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Practical Inheritance

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المرحلة الثانية- للدراستين الصباحية والمسائية

الفصل الدراسي الثاني

تدريسي المادة

أ.م.د. لمى سعيد محمد م.د. نهاد طه محمد

م.م.هدى محمد حسين

المحاضرين:

علي محسن

احمد مزاحم

صفا محسن

Lab 1 *Drosophila*

1.1-*Drosophilamelanogaster*:Is a small, common fly found near ripe and rotted fruit. It has been in use for over a century to study genetics. **Thomas Hunt Morgan** was the preeminent biologist study Drosophila early 1900s. **Morgan** was the first to discover **sex-linkage and genetic recombination**, which place the small fly in forefront of genetic research.

Drosophilais one of the few organisms whose entire genome is known and many genes have been identified.

1.2- Why use *Drosophila*?

1- Its care and culture requires little equipment and uses little space even when using large cultures and the overall cost is low.

2- It is small and easy to grow in the laboratory and its morphology is easy to identify once anesthetized (usually with **ether, carbon dioxide gas, by cooling, or with products like FlyNap).**

3- It has a short generation time (about 10 days at room temperature), so several generations can be studied within a few weeks.

4- It has a **high fecundity** (female lay up to 100 eggs per day, and perhaps 2000 in a lifetime).[2]

5- Males and females are readily distinguished and virgin females are easily isolated, facilitating genetic crossing.

6- The mature larvae show giant chromosomes in the salivary glands called **polytene chromosomes** indicate regions of transcription and hence gene activity.

7- It has only **four pairs** of chromosomes: **three autosomes**, and **one pair of sex chromosomes.**

1.3- Classification of *Drosophila*

Kingdom:Animalia

Phylum:Arthropoda

Class:Insecta

Order:Diptera

Family:Drosophilidae

Genus:Drosophila (“dew lover”)

Species:melanogaster (“dark gut”)

1.4- Breeding (culturing) of *Drosophila*

The age of *Drosophila* is depended on the:

1. Type of manipulation**.**
2. Culture conditions**.**
3. Race of flies**.**

The wild type found to have long lifespan reach to **100 days**. In order to incorporate *Drosophila* in the laboratory, it will be necessary to maintain culture of flies for manipulation in crosses and as backup for any mishaps (حوادث) which may occur. Culturing is very easy and it is recommended.

Equipments:-

1-Breeding Bottles and Vials:

Thomas Morgan used glass milk bottle for his experiments. However uniform bottles and vials are the best approach (both can be purchased from a biological supply store).

Bottles are used mainly for the maintenance a large population of flies whereas culture vials are used mainly for the maintenance smaller population and are preferred container for constructing student crosses. If there is a desire to maintains stock culture for long period of time. It is important completelyclean and sterilized bottles and vials. This to prevent outbreak of pest and diseases.

Bottles and vials are variety of size and material. Glass is effected (plastic vials are available and preferable for students use).

Vials size ranges 96*25 mm to larger sizes. There are a variety of plugs available from soft cotton to rubber plugs.

Figure1-1: Breeding Bottles and Vials

Lab2:

2- Media (feeding):

The first step in preparing culture vials is adding food media. There are variety types of food available for the flies; some require cooking and others are bought already prepared and dehydrated.

Cooking media can be stored in a refrigerator for several weeks. Be sure to allow media to warm to room temperature before adding flies. Don't allow media to dry out. Media should fill the culture vial, bottle or vial $1/5^{th}$ to $2/5^{th}$ full. Keep the media out overnight to cure, being sure completely cover the vials with cloth to keep flies from laying eggs in them. **The next day add yeast** (several grains but not more) and plugs before adding flies. Refrigerateany unused media vials. Unused media can last up to two weeks.

Cooking media consist of:

20g agar (for hardening the media)

100g dry yeast (consumed as file's food)

100g flour

100g sugar

1000ml distil water

0.3ml propionic acid (to prevent fungi outbreak)

Agar put in the cold distils water and mixed gently after that the mixture put on the heater. Then add the sugar, yeast and flour with continuous mixing for 5-10 min until reached to the boiling mixture. The mixture (media) put away until be cool. After that the media fill culture vial and bottle.

1.5-*Drosophila melanogaster*(Wild Type "W.T")

A wild type phenotype is the most common expression of particular allele combination in population. Fruit flies have red eyes, gray (yellow-brown) body, and have transverse black rings across their abdomen. They exhibit sexual dimorphism: female about 2.5mm (0.1 inches) long;males are slightly smaller.

1.6- Male and Female *Drosophila* characteristics:

Use the following characteristics to distinguish male from female flies among the anesthetized flies provided by your instructor:

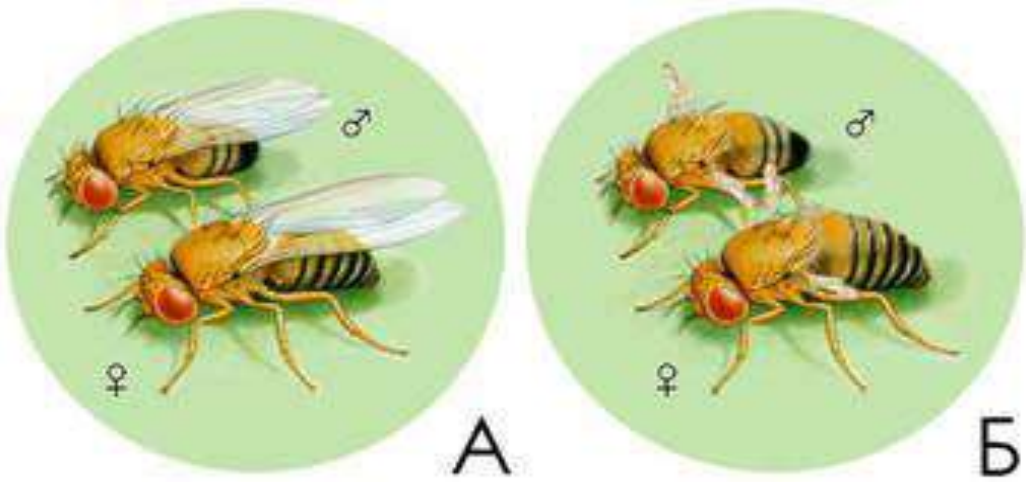
The male is generally smaller.

The male has a more rounded abdomen than female. The female has a pointed abdomen.

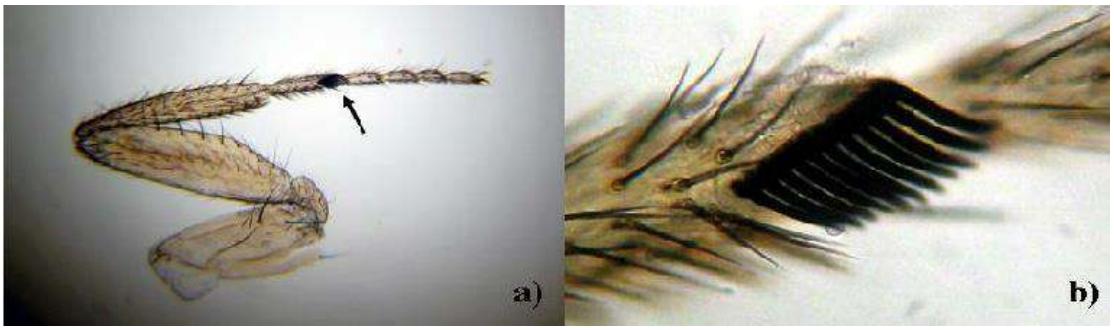
The male has **sex combs** on the forelegs.

Dorsally, the male is seen to have a black-tipped abdomen. Whereas the female appears to have dark lines only at the tip**.**

Ventrally, the abdomen of the male has a dark region at the tip due to the presence of claspers, this dark region is lacking in female.



1.2 Male and Female *Drosophila*



1.3 Sex comb

1.6- Life cycle of *Drosophila*

D. melanogaster exhibits complete metamorphism, meaning includes an egg, larva (worm-like) form pupa and finally emergence (eclosure) as aflying adult. This is the same as the well-known metamorphism of butterflies and many other insects. The larval stage has three instars or molts.

