

SECTION

6

DISEASES AND INFECTIONS



DIVERSITY OF LIVING THINGS AND THEIR ENVIRONMENT

Diseases and Infections

INTRODUCTION

Diseases and disease-causing organisms have for ages affected living things and caused adverse effects in diverse ways. These adverse effects have had negative impacts on individuals, communities and nations at large. It is with this background that knowledge about diseases and all about them becomes necessary. This section will introduce you to common diseases such as water-borne, air-borne, food-borne, and vector-borne, as well as zoonotic and soil-borne diseases and their causative organisms, transmission cycle and preventive measures. It is important for you to know about these diseases so that seasonal diseases such as cholera, malaria and other vector-borne diseases can be reduced through education in simple ways such as attitudinal changes. Also, with the knowledge gained about these diseases, their transmission and control, you can help prevent/control zoonotic infections from pets as well as prevent/control transmission of food and water-borne diseases like typhoid. The section is designed to help you share knowledge gained with family, friends and community members, ensuring that preventing the spread of diseases is a collective responsibility.

At the end of this section you will be able to:

Discuss how common disease are transmitted within the environment and the causes, symptoms and control/preventive measures taken to check these diseases.

Key Ideas

- **Water-borne diseases** refer to those diseases whose causative agents are transmitted through water e.g. Cholera.
- **Food-borne diseases** are diseases acquired from the consumption of contaminated food e.g. Typhoid.

- **Air-borne diseases** are those diseases acquired through inhalation of pathogens found in the air e.g. Tuberculosis.
- **Vector-borne diseases** refer to those diseases whose causative agents are transmitted through other organisms e.g. Malaria.
- **Zoonotic diseases** refer to those diseases that can infect both animals and humans e.g. Anthrax.
- **Soil-borne diseases** are infections that are contracted through contact with contaminated soil e.g. Roundworm infection.

CAUSATIVE ORGANISMS, TRANSMISSION CYCLE, EFFECTS AND CONTROL/PREVENTION OF SOME COMMON DISEASES

Table 6.1: Common diseases, causative agents and transmission

Examples of water-borne disease	Causative organism	Transmission cycle	Effects/Symptoms	Control/prevention
Cholera	<i>Vibrio cholerae</i>	Through contaminated food and water	Diarrhoea, vomiting, fever, abdominal pain, loss of appetite, body weakness	Proper sanitation and waste disposal, boiling/chemical treatment of water before consumption, and hygienic handling of food.

Examples of water-borne disease	Causative organism	Transmission cycle	Effects/ Symptoms	Control/ prevention
Dysentery	<i>E.coli</i> & <i>Entamoeba hystolytica</i>	Through contaminated food and water	Diarrhoea, vomiting, fever, abdominal pain, blood and mucoid stool	Consumption of treated water, hygienic handling of food, proper disposal of waste.
Typhoid fever	<i>Salmonella typhi</i>	Through contaminated food and water	Fever, general body pain, headaches, chills, loss of appetite, vomiting	Hygienic handling of food and water before consumption, proper waste disposal
Schistosomiasis (bilharzia/snail fever)	<i>Schistosoma sp.</i>	Wading/ bathing in contaminated water.	Diarrhoea, intestinal pain, fever, blood stained urine and stool.	Boiling or treating water before consumption, destruction of the intermediate host (water snail).
Hepatitis A	HAV (hepatitis A virus)	Contaminated food/ water	Fever, loss of appetite, diarrhoea, nausea, abdominal discomfort, dark urine, jaundice	Proper and hygienic handling of food.

Examples of water-borne disease	Causative organism	Transmission cycle	Effects/ Symptoms	Control/ prevention
Hepatitis E	HEV (hepatitis E virus)	Contaminated food/water	Abdominal discomfort, fever, loss of appetite, diarrhoea, jaundice.	Proper and hygienic handling of food.

