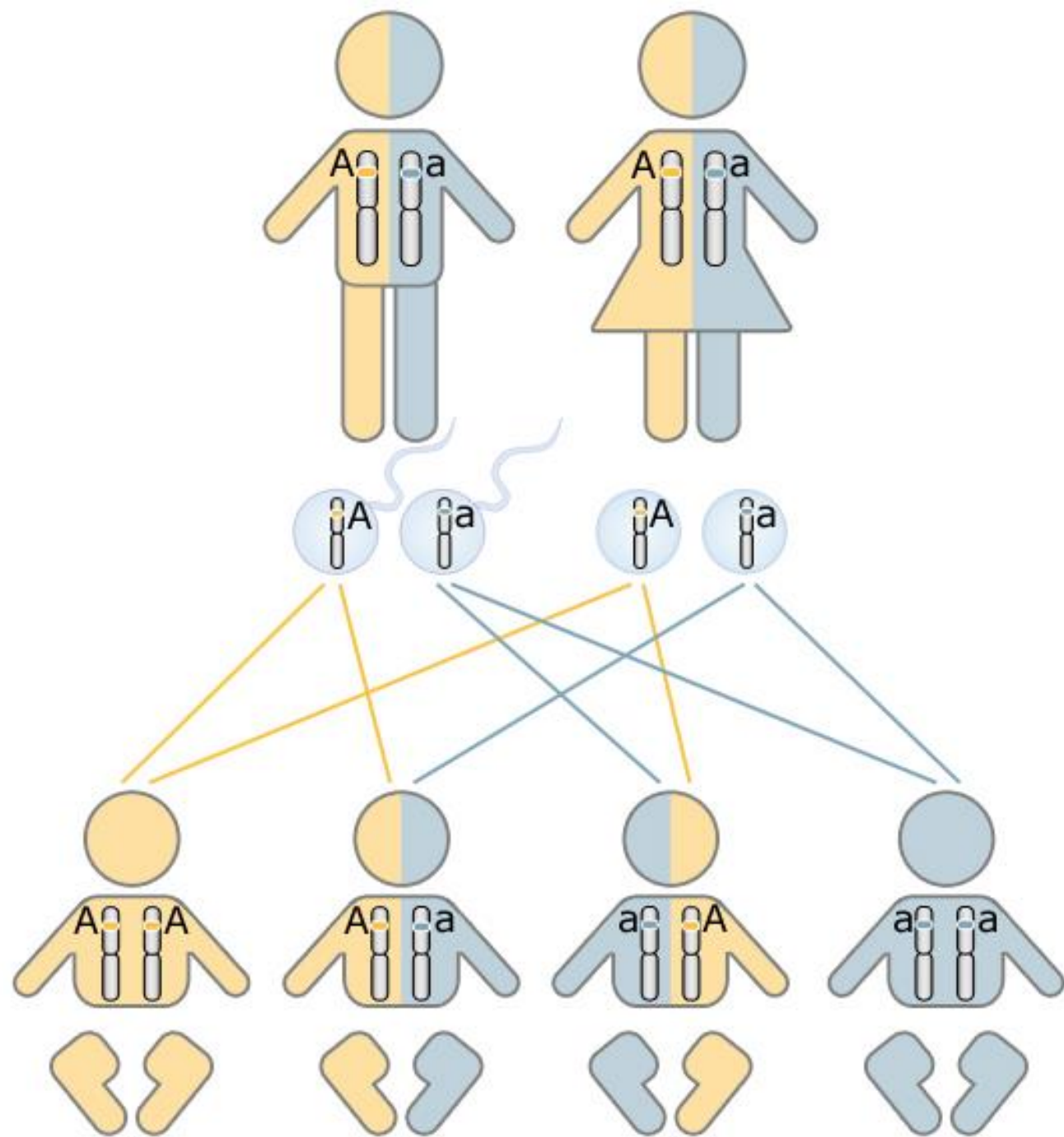


LAW OF SEGREGATION

- Each inherited trait is defined by a gene pair.
- Parental genes are randomly separated to the sex cells so that sex cells contain only one gene of the pair.
- Offspring therefore inherit one genetic allele from each parent when sex cells unite in fertilization.