Life cycle by days:

Day 0: female lays eggs contain pairs of spike helps attach the media surface.

Day 1: eggs hatch

Day 2: first instar (one day in length)

Day 3: second instar (one day in length)

Day 5: third and final instar (two day in length)

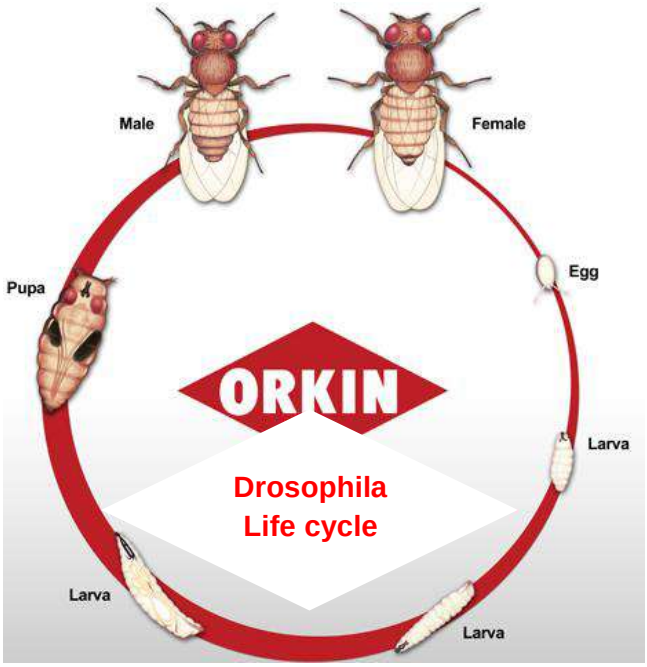
Day 7: larvae begin roaming stage puparation (pupal stage) occur 120 hrs after egg lying.

Day 11-12: eclosin (adult emerage from the pupa case). Females become sexually mature 8-10 hrs after eclosion.

The time from egg to adult is temperature- dependent. The above cycle is for temperature range of 21-23**C**°. The higher temperature cause faster generation time. Whereas a lower (to 18**C**°) temperature causes a longer generation time. After the egg hatch, small larvae should be visible in the growing medium.

1.7- Collecting virgin female

Remove all flies 8-10 hrs before collecting. Visually inspect surface of food to ensure complete removal of flies. After 8-10 hrs collects all femalesthat are present. All will be virgins. Place in a fresh culture vial and wait 2-3 days look for larvae. Virgin females can lay eggs, but they will be sterile. Since they are photoperiod sensitive, females tend to eclose early in morning. Therefore early collections will ensure the greatest number of virgins for experimentation. However collection is possible later in the day.



Lab 3:*Drosophila* mutations

2.1- Mutation: is a change: is a change in **gene nucleotide base** sequence. It can occur at **DNA base** for anther or adding or deleting few bases, or **at chromosomal level**. Chromosomes can exchange parts, and genetic material can even jump from one chromosome to another. These events can cause mutation**.**

2.2- **Types of mutations**

1. **Spontaneous mutation**: that just happens in Nature. **Achondroplasia** is a common cause of **dwarfism**. It occurs as a sporadic mutation in approximately 80% of cases (associated with advanced paternal age) or it may be inherited as an autosomal dominant genetic disorder.People with **achondroplasia** have short stature, with an average adult height of 131 centimeters for males and 123 centimeters for females. Achondroplastic adults are known to be as short as 62.8 cm (24.7 in) fig 2-1. If both parents of a child have achondroplasia, and both parents pass on the mutant gene, then it is very unlikely that the homozygous child will live past a few months of its life.

2.**Induced Mutation**: Those that result from the influence of any artificial factors. Researchers can sometimes interfere with normal genes function. Spontaneous mutation rate is far too low to be practical source of genetic variation, fig 2-2.

Chemicals (EMS, ect.)

Physical (X-RAY, GAMA RAY, UV-radiation).

2-1

2-2

3.Conditional mutation: Affect the phenotype only under certain conditions.Organisms can be protected by avoiding the exposure to these trigger symptoms. For example X-linked that encoded to Glucose-6-phosphate dehydrogenase. **Glucose-6-phosphate dehydrogenase (G6PD)** deficiency is a genetic disorder that occurs most often in males. This condition mainly affects red blood cells, which carry oxygen from the lungs to tissues throughout the body. In affected individuals, a defect in an enzyme called glucose-6-phosphate dehydrogenase causes

red blood cells to break down prematurely. This destruction of red blood cells is called **hemolysis**.**Hemolytic anemia** is most often triggered by bacterial or viral infections or by certain drugs (such as some antibiotics and medications used to treat malaria). Hemolytic anemia can also occur after eating **fava beans** or **inhaling pollen** from fava plants (a reaction called **favism**).

Glucose-6-dehydrogenase deficiency is also a significant cause of mild to severe jaundice in newborns. Many people with this disorder, however, never experience any signs or symptoms.

2.3:Drosophila mutation

Table 1.2**:Drosophila mutation**

characteristic	**kind**	**Chromosome number**	**Mutation symbol**	**Wild type**	
Vestigial wing	Recessive	II	vg	**vg^+**	Single mutation
Dumpy wing	Recessive	II	dp	**dp^+**	
Ebony body	Recessive	III	e	**e^+**	
White -eye	Recessive	I	w	**w^+**	
Ebony-vestigial	Recessive	II, III	evg	**ev^+g^+**	Double mutation
Ebony-dumpy	Recessive	II, III	edp	**ed^+p^+**	

Drosophila melanogaster has been important in mutation studies **because this organism has very low chromosome number.** The haploid (n) number of chromosome is 4, and the chromosomes are designed X (1),2, 3, and 4 (figure 2-3).

The **2, 3, and 4** chromosomes are the same in both sexes and are referred to as **autosomes** to distinguish them from the **X and Y sex chromosomes**. XDrosophila females are characterized by two **X chromosomes XX**, while males have an **X and Y chromosome.**

Chromosome **4 and the Y** chromosome **contain so few genes that for all practical purpose, they can be ignored.** Thus, almost the entire genetic content of drosophila genome resides on only three chromosomes**: X, 2, and 3.**

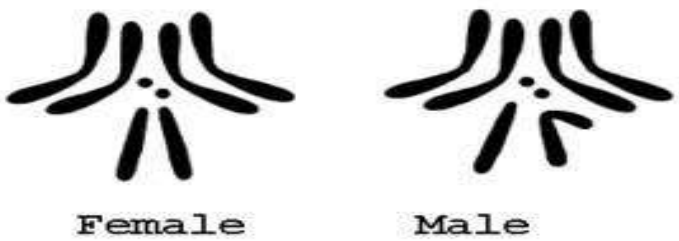


Figure 3-3 *Drosophila melanogaster*Chromosome**.**

2-4: **Phenocopy**

Is a variation in phenotype (generally referring to a single trait) which is caused by environmental conditions (often, but not necessarily, during the organism's development), such that the organism's phenotype matches a phenotype which is determined by genetic factors. It is not a type of mutation, as it is non-hereditary.

Example: 1-**AgNo3** its effect on the **color of body** for drosophila insect its effect on the mechanism of the enzyme **tyrosinase.** If larva of normal flies were fed with silver salts, they develop into **yellow bodied** flies irrespective of their genotype. The yellow bodied flies which are genetically **brown** is a variant of the original yellow bodied fly.

Tyrosine (yellow) **tyrosinas**e melanin (gray)

AgNo3 **yellow**

2-Another chemical factor is **sodium metaborate** its effect on the **color of eyes for drosophila**

LAB 4: Mendelian inheritance

Publishing papers are the primary means to communicate scientific discoveries. One of the most famous of these papers, entitled "Experiments in Plant Hybridization" was written in 1866 by **Gregor Mendel**, an Austrian monk. Although his paper later becomes the basis for genetics and inheritance, it went largely unnoticed until it was rediscovered independently by several European scientists in 1990. The experiments and conclusions in Mendels paper now from the foundation of **Mendelian genetics,** the topics of today exercise.**Mendel, sometimes called "father of genetics".**

3-1: Particulate theory

Inherited characters are determined by factors called (**genes**).

These factors occur in **pairs** (genes on maternal and paternal homologous chromosomes.