Examples of air-borne diseases	Causative organism	Transmission cycle	Effects/ symptoms	Control/ prevention
Influenza	Influenza A virus	Through droplets from the coughs / sneeze of infected persons	Fever, chills, cough, sore throat, runny nose, headache, fatigue, body aches.	Wearing nose masks, proper ventilation, vaccination, isolating infected persons, hand hygiene.
Tuberculosis	<i>Mycobacterium tuberculosis</i>	Droplets from coughs, sneezes or talks of infected person	Prolonged coughs, blood stained sputum, chest pain, fatigue, weight loss, night sweats	Wearing of nose mask, isolation of infected persons, hand hygiene, vaccination

Examples of air-borne diseases	Causative organism	Transmission cycle	Effects/symptoms	Control/prevention
COVID-19	SARS-CoV-2 virus	Droplets from coughs/sneeze or close contact with infected person. Contaminated surfaces.	Fever, difficulty breathing, headache, body aches, loss of sense of smelling	Wear nose mask, physical distancing, frequent hand washing/sanitizing, avoid touching face, isolation of infected person, vaccination.
Whooping cough (Pertussis)	<i>Bordetella pertussis</i>	Droplet infection through sneezes/coughs of infected person, contaminated surfaces, close contact.	Repetitive coughs with a “whoop” sound, sneezing, fever, chest pain	Vaccination, frequent hand washing, isolation of infected person
Common cold	Rhinovirus	Droplets from cough/sneeze of infected person, close contact with infected person, contaminated surfaces.	Runny/stuffy nose, sneezing, coughing, sore throat, headache, fever.	Hand hygiene, good ventilation, physical distancing, hydration.

Examples of air-borne diseases	Causative organism	Transmission cycle	Effects/symptoms	Control/prevention
Pneumonia	<i>Streptococcus pneumoniae</i>	Airborne droplets, close contact, contaminated surfaces.	Fever, headaches, chest pain, body aches, difficulty breathing, loss of appetite, fatigue	Physical distancing, handwashing, proper disposal of respiratory secretions, vaccination.

Examples of vector-borne diseases	Causative organism	Transmission cycle	Effects/symptoms	Control/prevention
Malaria	<i>Plasmodium sp.</i>	Through bite of an infected female Anopheles mosquito.	Fever, chills, headache, joint aches, loss of appetite, anaemia	Sleeping under treated mosquito nets, using insecticide spray, clearing bushes, biological control of larvae, draining stagnant water.
Lyme disease	<i>Borrelia burgdorferi</i>	Bite from an infected tick	Fever, muscle aches, rashes, swollen and painful joints and lymph nodes	Wearing protective clothing to avoid bites, chemical control of ticks.

Examples of vector-borne diseases	Causative organism	Transmission cycle	Effects/symptoms	Control/prevention
Dengue fever	Dengue virus (DENV)	Bite from an infected Aedes mosquito	Severe headache, fever, joint and muscle pain, rash, nausea and vomiting, mild bleeding (nose & gum).	Chemical control of adult mosquito and larvae, vaccination, sleeping under treated mosquito nets, wearing of protective clothing, eliminating breeding sites of mosquitoes.
Onchocerciasis (river blindness)	<i>Onchocerca volvulus</i>	Through bite of an infected black fly	Severe skin itching, rash, swollen lymph nodes, skin lesions, muscle weakness, joint pain, blindness	Use of insect repellents and treated nets, wearing protective clothing, eliminating breeding sites of the blackfly.
Lymphatic filariasis (elephantiasis)	<i>Wuchereria bancrofti</i> , <i>Brugia malayi</i> , <i>Brugia timori</i> .	Through bite of an infected Anopheles, Aedes or Culex mosquito.	Enlargement of limbs and other parts of the body, skin thickening (elephant-like texture)	Use of insect repellents and treated nets, wearing protective clothing, eliminating breeding sites of mosquitoes.

