Box Extension 7.4

to accompany

Animal Physiology, Fifth Edition

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Respirometry

In **closed respirometry** (see Figure A), air does not flow through the animal chamber during measurement. The principal practical challenge with closed respirometry is to prevent temperature-induced changes in gas volume from confounding the results. This problem is solved in the closed respirometer shown in Figure A by connecting two identical chambers to either side of a *manometer*, a U-shaped water column that serves to measure gas-pressure differences. If the environmental temperature changes, the gas pressure inside both chambers rises equally, exerting equal and opposite increases of pressure on the two sides of the manometer; in this way, the position of the water in the manometer is unaffected by changes of environmental temperature.

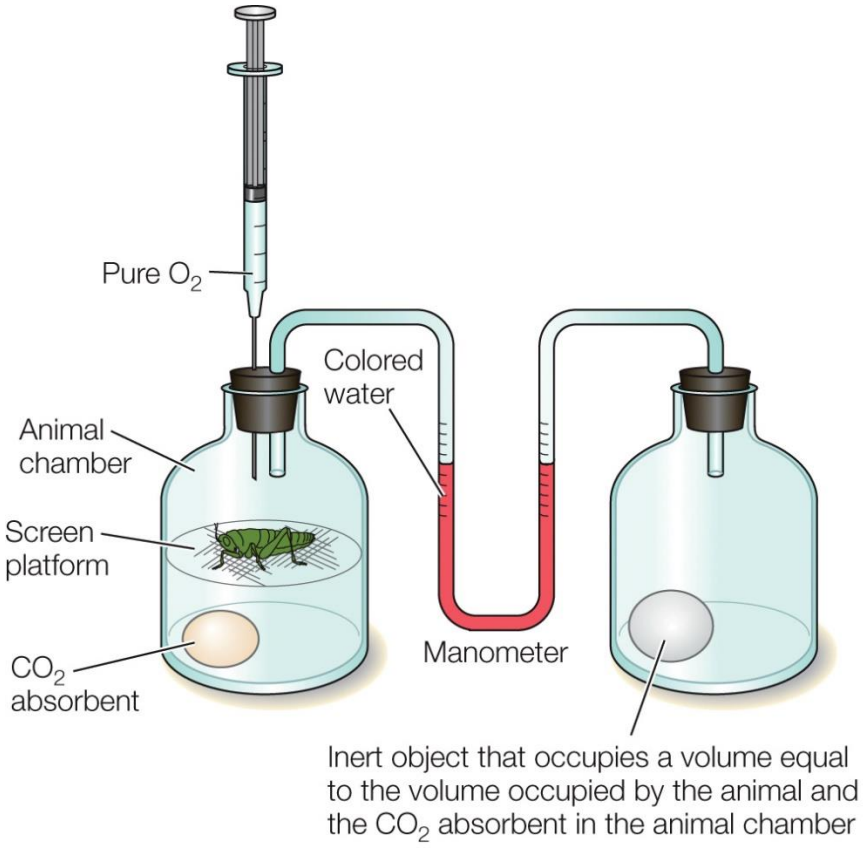

Figure A A closed respirometer

In the closed respirometer, as the animal uses O_2, the CO_2 absorbent in the animal chamber removes exhaled CO_2 from the air in the chamber. Thus, the animal's O_2 consumption causes the total gas volume in the animal chamber to decrease relative to that in the other (animal-free) chamber; this decrease in the gas volume in the animal chamber causes the water in the manometer to shift, rising higher in the left arm than the right. At timed intervals, enough pure O_2 is injected from the syringe into the animal chamber to make the manometer return exactly to the initial, unshifted position shown in Figure A. The amount of O_2 injected at any one moment in this procedure must equal the amount of O_2 that the animal consumed during the interval of time preceding the injection. By measuring the O_2 injected and knowing the length of the preceding time interval, a researcher can calculate the animal's O_2 use per unit of time.

In **open respirometry** (see Figure B), air flows through the animal chamber (or through a mask worn by the animal) during the measurement of O_2 consumption. The rate of airflow is measured carefully. Moreover, a precision O_2 meter, typically using an electrochemical or paramagnetic cell for O_2 detection, measures the O_2 concentration of the flowing air just before the air enters the animal chamber and just afterward. The researcher calculates the animal's rate of O_2 consumption by taking into account the volume of air passing through the chamber per unit of time and the amount of O_2 extracted from each unit of volume. Although open respirometry requires the use of far more costly equipment than closed respirometry, it permits continuous, minute-by-minute (even instantaneous) monitoring of an animal's rate of O_2 consumption.

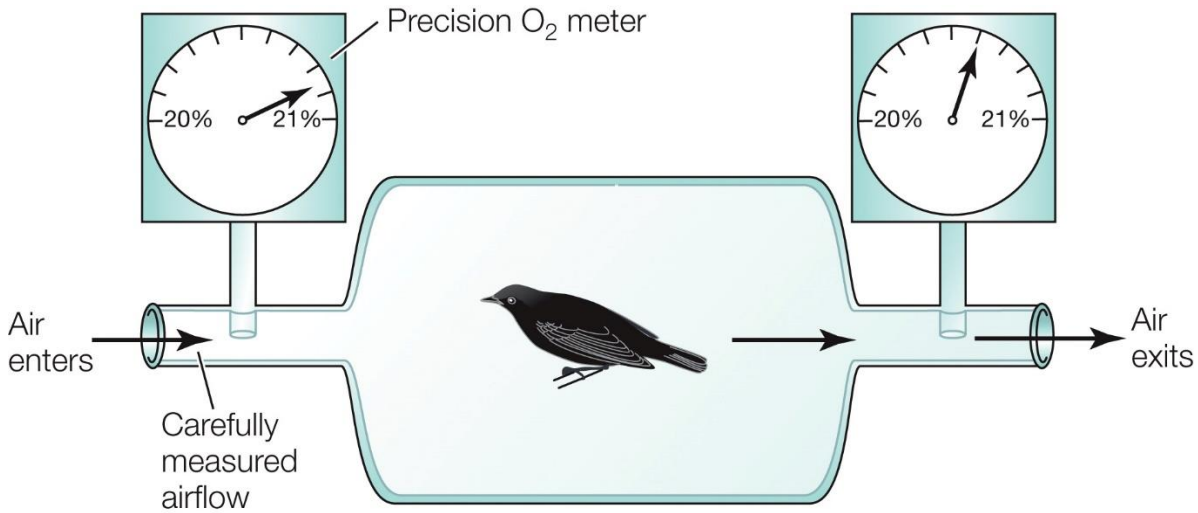

Figure B An open respirometer