When gametes form, these genes segregate so that only**one**of the homologous pairs is contained in a particular gamete.

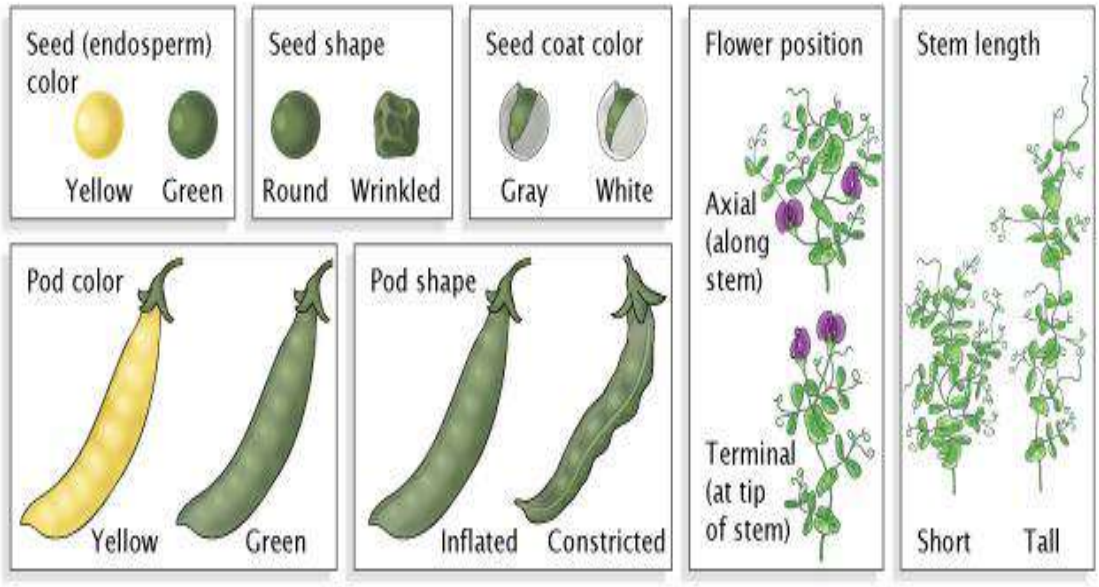
3-2: Mendel's experiment

Mendel's approach centered on the use of **pea plant *Pisum sativum* L.a model organism. It is unlikely that Mendel was truly interested in the genetic of pea's plant, but he recognized that organism had the characteristics necessary to study genetics:**

First: It was relatively easy to grow, develop quickly.

Second: It had easily identifiable variants of trait.

Third: He could easily self-fertilize the plant and produced true-breeding lines. Figure 3-1.



3-1: *Pisum sativum* L.Traits Mendel studied

3-3 Law of Segregation of genes (the "First Law")

The Law of Segregation states that every individual organism contains **two alleles** for each **trait,** and that these alleles segregate (**separate**) during **meiosis** such that each gamete contains **only one of the** alleles. An offspring thus receives a **pair of alleles** for a trait by inheriting homologous chromosomes from the parent organisms: **one allele for each trait from each parent.**

***Before you start the exercise, briefly review some principles and terms:**

- **Gene** is an unit of heredity on a chromosome.
- **Gene** has an alternate state called allele.
- **Allele** for particular gene occurs in pairs. Why?
- **Alleles** that **mask expression** of other alleles but are themselves expressed are **dominant**; this allele is usually designated by capital letter (for exp., T).
- **Alleles** whose expression is **masked by dominant** alleles are **recessive**, and they are designated by a lowercase letter (for exp., t).
- **The genotype** of an organism includes all alleles present in the cell, whether they are dominant or recessive. Tt, TT, tt, ee, dpdp
- **The physical** appearance of the trait is **the phenotype**.
- Thus if **tallness (T)** is dominant to **dwarfness (t)**, a tall plant can have a genotype **TT or Tt.**

- **A dwarf** plant can only have a genotype **tt.**
- When the paired alleles are **identical** (**TT or tt**), the genotype is **homozygous.**
- **Heterozygous** refer to a pair of alleles that are **different (Tt)**.Figure 3-2.

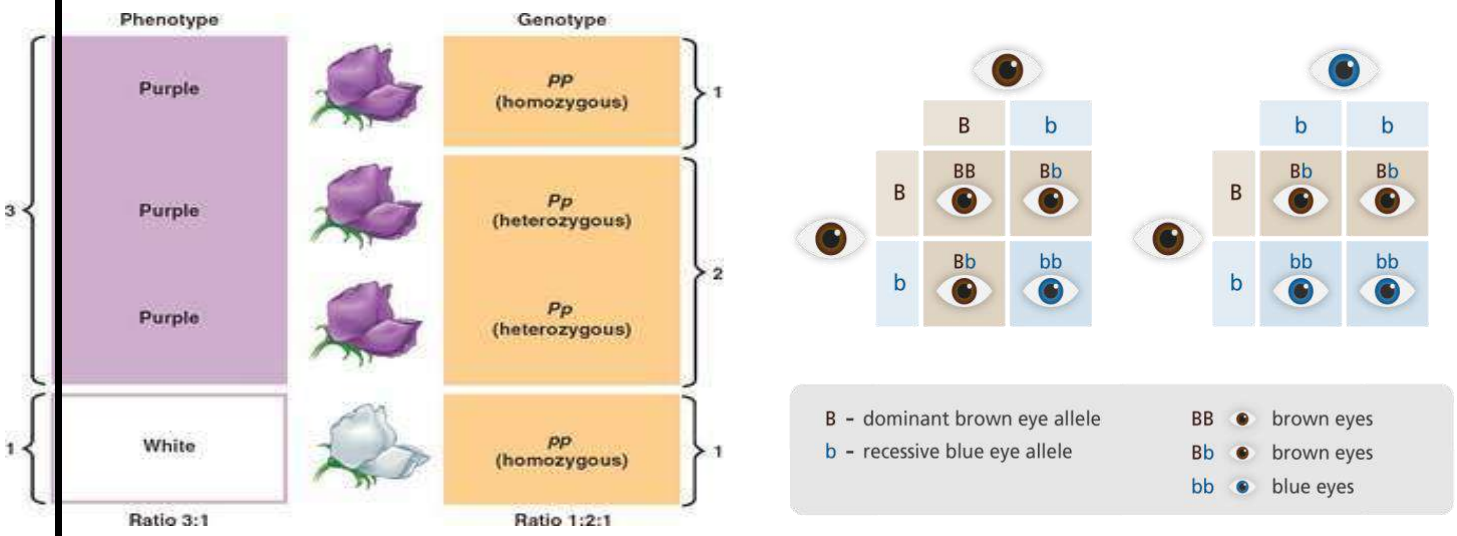


Figure 3-2 (Heterozygous and homozygous)

3-4: Monohybrid Crosses

Mendel found that reproduction between **two heterozygous monohybridindividual(Aa**) result in both dominant and recessive phenotypes among the offspring. **The phenotype ratio** among the offspring was **3:1; three offspring had the dominant phenotype for every one that had the recessive phenotype.**Mendel realized that these results were obtainable only if the allele of each parent segregated during meiosis. Figure 3-3.

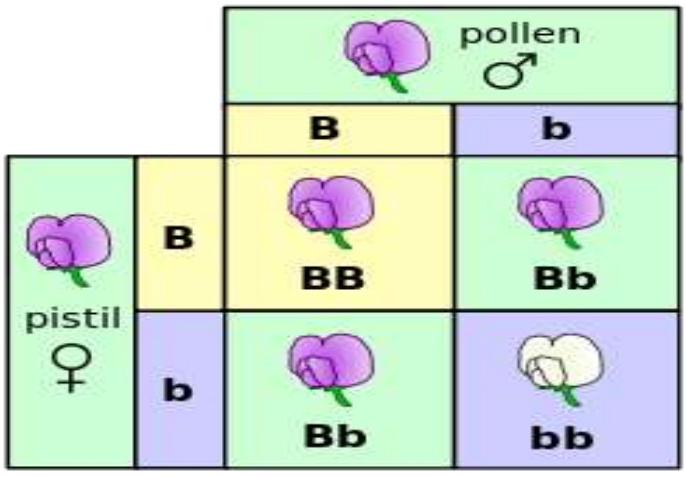


Figure 3-3:Monohybird cross (its ratio 3:1)

3-5Test cross

- Used to **determine**whether or not an individual with the dominant trait has two dominant factors for a particular trait.Figure 3-4.

