CLASSICAL

Genetics

BOOKLET 1

The study of Heredity

Inheritance of traits coded for by genes


HERE'S AN INTERESTING ITEM!
STUDIES ARE FINDING THAT DIRT AND DUST ARE GOOD FOR YOU
DAILY EXPOSURE TO FILTH BOOSTS THE IMMUNE SYSTEM
SO IT SEEMS THE REWARD FOR BEING A GOOD HOUSEKEEPER IS IN RAISING SICK KIDS
I HAVEN'T HAD A SICK DAY IN MY LIFE!
JUST SO YOU KNOW—IN YOUR CASE—IT'S GENETIC!
Delainey and Rasmussen.
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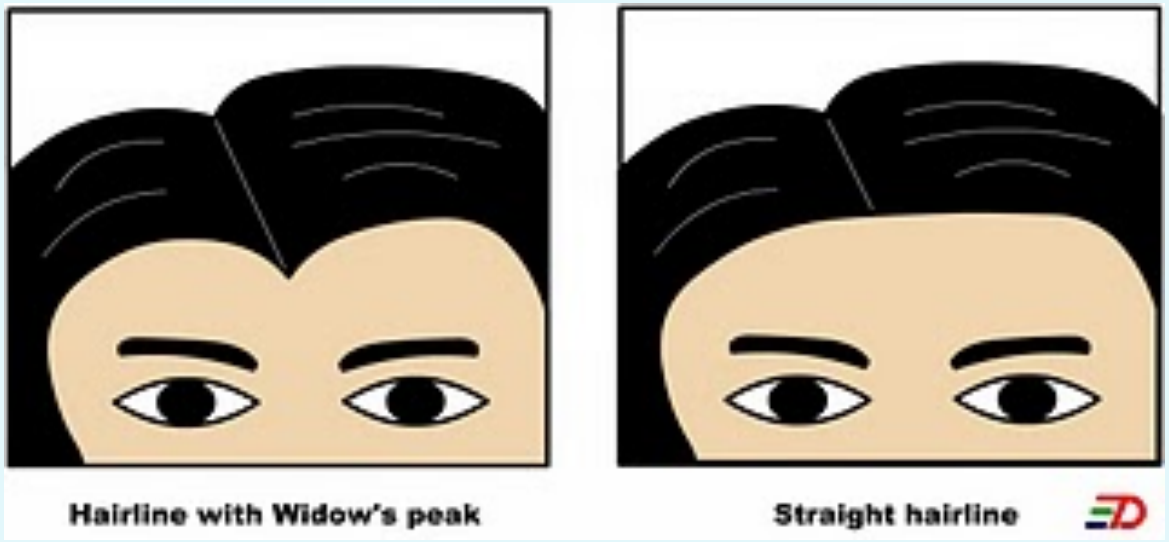
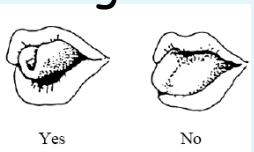
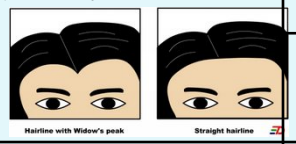
www.comics.com 10-17

Interesting Traits

- Do you have a widows peak or straight hair line?



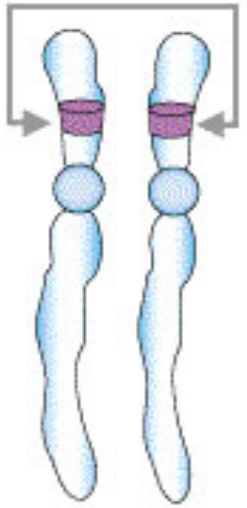
Inheritance of Human Characteristics Activity

Trait	Phenotypes and Genes	Your Phenotype	Class Data	% of Class
Ear lobes 	Free (E)			
	Attached (e)			
Tongue rolling 	Roller (R)			
	Non-roller (r)			
Hairline 	Widow's peak (W)			
	Straight ($\tilde{w}$)			
Interlocked fingers	Left over right (L)			
	Right over left (l)			

Dominant and Recessive Traits 1:57 http://www.youtube.com/watch?v=mnSkz8s-b44

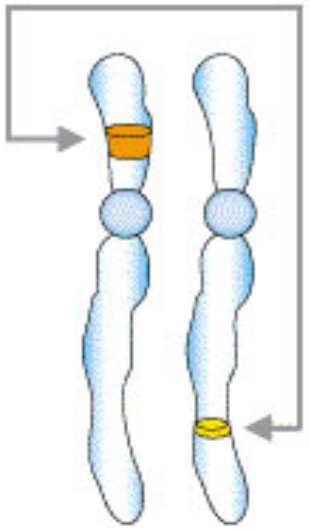
Genes and Heredity

- **Genetics** is the study of inheritance
- **Heredity** is controlled by genes
- Genes are found on **chromosomes**
- Each person has 2 genes (**alleles**) for each trait - one from each parent



Alleles

(code for same trait, same location on chromosome)

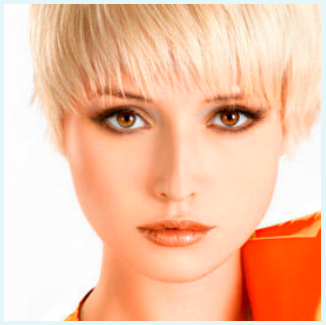


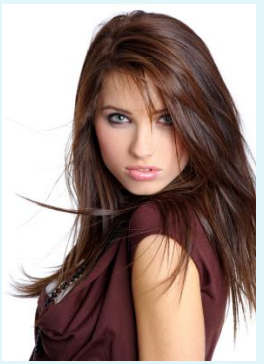
Genes, but *not* alleles

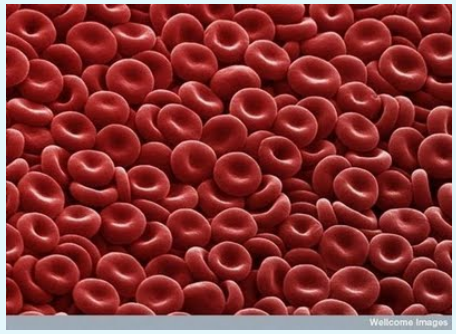
(code for different trait, different locations on chromosome)

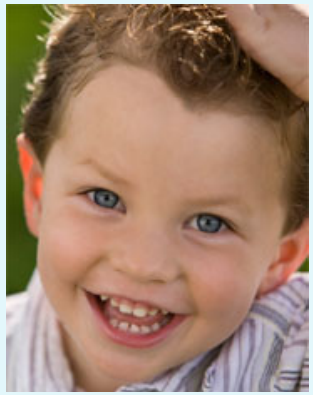
Genes and Heredity

- Ever wondered why you look more like your mom than your dad?
- Its all in your **genes**!
  - **Gene = specific units on a chromosome which code for traits (ex: hair colour, eye colour, blood type, hairline etc…)**









A gene pool is all the genes in a given population

Terminology you need to kn

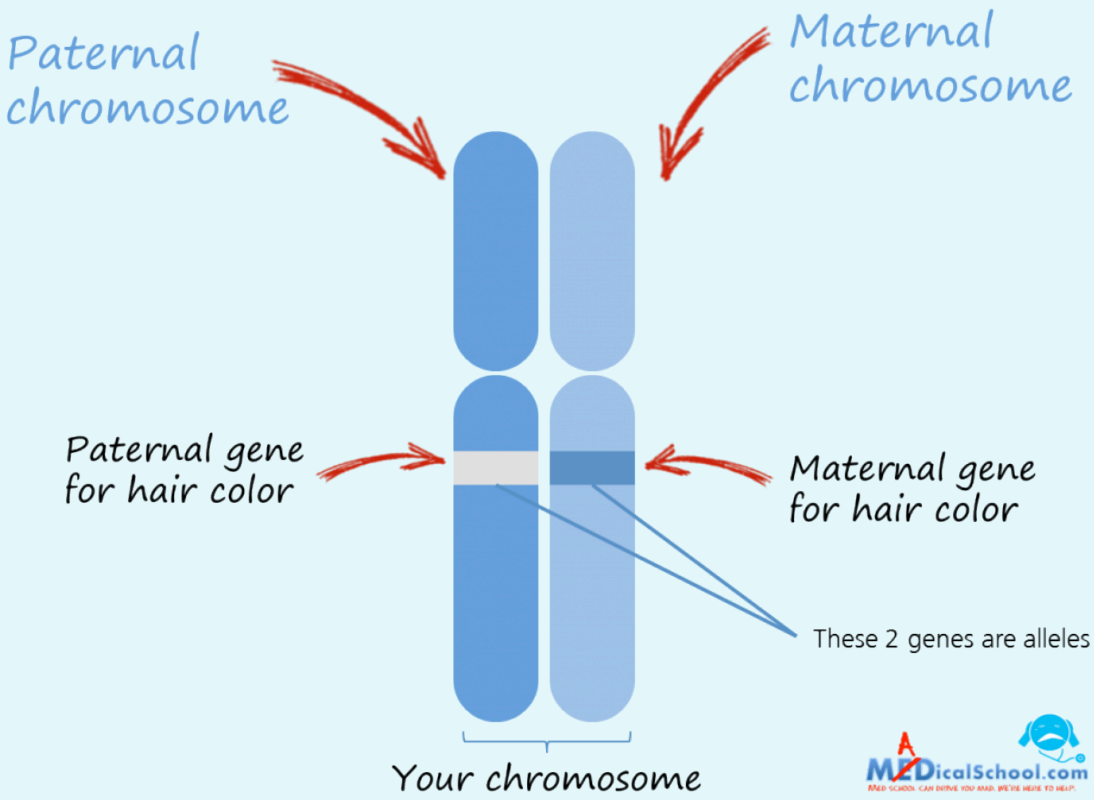
- **Allele**- alternate form of a gene

We inherit one allele from each parent

Each trait is controlled by at least 2 alleles

Each Allele is represented by two letters:

AA
aA
Aa
aa



Terminology you need to know

Allele vs Gene

(eg) the gene for eye color has several variations (alleles) such as an allele for **blue** eye color or an allele for **brown** eyes.