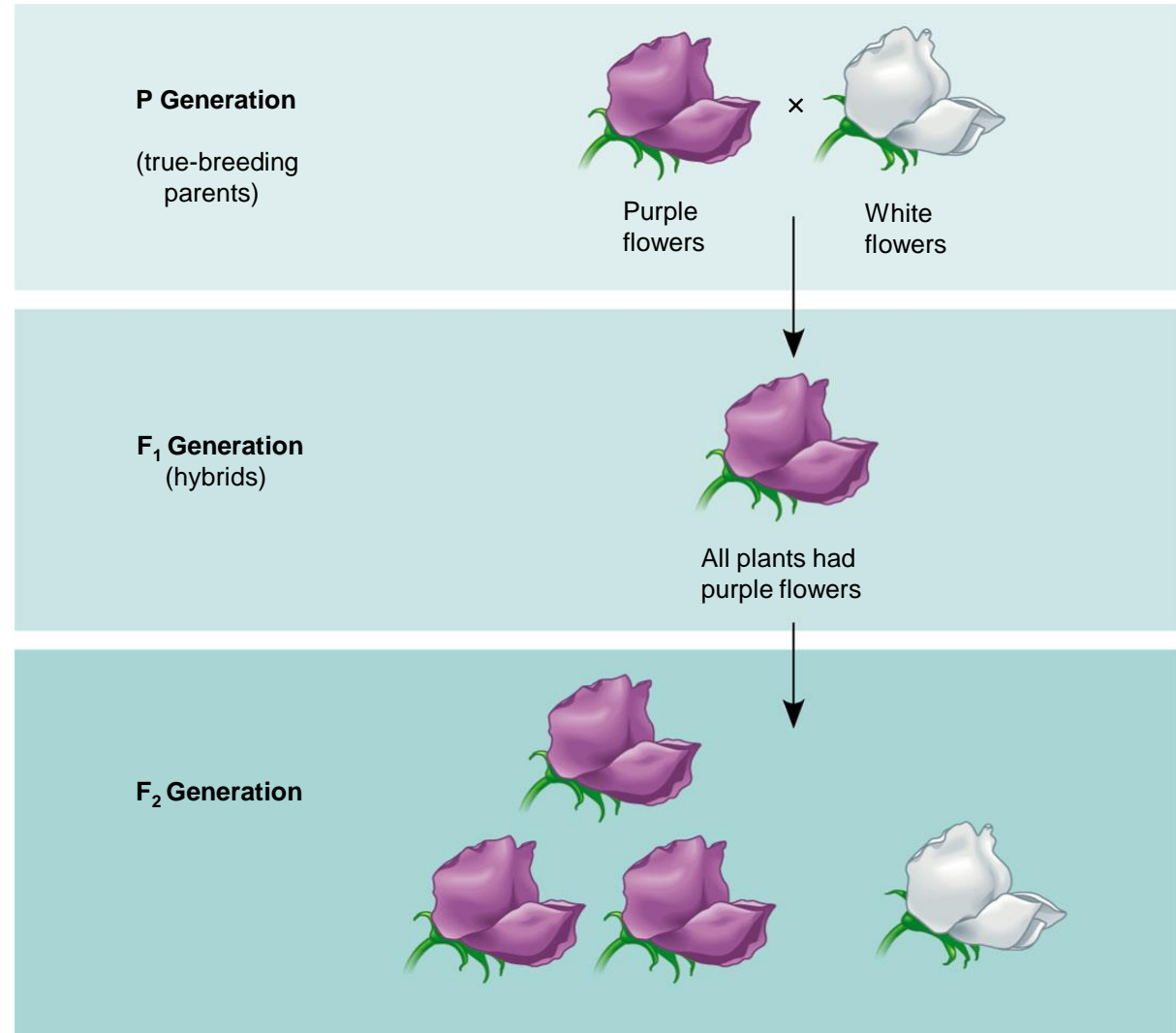
LAW OF INDEPENDENT ASSORTMENT

- Genes for different traits are sorted separately from one another.
- The inheritance of one trait is not dependent on the inheritance of another.