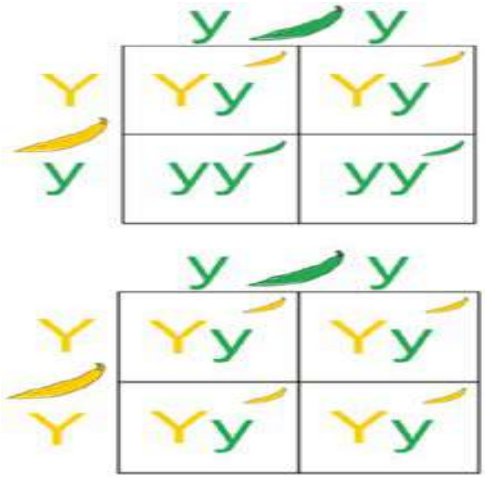


Figure 3-4 Test cross (its ratio 1:1)

Exercises:-

1. A man with **brown eyes** (his father had **blue eyes**) marries a **brown-eyed** women (her mother had **blue eyes**), what is the proportion of children would be expected to have blue eyes? (The brown color is **dominant**).

2. A **right** handed man marries a **left** handed women and produce **left** handed children. Write the complete cross (**right** hand is **dominant**).

3. A mating between *Drosophila* fly **wild type** and **dumpy winged** fly, what is the possible result of this mating?

LAB 5: Data analysis

4-1: Chi-Square Analysis x2

Geneticists typically use the Chi-Square Analysis (X^2) statistical test to determined whether experimentally obtained data are a satisfactory approximation of the expected data .This test expresses the difference between **(hypothetical**) and **observed(collected**) numbers as a single value, **X^2.**

The formula for the test is:

$$\chi^2 = \sum \frac{(o-e)^2}{e}$$

— **o =** the observed value

— **e** = the expected value

— =The sum of all values of $(o-e)^2/e$ for various categories of phenotypes.

— Probability level

—

—

—

—

—

Df	0.5	0.10	0.05	0.02	0.01	0.001
1	0.455	2.706	3.841	5.412	6.635	10.827
2	1.386	4.605	5.991	7.824	9.210	13.815
3	2.366	6.251	7.815	9.837	11.345	16.268
4	3.357	7.779	9.488	11.668	13.277	18.465
5	4.351	9.236	11.070	13.388	15.086	20.517

— **Df=n-1**

— **In mendelian first law df=1 , but in mendelian second law df=3**

— **The critical value of χ2 with 1 degree of freedom is 3.841.**

— **The critical value of χ2 with 3 degree of freedom is 7.815.**

— If calculated **X^2** value is **less than** 3.841, it is likely that variation in the observed and expected is the result of chance, and our hypothesized outcome is correct(**the differences not significant).**

— A value **greater than** 3.841, however would indicate that chance alone, cannot explain the deviation between observed and expected, and would reject our hypothesis (**the differences are significant).Calculated X^2** value exceeds the critical value in the table for a 0.05 probability level,and then we can reject the null hypothesis.

— **Example 1**:In garden peas, tall plants are dominant over short plants. If there were in the second generation offspring **F264**tall plants and **17**short plants write the complete cross, and make certain of results statistically.

— Observation is: 64+17=81

— Our hypothesis (expectation) is: ¾ of them will be tall:-

— E for tall plants = ¾ x 81=60.75

— E for short plant= ¼ x 81= 20.25

— O-E FOR TALL = (64-60.75)2/60.75=0.174

— O-E FOR SHORT= (17-20.25)2/20.25= 0.696

— X^2=(0.174+ 0.522)= 0.696

Phenotype	Observation	Ratio	Expected	O-E	$(O-E)^2/E$	X^2	
Tall	64	3	60.75	64-60.75	(64-60.75)2/60.75	— 0.174	
Short	17	1	20.25	17-20.25	(17-20.25)2/20.25	0.522	
2	81	4	81			— 0.696	

If calculated $\mathbf{X^2}$ value is **less than** 3.841, it is likely that variation in the observed and expected is the result of chance, and our hypothesized outcome is correct (the **differences not significant**).

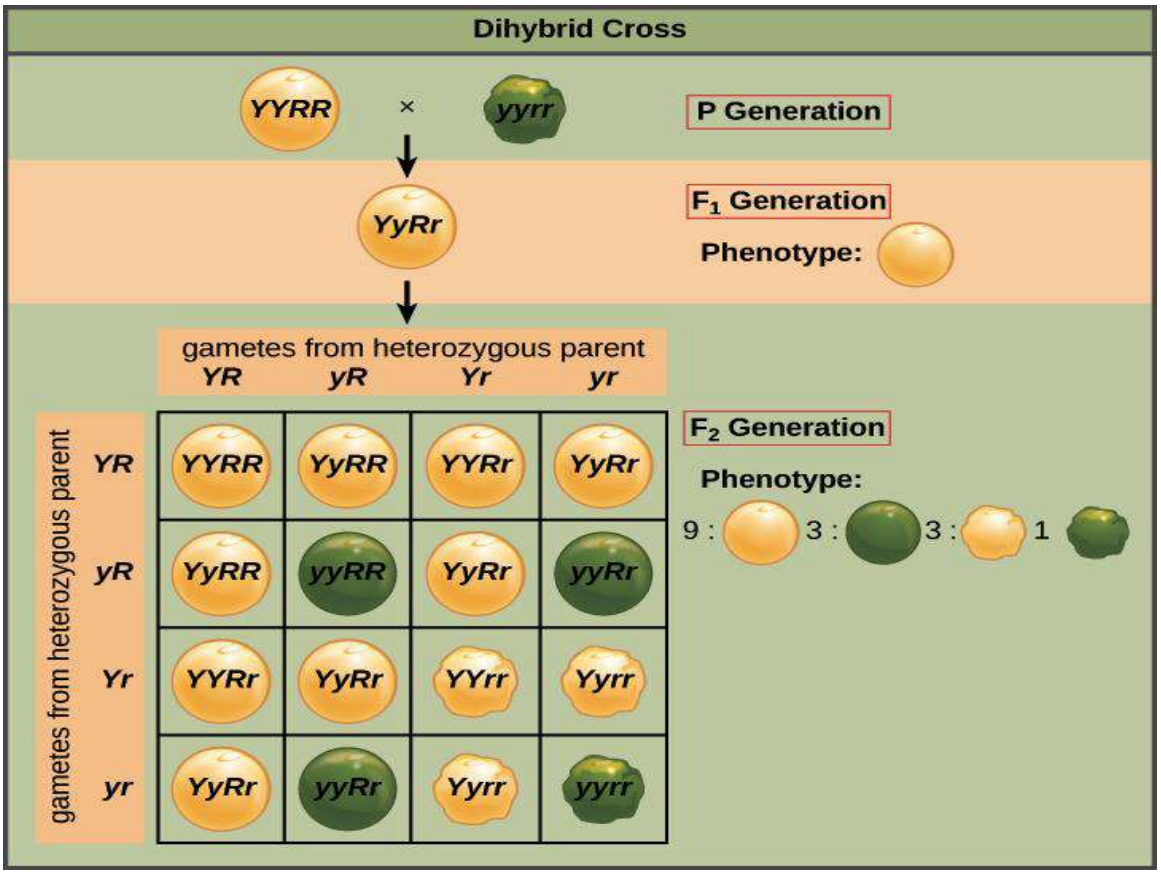
Lab6

4-2:Mendelian Second Law- the Law of Independent Assortment

During gamete formation the segregation of alleles of one allelic pair is independent of the segregation of the alleles of another allelic pair.

1-Genes for different traits are inherited independently from each other.

2- This is why Mendel found all the different combinations of traits



— **Q1:** In ***Drosophila***, gray body colour is dominant to ebony body colour, while long wings are dominant to vestigial wings. Assuming that the P1 individuals are homozygous, work the following crosses through the F2 generation, and determine the genotypic and phenotypic ratios for each generation.

