

Contents

Section	Learning competencies
1.1 Renowned Ethiopian biologists (page 1)	<ul style="list-style-type: none"> Name at least one renowned Ethiopian biologist. Explain the contributions of these Ethiopian biologists to international biological knowledge.
1.2 Biological research in Ethiopia (page 7)	<ul style="list-style-type: none"> Explain how scientific institutions contribute to scientific research. Name some Ethiopian institutions involved in biological research. Explain the activities and contributions of some of these Ethiopian research institutions.

1.1 Renowned Ethiopian biologists

By the end of this section you should be able to:

- Name at least one renowned Ethiopian biologist.
- Explain the contributions of these Ethiopian biologists to international biological knowledge.

Welcome to the study of biology! Biology is the study of life and living organisms. All around you there are many different types of plants, animals and other living organisms. They depend on each other and on the environment where they live. Biologists study both the outer appearance and the internal workings of living things. They study how living organisms interact and where human beings fit into the living world.

All of our biological knowledge comes to us by the work of biologists, scientists who study living organisms. Biology, like all the sciences, moves forward most of the time in small, steady steps. One biologist comes up with an idea. Another carries out more experiments, which either support the new idea or suggest it is wrong. Then more biologists join in until eventually a new idea, or **hypothesis**, is accepted. Like all scientists, biologists publish their new work (called research) in special magazines called **journals**. Before an idea is published in a journal, several other well-known biologists have to read it and check that the research has been done to a high standard. This process is called **peer review**. Sometimes biology takes a great leap forward, when a very gifted biologist comes along with a big new idea!

If you think you would like to be such a biologist, start right now by observing living things around you.

Here in Ethiopia we have some very renowned biologists. Their work is known and important not just here in Ethiopia but around the world. Here are some of their biographies.

KEY WORDS

hypothesis *an idea or statement that explains observed facts and predicts new outcomes*

journal *a regular publication presenting articles on a particular subject*

peer review *evaluation of a person's work done by others in the same field*



Figure 1.1 Highly magnified image of the parasitic flatworms that cause schistosomiasis

KEY WORDS

immune reaction a biological response involving the production of antibodies etc. as a reaction to the presence in the body of bacteria, a poison, or a transplanted organ

treated water filtered or disinfected water made safe for consumption

genetic engineering the deliberate, controlled manipulation of the genes in an organism, with the intent of making that organism better



Figure 1.2 Dr Aklilu Lemma, one of Ethiopia's most renowned biologists, with the snail-killing soapberries known locally as Endod

Dr Aklilu Lemma and the battle against bilharzia (schistosomiasis)

Schistosomiasis (also known as bilharziasis) is a common parasitic disease. It affects 200–300 million people in Africa (including Ethiopia), South America, Asia and parts of the Caribbean. It is caused by parasitic flatworms which spend part of their lifecycle in freshwater snails and part in humans. Anyone washing, working or playing in shallow fresh water is at risk. Once inside a person, the parasites mature and produce eggs which are passed out in the urine and faeces. They also infest the blood vessels, liver, kidneys, bladder and other organs. The body sets up an **immune reaction** and an infected person can become weakened and ill for many years.

Some of the most important work in finding a way of controlling this parasite, which is effective but does not cost too much, was carried out by Dr Aklilu Lemma, one of Ethiopia's most renowned biologists.

Dr Aklilu began his work in 1964, when he was investigating the freshwater snails that carry the schistosomiasis parasite around Adwa in northern Ethiopia. He saw women washing clothes in the water and he noticed that downstream of the washing party there were more dead snails than anywhere else he had collected. The women were using the soapberry, Endod (*Phytolacca dodecandra*), to make washing suds. Dr Aklilu collected some live snails from above the washing party and asked one of the women to give him some of her Endod suds. Not long after the suds were put in the snail container, the snails all died. This was the start of years of work for Dr Aklilu.

