- thin for a short diffusion distance •
- large area achieved by being long and thin, flat, or folded
- moist so that substances can be dissolved for diffusion to happen
- Common features of transport systems: •
- tubes or 'vessels' that carry materials from one part of the organism to another •
- close contact with cells, such as those of exchange surfaces

The circulatory system in humans has a pump, the heart. However, the transport systems in plants - the xylem and phloem - do not have pumps.

LYMPHOCYTES

About 25 per cent of the white blood cells are lymphocytes. They are part of the body's immune system and produce soluble proteins called antibodies.

Antibodies

Antibodies attach to antigens. Antigens are substances found on the surface of cells, including bacteria and other pathogens. Different antibodies attach to different antigens. In this way, the body's immune system can recognise foreign antigens – antigens that are not normally produced by the body, but by pathogens instead.

Antibodies can neutralise toxins produced by pathogens. They can also cause the destruction of pathogens by:

- causing bacteria to burst open and die ٠
- labelling the pathogen so that it is recognised more easily by phagocytes
- sticking pathogens together in clumps so that they can be engulfed by bracocytes Notesa

PHAGOCYTES

tes. They are not of the body's **immune system**, but they do About 70 per cent of the white blood cells a replace tromatilegens such as bacteria. not produce antibodies. Instraction ingest and des

This is what hat be

- 1. the phagocyte surrounds the bacterial cell, enclosing it in a vacuole
- 2. enzymes are secreted into the vacuole to destroy the bacterial cell

The process of ingesting the pathogen is called **phagocytosis**.

VACCINATION

People can be immunised against a pathogen through vaccination. Different vaccines are needed for different pathogens. For example, the MMR vaccine is used to protect children against measles, mumps and rubella (German measles). Vaccination involves putting a small amount of an inactive form of a pathogen into the body. Vaccines can contain:

live pathogens treated to make them harmless

harmless fragments of the pathogen

- toxins produced by pathogens
- dead pathogens
- These all contain antigens. When injected into the body, they stimulate lymphocytes to produce antibodies that can recognise the pathogen. Some lymphocytes develop into memory cells. If the vaccinated person later becomes infected with the same pathogen, the immune system is prepared, and the required lymphocytes are able to reproduce rapidly and destroy it. This means that the person is unlikely to become ill.