

Traffic Cops in Cellular Walls

Doing it like nature in the lab

Scientists are at work making laboratory versions of nature's workhorse, the living cell, says S. Ananthanarayanan.

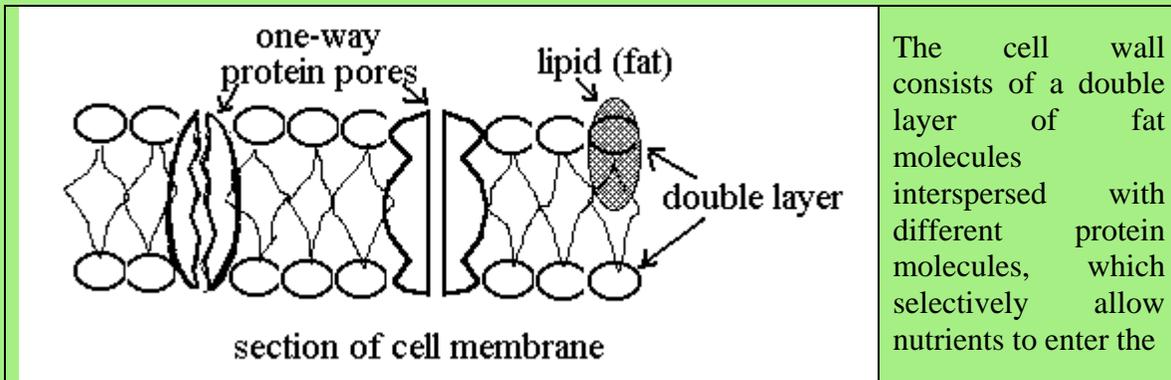
Natural systems are marvels of environmental balance and efficient use of energy. The way the earth's green cover acts to produce food, using sunlight as the energy source and regenerating oxygen to sustain life at the same time is an example. And all the work is done inside the humble cells in the leaves of trees and plants.

Structure of Cell

The living cell is a microscopic assembly line. It consists of a bag, or cover, made of fat molecules, which has one-way gates to allow raw material in and finished good out. Inside the bag the cell has the 'soup' of raw materials, and also a frame, or template, for putting them together. The intelligence, or 'program' is contained in the nucleus, a little oil-bag-covered structure that has the code for millions of things that different cells can generate.

The code is in the form of the DNA, which can be likened to a string of different coloured beads, specific beads denoting the start and end of a particular sequence. Messengers called messenger RNA take copies of bits of DNA, each of which codes for a particular protein, and carry them out of the nucleus to structures called Ribosomes. Here, because of the way the 'beads' in the bit of DNA are formed, just the right components floating about in the fluid in the cell attach themselves in the sequence coded by the fragment of DNA. And there, a complex and highly specialized protein is synthesized!

The one-way gates



cell and products of the cell or waste substances to leave the cell. This completes the cell arsenal. Raw material and energy sources keep entering and getting processed, and the products keep going out. Nutrients cannot leak, because the exit gates are shut and products or waste cannot get in, because they have no entry. The cell wall, in fact, plays a role of defining the cell – which nutrients get in decides what products the cell will generate!

Artificial Cell

Using a ‘soup’ of the bio-molecules needed for making an industrially important protein, for instance, usually with the help of specific bacteria, has been known for some time. The big problem in the method was that the process get blocked in about 2 hours because of build-up of waste products and lack of nutrients around the bacteria.

Scientists at the Rockefeller University in New York have found a way to mimic the living cell, to regulate the traffic of wastes and nutrients and also to churn out the product. The ‘soup’ of raw materials is first formed into tiny (bacteria-sized) drops in a bath of oil. The droplets get covered with a layer of fat molecules, which keeps them apart. The droplets were then treated to form another layer of fats, to be covered with a double-layer, much like real cells are.

To provide the one-way gates, a special, bacterial gene (scrap of DNA), which has the code for a protein called alpha-hemolysin was added to the mixture inside the droplet. This protein has a hollow, barrel-shaped structure and it inserts itself into cell membranes to create pores which act in just the way desired.

Now, when selected DNA were added to the mixture, it was found that the droplet did behave like a real cell. When DNA that coded for a kind of protein that ‘glowed’ in a special light was used, it was found that the ‘glowing’ protein was produced for hours after production of the protein stopped in other ‘cells’ that were not fitted with the double-layer of fat with the protein pores.