Back in the laboratory he showed that if the Endod berries were dried, crushed and diluted in water they would kill snails at very low concentrations. Other scientists carried out similar investigations and got the same results. If the freshwater snails can be controlled, the spread of schistosomiasis can be greatly reduced. The World Health Organisation recommended a chemical molluscicide (i.e. a compound that kills molluscs including snails) but it was extremely expensive. Endod works well, it is cheap, it is well known by local people who are likely to use it and it is environmentally friendly as it breaks down naturally within about two days.

Dr Aklilu Lemma worked for many years to convince scientists all around the world that his ideas would work. Trials using locally collected Endod showed that using the molluscicide worked. Before the water was **treated**, 50% of children 1–6 years old were infected. After treatment only 7% were infected by the flatworm. Dr Aklilu's results were published in journals around the world. He found the best species of the soapberry plant and developed programmes for local communities to treat their own water. Eventually people were convinced and the use of Endod-based molluscicides is spreading throughout Africa and beyond. Hopefully a combination of Endod water treatment to kill the snails, improved hygiene, clean water

wells and medicine for affected people will mean that Ethiopia can be free of this terrible disease. If we succeed it will be largely due to the work of Dr Aklilu Lemma. He has been honoured and recognised in many different ways both in Ethiopia and around the world for his work.

Dr Tewolde Berhan Gebre Egziabher, an ardent lover of nature

Dr Tewolde Berhan Gebre Egziabher was born in 1940. In 2000 he won the Right Livelihood Award (often called the Alternative Nobel Prize) “for his exemplary work to safeguard biodiversity and the traditional rights of farmers and communities to their genetic resources”.

During the 1990s Dr Tewolde Berhan was involved in negotiations at the various biodiversity-related meetings, including the Convention on Biological Diversity (CBD) and the Food and Agriculture Organization. Having built a strong and able team of African negotiators, he managed to help achieve progressive, unified policies for Africa, such as recognition of community rights.

Dr Tewolde Berhan was instrumental in securing recommendations from the Organisation of African Unity (OAU) encouraging African countries to develop and implement community rights, a common position on Trade Related Aspects of Intellectual Property Rights, and a clear stance against patents on living materials. He also helped to draft the OAU model legislation for community rights, which is now used across Africa.

In January 2000 Dr Tewolde Berhan acted as chief negotiator on biosafety for the Like-Minded Group, made up of most of the G77 countries, in Montreal. Here he was central to achieving an outcome protecting biosafety and biodiversity and respecting community rights, against strong US-led representations.

Dr Tewolde Berhan also won the United Nations top environmental prize, Champions of the Earth, in 2006.

Professor Tilahun Yilma and his vaccines

Professor Tilahun Yilma is known internationally for the vaccine he developed to help get rid of the terrible cattle disease rinderpest, and for his work on HIV/AIDS vaccines. Rinderpest arrived in Ethiopia in 1888, carried by three infected cattle brought into the country by Italian soldiers. Within a year 90% of the domestic cattle plus many wild animals such as buffalo, giraffe and antelope died. As a result 30–60% of the people starved.

In the 1980s rinderpest became a major problem again. Professor Tilahun worked to develop a vaccine using **genetic engineering**. He was very successful – his vaccine doesn't need refrigeration, it is easily scratched onto the animal's neck or abdomen so cattle don't need injections from vets and it can be made relatively cheaply in large quantities. By 1997 the vaccine was ready for use across Africa,

DID YOU KNOW?

Around 300 million people are affected by schistosomiasis in the tropical and sub-tropical parts of the world – so the work of Aklilu Lemma could make an enormous difference in many other countries as well as Ethiopia. Dr Aklilu recognised this when he said “we found a poor man's medicine for a poor man's disease”.