- **Dominant allele**

  masks the effect of the recessive allele

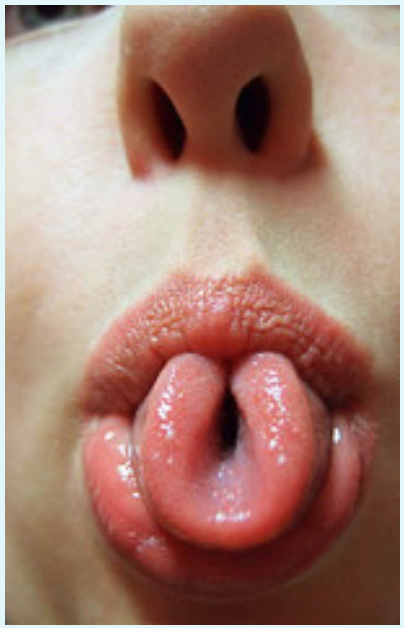
  Represented by a capital letter: **B**

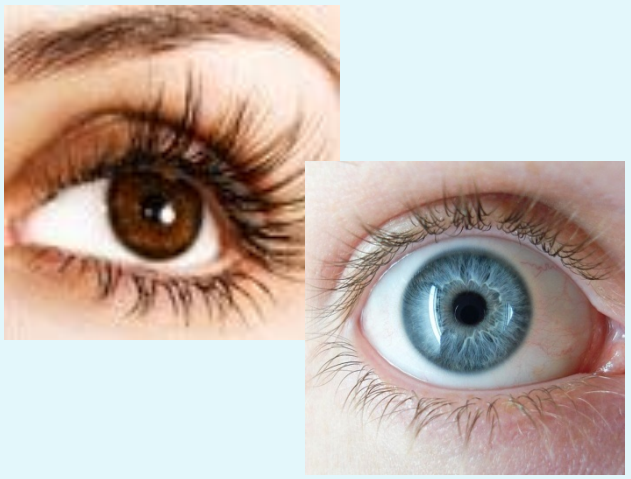
- **Recessive allele**

  Represented by a lower case letter **b**

More terminology…

- **Genotype**
  - genes that make up a trait
  - represented by at least two letters
    - ex: T = Tongue rollers (dominant); t = non-tongue rollers (recessive)
      - Tongue roller = TT or Tt
      - Non Tongue roller = tt
- **Phenotype**
  - description of the physical appearance of an organism; depends on its genotype
  - ex: brown eyes or blue eyes





More terminology ahhhh!!!

Homozygous dominant (purebred, or true-breeding)

Genotype with **2 dominant alleles:** TT

Homozygous recessive

Genotype with **2 recessive alleles:** tt

Heterozygous (hybrid)

Genotype with **1 dominant and 1 recessive allele:** This individual is a carrier for the recessive allele Tt

"Homo-" in greek means "same"
"Hetero-" in greek means "different"

Terminology Practice I

Allele: Give an example of an allele (other than eye colour) **AND** what could be an alternate form of that allele?

Dominant Allele: **a)** in your own words what is dominant allele?

b) what letters could be used to represent a dominant allele (give 26 examples)

Recessive Allele: **a)** in your own words what is recessive allele?

b) what letters could be used to represent a dominant allele (give 26 examples)

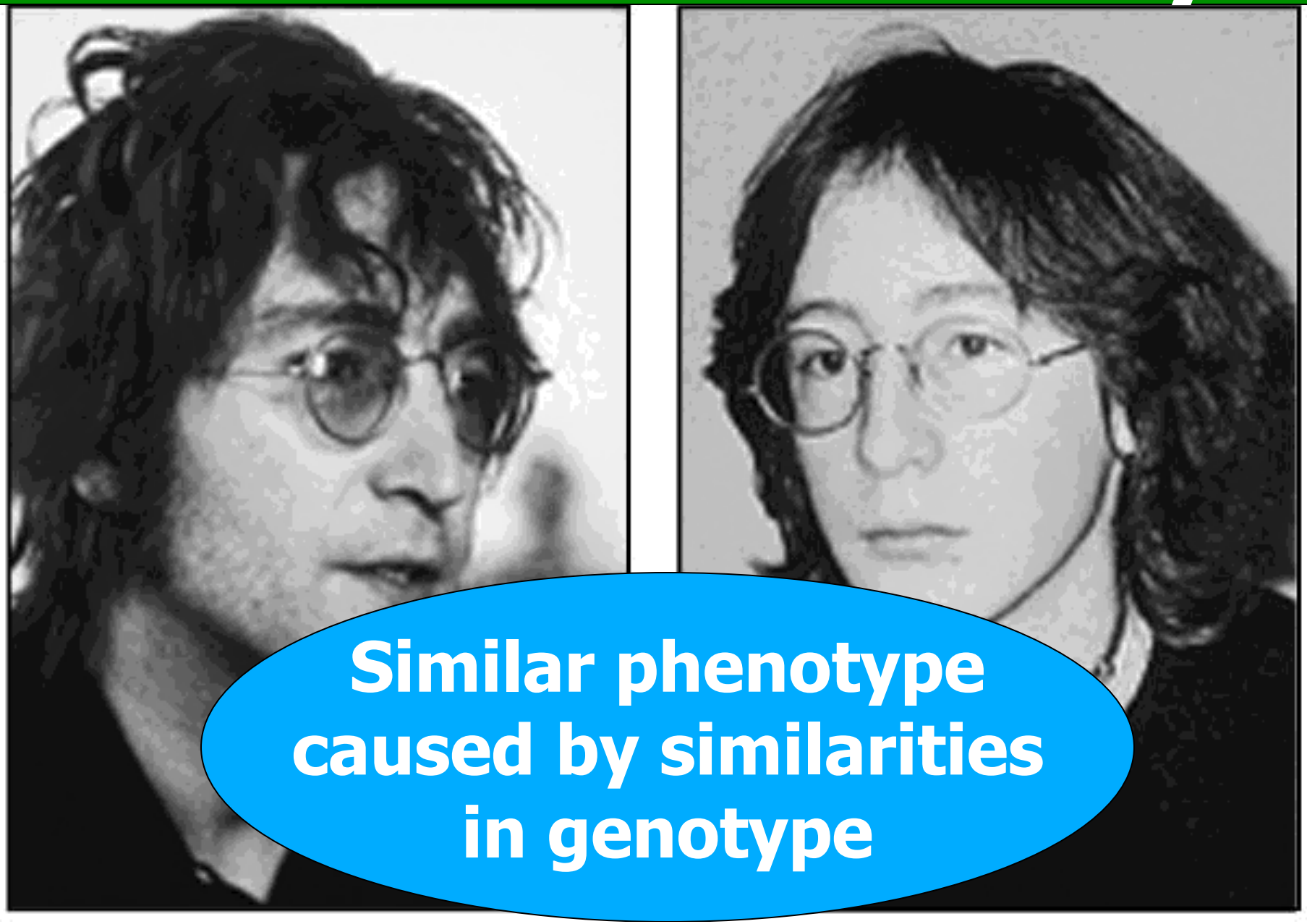
Terminology Practice II

Compare a genotype to phenotype?

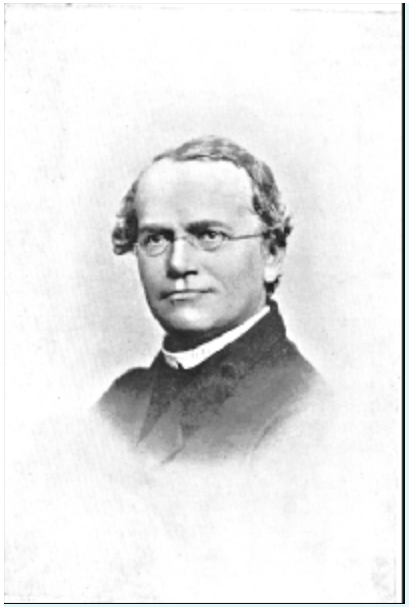
Are the following "homozygous recessive" or "homozygous dominant" or "heterozygous"

