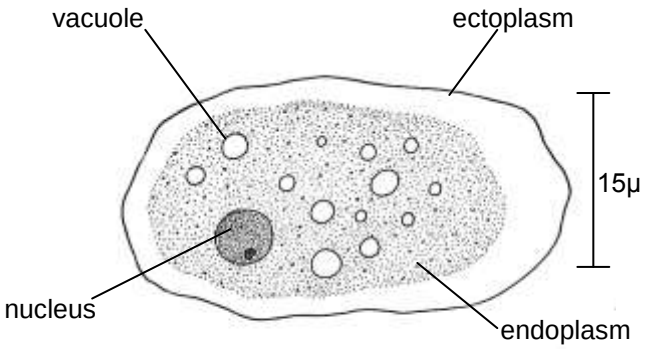
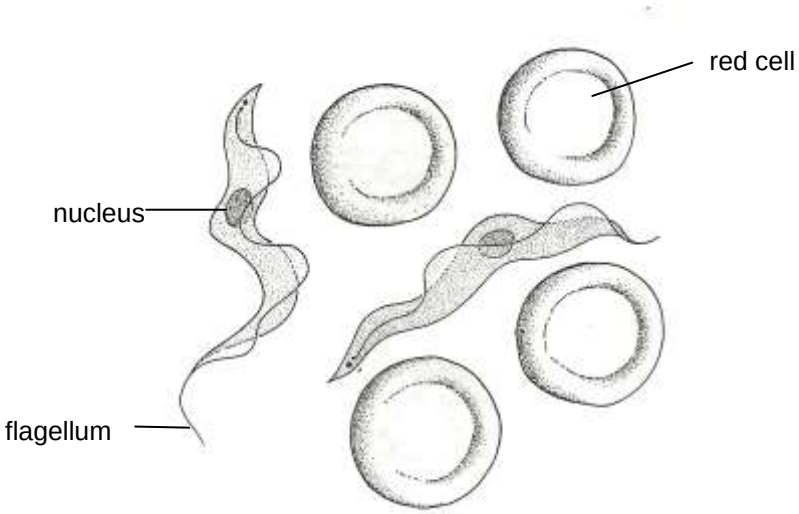
Parasitic protozoa

Entamoeba histolytica is one of a number of species of small amoebae which live in the alimentary canal of humans. These are usually harmless protozoa, feeding on bacteria and particles in the intestine. In certain conditions, entamoeba invades the wall of the intestine or rectum causing ulceration and bleeding, with pain, vomiting and diarrhoea, symptoms of amoebic dysentery. The faeces of infected people contain resistant forms (cysts) of entamoeba. Conditions of poor sanitation and hygiene, therefore, favour the spread of the disease.



Entamoeba histolytica

Trypanosomes are flagellate protozoa which live in the blood stream. There are several different species of trypanosome and they cause diseases such as *sleeping sickness*, *leishmaniasis* and *Chaga's disease* and, in cattle, *nagana*. The sleeping sickness and nagana parasites are transmitted by the bite of the *tsetse fly*. This insect has tubular mouthparts, like the mosquito, and these pierce the skin to suck blood from a capillary. If the tsetse fly bites an infected person, it sucks up the trypanosomes with the blood. The trypanosomes multiply in the body of the tsetse fly and invade the salivary glands. When the fly bites a healthy person, it injects saliva, which contains the trypanosomes. The prevalence of tsetse flies in some areas makes it impossible to raise cattle because of the high incidence of nagana. The main methods of control involve attempts to reduce the population of tsetse flies. This is done by using insecticides or by changing or removing the vegetation from the areas where the tsetse flies breed. These methods are only partially successful; spraying from the air, for example, is ineffective if the flies are resting on the underside of leaves.



Trypanosomes in the blood

Plasmodium, the **malarial parasite**, is another protozoan which lives in the blood stream of humans but, unlike the trypanosomes, the parasites enter the red cells and feed on their cytoplasm. The Plasmodium divides repeatedly inside the red cell which eventually bursts, liberating dozens of new parasites into the circulation. Each of these can invade another red cell and undergo the same cycle. When thousands of red cells all burst simultaneously, releasing parasites and their accumulated waste products, the host suffers from a fever. This cycle of feeding, division and release is repeated regularly, so the fever occurs every 48 or 72 hours, according to which of the four species of Plasmodium has become established.

The parasites are transmitted from person to person by female mosquitoes of the genus *Anopheles*, which pierce the skin with their sharp, tubular mouthparts and feed on the blood which they suck from the superficial skin capillaries. If the blood so taken contains the malarial parasites, these undergo a complicated series of changes within the mosquito, including extensive reproduction, and eventually accumulate in large numbers in the salivary glands. If this mosquito now bites a healthy person, saliva containing hundreds of parasites is injected into his or her blood stream. When the parasites reach the liver they enter the liver cells and reproduce there. The infected liver cells break down and release the parasites once again into the blood stream where they enter the red cells and begin the cycle of reproduction, release and re-infection. The person will now experience the symptoms of malaria.