Figure 1.3 Dr Tewolde Berhan Gebre Egziabher

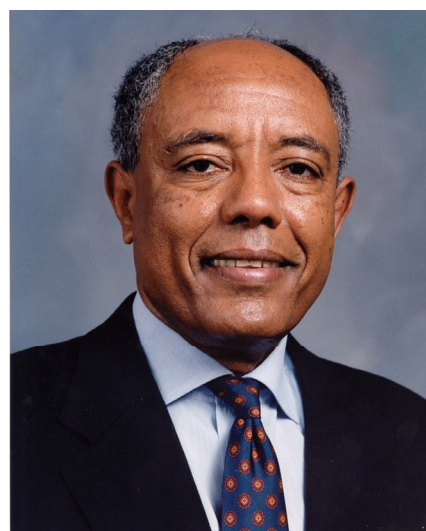


Figure 1.4 Professor Tilahun Yilma

including his own country Ethiopia. Now he is working on using similar methods to develop an effective vaccine against HIV/AIDS, which is affecting people all around the world including millions of Africans. Professor Tilahun has been given many international awards and honours over the years. He is also very active in encouraging young scientists and establishing the highest quality research establishments here in Africa.



Figure 1.5 Professor Yalemtehay Mekonnen working in the Biomedical Laboratory, Addis Ababa University

Professor Yalemtehay Mekonnen: The first female professor from AAU

Professor Yalemtehay Mekonnen is a biologist and an academic member of staff at the Department of Biology, Faculty of Science, Addis Ababa University. She has worked in this Department for the last 30 years. She received her PhD, specialising in human physiology, from the University of Heidelberg in Germany.

One of her research areas is the assessment of the impact of chemical pesticide hazard on humans. This research covers almost all government farms including the Upper Awash Agricultural farms and some private horticultural farms in the Rift Valley region. The other area of her research is in the use of plants as medicine against human and animal diseases.

Professor Yalemtehay Mekonnen served as Head of the Department of Biology from 1993 to 1995 and as the Director of the Aklilu Lemma Institute of Pathobiology from February 2003 to October 2007. In leadership positions she was involved and has initiated a number of national and international research networks and collaborations. She is a member of many professional societies, such as the Biological Society of Ethiopia, the Safe Environment Association, the Ethiopian Wildlife and Natural History Society, the New York Academy of Sciences and the Third World Organization for Women in Science. She has served as President of the Biological Society of Ethiopia.

She has been awarded research grants and fellowships nationally from the Ethiopian Science and Technology Commission and the Ethiopian Agricultural Research Organization, and internationally from the British Council, the International Foundation for Science, Third World Academy of Sciences, the German Academic Exchange Service and the Alexander von Humboldt Foundation from Germany.

Dr Melaku Worede

Dr Melaku Worede was born in 1936 and he has worked for many years to save the genetic diversity of Ethiopia's domestic plants. He is an internationally acclaimed plant genetics researcher. Dr Melaku set up the Plant Genetic Resources Centre in Addis Ababa. Our country is noted for its great genetic diversity but modern farming methods and problems such as drought can affect this badly. Dr Melaku Worede has preserved many different traditional crop varieties and developed ways of farming that

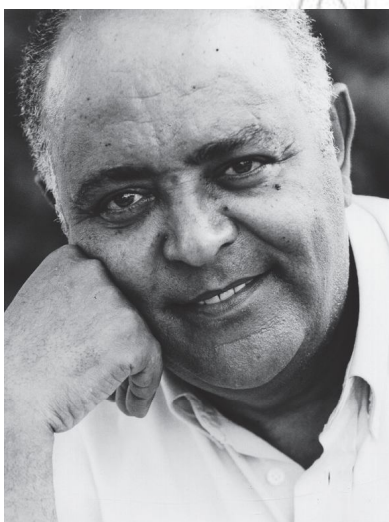


Figure 1.6 Dr Melaku Worede, an internationally acclaimed plant genetics researcher

produce high yields without commercial fertilisers. Dr Worede's methods are now widely used both in other areas of Africa and in Asia. He was the first chair of the African Committee for Plant and Genetic Resources and has been Chair of the United Nations Food and Agriculture Organisation's Commission on Plant Genetic Resources. He has also won the Right Livelihood Award (often called the Alternative Nobel Prize) in 1989 for outstanding vision and work and in 2008 he received the Outstanding International Contribution Award from the National Green Award Foundation.