bB
SS
Ss
aA
Aa
aa
AA
bb

Evidence for Heredity



Similar phenotype caused by similarities in genotype

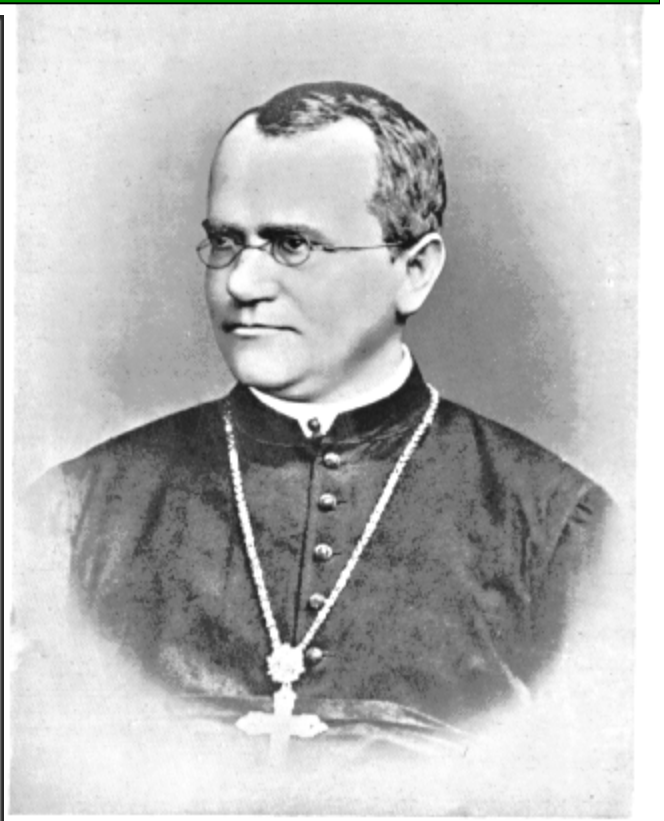


Gregor Mendel

Father of Modern Genetics

Austrian Monk

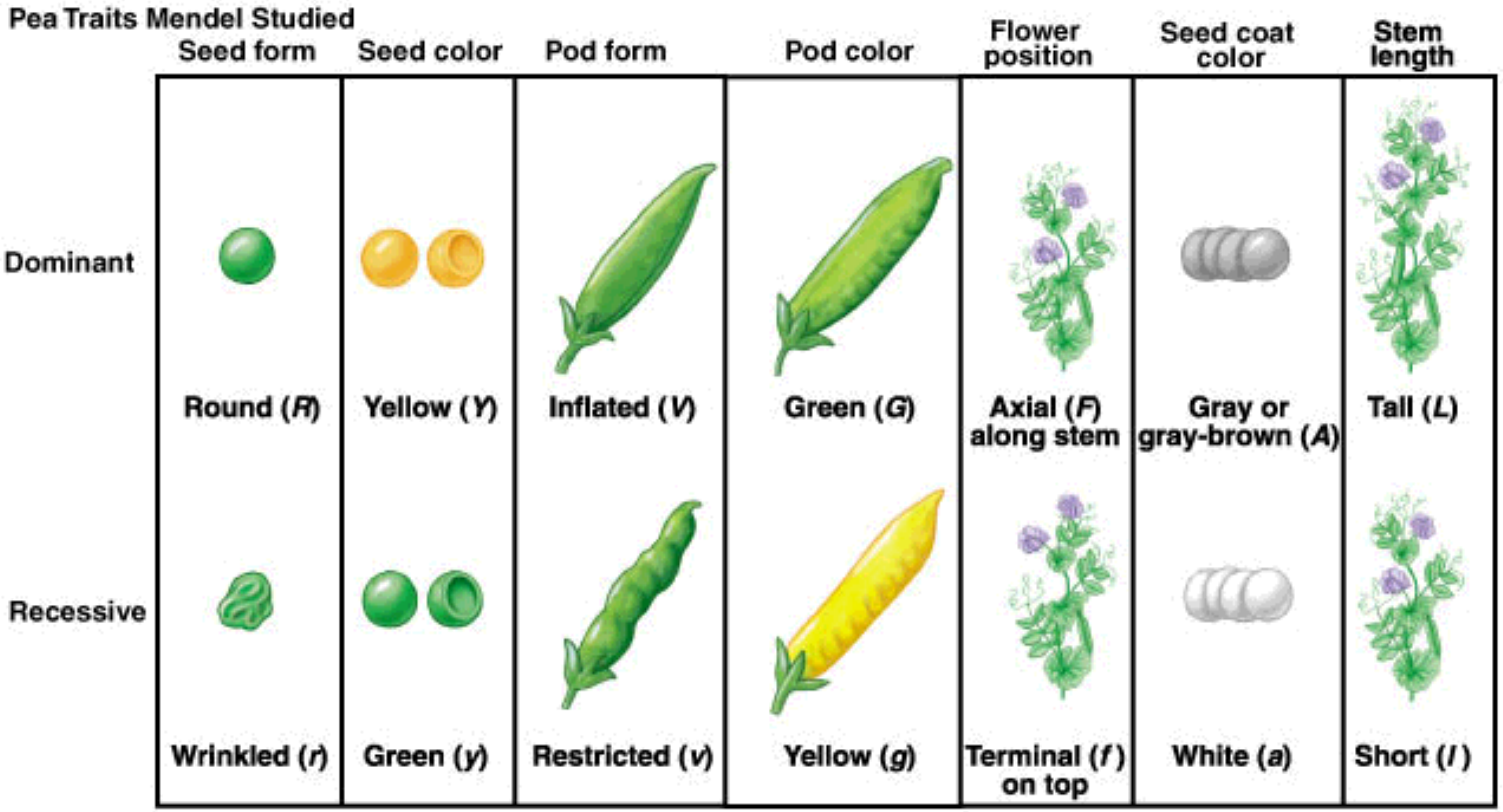
Studied and bred pea plants



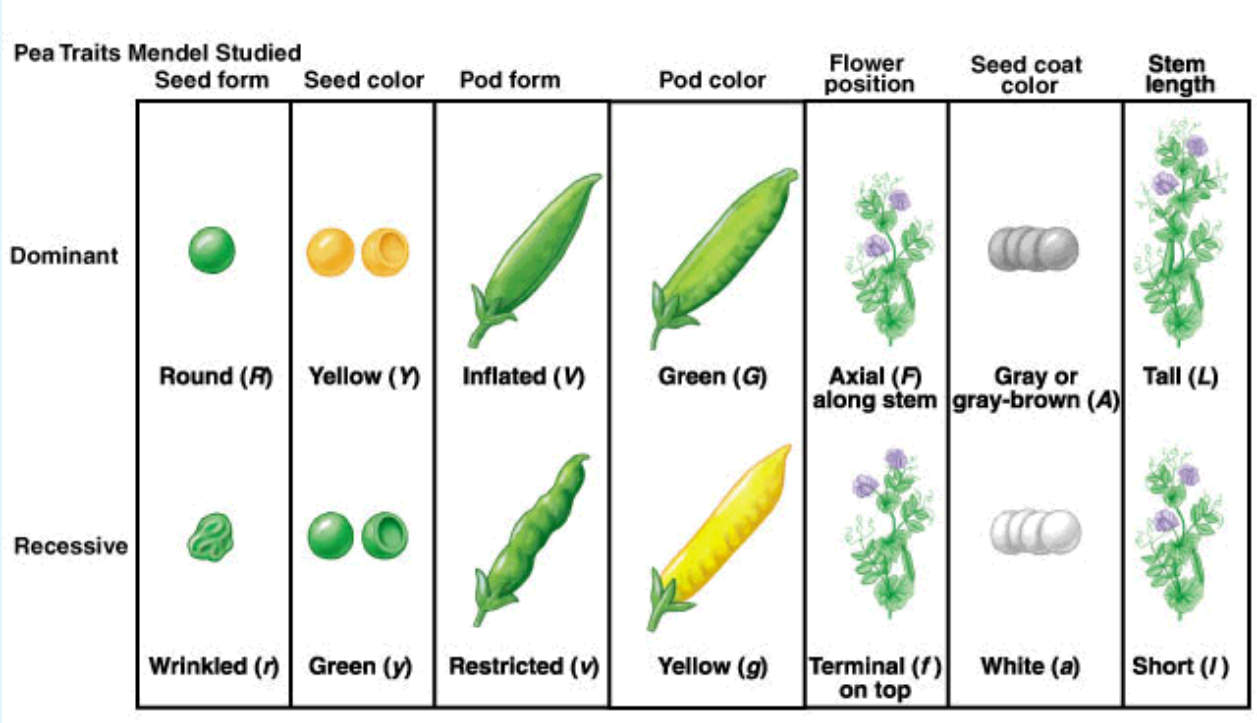
Mendel's pea plants showed traits that were markedly contrasting