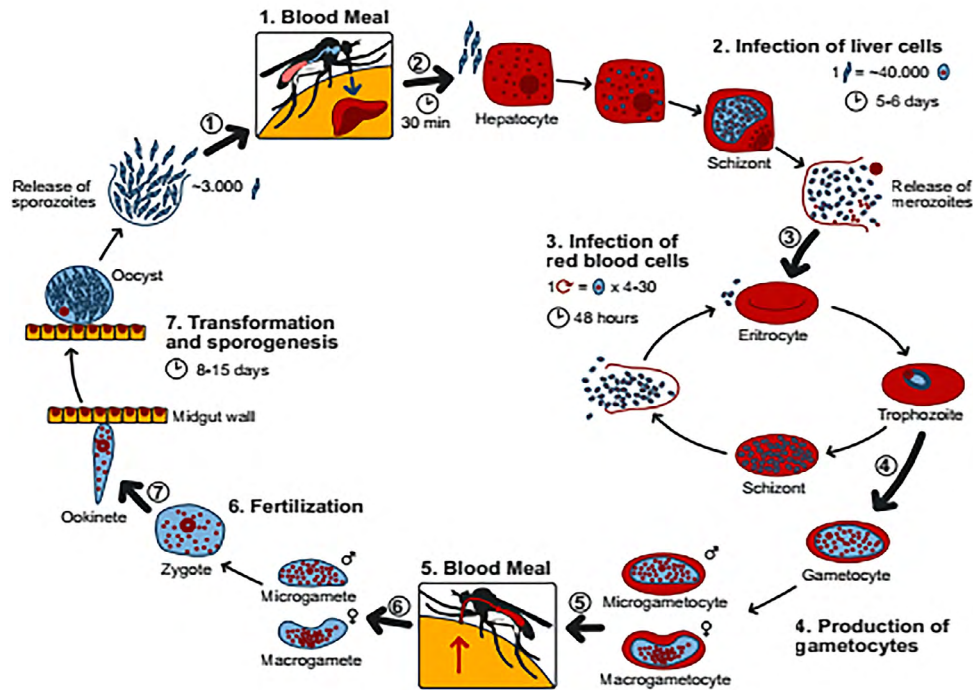


Fig. 6.1: Transmission cycle of Malaria

Food-borne Diseases

These are diseases caused by consuming contaminated or spoiled food and drinks. They're also known as food poisoning. Common examples include *Salmonella* infection, *E. coli* infection, Norovirus, *Listeria* infection and Aflatoxin infection. These infections can primarily be prevented through safe handling of food, cooking food thoroughly before eating, refrigerating perishable foods, proper sewage disposal and frequent hand hygiene practices before handling food.

