



# Beyond Simple Dominant and Recessive Alleles

# Concepts

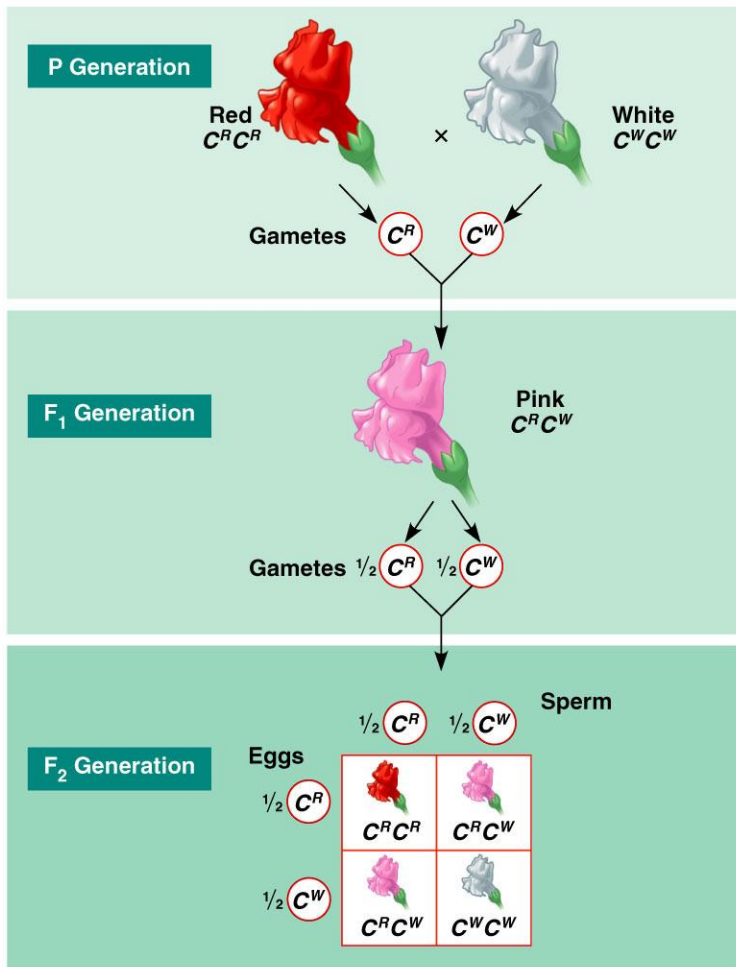
1. For some allele pairs, one allele is \_\_\_\_\_ over other.
2. Many genes have more than \_\_\_\_\_
3. Some genes are \_\_\_\_\_ (located on one of the two sex chromosomes).
4. Many characters are controlled by more than one \_\_\_\_\_

# Incomplete Dominant Alleles

- Pairs of alleles that **both** affect the phenotype when present in a \_\_\_\_\_
- The heterozygous phenotype maybe a \_\_\_\_\_ of the two homozygous phenotypes, OR...

# Incomplete dominance – **Blending**

Ex: flower color in snapdragons



Two alleles:

- \_\_\_\_\_ - red

- \_\_\_\_\_ - white

\_\_\_\_\_ plants are red

\_\_\_\_\_ plants are white

P -  $C^R C^R$  ×  $C^W C^W$

F<sub>1</sub> - 100%  $C^R C^W$  pink

F<sub>2</sub> - 1:2:1 red:pink:white

# Codominant Alleles

- Pairs of alleles that **both** affect the phenotype when present in a heterozygote
- Instead of a blend, phenotype shows \_\_\_\_\_ features of both \_\_\_\_\_



# Codominant alleles - phenotype shows distinct features of both alleles

Example: Feather color in chickens

- Two alleles: \_\_\_\_\_ = Black  
\_\_\_\_\_ = White

\_\_\_\_\_ = black chicken; \_\_\_\_\_ = white chicken

- Cross a black chicken with a white chicken ( $F^B F^B \times F^W F^W$ )
  - Offspring is \_\_\_\_\_ = black and white speckled



# Multiple Alleles

- Many genes have more than \_\_\_\_\_ alleles
- Does not mean an \_\_\_\_\_ can have more than two alleles
- Only means there are more than two possible \_\_\_\_\_ in the \_\_\_\_\_