Could tell tall from short easily

Traits studied by Mendel



Pea traits that Mendel studied

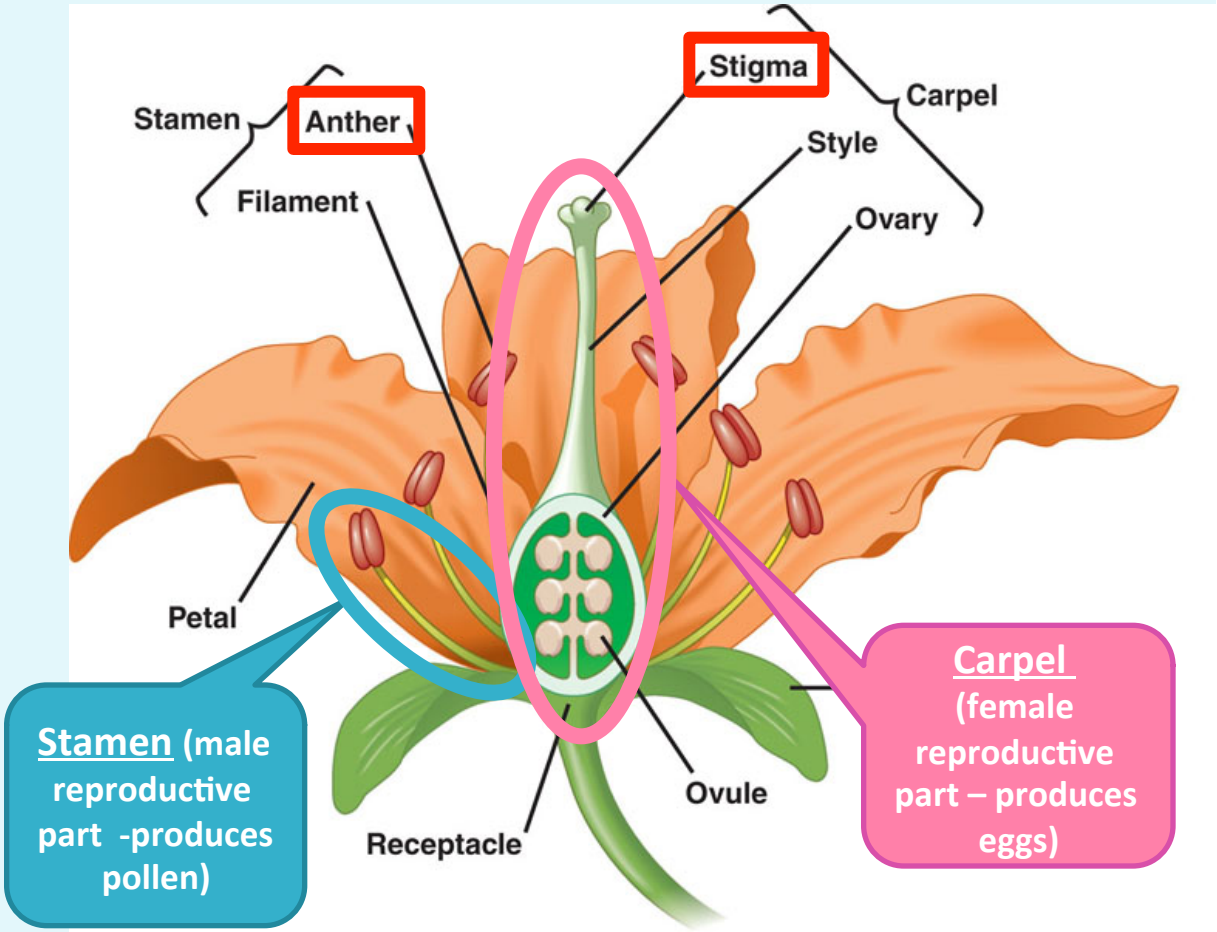


What is the phenotype of the following?

- **RR?** Round seed
- **Yy?** Yellow seed
- **gg?** Yellow pod

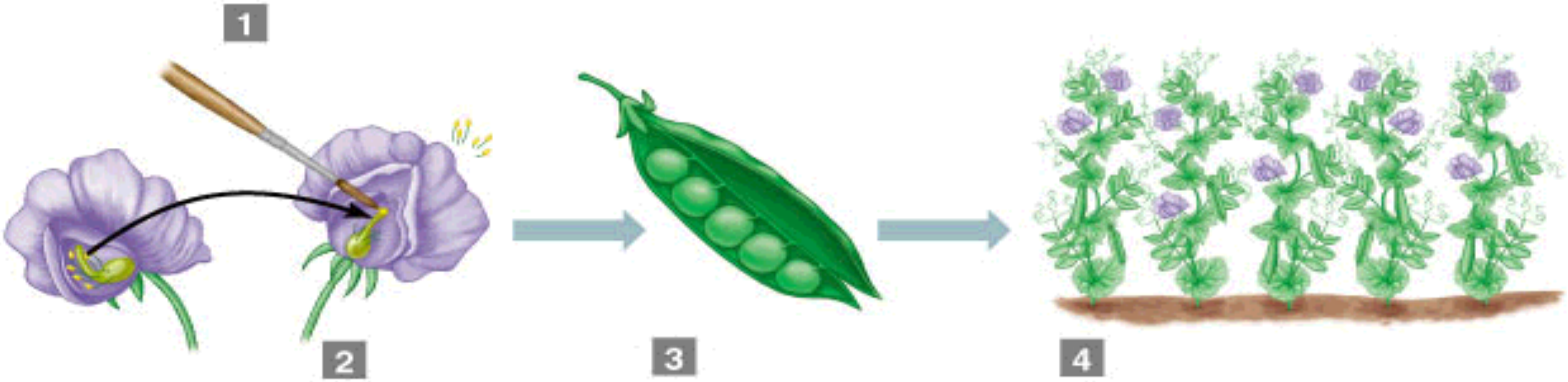
Cross-Pollination in Pea Plants

- Mendel cross-pollinated plants by hand
- Removed the **stamen** (male reproductive part) from one plant and transferred the pollen to the **carpel/pistil** (female reproductive part) of another plant



Cross Pollination/Cross Fertilization

Pollen from anther transferred by hand to stigma of female part



Gregor Mendel

– **CROSS 1:** **Pure Tall X Pure Short**

TT x tt

- **Result: All Tall offspring**

Tt Tt Tt Tt

Before doing experiments, Mendel creating "true breeding" or "pure" lines, plants that exhibited the same characteristics generation after generation

Note: Purebreeding = Homozygous

- **CROSS 2: two individuals from Cross 1**
  - **Resulting offspring: 75% Tall : 25% Short**

Tt x Tt

He reasoned that……

- **Gene for tall is dominant**
- **Gene for short is recessive**

This is an example of a monohybrid cross

monohybrid cross- comparing or looking at only 1 trait

Generations

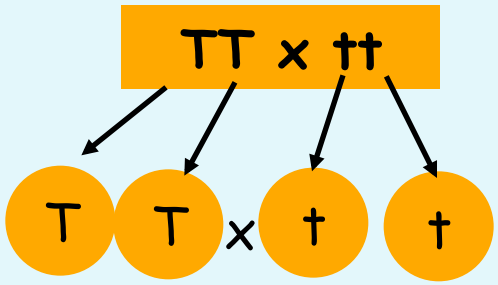
- **P_1 : Parental generation**
- **F_1 : First generation (F=Filial)** phili-al
- **F_2 : Second generation**
  - **Created by mating two individuals from the F_1 generation**

Predicting the outcome of a cross?

1. Write down a **legend** of the letters that you will use to indicate **dominant and recessive** alleles.
2. Write down the **genotypes** for the parents (write down the given and leave blanks for unknown).
3. Show the different **gametes** that each parent will produce. (Circle them!!)
4. Use a **Punnett Square** to show the results.
5. State the **phenotypic** and **genotypic** ratio.

T = Tall

t = short



Cross 1: Pure tall x Pure short

1. Legend:

T = Tall

t = short

2. Genotype of parents: TT x tt

3. Gametes: T T t t

Parental Gametes

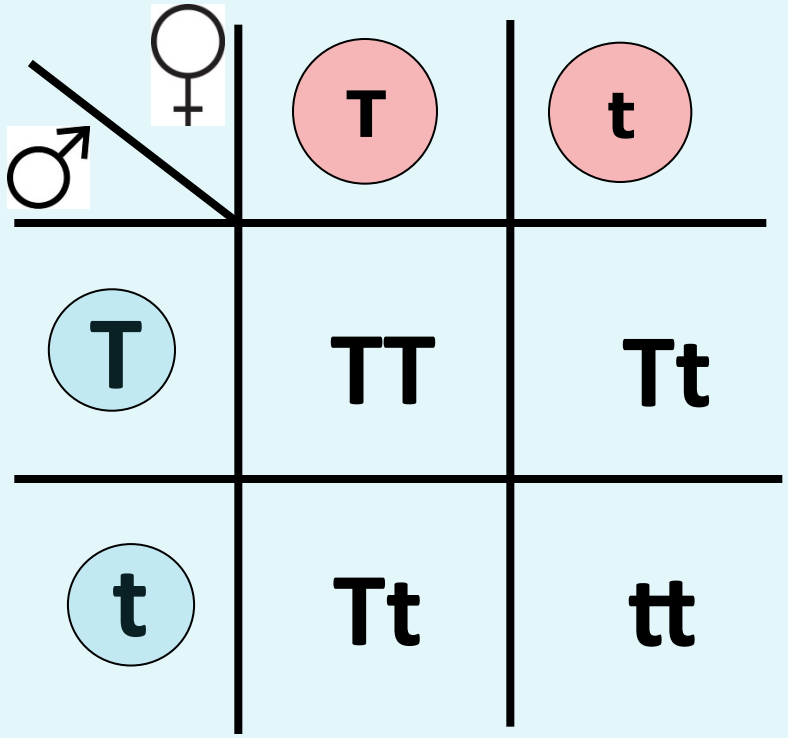
♀ / ♂	T	T
t	Tt	Tt
t	Tt	Tt

Phenotypes
All Tall

Genotypes
All Tt

Offspring
(F_1 generation)

