



HEALTH AND DISEASE

Organisms causing disease and the transmission and impact of diseases

The various definitions of health are broad and unclear. According to the World Health Organisation (WHO), health is a state of complete physical, mental and social wellbeing, and not merely the absence of disease. Disease can be defined as the departure of good health, although this is very oversimplified. A disease is a malfunction of the mind or body which causes physical, mental or social symptoms.

Health -

a complete state of physical, mental and social wellbeing and not just the absence of disease

Disease -

a malfunction of the body or mind causing symptoms

PATHOGENS AND PARASITES

A **parasite** is an organism that lives inside or on another organism, called the **host**, and gains its nutrition from that host, often harming the host. Parasites which live on organisms (e.g. the head louse) are known as *external parasites*, and those which live inside organisms (e.g. tapeworms) are known as *internal parasites*.

Many varieties of microorganism live in or on the human body, some of which have no effect, or may even be beneficial but there are some which can cause harm. A **pathogen** is an organism which causes disease. They live by taking nutrition from their host, but also causing damage in the process, which can be very faint but also can be fatal. There are four main groups of pathogenic organism:

- 1 **bacteria** – whilst their cells may be smaller than ours, they can multiply very rapidly (some every 20 minutes in the right conditions) in the human body, and their presence causes disease either by damaging cells or releasing waste products which are toxic to us
[Examples include *cholera caused by *Vibrio cholerae** and *tuberculosis caused by *Mycobacterium tuberculosis**]
- 2 **viruses** – there is much debate over whether or not a virus is classed as a living organism, as it does not have a cellular structure, often seen as the basic foundation of life; viruses invade cells and take over genetic machinery and other organelles, causing the cell to manufacture more copies of the virus, and when the host cell eventually bursts, many new viruses are released
[Examples include *tobacco mosaic virus* – the first virus discovery- in plants and the *HIV virus*]
- 3 **fungi** – a fungus can live under the skin, and send out reproductive hyphae which grow to the skin surface, releasing spores, which can cause redness and irritation
[Examples include *Tinea which causes ringworm and athlete's foot*]
- 4 **protocista** – these organisms enter cells and feed on their contents as they grow
[Examples include the malarial parasite genus *Plasmodium which causes malaria*]

The term **transmission** is used in biology to describe the way a pathogenic organism spreads a disease, usually parasitic organisms travelling from one host to another. The three most common forms of transmission are through means of a **vector** (a living carrier which transmits a disease), by physical contact or by **droplet infection** (i.e. sneezing).

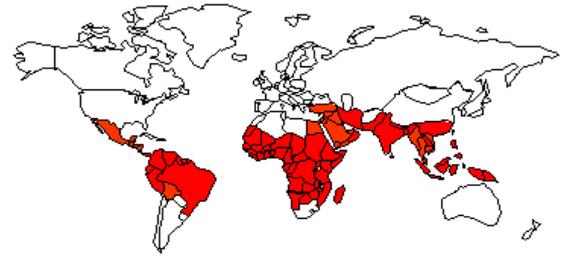
Your biology course requires that you understand the causes, transmission and epidemiology of the three diseases: malaria, HIV/AIDS and tuberculosis.

Malaria

Malaria is caused by eukaryotic organisms of the *Plasmodium* genus, most commonly the *P. falciparum*, but also others including *P. malariae*. It is spread by a vector, by the female *Anopheles* mosquito which carries the *Plasmodium* from one infected person to another. The mosquito feeds on blood, as it had adapted mouth organs which have developed into fine tubes to penetrate and draw blood.

A person with malaria has the *Plasmodium* gametes in their blood, and so when the *Anopheles* female mosquito sucks the blood, the *Plasmodium* develops in the mosquito and migrates to its salivary gland, where it causes infection of an uninfected person when bitten. The *Plasmodium* migrates to the liver when a person is bitten, so that the parasitic stages can multiply in the liver and then migrate into the blood, ready to be transmitted to someone else.

This malarial cycle is not the only way malaria can be spread. Less common causes include careless and unhygienic medical practices, and using blood transfusions with unscreened blood and unsterilised needles can cause the disease.



