



Genetic Lab 3

Drosophila Fly

An Introduction to *fruit or vinegar fly*

Drosophila Melanogaster

- Is a small (about 3mm long), common fly found near unripe and rotted fruit, **so that it called fruit or vinegar fly**.
- It has been in use for over a century to study genetics and lends itself well to behavioral studies.
- **Thomas Hunt Morgan** was the preeminent biologist studying *Drosophila* early in the 1900's.
- **Morgan** was the first to discover sex-linkage and genetic recombination, which placed the small fly in the forefront of genetic research.
- Due to its small size, ease of culture, short generation time, and is cheap and easy to keep large numbers geneticists have been using *Drosophila* ever since.. Mutant flies, with defects in any of several thousand genes are available.
- It is one of the few organisms whose entire genome is known and many genes have been identified.
- *Drosophila* genome consists of 165 million base pairs in contrast to the human's 3,000 million base pairs.
- Fruit flies are easily obtained from the wild and most biological science companies carry a variety of different mutations.

Why use *Drosophila*?

- 1. They are **small** , **easily handled** and **easy to keep** in a laboratory
- 2. Have a **short generation time**.
- 3. Have a **number of easy to see inheritable characteristics** and many **mutations** to study.
- 4. Have a **chromosome number** of **8** (4 pairs of chromosomes).
- 5. **You can anesthetize them easily** and manipulated individuals with very unsophisticated equipment.
- 6. *Drosophila* **are sexually dimorphic** (males and females are different), making it is quite easy to differentiate the sexes.
- 7. It is easy **to obtain virgin males and females** as they are distinctive from mature adults.
- 8. Flies have a **short generation time (10-12 days)** and do well at room temperature.
- 9. The care and culture **requires little equipment**, is **low in cost** and **uses little space** even for large cultures.
- 10. It Have **Giant polytene chromosomes**(unique to insects) in their larval stage, That chromosomes may be visualized with staining technique for study and can be used for **genetic mapping**.

Classification:

Domain: Eukarya

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta

Order: Diptera

Family: Drosophilidae

Genus: Drosophila ("dew lover")

Species: melanogaster ("dark gut")



Life cycle:

Life cycle. Drosophila go through 4 stages in their lives:

- **Egg:** Take about 1 day to hatch. They are small, oblong and translucent, with two "ears" sticking out.
- **Larva:** It go through 3 molts: they hatch from the egg as small, first instar larvae. Then after a day they molt to become larger, second instar larvae. After another day they molt again to become even larger third instar larvae.
- **Pupa:** Two days in the third instar, the larvae climb up on the sides of the vial, glue themselves to the glass, and settle down as pupae. Pupa are the cocoons in which the larvae metamorphose into adults. The pupal stage lasts five days. During the last day, you can see the red eyes and the dark wings forming inside.
- **Adult.** The adult emerges from the pupal case as a white, elongated thing whose wings are still folded up. After about an hour, the wings will expand the the body will take on its normal shape and coloration. The adult become sexually mature after 8-10 hours.

Flies can live for up to 3 months, but they are pretty decrepit after 6 weeks or so.

Life cycle by day:

Day 0: Female lays eggs.

Day 1: Eggs hatch.

Day 2: First instar.

Day 3: Second instar.