Cross 2: Determine F_2 Generation



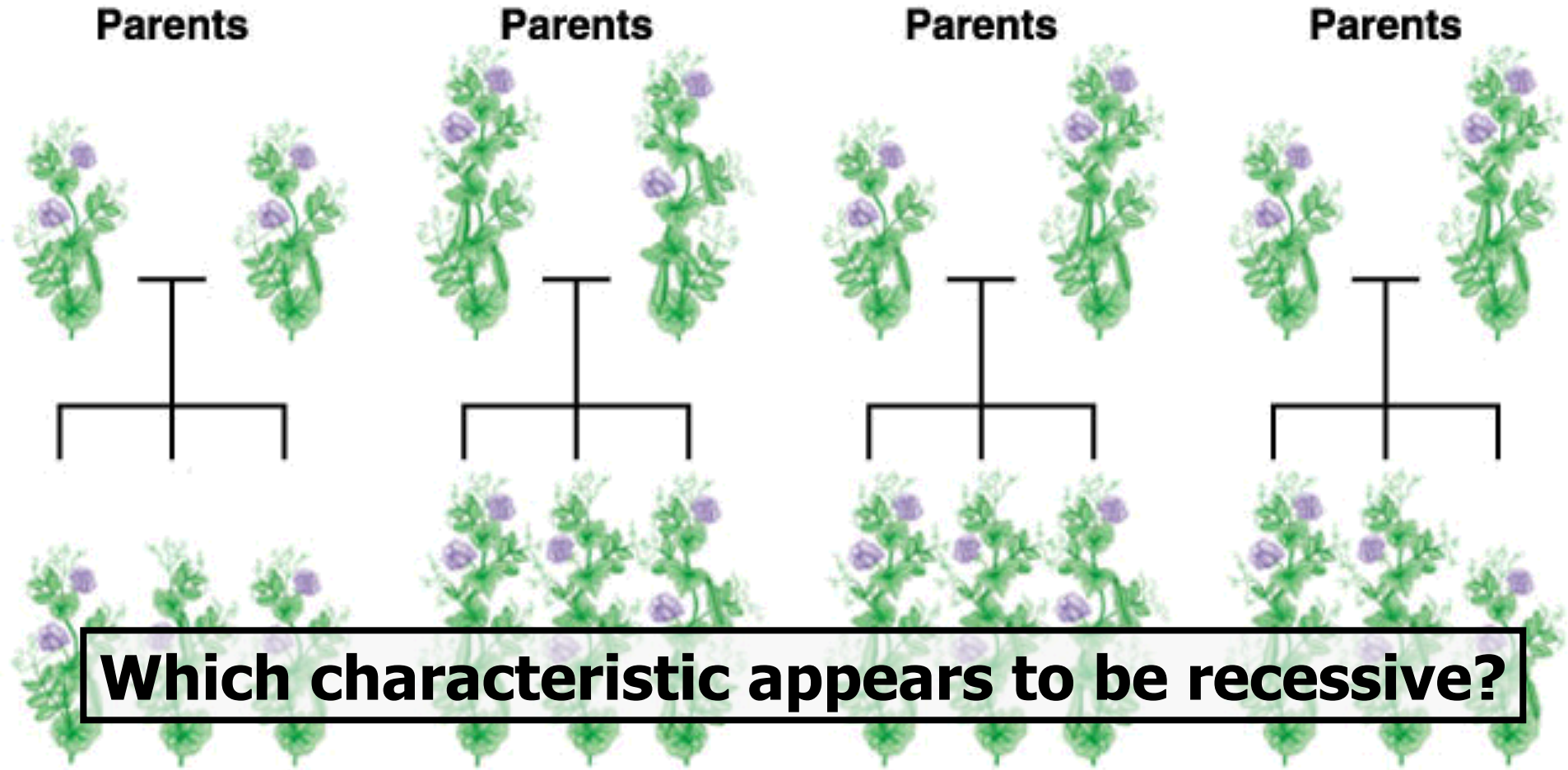
The dominant trait always shows up more often

What happens when fillial plants (F_1) generation are bred with other F_1 plants? (Tt x Tt)

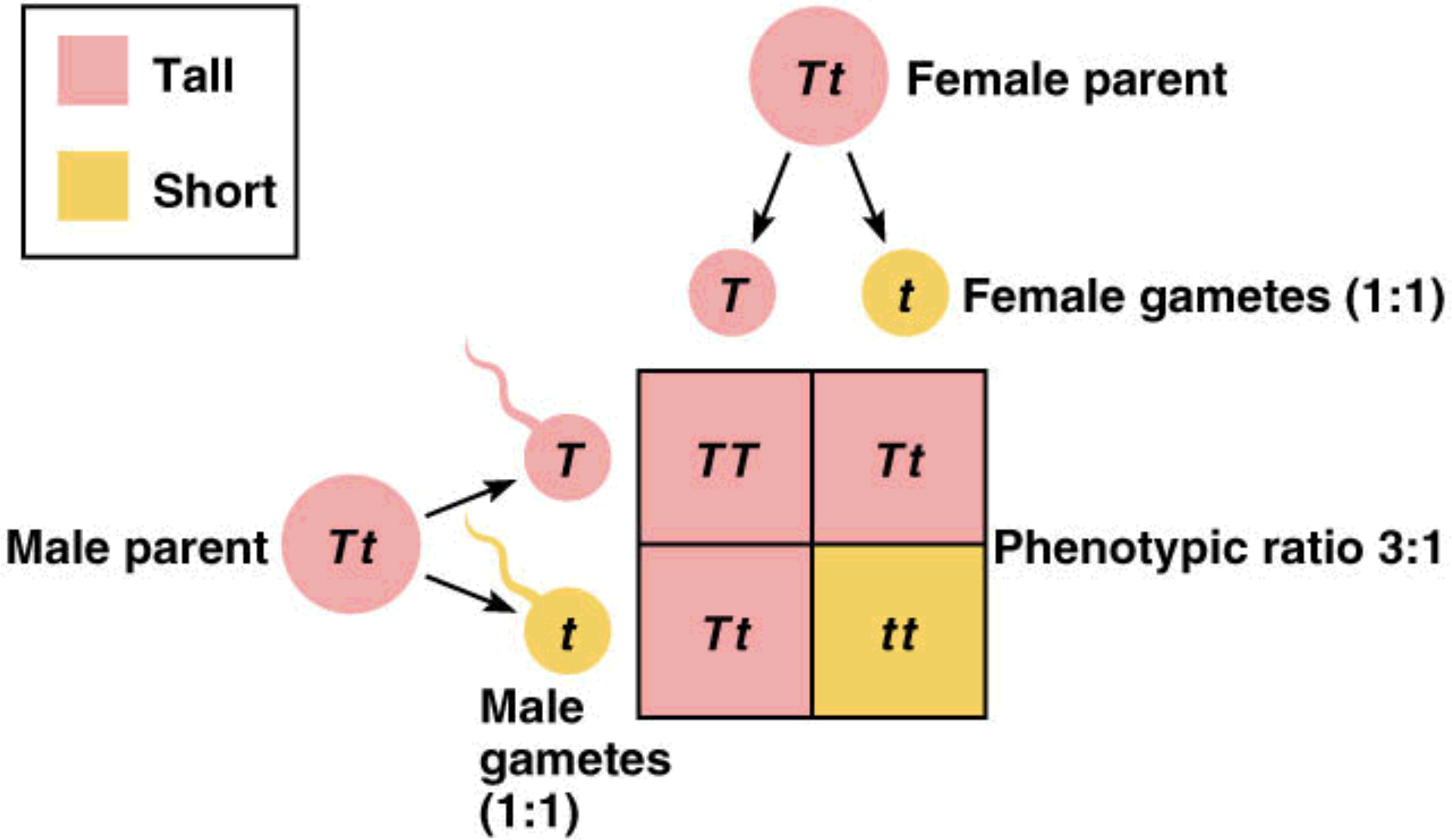
Phenotypes
3 Tall: 1 Short

Genotypes
1 TT : 2 Tt : 1 tt

Crossing Tall and Short Plants

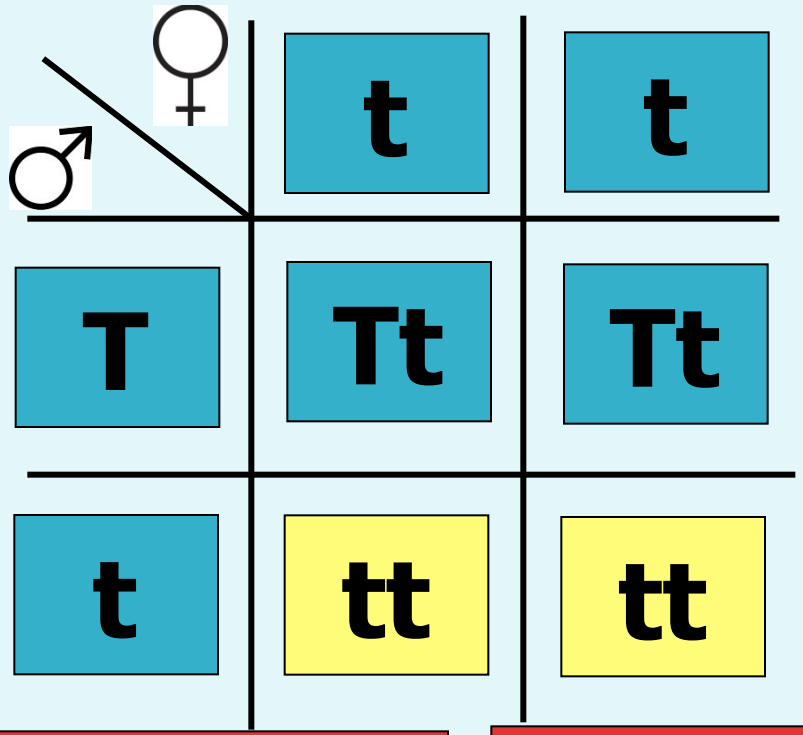


Identify the recessive allele & phenotype Using the following Punnett square



Try this example: Tt x tt

Monohybrid Cross



Phenotypes | **Genotypes**

Ratios: **1 Tall: 1 Short** **1 Tt : 1 tt**

Another example…

Problem:

Brachydactyly (short fingeredness) **is a dominant trait over normal length.**

A brachydactylous man (heterozygous) marries a normal woman.

What are the possible genotypes of their children?

