

Fruit Flies (Drosophila)

Background:

Fruit flies-sometimes called vinegar flies, drosophila (after their scientific name *Drosophila melanogaster*), or gnats-are the diminutive insects that sometimes appear around fruit bowls or stored fruit. Since fruit flies are also attracted to fruit peelings and cores, they are often found around garbage cans and compost piles. And, of course, they are common in fruit producing areas, where they feed and reproduce on overripe or decaying fruit. There are several kinds of fruit flies, all similar in appearance.

Characteristics:

Although small-about $\frac{1}{8}$ inch in length-and difficult to observe without a microscope or magnifier, fruit flies are similar to larger flies and show most of the typical insect attributes. They have three body parts: the head, thorax and abdomen. The head has two prominent red eyes, a pair of barely perceptible antennae and the mouth parts. Three pairs of legs and a single pair of wings are attached to the thorax, which contains the heart and part of the digestive system (though most of the thorax is filled with muscles that move the wings and legs). The abdomen contains the remainder of the digestive system and the reproductive structures.

Fruit flies are generally yellowish in color with several black bands across the abdomen. Females and males can be readily distinguished by examining their abdomens with a magnifier. In male fruit flies, the tip of the abdomen is rounded and has a broad black band: in females, it is slightly more elongated and has a narrow black band. Also, the abdomen of the female has seven segments, while the male's has only five. These differences become more obvious when the female's abdomen becomes distended with eggs. Another distinguishing feature of the male (which requires still higher magnification to observe) is the "sex comb," several bristles found on each front leg.

Life Cycle and Reproduction:

Fruit flies undergo complete metamorphosis, so there are four distinct stages in their life cycle: egg, larva, pupa and adult. The length of the life cycle and of each stage is directly related to the temperature, with warmer temperatures tending to increase the rate of development. For example, at about 68°F, the entire life cycle takes about 15 days, but at 76°F, the time required is reduced to about 10 days.

Fruit flies produce astonishing high numbers of offspring. A female fly, which can mate during the first day of her life and begin laying eggs the next day, can produce as many as 500 eggs in her first 10 days. She continues laying eggs though at a slower rate, for as long as one month. Under natural conditions, the fruit fly population is usually low following the rigors of winter, but as spring and summer progress, and as more fruit is available on which the flies can reproduce, their number continues to increase until seasonal high is reached in the autumn.

Fruit flies can be annoying when they appear around a bowl of fruit, but most kinds of fruit flies are harmless. They do not have biting mouth parts, and they have not been implicated in the transmission of disease. And since they feed and reproduce primarily on decaying fruit, they do no harm to usable fruit. However, the Mediterranean fruit fly, which is not native to the United States, could pose a serious danger to crops. This species lays its eggs on unripened fruits, and the developing larvae (maggots) can destroy a whole crop before it can be harvested: but agriculture officials are taking great care to keep them under control.

Fruit flies are best known for their role in the study of heredity. Since they have such a short life cycle, a high reproductive rate, and several easily identifiable characteristics, such as eye color and wing shape, it is possible to trace a single genetic trait through several generations in a relatively short time. As a result, fruit flies have probably contributed more to our knowledge of heredity than any other organisms.

Fruit Flies (Drosophila) (cont)

Fruit Flies in the Classroom:

Since fruit flies are easy to raise in captivity, they are especially useful in teaching the concepts of metamorphosis and life cycle. They can also be used as food for anoles, web-spinning spiders, praying mantises and other small insect-eating animals.

How to Obtain:

Fruit flies are easy to raise in the classroom; so easy, in fact, that one autumn several generations of them lived and reproduced in a classroom jack-o-lantern (which was left in the room long after Halloween). This was discovered when someone bumped the jack-o-lantern and a cloud of flies emerged from the eyes, nose and mouth. In this case, the flies lived there without any special care. Most teachers, though, will probably prefer to raise the flies under more controlled conditions and in enclosures. *Drosophila* kits, available from some biological supply companies, include everything that is needed—containers, media (food) and flies—in classroom quantities. However, the flies can also be cultured using readily available materials, and, as indicated by the jack-o-lantern experience described above, fruit flies are not hard to find—they will find you.

To trap wild fruit flies, put a few pieces of ripe, or even decaying, fruit—such as apple, cantaloupe or banana—in open jars and place the jars outdoors. Placing the jars near refuse containers where the flies tend to congregate, while not necessary, will help ensure a good catch. It should take two or three weeks to establish the colonies. Flies hovering around the jars are a good sign that eggs have been laid inside, but even if no flies are visible, it is likely that some will have visited the traps and laid eggs on the fruit by this time. One need only place a cover (a piece of cloth secured with a rubber-band) on the jars and bring them indoors. Keep the jars at room temperature, and the flies will reproduce and become the “stock” culture from which students can establish smaller colonies.

Caring for Fruit Flies

Housing:

Student’s fruit fly colonies can be housed in test tubes, plastic pill vials, baby food jars or any similar containers. The size and shape of the containers is not important, but they do need covers that will both prevent the flies from escaping and allow air to enter. Cotton or foam rubber plugs will work in test tubes and small vials. Metal or plastic vial covers can be perforated with a paper punch or a nail and the holes can be plugged with cotton.

Diet:

Commercial fruit fly medium is probably the most convenient food source for fruit flies, but they can also be raised on various kinds of fruit, preferably very ripe or partially decayed. The fruit should be cut or crushed so that the flies have access to the juices. In either case, place the fruit or medium in small containers and add a loose wad of paper towel to hold it in place when the vial is tilted

Transferring the Flies:

Prepare to transfer the flies from the stock culture to students’ containers by sharply tapping the jar on the table to shake the flies to the bottom. Then quickly replace the cloth cover with a 3x5 inch card in which one or more holes have been made with a paper punch. If students invert their containers over the holes, the flies will crawl in. When 10 or 12 flies have entered, students can quickly cover the containers and their cultures are complete.

Fruit Flies (Drosophila) (cont)

Students should observe their colonies each day. The eggs, which the flies will lay on the cut surfaces of the fruit, will be difficult to see because they are so small. If students look carefully, they should be able to find some larvae after three or four days, but even these will be difficult to see at first as they are small and spend most of their time burrowing through and consuming the fruit. Eventually, after four or five days, the larvae will crawl out of the fruit and change into pupae. These, then, will soon change into adult flies, and the life cycle will have been completed within 10 to 15 days, depending on the temperature.

Through observing their fruit fly cultures, students can discover many things about insects and their life cycles. They may also be encouraged to use their ingenuity to find out about fruit fly food preferences and factors that affect reproduction and longevity.

Observations, Activities and Questions:

- Observe and describe each stage of the fruit fly life cycle-egg, larvae, pupae and adult. Which of them can move about? How do they move? How long does each stage last? During which stage does the most growth occur?
- Try to find out what foods fruit flies prefer by placing various fruits in jars and placing these outdoors. Wait two or three weeks and then see which foods have attracted more fruit flies.
- Find out whether fruit flies are affected by light. Shine a bright light on the fruit fly container. Do the fruit flies move toward or away from the light?
- Find out whether fruit flies are affected by gravity. Slowly rotate a container of flies. Which way do the flies appear to move?