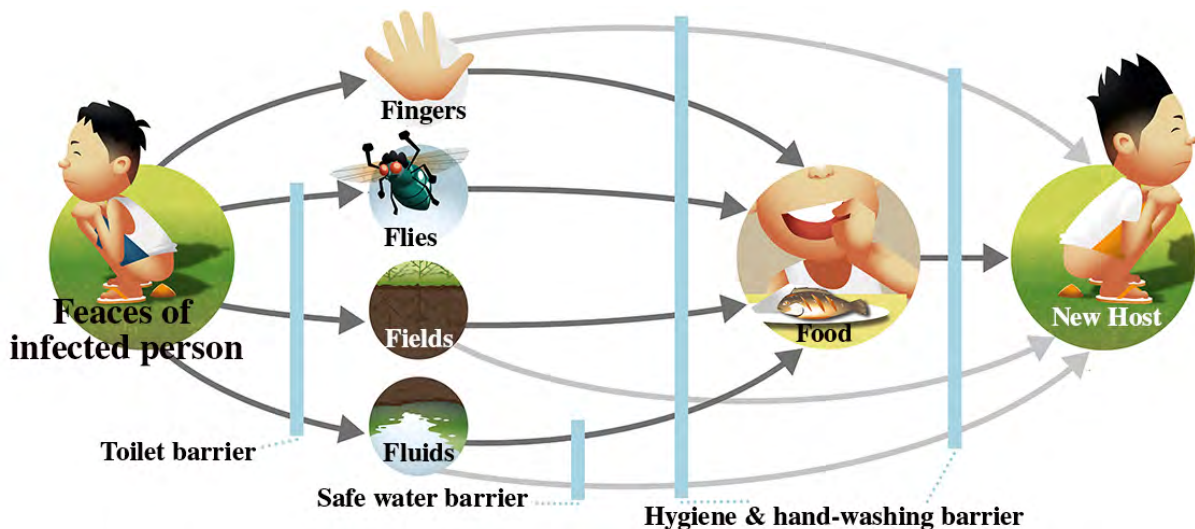


Fig. 6.2: Transmission food-borne disease

Zoonotic Diseases

These are diseases that can be transmitted from animals to humans through physical contact with infected animals or their waste products. In other words, they can affect both animals and humans. Typical examples include **Rabies, Avian influenza (bird flu), Ebola virus, Scabies, Ringworm, Zika virus and Toxoplasmosis**. Occasionally, bovine Tuberculosis (the form of TB found in cattle), can be passed to humans when bacteria from an infected animal gets into a cut on a person's skin. It's important to note however that this is a less common form of human TB.

Soil-borne Diseases

Soil-borne diseases are caused by pathogens found in soil. They can infect plants, animals and humans through contact with contaminated soil. Typical examples include **hookworm infection, roundworm infection, histoplasmosis and tetanus (caused by *Clostridium tetani*)**. Symptoms of soil-borne diseases generally include gastrointestinal discomfort/pain, skin problems, fever and muscle stiffness (in the case of Tetanus). These diseases can be controlled/prevented through proper sanitation and waste disposal, wearing protective footwear in areas with contaminated soil and vaccination (in the case of Tetanus).

Activity 6.1

- a. Write down in your notebook with suitable examples, the meaning of the following classes of diseases:
 - i. Vector-borne disease
 - ii. Food-borne disease
 - iii. Air-borne disease
 - iv. Zoonotic disease
 - v. Soil-borne disease
- b. Share your write-up with a friend.
- c. Discuss and compare your answers with those of your friend and conclude on a common acceptable answer.

Activity 6.2

- a. Work with your friend and draw on a plain cardboard or large sheet of paper, a diagram of the transmission cycle of malaria clearly showing the following stages:
 - i. **Stage 1:** infected Anopheles mosquito feeding on a human host.
 - ii. **Stage 2:** Parasite multiplication in a human host.
 - iii. **Stage 3:** infection of a mosquito through feeding on an infected person.
 - iv. **Stage 4:** transmission of the parasite through a bite to another human host.
- b. Discuss the key factors that contribute to the transmission cycle.
- c. Carry out the same exercise with a friend, this time showing the transmission cycle of cholera.
- d. Again, identify and discuss the key factors that contribute to the transmission cycle.

Activity 6.3

Pair up with a friend and role-play a doctor-patient conversation. Describe to your friend (doctor), the signs/symptoms you're experiencing from any of the diseases mentioned in **Activity 6.1** that you've contracted e.g. Malaria. Take turns in role-playing the doctor-patient roles with your friend.

Activity 6.4

Your class has been invited to represent your school to give a talk on control and preventive measures needed to stop the spread of diseases in your local community. As the speaker for the class, write out the key points raised from your class discussion which you will be educating the community on.

REVIEW QUESTIONS 6.1

1. Classify the following diseases as either:

- a. vector-borne
- b. food-borne
- c. air-borne
- d. Zoonotic
- e. soil-borne
- f. water-borne disease

Leishmaniasis, Yellow fever, Chicken pox, Cerebrospinal Meningitis (CSM), Tuberculosis, Snail fever, River blindness, Anthrax, Monkeypox (Mpox), salmonellosis, Lassa fever, E. coli, Listeriosis, Ebola virus, hookworm and Amoebiasis.

2. Briefly explain how water-borne diseases are transmitted to humans.

3. Explain any three preventive ways by which a named water-borne disease can be avoided.

4. Suggest at least two ways by which the following diseases can be stopped.

- a. Typhoid
- b. Malaria
- c. Cholera
- d. COVID-19
- e. Rabies

5. Malaria cases have been observed to be on the rise during the rainy season in the tropics. Explain why this is so and suggest how to control its spread.

6. A community is experiencing a high incidence of water-borne diseases. What steps would you recommend to curb this challenge?

