# OXYGEN CONSUMPTION IN MALE AND FEMALE FLY DROSOPHILA MELANOGASTER[1]

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There have been many investigations conducted on the fruit fly, **Drosphila melanogaster** in Genetics; however, only relatively few physiological studies have been made on this fly.

The object of this experiment was to show the different rates of metabolism between the two sexes of Drosophila.

A normal, red-eyed strain of flies, **Drosophila melanogaster,** the so-called wild type, was used in the experiment. The stock was obtained from the Department of Agronomy, Cornell University. They were kept and bred in one-half pint milk bottle and fed banana-agar-yeast mixture as used by many investigators. Paired matings of young male and virgin female flies were made each day and put into newly prepared culture bottles. These culture bottles containing the mated flies were kept in an electric incubator, which was adjusted and controlled at 26 degrees C. The temperature of the incubator was the same as that of the water bath in which, later, the experiments were made. Thus, after the experiments were started, each day young flies were emerging from the pupa cases, which insured one of having flies of the same age to be used in the experiments. However, when the pupae appeared on the paper in the culture bottles, they were carefully removed and each pupa was placed separately on a small piece of moistened towelling paper, to prevent its desiccation, and put into a small vial.

This segregation of the pupae prevented the emerging flies from mating after they had emerged from the pupa cases, and also prevented them from eating, which would have affected their metabolism when the experiments were made. These vials were labeled, stoppered with a cotton plug, and placed in the electric incubator. On the next day after

[1]Experiment conducted in the laboratory of the Department of Zoology, University of Nebraska, Lincoln, Nebraska.

the flies emerged from the pupa cases their oxygen consumption was measured.

Fifty individual males and fifty individual females of the same age were used in the experiments. To determine the oxygen consumed by each individual of both lots, after the experiments were completed, it was found necessary to obtain the average weight of control males and control female flies, since the rate of respiratory metabolism is expressed in terms per gram body weight per unit of time. It was necessary, therefore, to weigh two hundred and fifty male and two hundred and fifty female control flies. The flies were weighed in fifty lots of five flies of each sex, and the average weight per fly of each lot of five was determined. Due to the small size of the flies, it was necessary to use an apparatus sufficiently sensitive to enable the recording of minute quantities of oxygen consumed when individual flies were tested. In the investigations the apparatus employed for the determination of oxygen consumption was Thunberg's micro-respirometer, modified slightly, at first by Fenn and later by Obreshkove. It consists of two small bottles, each having a capacity of 12 cubic centimeters; one bottle is used as an animal chamber and the other as a compensation chamber. The two bottles are connected by a horizontal capillary index tube. The capillary index tube is graduated in the millimeter scale to a total of 139 mm., and a bore of 0.52 mm. The capillary index tube contained a minute drop recorded the reduction in oxygen pressure in the bottle. By the absorption of oxygen in the animal chamber, the oil index drop is caused to move toward the vessel containing the animal. Between the horizontal capillary index tube and each bottle there is a three-way stopcock, which makes it possible to connect the bottles either directly to the capillary index tube or to the outside. Each bottle is provided with a glass spoon or bulb attached to the base of the stopper. In one of these bulbs was placed the individual fly whose rate of oxygen consumption was to be measured. The bulb was small enough to assure that all possible muscular movements of the fly were at a minimum. The experimental procedure employed was as follows. A fly was slightly etherized, placed in the bulb in the animal chamber bottle,



and covered with a small piece of cotton to prevent its escape and also aid in keeping its muscular movements at a minimum. The small drop of kerosene oil of 1 millimeter was placed in the capillary tube and brought as close to the center of the capillary tube as possible. Then 1 cubic centimeter of 2 per cent sodium hydroxide solution was put into each of the chamber bottles to absorb the carbon dioxide. After the fly had been placed in the bulb in the animal chamber bottle, the stopcocks were turned so that both bottles were made to communicate with the outside. Then the apparaus was immersed in a Treas water bath in which the thermostat was set for 26 degrees C, and this temperature was maintained and controlled within 0.5 degrees C. The microrespirometer was left in the bath for a period of one half hour until the apparatus had come out of the water bath quickly, and the stopcocks turned so that both bottles communicated with the capillary index tube. The microresperometer was again immersed in the water bath. An additional 15-minute period of time was allowed before the position of the kerosene oil drop was recorded, thus insuring no disturbance of the kerosene oil drop from the turning of the stopcocks. After this period, when the apparatus had reached its temperature equilibium, the position of the index drop was read at 15-minute intervals for a period of one hour. In calculating the absolute amounts of oxygen used by the fly, from a microrespirometer, reading of 1 mm. in the capillary index tube, it was necessary to employ the following formula given by Krogh (1916):

$$\frac{\text{Ap. } 273}{273 \text{ plus t w}} \qquad \text{Plus V.}$$

Since the rate of metabolism is expressed per milligram of body-weight per unit of time, it was necessary to weigh five hundred control flies similar to those used in the experiments. Two hundred and fifty flies of each sex were weighed. They were of the same age and reared under the same conditions as those which were used in the expriments.. By weighing two hundred and fifty control flies of each sex in groups of five individuals, a more accurate weight of the flies was ob-

tained than if each fly had been weighed separately. Comparing the average weights of the groups of control females, it was found that the average weights of the groups of control females, it was found that the average weight of each male fly was 0.88 milligram, while the average weight of each female fly was 1.1 milligrams. The average manometer for the males was 9.2 mm. per hour per fly, that for the females 14 mm. per hour per fly, that is, the females show a higher average than the males. The average quantity consumed by each of the fifty male flies was 0.002798 milligrams per milligram body-weight of fly per hour. The average quantity of oxygen consumed by each of the fifty females was 0.003386 milligrams per milligram body-weight of fly per hour. The female fly consumes on an average 0.000588 of a milligram more of oxygen per milligram body-weight per hour than the male. It is evident that the female **Drosophila melanogaster** has a higher rate of oxygen consumption than the male. In the present experiments the determination of oxygen consumption was made on individual adult flies of the same age and not upon a number of flies collectively as has been done by previous workers. Although the differences in oxygen consumption are small, nevertheless it indicates that there is a higher rate of metabolism in the female than in the male fly.