Bra-key-dac-ta-lee

♂ \ ♀	b	b
B	Bb	Bb
b	bb	bb

Legend:
B = brachydactyly (dominant)
b = normal fingers (recessive)

Parents: Bb x bb

Phenotypes:
1 brachydactyl : 1 normal fingers

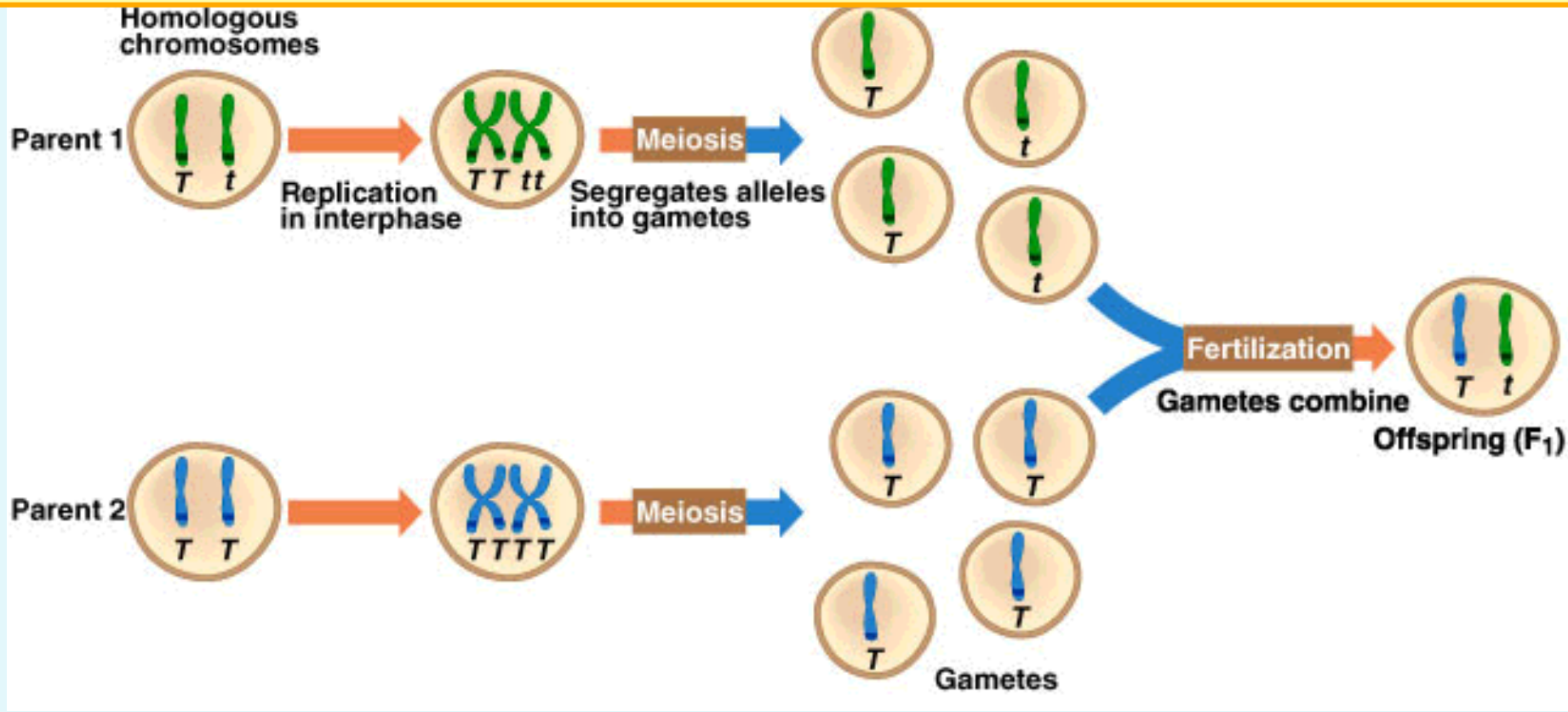
Genotypes:
1 Bb: 1 bb

Bozeman Beginner's Guide to Punnett Squares VIDEO

- http://www.youtube.com/watch?v=Y1PCwxUDTl8

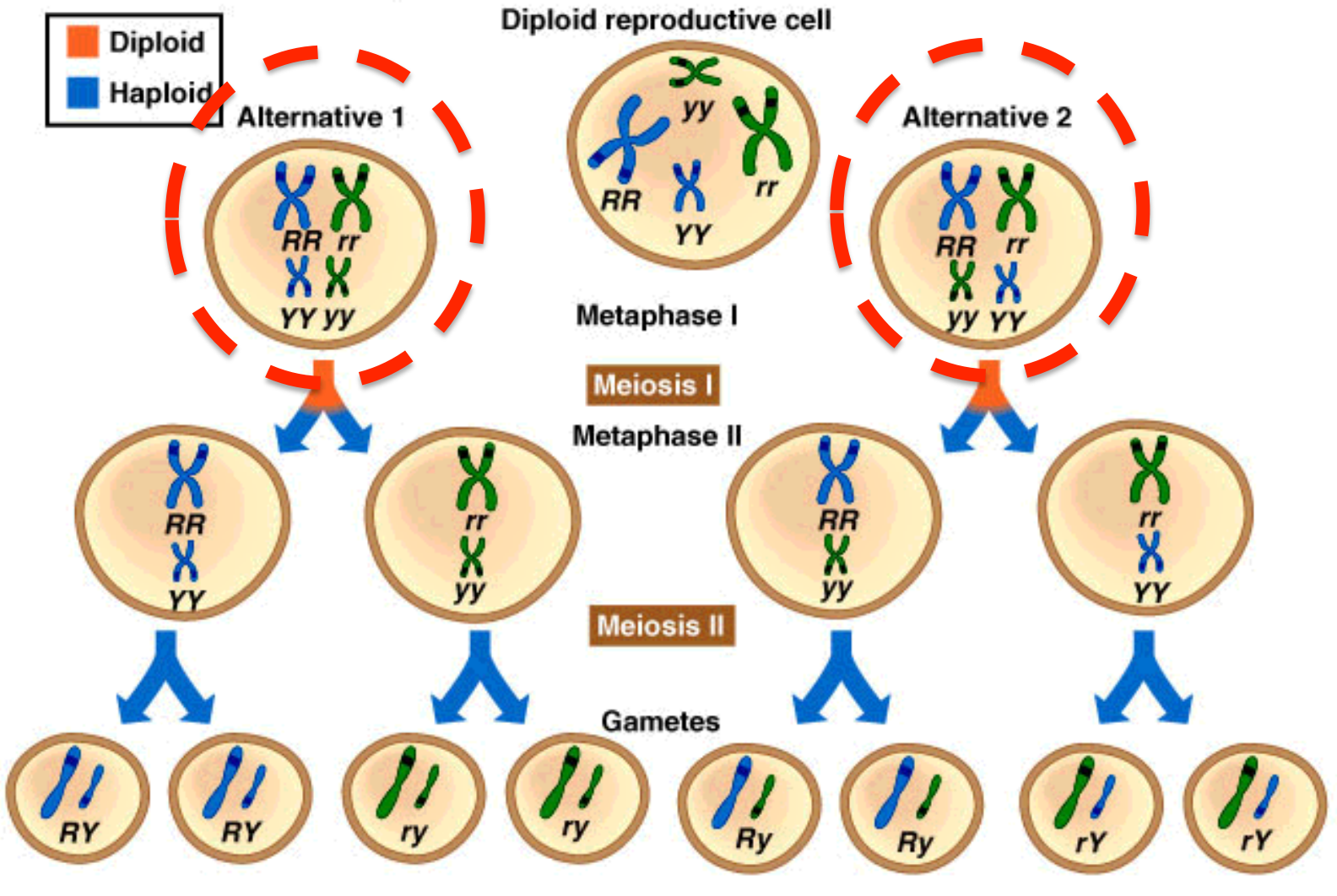
Mendel's Law of SEGREGATION

Law of Segregation: All individuals have two copies of each gene. Pairs of genes segregate (separate) when homologous chromosomes move to opposite poles during meiosis (anaphase 1). Each gamete (normally) contains one copy of every gene.



Mendel's Law of Independent Assortment

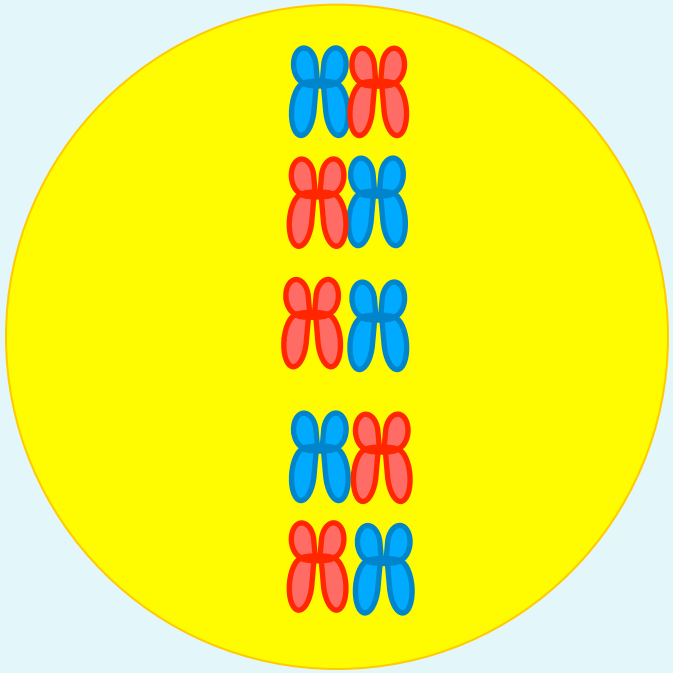
Law of Independent Assortment: Different pairs of alleles align independently of each other. (ie: The alignment of homologous chromosomes in meiosis is completely random!)