# Example of Multiple Alleles:

- Human blood type
- Gene codes a \_\_\_\_\_ which can place a carbohydrate on the surface of red blood cells
- Three possible alleles
  - $I^A$  - \_\_\_\_\_
  - $I^B$  - \_\_\_\_\_
  - $i$  - \_\_\_\_\_

# Possible genotypes and phenotypes

## Genotype

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

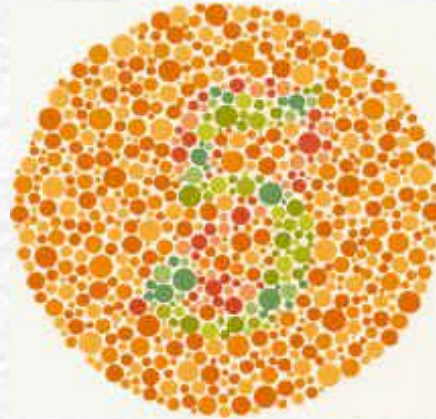
## Phenotype

- Blood type \_\_\_\_\_
- Blood type \_\_\_\_\_
- Blood type \_\_\_\_\_
- Blood type \_\_\_\_\_
- Blood type \_\_\_\_\_
- Blood type \_\_\_\_\_

# Sex-linked Traits

- If a sex-linked gene is located on the X chromosome, females will have \_\_\_\_\_, but males will only have \_\_\_\_\_.
- If it's located on the \_\_\_\_\_ chromosome, males will have one allele, and females will have \_\_\_\_\_.
- Usually refers to traits coded for by genes on the \_\_\_\_\_

# Red-green color-blindness: an example of a sex-linked trait



Two possible alleles

- \_\_\_\_\_ - normal (dominant)
- \_\_\_\_\_ - color blind (recessive)



# Color-blindness - Possible genotypes and phenotypes

Genotype

Phenotype

$X^B X^B$

---

$X^B X^b$

---

$X^b X^b$

---

$X^B Y$

---

$X^b Y$

---

# Hemophilia – a second example of a sex-linked trait

- \_\_\_\_\_ disorder defined by absence of one or more of the proteins required for \_\_\_\_\_

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- Two possible alleles:
  - \_\_\_\_\_ – normal
  - \_\_\_\_\_ - hemophilia