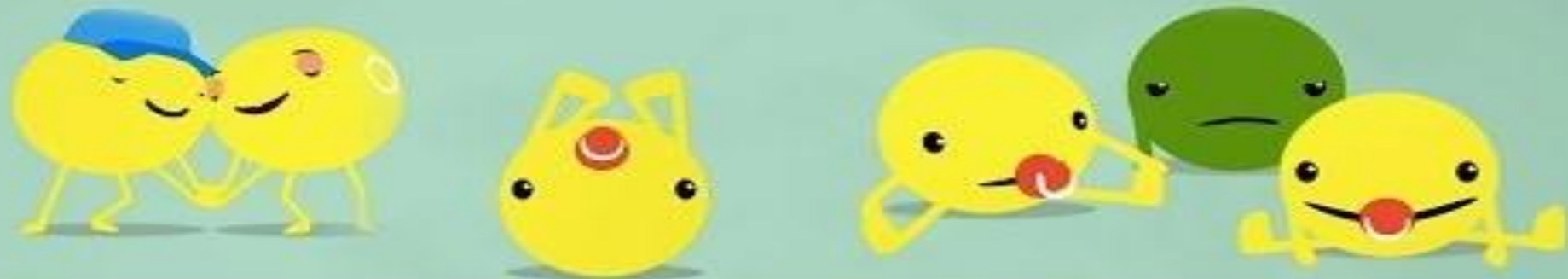
WHAT IF?

If you mated **two purple-flowered plants** from the P generation, what **ratio of traits** would you expect to observe in the offspring F₁?





HOW MENDEL'S
PEA PLANTS
HELPED US UNDERSTAND
GENETICS



WHAT IS A PUNNETT SQUARE?

- A tool to **predict the probability of certain traits** in offspring that shows the different ways alleles can combine
- A way to **show phenotype & genotype**
- A chart that **shows all the possible combinations** of alleles that can result when genes are crossed



WHAT IS A PUNNETT SQUARE? (CONT'D)

Parental Genotypes

		♂	
		D	d
♀	D	DD	Dd
	d	Dd	dd

D = Dominant Allele
d = Recessive Allele

- Letters stand for dominant and recessive alleles
- An **uppercase letter** stands for a **dominant** allele
- A **lowercase letter** stands for **recessive** alleles