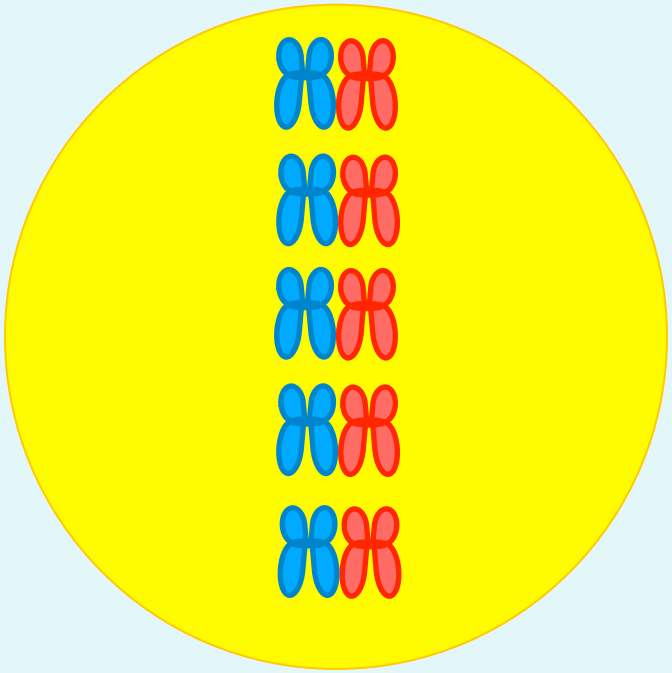
Law of Independent Assortment

– **Different pairs of alleles line up independently of each other (completely random!)**