Dr Gebissa Ejeta

When Dr Gebissa Ejeta was born in a small rural village his mother was determined her son would receive a good education. He walked 20 miles to school every Sunday evening, returning home on Friday after a week of studying. It all paid off as he gained a place at Jimma Agricultural and Technical School and then Alemaya College where he took his first degree. He specialises in plant breeding and genetics. Dr Gebissa Ejeta did his research on sorghum – he got his PhD from Purdue University in the USA where he still holds a professorship. He has helped to develop Africa's first commercial hybrid strain of sorghum. This not only needs less water and so is resistant to drought, but it also yields more grain than traditional varieties. Dr Gebissa Ejeta developed other strains of sorghum which are also resistant to the parasitic Striga weed, which can destroy a big percentage of a crop. Dr Ejeta's work has made a very big difference to the food availability in many areas of Ethiopia and other African countries – his varieties yield up to ten times more than the original strains. In 2009 Dr Gebissa Ejeta was awarded the World Food Prize, which is the most important agricultural prize in the world! He has also been awarded the National Hero award of Ethiopia for his work in science and technology.

These are just some of many renowned Ethiopian biologists who have carried out work of great value both in our own country and across the world. You will have the opportunity to find out more about some of the other scientists with your teacher in activity 1.1.

Here are some more examples of Ethiopian biologists.

- *Professor Beyene Petros* is a biomedical scientist and long serving professor at Addis Ababa University. Professor Beyene Petros, in addition to his distinguished academic career, served as Chairman, Advisory Committee on Health Research and Development, WHO/AFRO, 1997–2000; as vice minister of Education (1991–1993) and many other scientific societies. He has produced more than 43 publications in reputable scientific journals and Published books. Professor Beyene has won Gold Medal Award from Ethiopian Health Association; Fellowships from Fulbright and from Centers for disease control and prevention, Atlanta, USA.
- *Professor Sebsebe Demissew* is a plant taxonomist. He is now the Director of the National Herbarium and the leader of the Ethiopian Flora Project (EFP).



Figure 1.7 Dr Gebissa Ejeta who has been honoured for his work in developing new, high yielding strains of sorghum which grow well in our conditions

Activity 1.1: Discovering Ethiopian biologists

It is inspiring to know what great work is being done by Ethiopian biologists today. Here you have the opportunity to do some research and find out about some of the people who are active in biology in our country.

- You can choose a biologist from the list on pages 5 and 6, find out more about one of the biologists already mentioned in this chapter or write about a biologist you have discovered for yourself. If you look at the research institutions mentioned in the rest of this chapter you will be able to find lots of Ethiopian biologists to choose from!
- Use any resources you have available. You may find out about Ethiopian biologists in books, magazines, journals, leaflets, in the news or even on the internet if it is available.
- Write a report about your biologist and prepare to give a brief talk on him or her to the rest of the class.

- *Dr Zeresenay Alemseged* discovered a 3.3 million-year-old humanoid child fossil in 2006.
- *Dr Tsehaynesh Meselle* was the Director General of the Ethiopian Health and Nutrition Research Institute (EHNRI) during the writing of this book and leads research in human health, including HIV/AIDS.
- *Dr Berhane Asfaw* is an Ethiopian scientist whose team discovered two 160 000-year-old human skulls, some of the oldest that have ever been found. His discoveries were published in the famous scientific journal *Nature*. They have had a great impact on the study of human evolution around the world.
- *Professor Legesse Negash* is a Professor of Plant Physiology in the Department of Biology, Faculty of Science, Addis Ababa University. He is a pioneer in the propagation of Ethiopia's indigenous trees and is the Founder and Leader of the Center for Indigenous Trees Propagation and Biodiversity Development in Ethiopia. Professor Negash is a winner of several awards, including that from the Stockholm-based International Foundation for Science.
- *Professor Mogessie Ashenafi* works at the University of Addis Ababa and leads international research into food microbiology.
- *Professor Ensermu Kelbessa* is one of the leading systematic botanists who has discovered and named many new plants.

Review questions

Select the correct answer from A to D.

