

## What do we mean by respiration?

TD Hughes

In the teaching of biology, the term *respiration* should be used only to mean those biochemical processes primarily responsible for the production of energy-rich compounds, such as ATP, within the cell. These processes are glycolysis, Krebs cycle, electron transport coupled to the oxidative phosphorylation of ADP, and the conversion of pyruvic acid into lactic acid. The first three of these pathways constitute aerobic respiration, for which oxygen is required, and are also used in an equivalent process carried out by some bacteria that use sulphur as an alternative to oxygen. Glycolysis and the conversion of pyruvic acid into lactic acid are the pathways of anaerobic respiration, for which neither oxygen or sulphur is required. Some cells can synthesize energy-rich compounds by processes other than respiration, for example by the light reaction of photosynthesis.

When organisms obtain their supply of oxygen for aerobic respiration from external sources, they do so by *breathing*. Oxygen diffuses into the organism through surfaces designed for this purpose. Carbon dioxide is a waste product of aerobic respiration. If carbon dioxide diffuses from the organism as oxygen diffuses in, then respiratory *gaseous exchange* takes place. In animals, gaseous exchange occurs at all times. In plants, during the day, photosynthesis provides some or all of the oxygen required for aerobic respiration and utilizes some or all of the waste respiratory carbon dioxide. Respiratory gaseous exchange will only be evident in plants when the demand for oxygen exceeds its output from photosynthesis; this will occur at lower light intensities or at night.

One of the factors affecting the rate of oxygen uptake or of carbon dioxide release by an organism will be the concentration gradient across the gaseous exchange surface. To ensure that concentration gradients do not become rate-limiting, the external face of the exchange surface must be *ventilated*. Movement of the external

medium may provide some ventilation, and this is the only method available to plants. In many animals, feeding or locomotory movements provide ventilation. In more active animals, specific ventilatory movements are required.

Confusion can arise if the term *respiration* is used to describe breathing or ventilation. This practice is found in medicine, with expressions such as artificial respiration and respiratory rate referring to what, in a strict biological sense, is ventilation. The ambiguity that arises has resulted in terms such as 'internal respiration' and 'cellular respiration' to distinguish respiration in its correct sense.

Quite simply, a cell obtains some or all of its energy by respiration. Respiration may be aerobic or anaerobic. If an organism respire aerobically then it will need oxygen. If it obtains this oxygen from an external source then it is breathing. An adequate oxygen supply may be ensured by the ventilation of the surface responsible for gaseous exchange.

TD Hughes, St Mary's School, Wantage, Oxon