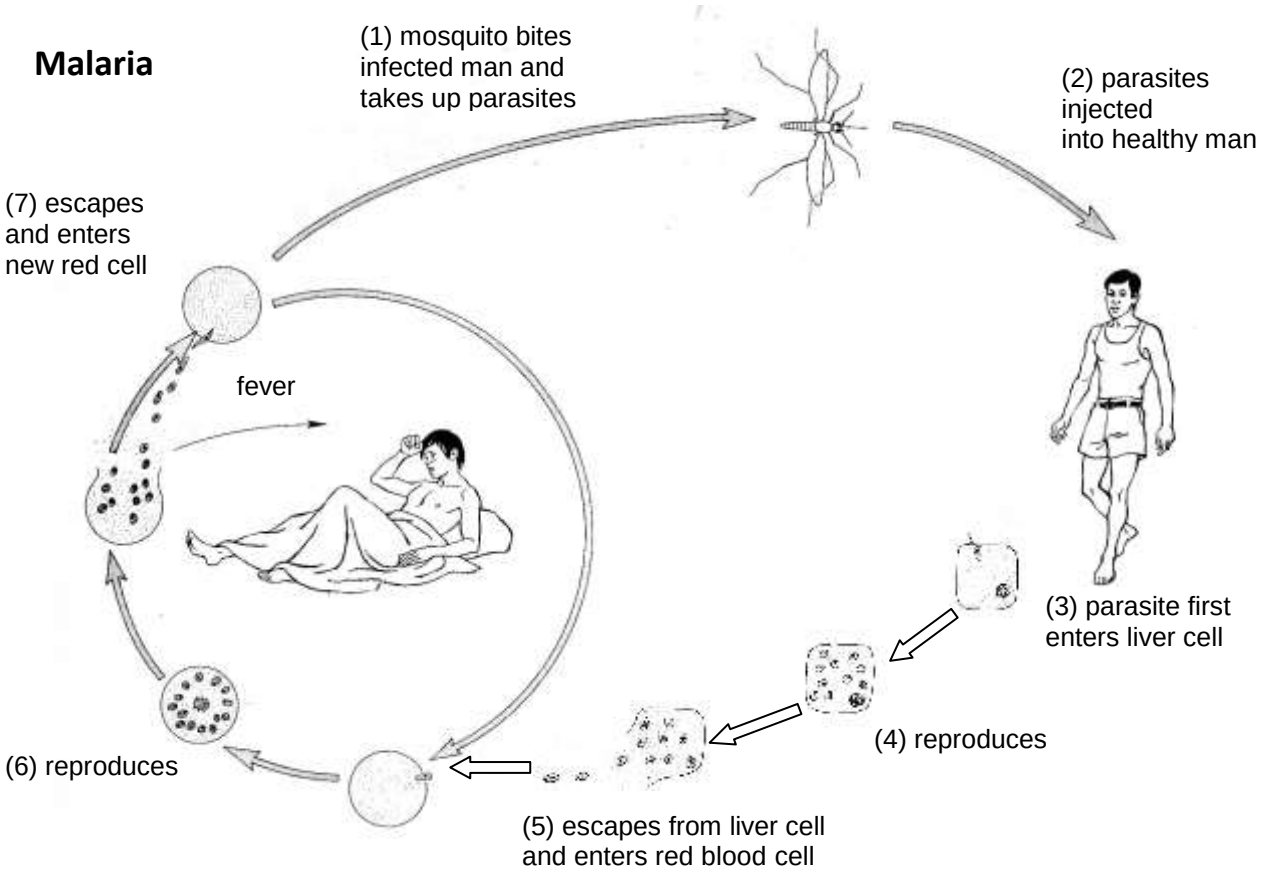
It is estimated that 300-500 million people each year catch malaria. In about four years or less, depending on the species of the parasite, Plasmodium dies out naturally. However, nearly 3 million people each year, die from the disease.

Some forms of malaria can be treated with drugs such as *quinine*, *choroquine* or *proguanil* but the malarial parasites in many parts of the world have developed resistance to these drugs. Combinations of chloroquine and proguanil are still effective in South America and parts of Africa, but in the Far East, the drugs are largely ineffective. A relatively new drug, *mefloquine* ('Lariam') is effective against most strains of Plasmodium but in about 20 percent of cases it has unpleasant side-effects, sometimes severe in a small number of people. A herbal drug, *artemesinin*, extracted from the 'wormwood' shrub (*Artemesia annua*) is proving valuable, and resistance is not yet a problem. Currently there are attempts to develop a vaccine but so far these have not been successful.

If anti-malarial drugs are taken before entering a malarial country, they act as prophylactics, killing off any parasites which get into the blood from an infected mosquito. Unfortunately these drugs suffer from the disadvantage that, in many cases, the parasite has become resistant to them.

If mosquitoes could be prevented from biting humans, the disease would die out. An attempt to eradicate malaria was made in the 1950s by spraying insecticides such as DDT on the walls of dwellings. The eradication programme failed largely because mosquitoes became resistant to the insecticides. Other strategies involve draining swamps or turning sluggish rivers into swifter streams. Mosquitoes lay their eggs in static water and the larvae hatch and grow there, so these measures reduce the population of mosquitoes. Water which collects in pots, tin cans, discarded tyres or open tanks is a breeding ground for mosquitoes.

One of the most effective ways of preventing infection with Plasmodium is to sleep under mosquito nets impregnated with an insecticide such as *permethrin*. Studies involving thousands of children in Ghana, Kenya and The Gambia have found that deaths from malaria can be reduced by two thirds by adopting this practice.



Transmission and life cycle of Plasmodium