1. Biology is:
 - A the study of matter
 - B the study of life and living organisms
 - C the study of how living organisms interact
 - D the study of the way atoms and molecules react together
2. Bilharzia is caused by:
 - A snails
 - B bacteria
 - C viruses
 - D parasitic flatworms
3. Dr Tewolde Berhan Gebre Egziabher is a biologist who researches into:
 - A HIV/AIDS
 - B genetic engineering
 - C environmental protection and diversity
 - D human evolution

1.2 Biological research in Ethiopia

By the end of this section you should be able to:

- Explain how scientific institutions contribute to scientific research.
- Name some Ethiopian institutions involved in biological research.
- Explain the activities and contributions of some of these Ethiopian research institutions.

Biologists, like other scientists, do not work alone. A biologist needs equipment, laboratories and other biologists to discuss ideas with and develop theories. Biologists work in many different areas, from plants to animals, and from medicine to classification and genetics. Ethiopia has a number of well-known institutions that are involved in biological research. Our country continues to invest in these institutions and to develop more. Our biologists have international reputations in many fields. Biologists from other African nations and from other continents come to our institutions to take part in the research programmes, and our biologists also travel to other countries. Sharing knowledge across the world is an important part of science and Ethiopia plays her part in this.

Here are some of the institutions that play an important part in biological research in Ethiopia.

Addis Ababa University (AAU) Biology Department

Addis Ababa University (AAU) is a very large university with an international reputation and the Biology Department is no exception. A top university, AAU is one of the major centres of biological research in the country and it is also home to the Aklilu Lemma Institute of Pathobiology (see the next page).

The university entrance is impressive and the Department of Biology contains much modern and high-level equipment to help biologists in their research.

Addis Ababa University is not the only renowned university in Ethiopia. There are many others, including Haramaya University, Mekelle University, Jimma University, Hawassa University, Gonder University and Bahir Dar University. They all have active biology departments where teaching and research takes place.



Figure 1.8 Addis Ababa University is home to much internationally recognised research.



Figure 1.9 The AHRI buildings and some of the workers who work there

Armauer Hansen Research Institute (AHRI)

When Armauer Hansen Research Institute (AHRI) was first set up in 1969 it was sited next to a big hospital dedicated to patients with leprosy and it carried out research only into leprosy. However, in the years since 1969 leprosy has become a disease that we can treat quite effectively. Since 1996 AHRI has widened its research to include tuberculosis (TB, which has become a big threat with the rise in HIV/AIDS), leishmaniasis, malaria and HIV/AIDS, as well as leprosy.

Aklilu Lemma Institute of Pathobiology (ALIPB)

The department of pathobiology at Addis Ababa University has been renamed the Aklilu Lemma Institute of Pathobiology (ALIPB) in honour of Professor Aklilu Lemma (see page 2). The institute sets out to be a centre of excellence for biomedical research and training. ALIPB carries out research in five major areas. They have a microbiology research programme into the major infectious diseases, they look into vectors of diseases and how to control them, some of the biologists are focused on human parasitic diseases and others work on animal health and disease. Finally, some of the biologists are carrying out research into Endod and other plants, which may be useful as medicines. The institute also plays an important role in training new Ethiopian pathobiologists. Students with a first degree in biomedical sciences (i.e. biology, human medicine, veterinary medicine, laboratory technology) can apply to do a Masters degree in tropical and infectious diseases at the institute.

Ethiopian Health and Nutrition Research Institute (EHNRI)

The Ethiopian Health and Nutrition Research Institute (EHNRI) is an organisation that carries out research into health and nutrition issues which affect public health. Its role is both to identify problems and to help everyone in the country become aware of how to overcome the problems and improve their levels of nutrition and health. The laboratory facilities at EHNRI are good and are well equipped for research into immunology and viral diseases. At the moment EHNRI is carrying out a lot of work into HIV/AIDS in Ethiopia. For example, biologists working with EHNRI are following the progression of HIV/AIDS in two populations of factory workers (about 2000 people) over a long period of time – the research began in 1994! They are planning to work with more people in the future, and are also hoping to set up trials of a possible HIV vaccine. EHNRI is also very active in the battle against TB and it houses the National TB Reference Laboratory. It is involved in rapid diagnosis of TB. EHNRI is also involved in many other projects including issues such as the nutritional state of mothers and babies in the country as well as infectious diseases.