— (a) Gray, long X ebony, vestigial

— (b) Gray, vestigial X ebony, long

— (c) Gray, long X gray, vestigial

Example-2:Let us examine Mendel's F2 data for the **Round/wrinkled** and **Yellow/green** dihybrid cross. He counted a total of **556** peas with this observed ratio: **315: 108: 101: 32**. We will use to test Mendel's data by the X2 method?

Lab7:Sex Linkage Inheritance

5-1: The chromosome theory of inheritance

The fact that genes are located on chromosomes and the segregation of these chromosomes during meiosis was finally worked by **Sutton and Boveri, in 1903, figure 1-5.**

States that genes are found at specific locations on chromosomes, and that the behavior of chromosomes during meiosis can explain Mendel's laws of inheritance.

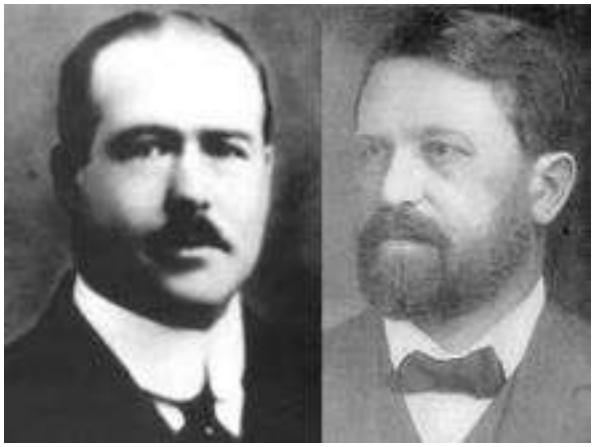


Figure 5-1:**Sutton and Boveri, in 1903**

5-2:Holandric Inheritance: Found only in males, such as traits inherited through genes on the Y chromosome (hairy pinna).

5-3:SEX LINKAGE INHERITANCE

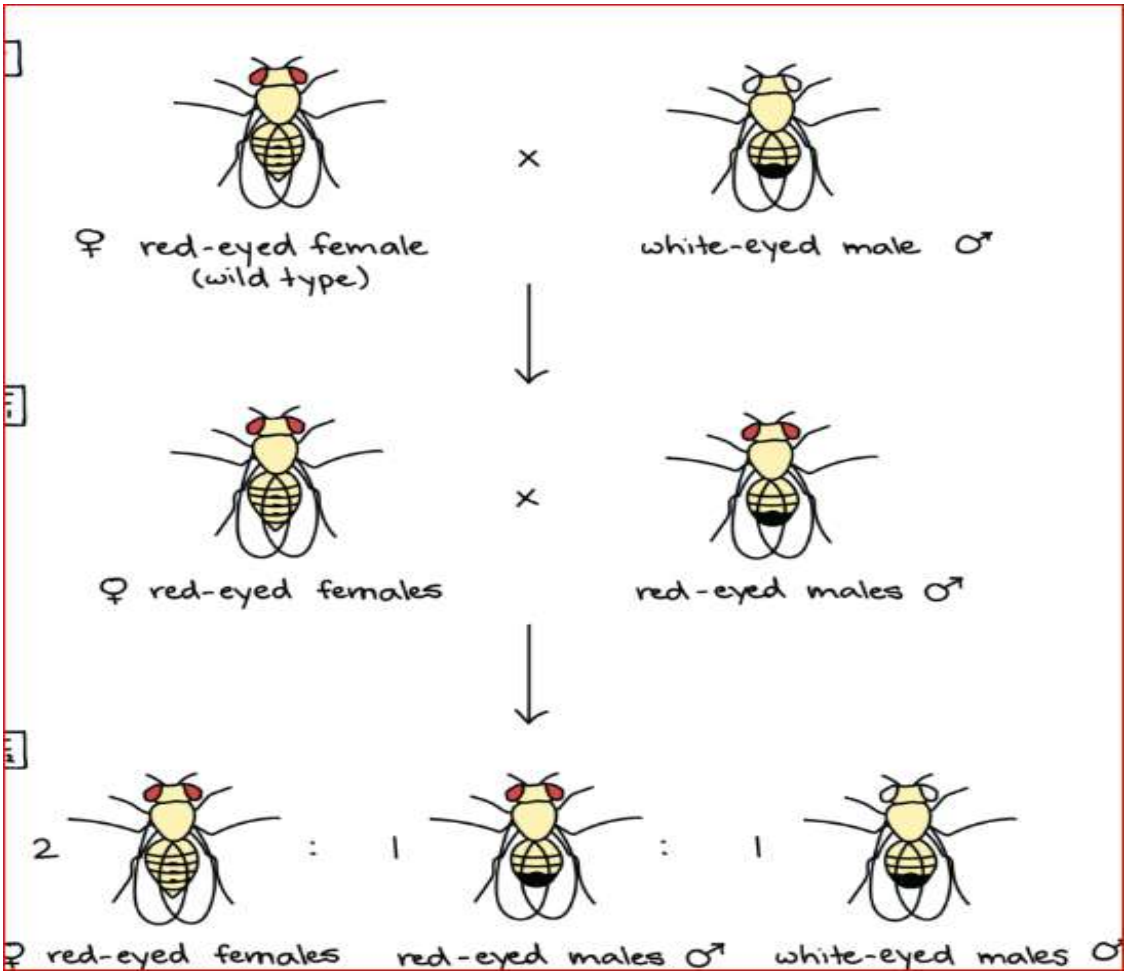
About **1910, T.H. Morgan** and his students at Columbia University began to study inheritance in ***Drosophila***. Among the first mutants found were flies that had **developed white eyes instead of normal red eyes.**

The researchers noticed that eye color inherited as if the causative gene were located on the **X chromosome**, and missing from the Y chromosome.

Red was dominant to white

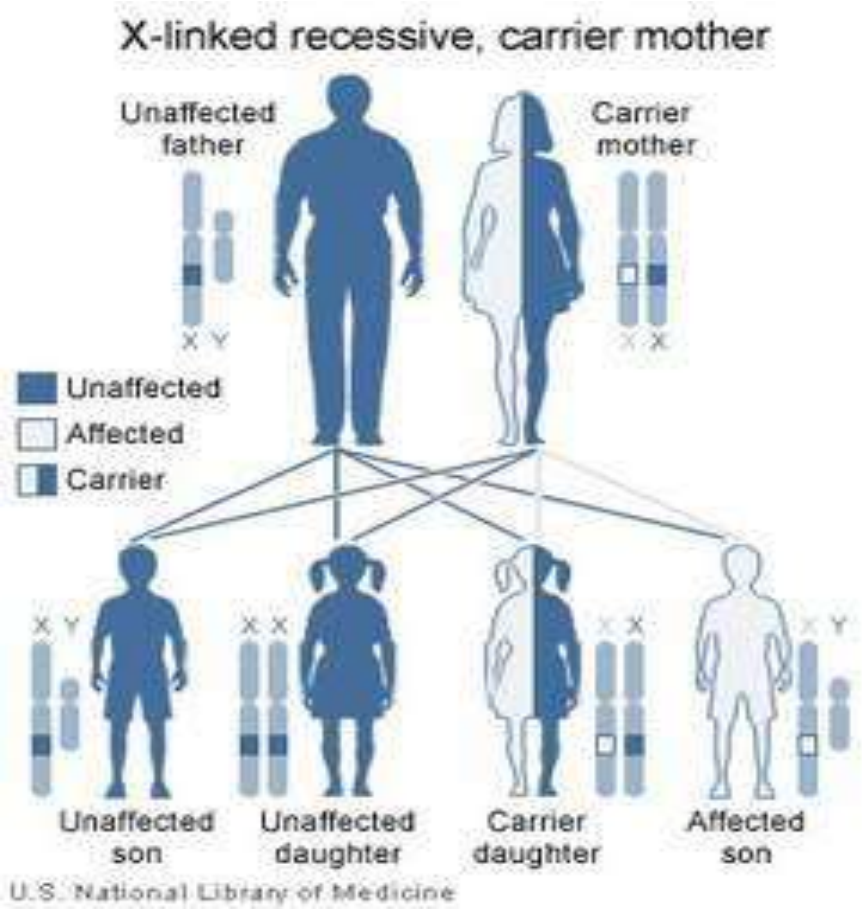
Thomas Hunt Morgan

- If **homozygous** red-eyed female was mated to a white eyed male, all the offspring had red eyes; but if a white eyed female was mated to a red-eyed male, the **males** had white eyes.
- When a **heterozygous red-eyed female** was crossed to a **red-eyed male**, half the sons (male) were white-eyed.
- The results were compatible with the hypothesis that the color eyes gene is located on the**X chromosome**, **but not on the Y.**
- Characters that inherited in this way are called **sex linked, or X- Linked.**
- The female, since she has **two X chromosomes** may be either **homozygous or heterozygous** for an X-linked gene.
- A male having one **X-chromosome,** is said to be **hemizygous.**



Lab8

5-4:X-linked inheritance



- The best known example of **X-linked** inheritance in human species are color blindness and Hemophilia.
- **5-4-1:Color Blindness**
- **Color blindness** caused by recessive gene (c) on X-chromosome.
- Most color blind people are able to see things as clearly as other people but they unable to fully ‘see’
  red, green or blue light.