# Hemophilia - Possible genotypes and phenotypes

Genotype

Phenotype

$X^H X^H$

\_\_\_\_\_

$X^H X^h$

\_\_\_\_\_

$X^h X^h$

\_\_\_\_\_

$X^H Y$

\_\_\_\_\_

$X^h Y$

\_\_\_\_\_

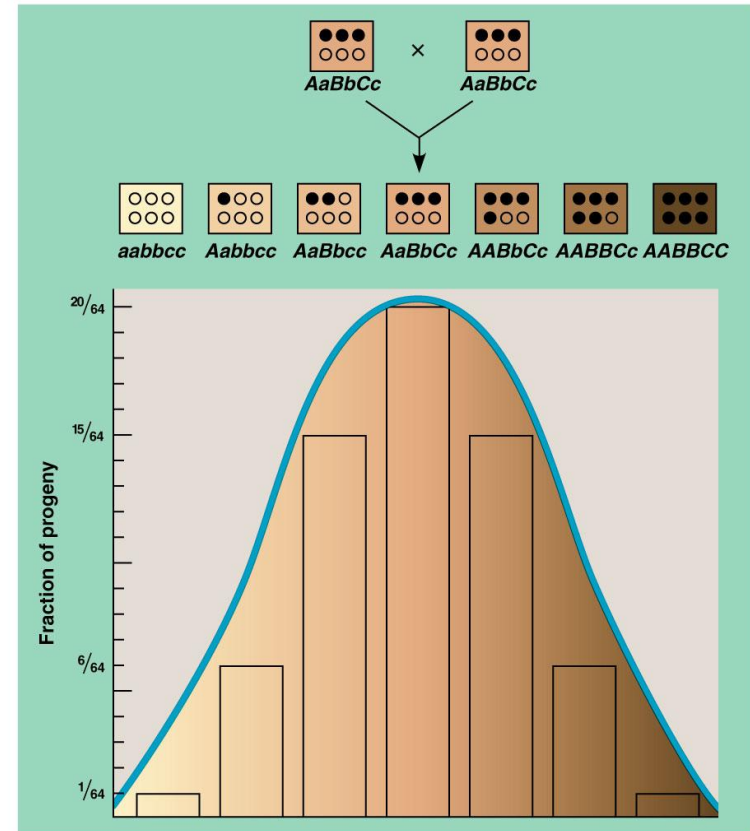
# Polygenic Characters

- Characters such as height, weight, and skin color result from the cumulative effects of \_\_\_\_\_.
- These characters are not expressed as “either/or” as was the case with Mendel’s pea plant characters; instead they vary in the population along a continuum



# Skin Color as Example of a Polygenic Character

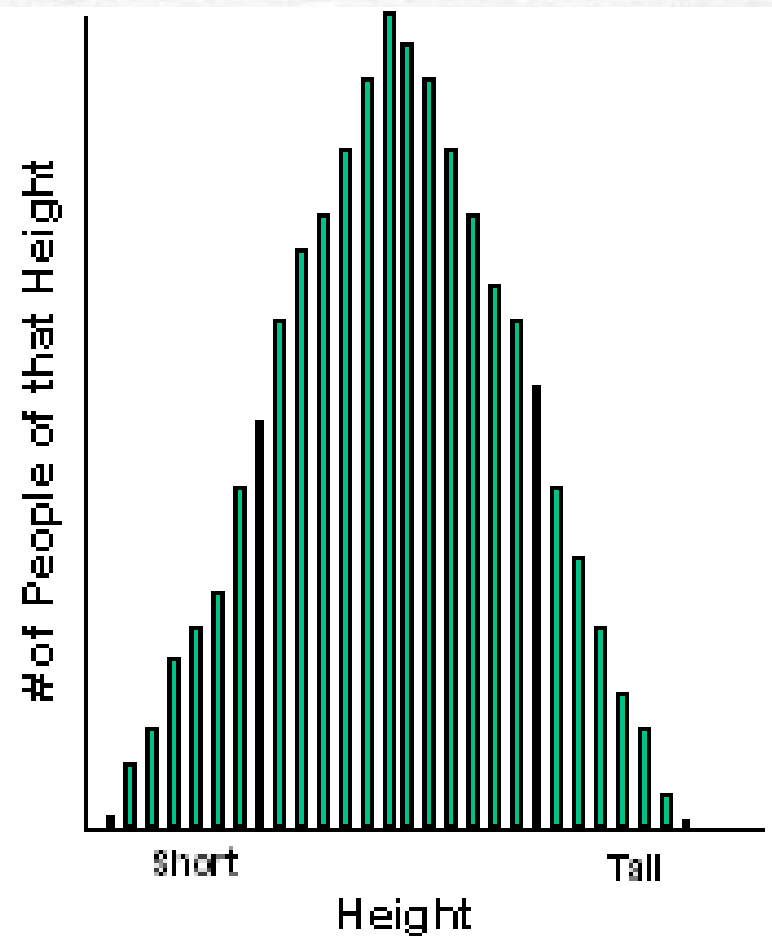
- Skin pigmentation (melanin production) is coded for by at least 3 separately inherited genes
- Each gene has a dark-skin allele (A,B, or C), which is codominant with other light-skin allele (a,b, or c).
- The more dominant alleles present, the darker the skin.



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# Polygenic inheritance – Human Height

- As few as 7 or as many as 20 genes might contribute to human height



# Epistasis

- Black is dominant to chocolate B or b  
Yellow is recessive **epistatic** (when present, it blocks the expression of the black and chocolate alleles) E or e
- PhenotypePossible Genotypes
- BBEE  
BbEE  
BBEe  
BbEe
- bbEE  
bbEe
- BBee  
Bbee  
bbee
- 
- Task: Determine the number of chocolate labs produced from a black female and a yellow male (BbEe x bbee)



- Pleiotropy

- Some single alleles have more than one distinguishable phenotypic effect - This is called pleiotropy.
  - An example is the coloration pattern and crossed eyes of Siamese cats, which are both caused by the same allele. These unrelated characters are caused by the same protein produced by the same allele.
  - Another example is the gene that causes pigment color in rats. White rats also have very sensitive eyes and often become blind.
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