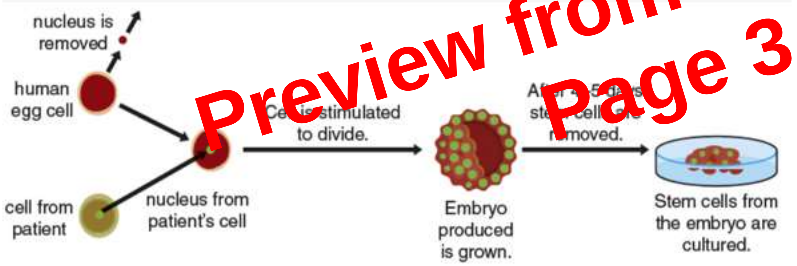
Biology Chapter 1: Cell Biology

Therapeutic cloning

The idea of therapeutic cloning is to produce stem cells with the same genes as the patient. They would not be rejected by the patient's immune system. The process involves nuclear transfer. The nucleus of a body cell from the patient is transferred to an egg cell that has had its nucleus removed. The stem cells are used to treat the patient. The embryo is discarded



Energy is needed

Organisms need energy:

- to drive the chemical reactions needed to keep them alive, including building large molecules
- for movement
- for keeping warm
- Energy is needed to make our muscles contract and to keep our bodies warm. It's also needed to transport substances around the bodies of animals and plants.
- for cell division
- to maintain a constant environment within our bodies
- for active transport. Plants use active transport to take up mineral ions from the soil, and to open and close their stomata
- to transmit nerve impulses.

Bioenergetics

This is the equation for aerobic respiration:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6O_2 + 6H_2O$$

This equation describes the overall change brought about through each of a series of chemical reactions. A small amount of energy is actually released at each stage in the series. The first group of steps occurs in the cytoplasm of cells, but most of the energy is transferred by chemical reactions in mitochondria.

Anaerobic respiration

This is anaerobic respiration – respiration without oxygen. Anaerobic respiration in yeast cells and certain other microorganisms is called fermentation. Anaerobic respiration occurs in the cytoplasm of cells.

The biochemistry of fermentation

The equation for fermentation is:

Glucose→ethanol+carbon dioxide (energy released)

Anaerobic respiration is much less efficient than aerobic respiration. It produces only around a nineteenth as much energy. This is because the oxidation of glucose is incomplete. But in situations where there's little oxygen, it means that cells can stay alive, and the amount of energy produced is still enough to keep single cells running.

Certain plant cells can also use alcoholic fermentation to obtain their energy. These include plants that grow in marshes, where oxygen is in short supply. Pollen grains can also respire anaerobically.

Oxygen Debt

Without oxygen, we would die. But when actively contracting, our muscles run short of oxygen. They are able to respire anaerobically for short periods of time. Lactic acid, and not ethanol, is produced.

Glucose → lactic acid(energy released)

The incomplete oxidation of glucose causes a build up of lactic acid and creates an oxygen debt. As a result, our muscles become fatigued and stop contracting efficiently. When the period of exercise is over, lactic acid must be removed. The body's tolerance of lactic acid is limited. It is taken to the liver by the blood, and either oxidised to carbon dioxide and water, or converted to glucose, then glycogen. Glycogen levels in the liver and muscles are then restored. These processes require oxygen. This is why, when the period of activity is over, a person's breathing rate does not return to normal straightaway. Oxygen debt is the amount of oxygen required to remove the lactic acid, and replace the body's reserves of oxygen. Paying back the oxygen debt can take from a few hours, to several days after a marathon.

Cell size

1 millimetre (mm)	= $\frac{1}{1000}$ m	or	10^{-3} m		
1 micrometre (µm)	= $\frac{1}{1000}$ mm	or	10^{-3} mm	or	10^{-6} m
1 nanometre (nm)	= $\frac{1}{1000}$ µm	or	10^{-3} µm	or	10^{-9} m

The smallest thing we can see is about 0.04 mm, so you can see some of the largest cells with the naked eye. For all cells, however, we need a microscope to see them in any detail. Most animal and plant cells are 0.01–0.10 mm in size. The unit we use to measure most cells is the micrometre, symbol µm. For some sub-cellular structures, or organisms such as viruses, it is best to use a smaller unit: the nanometre, symbol nm.

Aerobic respiration

Respiration is the continuously occurring process used by all organisms to release the energy they need from food. Respiration using oxygen is called aerobic respiration. This type of respiration takes place in animal and plant cells, and in many microorganisms. Glucose is a simple sugar. It is the starting point of respiration in most organisms. The food that organisms take in is, therefore, converted into glucose. This chemical reaction is exothermic. A reaction is described as exothermic when it releases energy. Some of the energy transferred is released as thermal energy.