♀Female genotype/phenotype	Male ♂ genotype/phenotype
C||C normal vision	C|í normal vision
C||c carrier	----------
c||c affected	c|í affected male

5-4-2: Hemophilia

- **Hemophilia** is a deficiency in a **protein** necessary for normal blood-clotting. The famous pedigree with **Queen Victoria**, who was a heterozygous carrier. She had one hemophilic son and two daughters. Because of the royal custom to exporting daughters, the hemophilia gene was passed to the royal families of Europe from Spain to Russia. The present British family, which is descended through a normal son, is free of this disease.

- **Hemophilia caused by recessive gene (h) located on X-chromosome.**

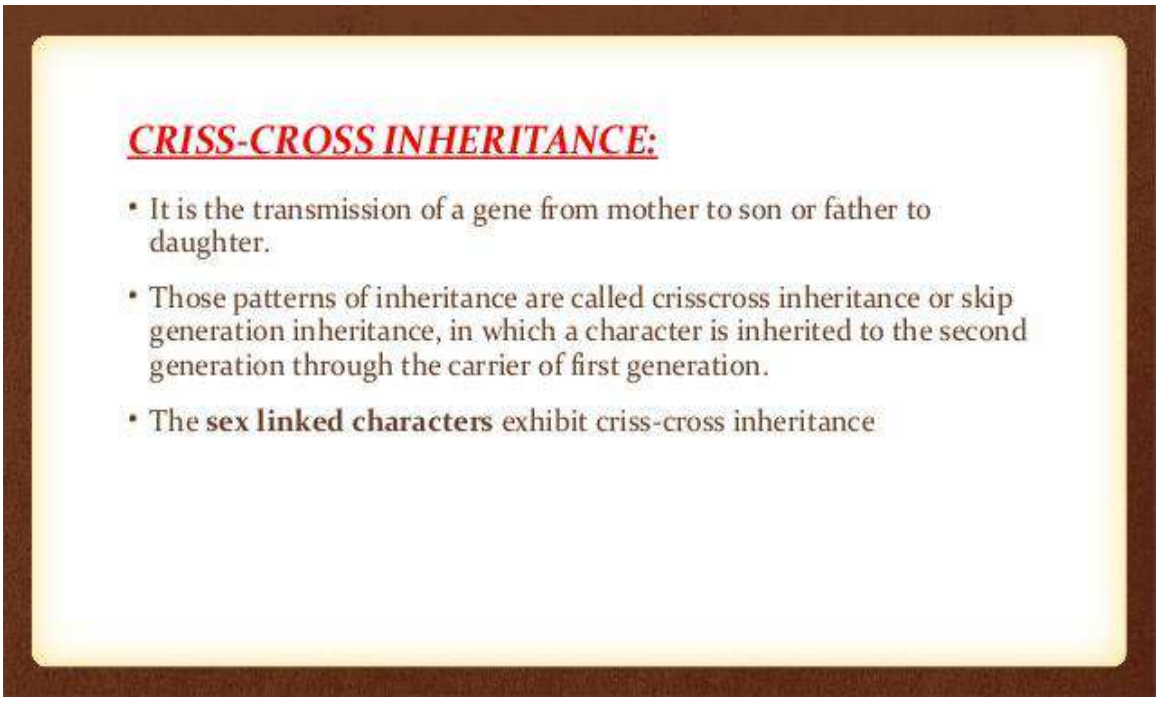
♀Female genotype/phenotype	♂Male genotype/phenotype
H||H normal female	H|í normal male
H||h carrier	----------
h||h affected	h|í affected male

5-5: Criteria for an X-Linked recessive trait:-

1. **Always expressed in male**
2. **Expressed in female homozygous**
3. **Passed from heterozygous or homozygous to affected sons.**
4. **Affected female has an affected father and a mother who is affected or heterozygous.**

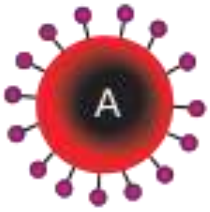
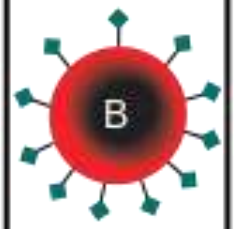
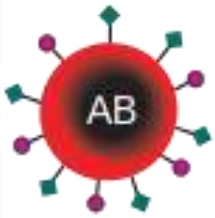
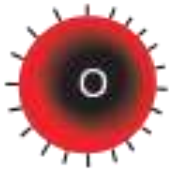
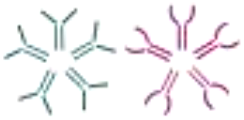
5-6:**Criteria for an X-Linked dominant trait:-**

1. **Expressed in female in one copy**
2. **Much more sever effect in males.**
3. **High rate of miscarriage due to early lethality in males.**
4. **Passed from male to all daughters but no sons.**



Lab9:Blood groups

- A blood type (also called a blood group) is a classification of blood based on the presence and absence of antibodies and also based on the presence or absence of inherited antigenic substances on the surface of red blood cells (RBCs).
- These antigens may be proteins, carbohydrates, glycoprotein's, or glycolipids, depending on the blood group system. Some of these antigens are also present on the surface of other types of cells of various tissues.
- Several of these red blood cell surface antigens can stem from one allele (or an alternative version of a gene) and collectively form a blood group system. Blood types are inherited and represent contributions from both parents.
- Blood serum is blood plasma without clotting factors**.**

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	 A antigen	 B antigen	 A and B antigens	None

5-1:**The ABO Blood Group System**

- There are four major blood groups determined by the presence or absence of two antigens – A and B – on the surface of red blood cells:
- **Group A** – has only the A antigen on red cells (and B antibody in the plasma)
- **Group B** – has only the B antigen on red cells (and A antibody in the plasma)
- **Group AB** – has both A and B antigens on red cells (but neither A nor B antibody in the plasma) (**universal recipient).**

☐ **Group O** – has neither A nor B antigens on red cells (but both A and B antibody are in the plasma) (**universal donor).**

Genotypes	Antibodies in serum	Antigens on RBCs	Blood group
I^AI^A**or** I^{Ai}	**Anti-B**	**A**	**A**
I^BI^B **or** I^Bi	**Anti-A**	**B**	**B**
I^AI^B	**Neither**	**A and B**	**AB**
Ii	**Anti-A and Anti-B**	**Neither**	**O**

5-2:The Rh system

☐ **The Rh** blood group system (including the Rh factor) is one of thirty-five known human blood group system. It is the second most important blood group system, after ABO.

☐ **Rh antigens** are transmembrane proteins with loops exposed at the surface of red blood cells. They be used for the transport of carbon dioxide and/ or ammonia across the plasma membrain.

☐ They are named for the **rhesus monky** in which they were first discovered. The commonly used terms Rh factor, **Rh positive and Rh negative** refer to the **D antigen** only.