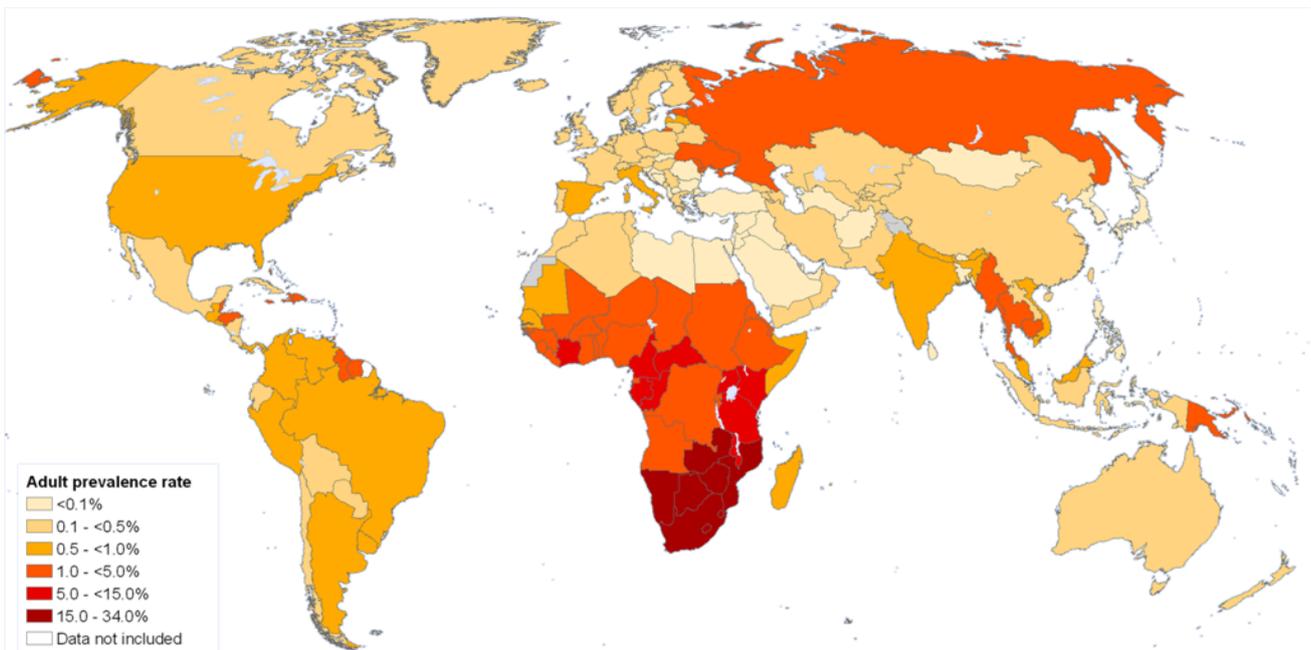
Malaria kills around 3 million each year. Approximately 300 million people are infected by the *Plasmodium*, but this number is ever-rising. Malaria is limited only to the areas where the *Anopheles* mosquito can survive, currently only tropical areas, but with the effects of global warming becoming more apparent, it is very possible that soon the disease could spread further up northwards, even affecting Europe.

HIV/AIDS

AIDS (acquired immune deficiency syndrome) is caused by the human immunodeficiency virus (HIV). A person infected with HIV is known as HIV-positive. The virus enters the body and remains largely inactive for a long period of time. When it becomes active, it attacks the immune system, destroying *T-helper* cells (see 4.5 The Immune Response). These cells are an essential component of the immune system, and so your chances of fighting off pathogenic infections are strongly reduced. It is these diseases which will eventually kill a person infected with HIV/AIDS rather than the virus itself, although those diseases are only present due to the HIV virus damaging the immune system.

Transmission of HIV occurs in a number of ways. It can be carried in many bodily fluids (blood, semen, breast milk and vaginal fluid) and is transmitted through any method of unprotected sexual intercourse, blood transfusions, sharing of needles, mother-to-baby infection during pregnancy, breastfeeding, childbirth, or any other exposure to these fluids, including blood-to-blood contact.

HIV/AIDS is a worldwide problem, with over 40 million people living with HIV worldwide, and more than half of those being from sub-Saharan Africa. The map shown displays the epidemiology of HIV infection.



Tuberculosis

Tuberculosis (or TB) is caused either by the bacterium *Mycobacterium tuberculosis* or sometimes also *M. bovis*. Whilst TB can infect many parts of the body, it is usually found in the lungs. It is believed that TB infects as much as 30% of the world's population, being inactive (or at least controlled by the immune system) in most people. It is spread by droplet infection, i.e. by sneezing, which expels hundreds of droplets containing the bacteria. Coughing, laughing, yawning and even talking, however, also release droplets containing the liquid with bacterium in.

Conditions which make the spread of tuberculosis more likely include overcrowding in a house, poor ventilation, poor diet, homelessness and living or working with people who have migrated from areas of high TB-concentration. The disease can also be contracted from cattle milk and meat, although this has been largely, if not totally eradicated in the developed world, but still remains a common problem in the underdeveloped world.

TB is, like HIV/AIDS a worldwide problem. Approximately 1% of the world's population becoming exposed to and infected with the disease, and around 10% to 15% of those people go on to develop the disease (0.1-0.15% of the total population).

The disease is most common in south-eastern Asia and sub-Saharan Africa. The numbers of infected people from TB have been increasing each year now for decades, and the WHO declared it a public health emergency in 1993. As different strains become more resistant to the treatments, the treatments become less and less effective, which causes the numbers to rise even more.