7. Discuss the health implications of the following activities in relation to soil-borne diseases:
 - a. Children eating their snacks with unwashed hands after playing in the garden.
 - b. Children play with unvaccinated pets such as dogs and cats.
8. A densely populated urban area has been experiencing outbreaks of airborne diseases. Design a comprehensive disease prevention programme to address this problem.
9. Explain any two effects of an epidemic on a nation.

ANSWERS TO REVIEW QUESTIONS 6.1

1.
 - a. **Vector-borne:** Leishmaniasis, Yellow fever, River blindness
 - b. **Food-borne:** Salmonella, *E.coli*, Listeriosis
 - c. **Airborne:** chicken pox, CSM, TB
 - d. **Zoonotic:** Anthrax, Mpox, Lassa fever, Ebola virus
 - e. **Soil-borne:** Hookworm, Amoebiasis
 - f. **Water-borne:** Snail fever.
2. Water-borne diseases can be transmitted to humans through physical contact i.e. bathing or wading through freshwater bodies containing the larvae (parasite).
3.
 - Treating water before consuming: this can be by boiling or chemical treatment to kill the parasite in order to make it safe for consumption.
 - Clearing bushes or spraying bushes along river banks to get rid of the vector of the parasite.
 - Avoid bathing or wading through slow-flowing rivers or streams.
4. Refer to Table 6.1 on pages xx-xx.
5. It is because there's an abundance of fresh vegetation for the vector to hide in and also fresh water collects in empty cans or containers. This is a suitable medium for the breeding of vectors.
6. Refer to Table 6.1 above for control/prevention of water-borne diseases.
7.
 - a. risk of contracting soil-borne or food-borne disease.
 - b. risk of contracting a zoonotic disease.
8. To design a comprehensive disease prevention programme will involve:
Steps targeting the immediate risks of the disease i.e. assessment and surveillance. These include:
 - Epidemiological studies identify specific diseases.
 - Surveillance systems to monitor disease outbreaks in hospitals.
 - Data analysis to identify hotspots and at-risk populations.

Steps that target the underlying factors contributing to the outbreak i.e. public health education. This may include:

- Awareness campaigns
 - Workshops and seminars
 - Vaccination programmes
 - Community engagement
 - air quality improvement
 - Access to healthcare
 - Contact tracing and quarantine measures
 - Monitoring and evaluation
 - Emergency preparedness
9. ● *Financial burden* - eradicating an epidemic requires a huge financial input to acquire drugs, consumables and other necessities to clear the disease burden.
- *Low productivity* – when people get ill/sick, work output is low. Meaning there's low productivity due to the disease burden.

EXTENDED READING

Click on the links below to find out more information about the various diseases discussed in this section.

- <https://www.cdc.gov>
- <https://www.who.int/health-topics>
- <https://www.paho.org/topics>

REFERENCES

1. Ali, S.A., Nyavor, C.B. & Seddoh, S. (2016). GAST Biology for Senior High Schools. (new ed.). WINMAT Publishers Ltd.
2. Ofori- Yeboah, S., Owusu, E., Adjibolosoo, S.V.K, Agamloh, R.B. & Meteku, B.K. (2010). Excellent Biology For Senior High Schools. Excellent Publishers and Printing.
3. Purves, W.K., Orians, G.H. & Heller, H.C. (1992). LIFE: The Science of Biology (3rd ed.). Sinauer Associates Inc.
4. Sone, R.H., Cozens, A.B. & Ndu, F.O. C. (1985). New Biology for West African Schools (2nd ed.). Longman Group Ltd.
5. <https://www.who.int/health-topics>
6. <https://www.paho.org/topics>

ACKNOWLEDGEMENTS



Ghana Education
Service (GES)



List of Contributors

NAME	INSTITUTION
Vincent Ahorsu	OLA SHS, Ho
Peter Blankson Daanu	Nkyeraa SHS
Very Rev. Lewis Asare	Prempeh College, Kumasi
Gloria N.D. Nartey	Nsutaman Catholic SHS