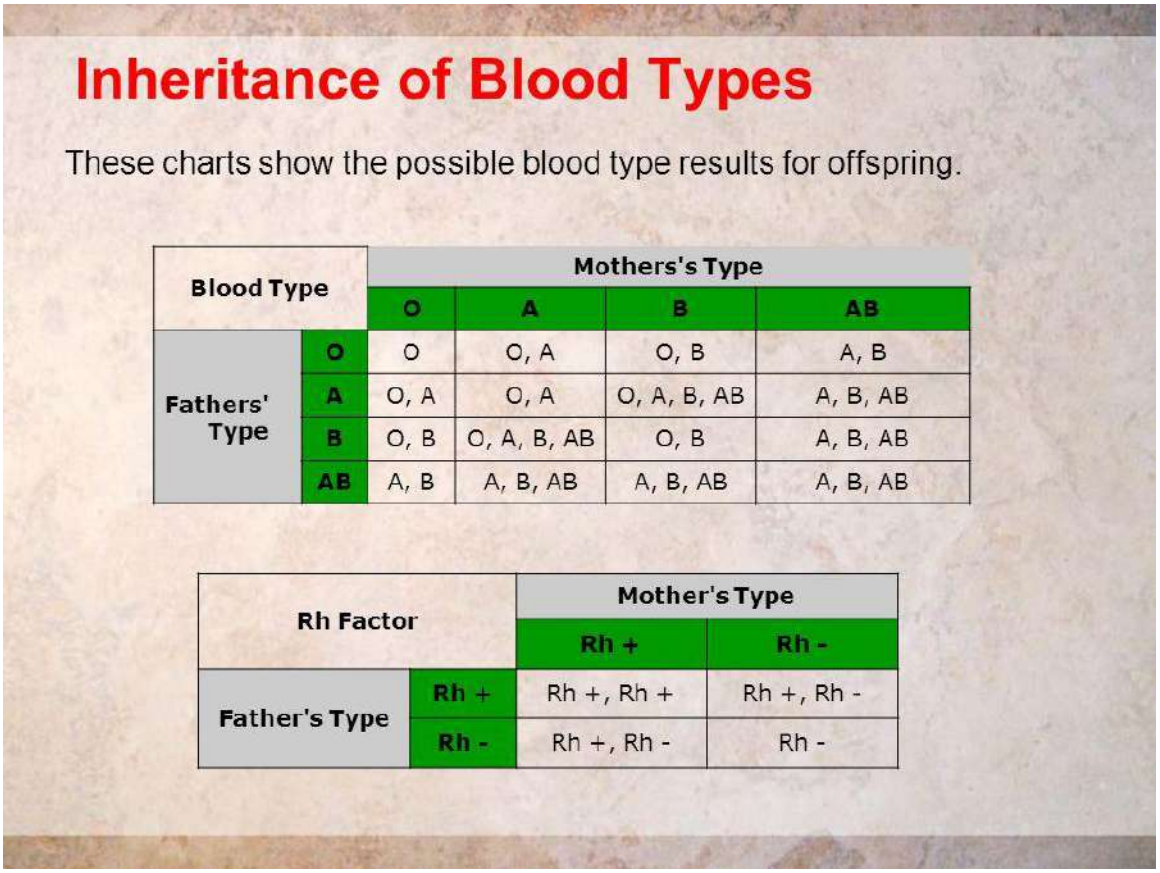
☐ Besides its role in **blood transfusion**,

☐ The **D antigen** is used to determine the risk of hemolytic disease of the new born (or **eryrthroblastosis fetalis**) for Rhdisease management.

☐ The hemolytic condition occurs when there is an **incompatibility** between the blood types of the **mother and the fetus**. There is also potential **incompatibility** if the **mother is Rh nega**tive and the **father is positive**.

☐ When any incompatibility is detected, the mother often receives an injection at 28 weeks gestation and at birth to avoid the development of antibodies toward the **fetus**. (**Rh immune globulin injection).**

☐ The disorder in the fetus due to **Rh D incompatibility** is known as ***erythroblastosis fetalis*.**



Inheritance of Blood Types

These charts show the possible blood type results for offspring.

Blood Type		Mothers's Type			
		O	A	B	AB
Fathers' Type	O	O	O, A	O, B	A, B
	A	O, A	O, A	O, A, B, AB	A, B, AB
	B	O, B	O, A, B, AB	O, B	A, B, AB
	AB	A, B	A, B, AB	A, B, AB	A, B, AB

Rh Factor		Mother's Type	
		Rh +	Rh -
Father's Type	Rh +	Rh +, Rh +	Rh +, Rh -
	Rh -	Rh +, Rh -	Rh -

Mother's Rh factor	Father's Rh factor	Baby's Rh factor	Precautions
Rh positive	Rh positive	Rh positive	None
Rh negative	Rh negative	Rh negative	None
Rh positive	Rh negative	Could be Rh positive or Rh negative	None
Rh negative	Rh positive	Could be Rh positive or Rh negative	Rh immune globulin injections

Exercises

- ☐ ***If one of your parents is blood type A and the other is type B, which of the following blood types would you likely are?***
- ☐ ***Can these parents have a child with blood group O? How?***
- ☐ ***A man is blood group A was get married from a women is blood group B, the Rh factor for each other was Rh+, they have two children one of them is blood group O- , and the other is blood group A+; now:***
- ☐ ***What are the genotypes for these parents and children?***

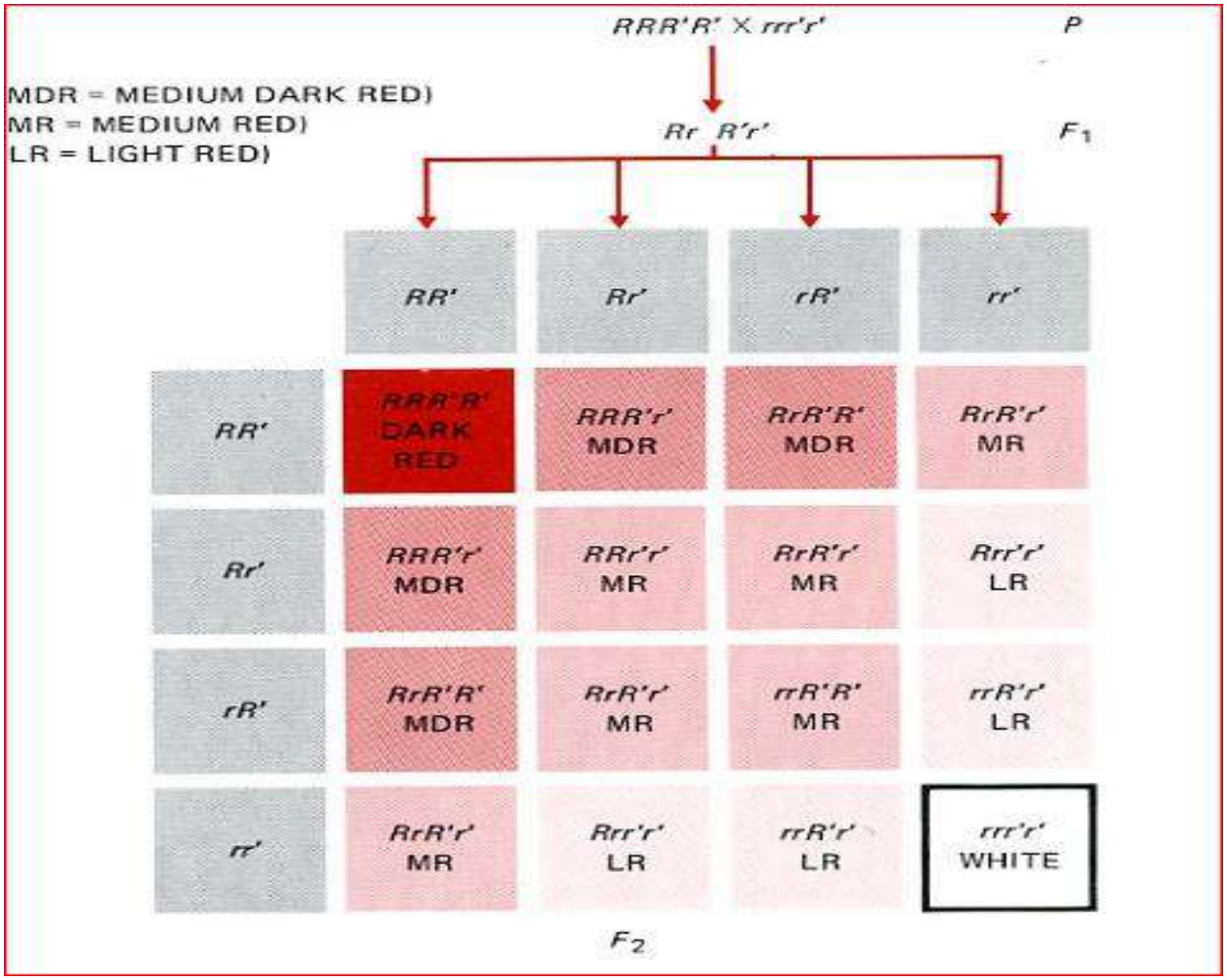
- ☐ A man with **unknown** blood group and **Rh-** get married from **two women**, the first is blood group **O+** she has one child is blood **group A+**, but the second women is blood group **A+** she have two children one of them **B-** and the other **B+**, What are the genotypes of parents and children?