MONOHYBRID CROSS

Parental Genotypes

		♂	
		D	d
♀	D	DD	Dd
	d	Dd	dd

D = Dominant Allele
d = Recessive Allele

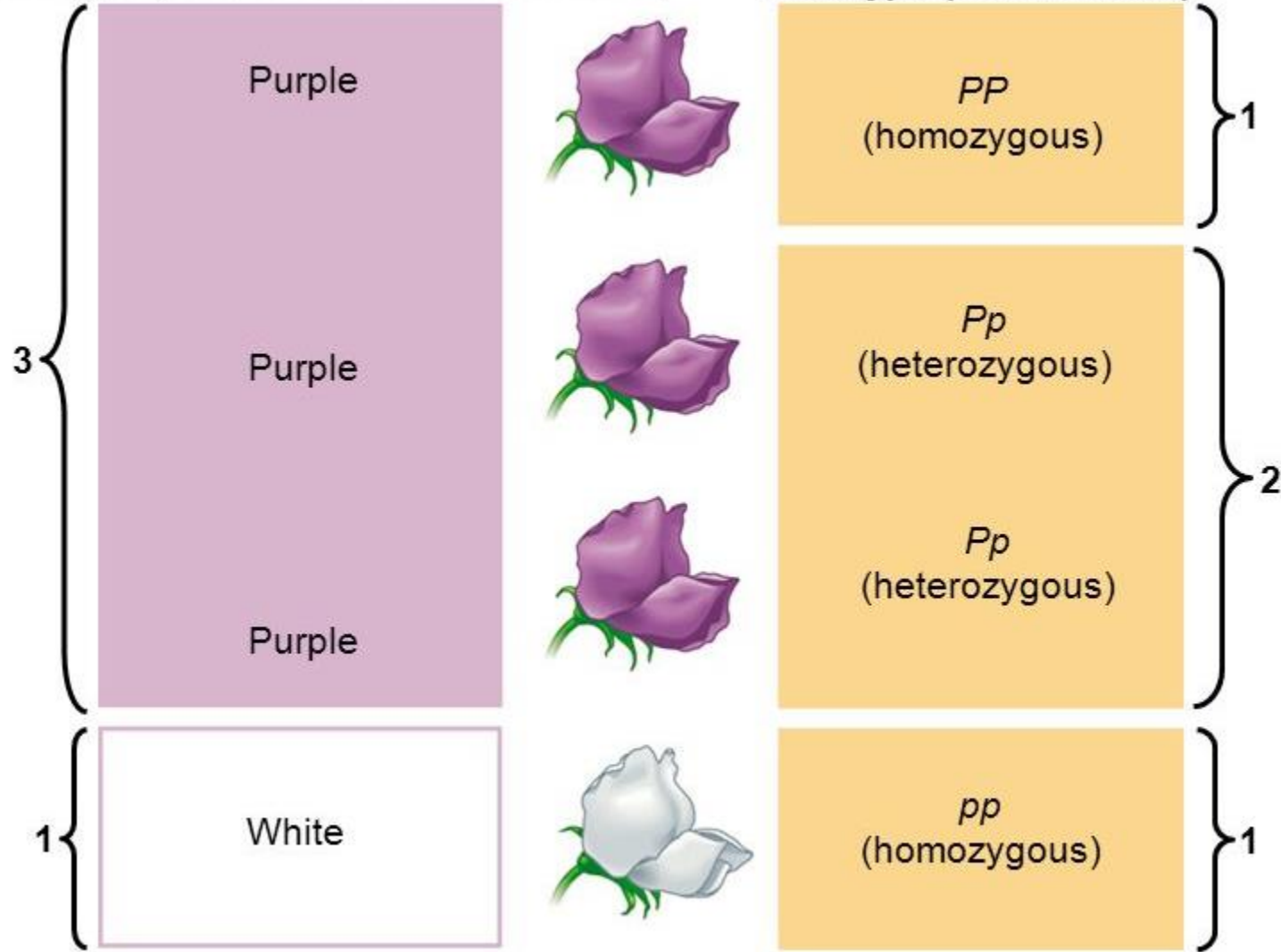
		pollen ♂	
		B	b
pistil ♀	B	BB	Bb
	b	Bb	bb

Mendel's F₁ Generation
Self- or cross-pollination



Phenotype (Observable characteristics)

Genotype (Gene alleles)



Ratio 3:1

Ratio 1:2:1



TOPIC 1 LEARNING TARGETS

- ✓ Use basic genetics vocabulary (**genotype, phenotype, heterozygous**, etc.)
- ✓ Describe Mendel's **experiments and his laws**.
- ✓ Use **Punnett squares** for basic monohybrid crosses.



REMAINING CLASS TIME

- For the **remainder of class**, independently work on the practice handout. ****It is due at the end of class.**
- Upon completion of the practice handout, create and finish making a **graphic organizer** that contains the 11 vocabulary words, descriptions, and examples.
- If you are **done with both of the above assignments**, you are to read article about “designer babies” at the following link:
<http://www.actionbioscience.org/biotechnology/agar.html>
 - Write **three** things that you’ve learned from the article.
 - Write **two** questions that you have after reading the article.
 - Write **one** idea that you found most interesting within the article.