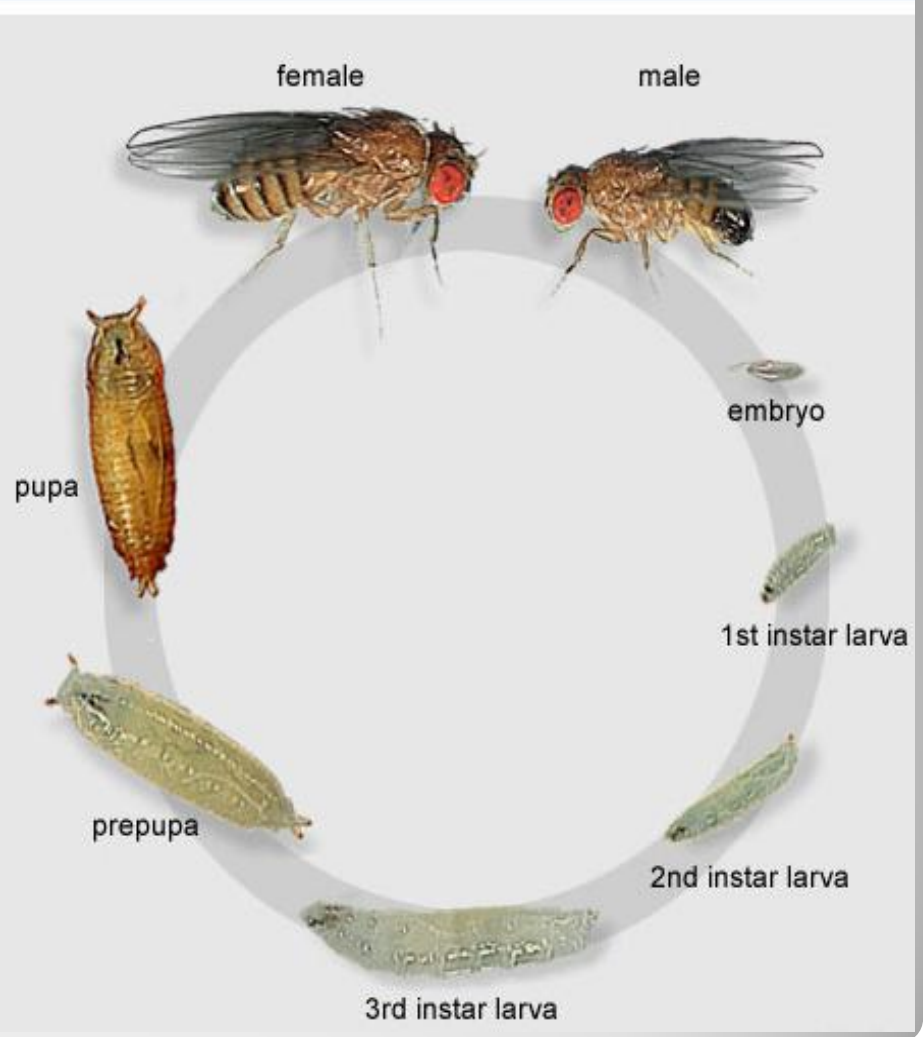
Day 5: Third and final instar.

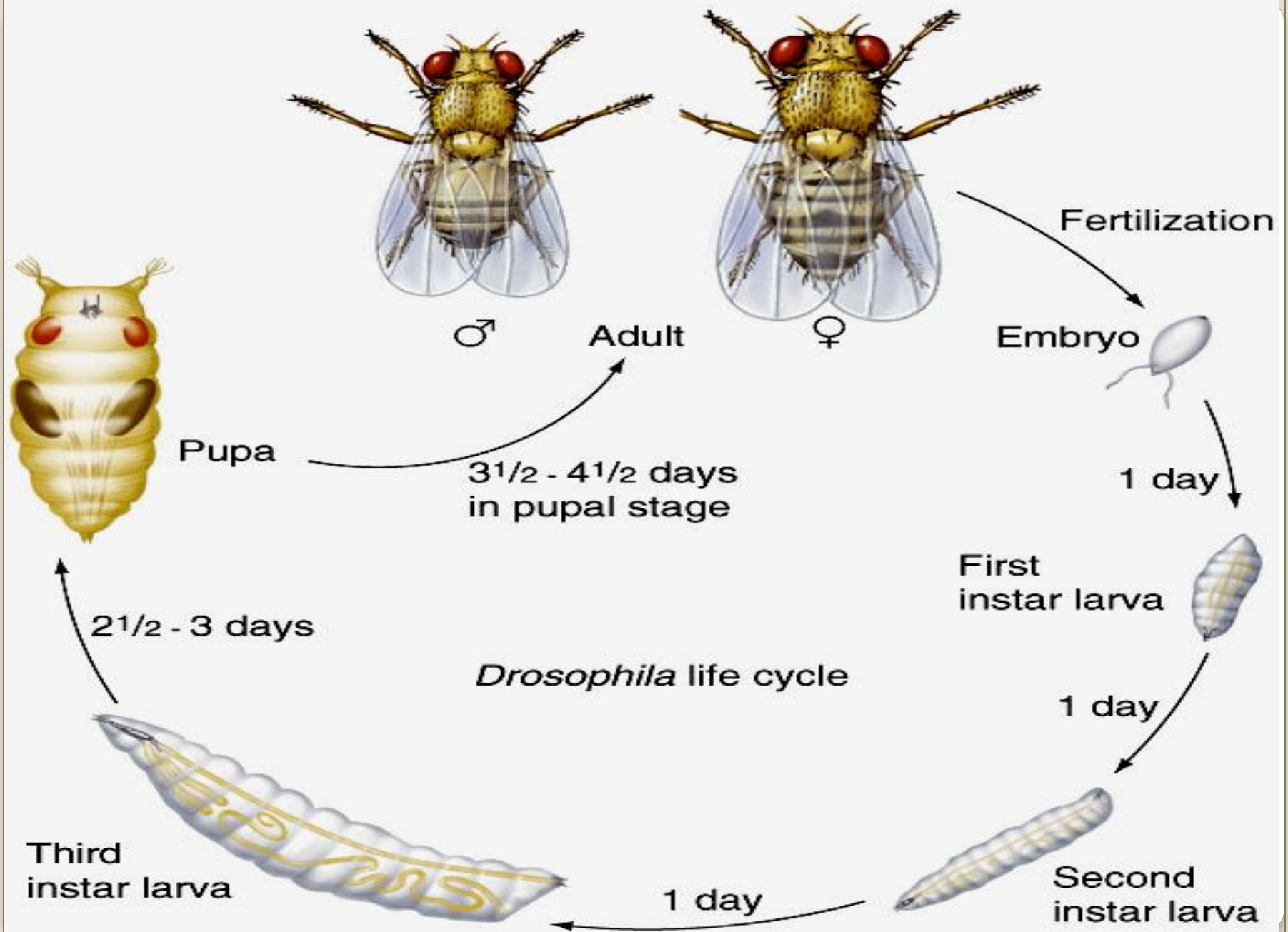
Day 7: Pupariation (pupal formation) occurs 120 hours after egg laying.