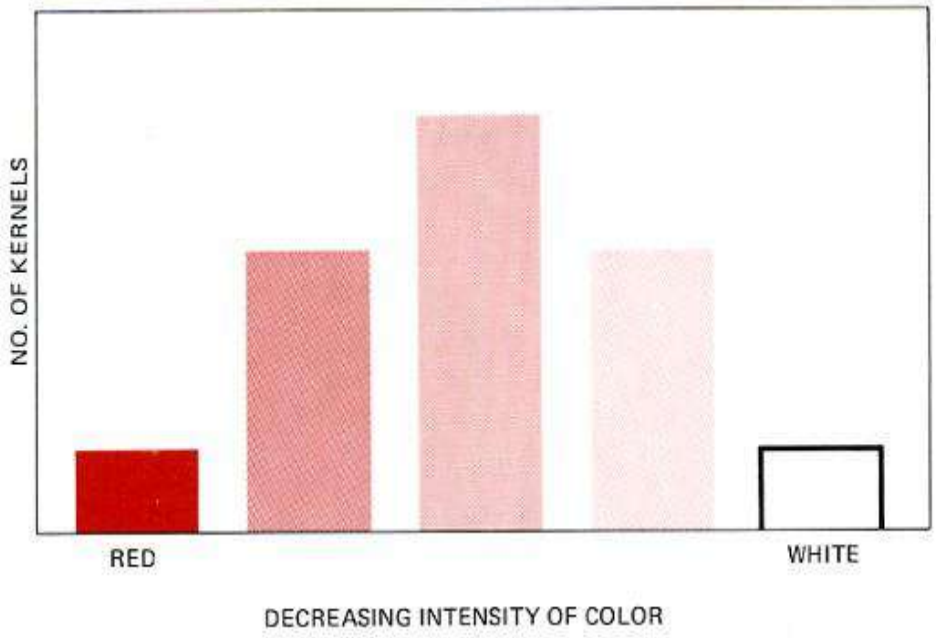
Lab 10:Quantitative Inheritance

Quantitative Inheritance: Are described numerically examples include **(height, weight, speed and metabolic rate).**In a population, a trait may be given a mean value, and the degree of may be described by the variance and standard deviation.Often exhibit a **continuum of phenotype** variation because they are usually influenced by multiple genes that exist as multiple allele.

Mendel considered **a single gene** to be responsible for a single trait, this type of inheritance called **Qualitative inheritance discontinuous traits**.

— **Quantitative inheritance**	**Qualitative inheritance**
1. **A continuous** trait is one that does not fall into discrete categories. Examples include height in human and fruit weight in tomatoes. 2. Occurs when **two or more different genes** influenced the outcome of a single trait (**no dominant principle**). 3. Depends on the **accumulative or additive action of several or many genes**, each of which produces a small proportion of the total effect. **4.** Environmental influence is especially important in the analysis of **Quantitative traits.**	1. **A discontinuous** trait is one that falls into discrete categories. Example includes brown eyes versus black eyes in human. 2. Occurs when a single gene to be responsible for a single trait (**dominant** principle). 3. Such this effect doesn't found.


RRR'R' X rrr'r'
P
MDR = MEDIUM DARK RED)
MR = MEDIUM RED)
LR = LIGHT RED)
Rr R'r'
F1
RR'
Rr'
rR'
rr'
RR'
RRR'R' DARK RED
RRR'r' MDR
RrR'R' MDR
RrR'r' MR
Rr'
RRR'r' MDR
RRr'r' MR
RrR'r' MR
Rrr'r' LR
rR'
RrR'R' MDR
RrR'r' MR
rrR'R' MR
rrR'r' LR
rr'
RrR'r' MR
Rrr'r' LR
rrR'r' LR
rrr'r' WHITE
F2


NO. OF KERNELS
RED
WHITE
DECREASING INTENSITY OF COLOR

Example

—We have length of 30 leaves of plant and they are: [54, (39), 48, 55, 60, 56, 47, 61, 57, 63, 67, 58, 45, 50, 55, 62, 55, (70), 63, 57, 68, 56, 58, 69, 49, 66, 51, 52, 49, 53]

—Are the results belonging to quantitative inheritance?

—Range (R) = **Maximum value- Minimum value**

70-39= 31

Class number (C.N)= 2.5 $\sqrt[4]{n}$

= $2.5\sqrt[4]{30}$

= 5.85

Class inter (C.I)= R/C.N = 31/5.85= 5.3 ~ 5

Each group contain 5 measures

C.I	F	X	FX	$X-\bar{X}$	$(X-\bar{X})^2$	$F(X-\bar{X})^2$
39-43	1	41	41	-15.33	235.01	235.01
44-48	3	46	138	-10.33	106.71	320.13
49-53	6	51	306	-5.33	28.41	170.46
54-58	10	56	560	-0.33	0.109	1.09
59-63	5	61	305	4.67	21.81	109.05
64-68	3	66	198	9.67	93.51	280.53
69-73	2	71	142	14.67	215.21	430.42
	30		1690			1546.68

—

X= maximum value+ minimum value/2

Mean ($\bar{x}$)= fx/n = 1690/30= 56.33

— **Variance (s^2)**= $F(X-\bar{X})^2/ n-1$

— = 1546.68/29

— = 53.47

— **Standard deviation (s)**= $\sqrt{s^2}$

— = $\sqrt{53.47}$

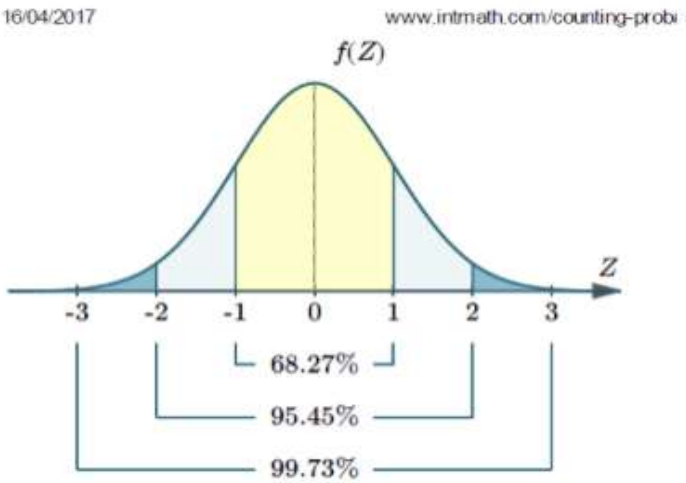
— =7.303

— $\bar{X}$±s= 68.27%

— $\bar{X}$+s= 56.33+7.303= 63.633 **~ 64**

— $\bar{X}$-s= = 56.33-7.303= 49.027 **~ 49**

— The measurements (49-64) must be ≥ 68.27 to have quantitative inheritance and normal distribution



The number of plants between(49-64) is 21

— 21x100/30

— =70%

— 70% > 68.27%

— **Quantitative inheritance and normal distribution.**

— **Note:**

— If the result < 68.27% that mean the experiment not belong to quantitative inheritance and there is experimental or distribution error.

— **Correlation variance (C.V)=(s/x)*100**

— **7.303/56.33*100= 12.69% length**

— **C.V. of width = 18.82% given in the question**

— **Correlation variance:** using to compare between two traits belong to quantitative inheritance such as the length and width of leaves, however if the c.v. for the study trait less than mean of the trait don't effected by the environmental changes and the result is best.