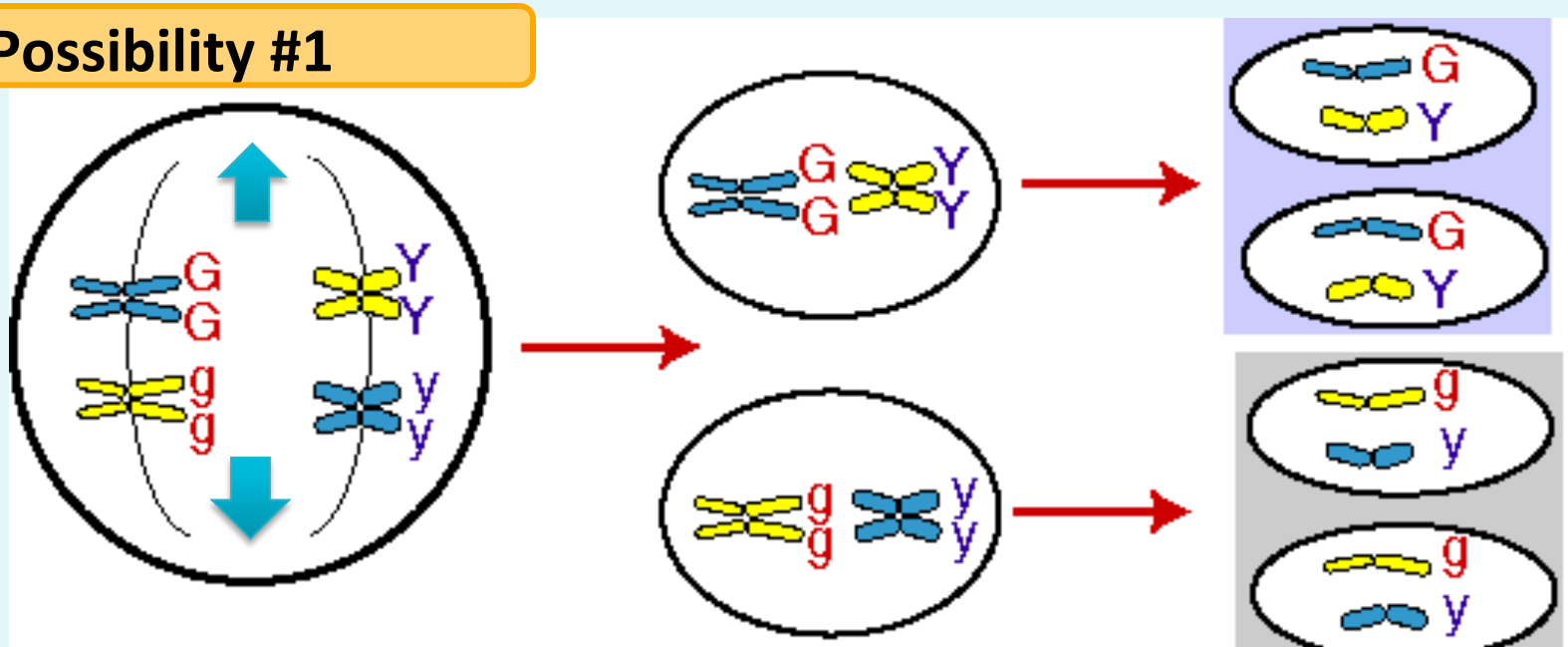
Independent Assortment



NOT very likely according to Independent Assortment

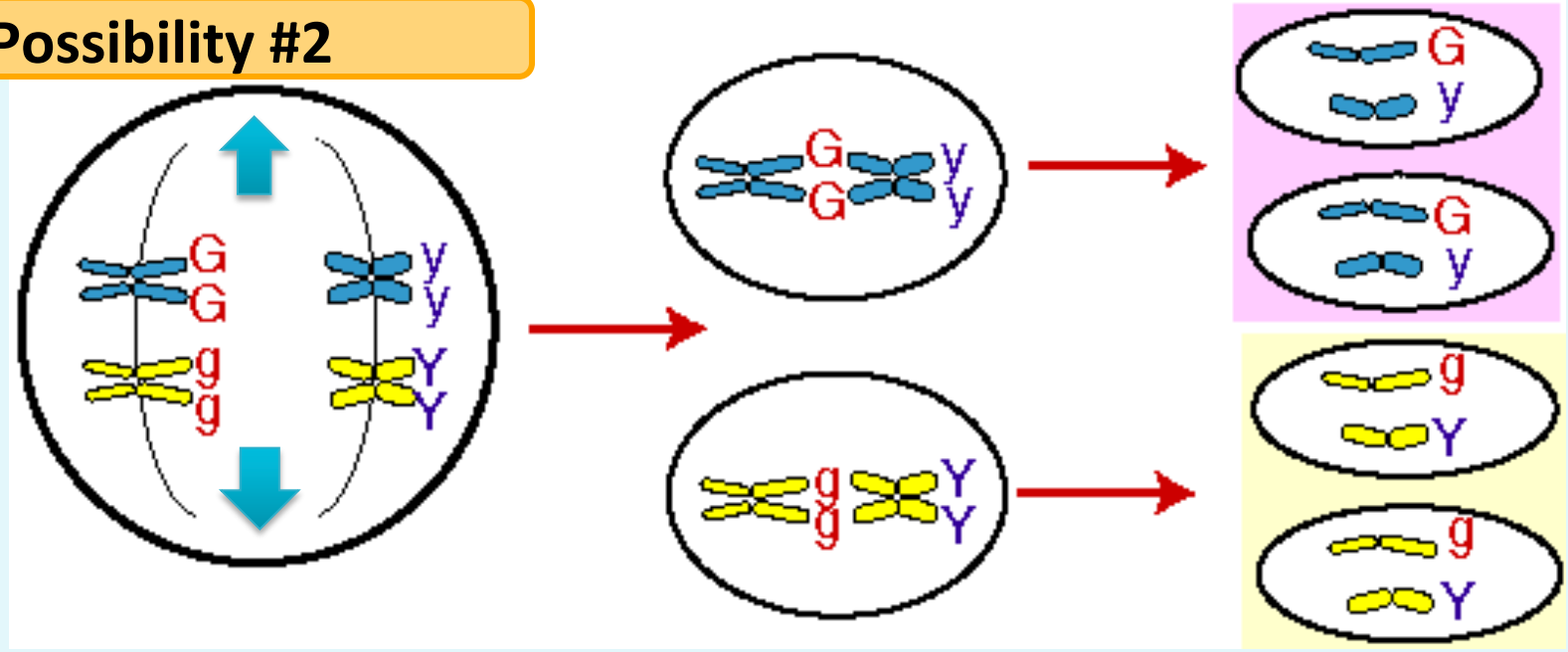


Possibility #1



or

Possibility #2



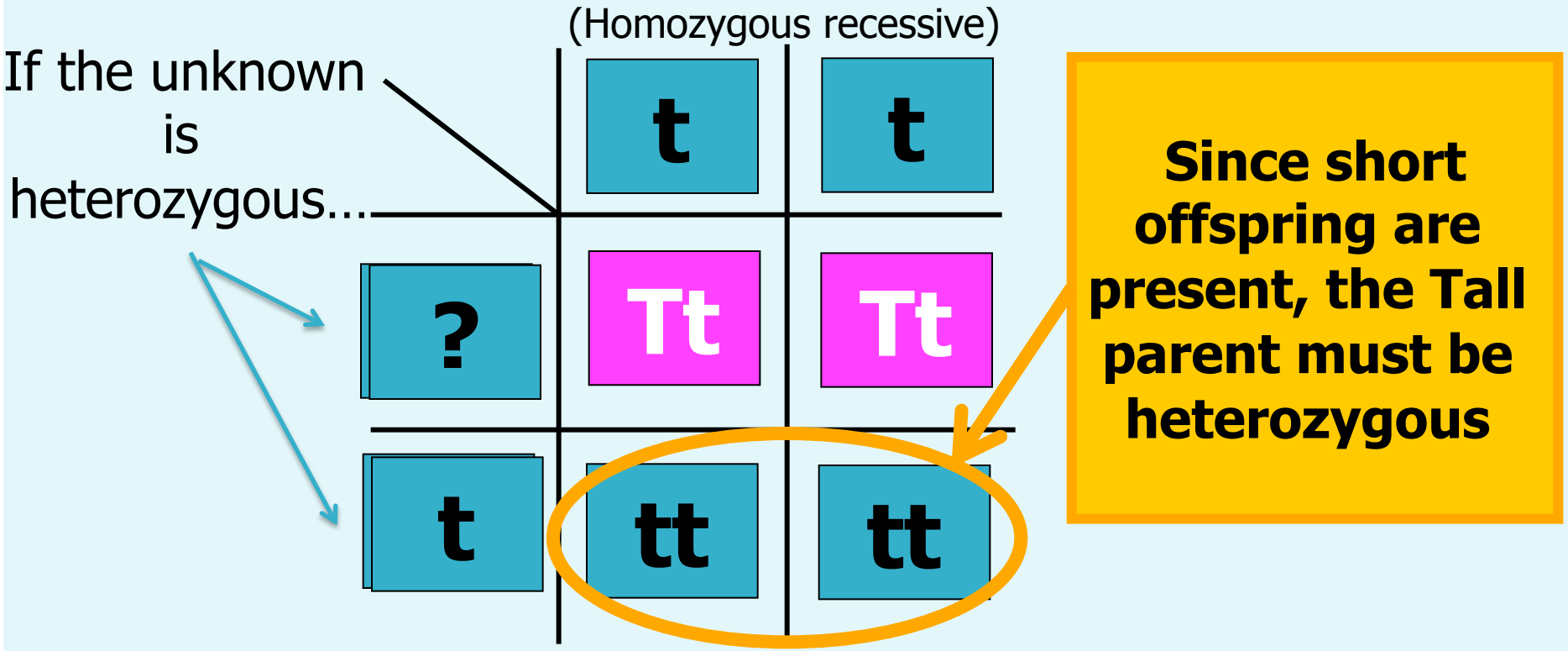
Test Cross

- Used to determine the unknown genotype of individual expressing dominant characteristic
  - eg. If pea plant is tall, is the genotype TT or Tt?
  - How can we figure it out?!?
- Only one way to find out!
- Cross with a homozygous recessive and examine the offspring produced.

TT or Tt?

Test Cross: Possibility #1

Unknown Tall x short plant (tt)



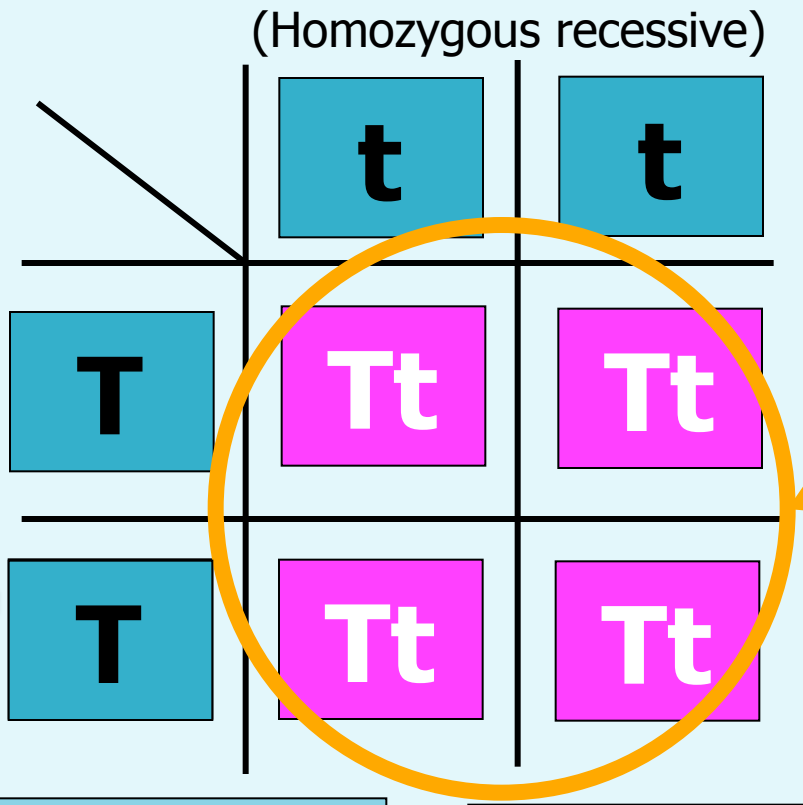
Phenotypes
1 Tall : 1 short

Genotypes
1 Tt : 1 tt

Test Cross: Possibility #2

Unknown Tall x short plant (tt)

If the unknown is homozygous dominant…



Since no short offspring are present, the Tall parent is PROBABLY homozygous

Phenotypes
All Tall

Genotypes
All Tt

Summary of Test Cross Results

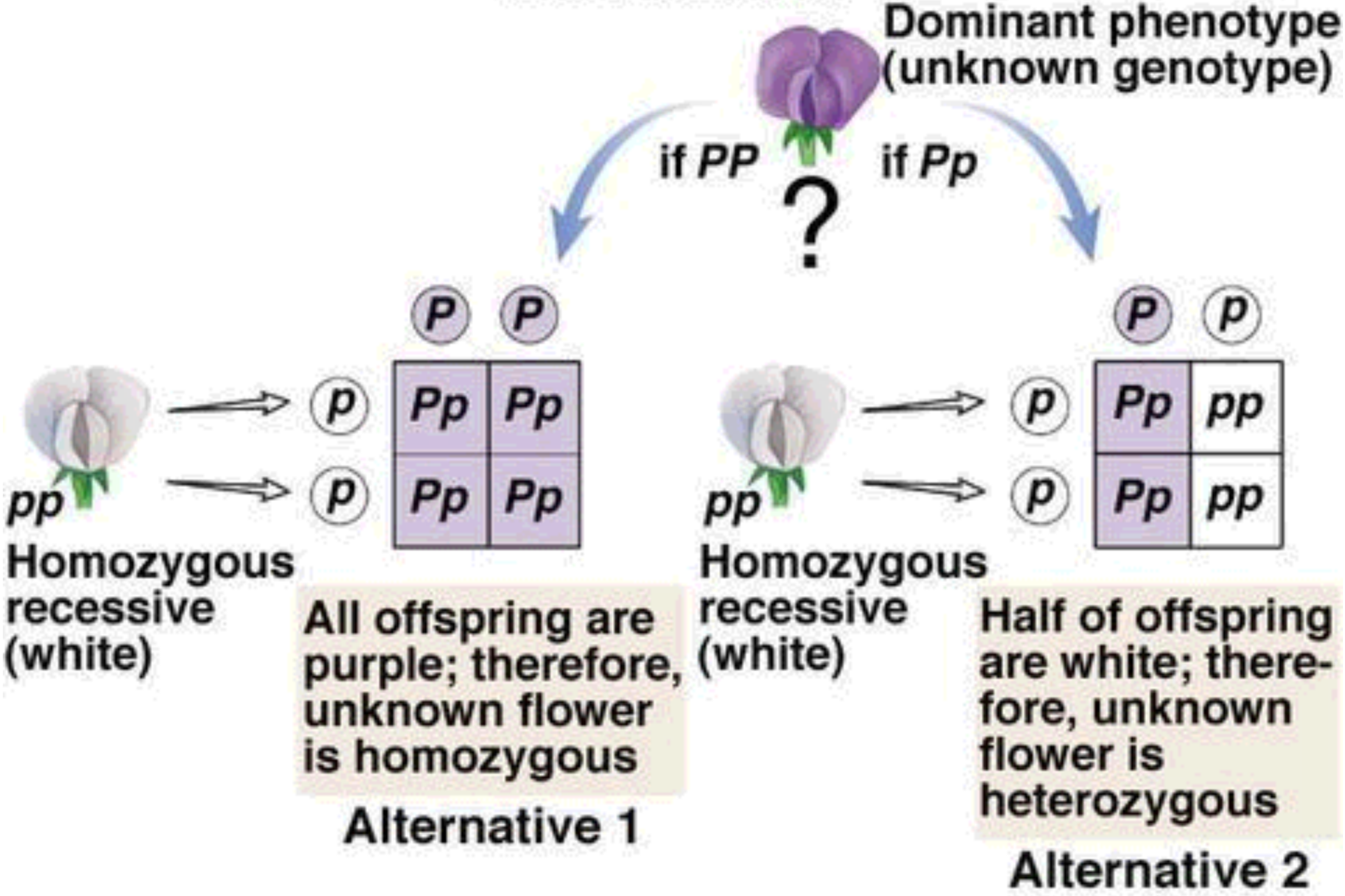
- **If some recessive (short) individuals show up then the genotype of the unknown**

  is heterozygous (Tt)

- **If no recessives (short) show up then the genotype is probably**

  homozygous dominant (TT)

Testcross with monohybrids



Black Sheep of the family?

- **Sheep ranchers like producing white wool**
  - **Easier to dye and less brittle than black**
- **White is dominant, black recessive**
- **If farmer suspects white sheep in herd are heterozygous(having black recessive info.)…**

-what can she/he do????

- Farmer may find out for certain by **crossing suspected carriers with homozygous recessive (ww)** black sheep
- If some black sheep show up as offspring…
- Sheep was a **carrier for black wool**! (heterozygous)

Check out the following links:

Genetics from the beginning!

Basic principles of genetics

University of Utah Review of Genes etc!