Day 11-12: Eclosion (adults emerge from the pupa).

Females become sexually mature 8-10 hours after

The life cycle of *Drosophila melanogaster*

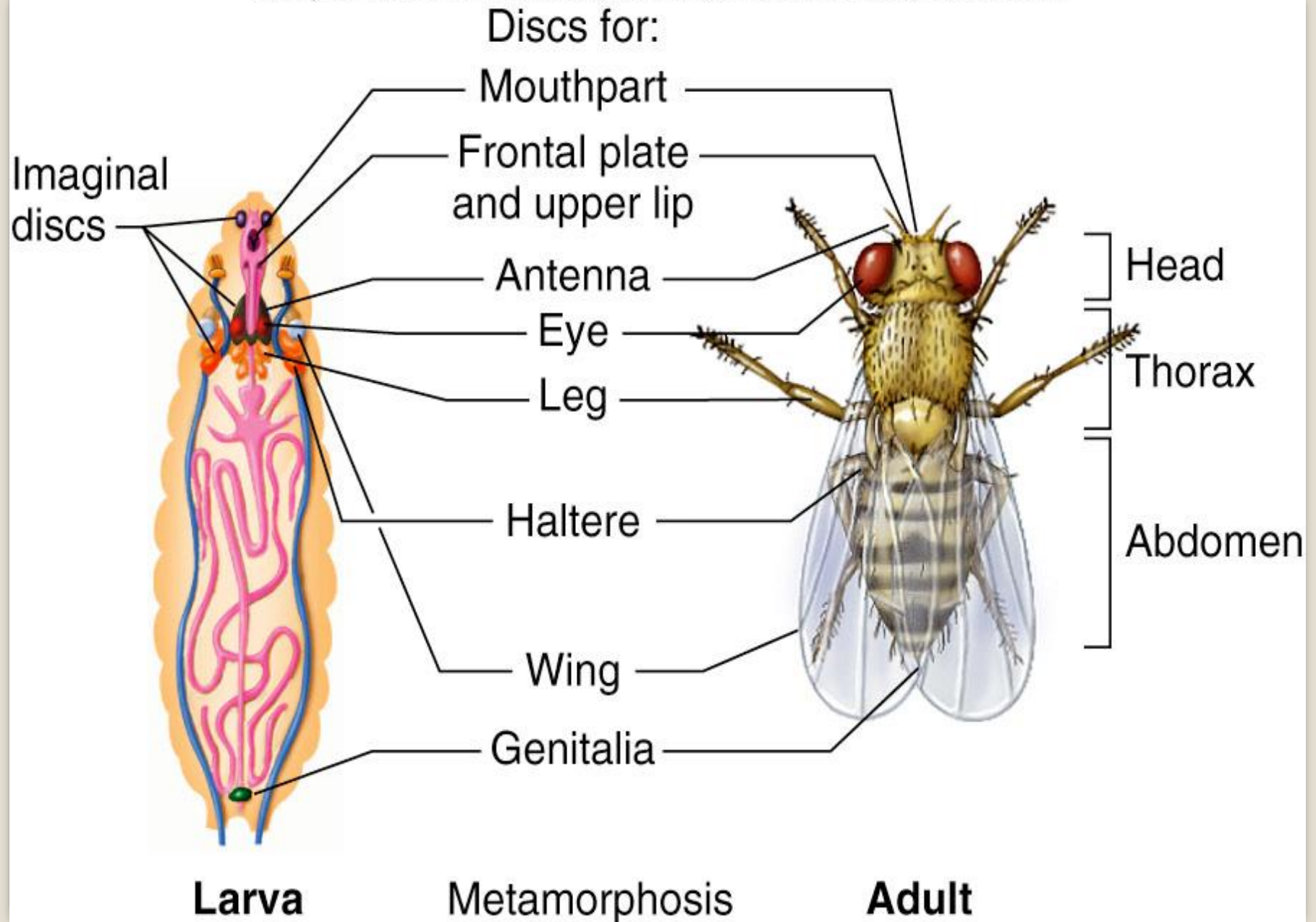


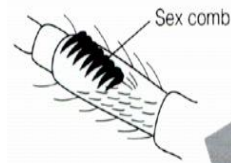


SEX DIFFERENCE

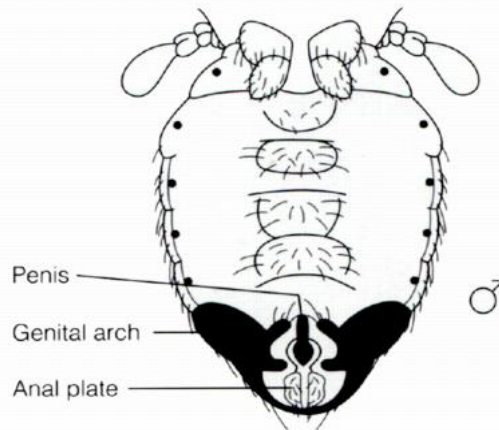
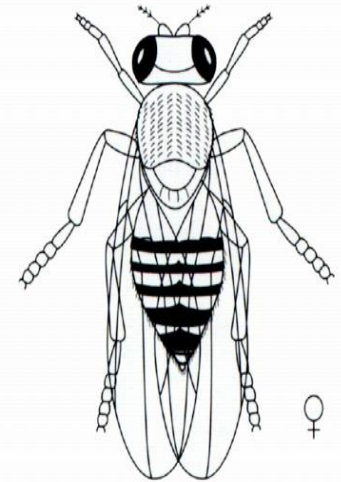
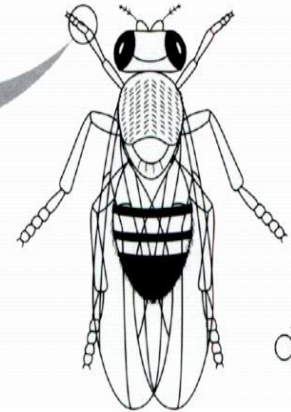
Several criteria may be used to distinguish male and female flies:

- 1. **Size of adult**: The female is generally larger than the male.
- 2. **Shape of abdomen**: The female abdomen curves to a point (seven segments); the male abdomen is round and much shorter (only five segments).
- 3. **Markings on the abdomen**: Light and dark bands are easily visible on the dorsal surface of the female. The last few segments of the male's dorsal surface have a fairly uniform dark pigmentation (segments of the male are fused).
- 4. **Appearance of sex comb**: On males there is a tiny tuft of hairs on the basal tarsal segment of the front leg.
- 5. **External genitalia on abdomen**: Located at the tip of the abdomen, the ovipositor of the female is pointed. The claspers of the male are darkly pigmented, arranged in circular form, and located just ventral to the tip.
- 6. **Sex organs during larval stage**: During the late larval stage males can be distinguished by the presence of a large, white mass of testicular tissue located at the beginning of the posterior third of the larva in the lateral fat bodies and can be seen through the integument.

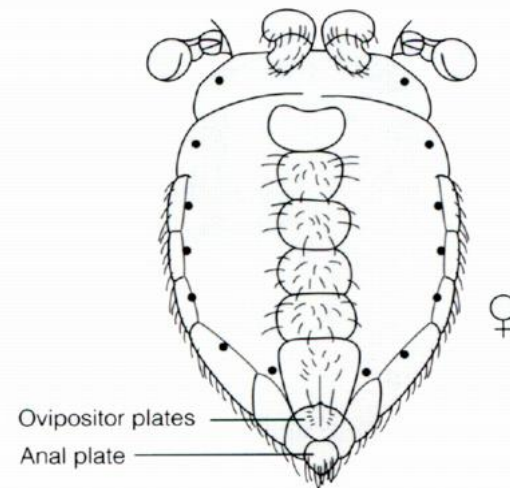




Dorsal view

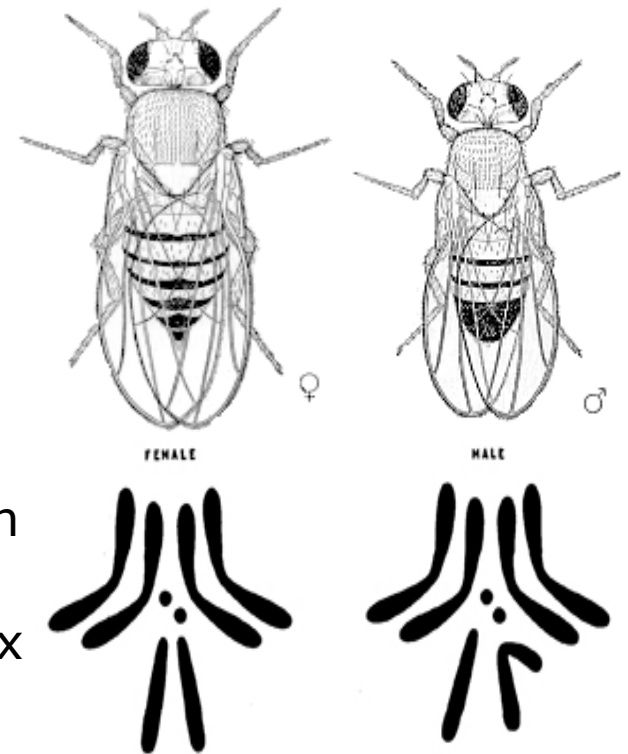


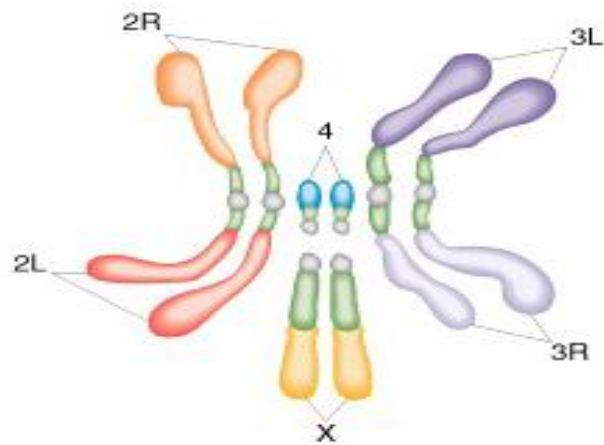
Ventral view



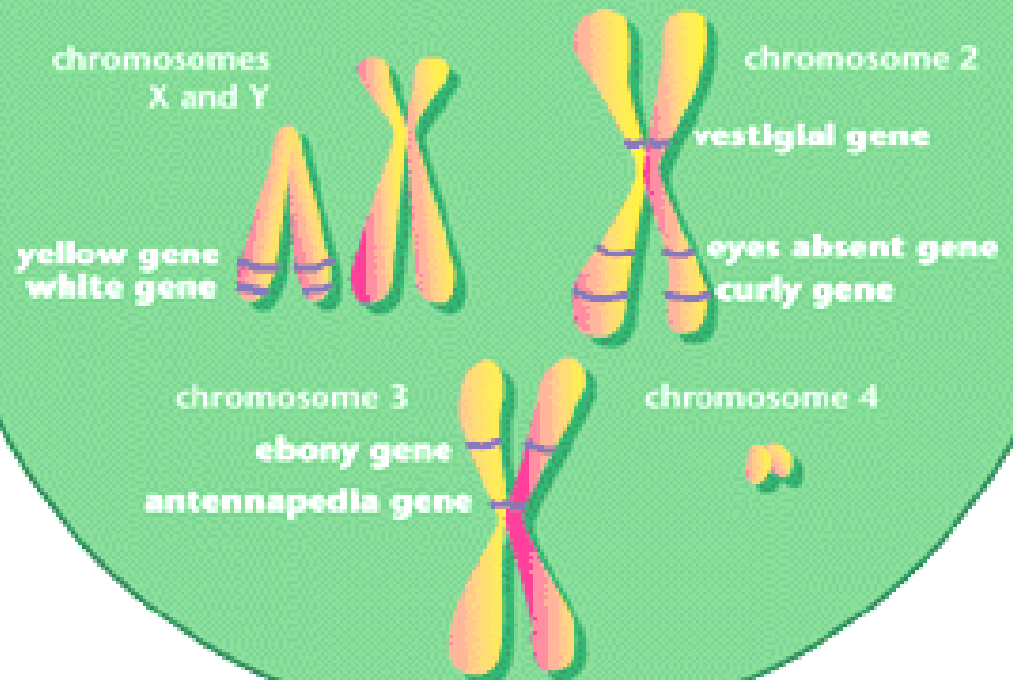
The chromosomes of *Drosophila melanogaster*

- The individual *Drosophila* has four pairs of chromosomes.
- A female has two each of chromosomes 1 (called the X chromosome), 2, 3, and 4.
- A male has one X chromosome, one Y chromosome, and two each of chromosomes 2, 3, and 4.
- The Y chromosome and chromosome 4 are both very small, and carry few genes.
- The majority of the fly's genes are carried on chromosomes X, 2, and 3.
- The X and Y chromosomes are involved in sex determination, and are thus called the sex chromosomes.
- Chromosomes 2, 3, and 4 are called the autosomes.





A fruit fly has four pairs of chromosomes in every cell. This diagram shows the locations of the genes that are mutated in the flies here.



HEREDITARY TRAITS:

- **Wild-type :** Flies that have the "normal" characteristics, red eyes, normal length wing and tan or gray body (brown) bodies, brick red eyes, large compound eyes, and long wings.
+/+ = wild type fly for any phenotype .
- **Mutant flies:** Any variation from the wild type. Mutant alleles can be carried on autosomes or sex chromosomes. Most mutations are recessive they are indicated with one or two letters in lower case.

HEREDITARY TRAITS differences:

- **1. Eyes:** **Wild type:** red, oval in shape, and many-faceted.
Mutants: In Eye color such as :white, black, apricot, scarlet red, pink, or brown.
And changes in shape of the eye and number of facets.
- **2. Wings:** **Wild type:** long, smooth edges, uniform venation, extend beyond the abdomen
Mutants: changes in size and shape; absence of specific veins; changes in position in which wings are held when at rest.
- **3. Bristles:****Wild type:** fairly long and smooth (note distribution on head and thorax)
Mutants: shortened, thickened, or deformed bristles changes in patterns of distribution.
- **4. Body color:** **Wild type:** basically gray, with pattern of light and dark areas
Mutants: black (in varying degrees), yellow, in doubtful cases, color can often be determined most clearly on wing veins and legs.
All mutant traits are recessive to the wild type.



CULTURING DROSOPHILA

- We grow flies in vials with about 2 cm of food on the bottom and a foam or cotton plug in the top. At the beginning of the semester, the food will be made by the lab preparator. The foam plugs are necessary to keep foreign flies out!
- **Fruit Fly Culture Media(Sugar media):** 30 gm flour, 50gm yeast , 100gm sugar, 15 gm agar, 5 ml propionate acid (for preventing molds from growing), and 1 liter distal water.
- **Procedure:** Mix all ingredients then heat until boiling. Quickly pour mixture into clean culture jars. Cap and let cool to room temperature. This mixture can be stored in the refridgerator with a tightly capped lid until ready for use. When ready to use add fruit flies. Propionate acid is a mold inhibitor used in bread.



- **Examination of wild-type fruit flies:** To examine the flies, you need to anesthetize them--otherwise they'll fly away!. The anesthetizer is a plastic gadget with a funnel-shaped opening in one end--this goes over the vial of flies. On the other end is a foam reservoir with a cap. Put several drops of FlyNap on the foam, then close the cover.
- **Putting the flies to sleep (anesthetizing the flies) :**
- **You will be provided with:** A vial containing wild-type fruit flies, a fly anesthetizer, fly anesthetic chemical(Fly nap or Ether), a white paper card, a paint brush, empty fly culture vials.
- **Caution :** Ether is ***dangerously*** explosive, so there must be ***no*** flames in the room.