Ethiopian Institute of Agricultural Research (EIAR) also known as Institute of Agricultural Research (IAR)

Agriculture – farming crops and livestock – is the life force of our country. We must grow food to eat. The EIAR (IAR) is the institute where biologists with a passion for improving agriculture and supporting everyone who cultivates the land or raises livestock in Ethiopia carry out research.

There are five main areas of research. Biologists working on crop technology are working to help us achieve food security and nutritional quality, so that we always have sufficient food. They are looking at different crops and ways of improving the crops we already grow. Other biologists are focusing on our livestock, looking at ways of managing our animals' breeding and feeding programmes to make sure that they grow as quickly and as well as possible. They also look at ways of improving the health of our livestock.

Biologists working on crop technology have improved crops like maize, teff and sorghum. Two of these are shown here.

Another important area of research is with regard to the soil and water. Biologists are looking into ways of improving the fertility of the soil, particularly ways of avoiding buying expensive inorganic fertilisers. Other scientists are also looking at ways to water the land more effectively. Forestry is also an area of research. Biologists are very involved in rehabilitating, restoring and conserving some of our forest ecosystems. Finally, the institute also looks at ways of mechanising farming. Biologists research into the species of crop plants that are most suitable for mechanised harvesting.

The Institute of Biodiversity Conservation (IBC)

Biodiversity – the range of living organisms in an area – is internationally recognised as one of the biggest issues in biology today. Here in Ethiopia we have a tremendous range of biodiversity, particularly in our plants. There are also many species which are found only in Ethiopia (endemic). So in world terms, when it was decided to set up gene banks to conserve the genetic material of as many plants as possible, Ethiopia was given the highest priority. The Institute of Biodiversity Conservation (IBC) started off conserving the genes of Ethiopian plants. Now the institute is involved in the conservation of plants, animals and micro-organisms in Ethiopia. Research into the management of the ecosystem is also an important part of the work.

Current research in the IBC looks at many areas including forest and aquatic plants, medicinal plants, animal genetic resources, biotechnology and safety, and ecosystem conservation. The institute also holds one of the leading gene banks in the whole of Africa with over 300 plant species represented.



Figure 1.10 Farming is vital to Ethiopia. Biologists with the EIAR work hard to improve our crops, our animals and our soil.

DID YOU KNOW?

Farming is vital to Ethiopia. About 90% of our exports and around 80% of our economy depends on agriculture.



Figure 1.11 An agronomist examining sorghum crop



Figure 1.12 Scientists have improved crop production of Quncho, an improved teff. It is a hybrid crop now yielding more than 30 quintals per hectare.

Activity 1.2: Discovering more about research in Ethiopia

There are many great institutions in Ethiopia carrying out biological research. You have learnt a little about some of them. Now you can find out more.

- Investigate the biology department at the university nearest to your school or any other institution with biologists working there. Find out as much as you can about the research they carry out and the biologists who are there.
- Investigate one other biological research institution in Ethiopia. You may choose to find out more about one of the institutions highlighted in this book or you may find another different one.
- Use any resources you have available. You may use books, magazines, journals, leaflets, university prospectuses or reports in the news or even on the internet, if it is available.
- Write a report about your local university biology department and one other Ethiopian research institute and prepare to give a brief talk on them to the rest of the class.

Activity 1.3: Making a table of research institutions

Make a table to summarise the biological research institutions in Ethiopia that are mentioned in this book. Add any that you or your classmates have discovered. Draw a table as shown below and complete it:

Institution	Focus of research

Review questions

Select the correct answer from A to D.

1. EHNRI carries out research into:
 - A health and nutrition issues
 - B farming
 - C biodiversity
 - D soil and water
2. Before it widened its research the Armauer Hansen Research Institute studied only:
 - A HIV/AIDS
 - B tuberculosis
 - C leprosy
 - D cervical cancer
3. ALIPB is world-renowned for research into:
 - A different diseases and their control
 - B improved agricultural practices
 - C human evolution
 - D environmental conservation

Summary

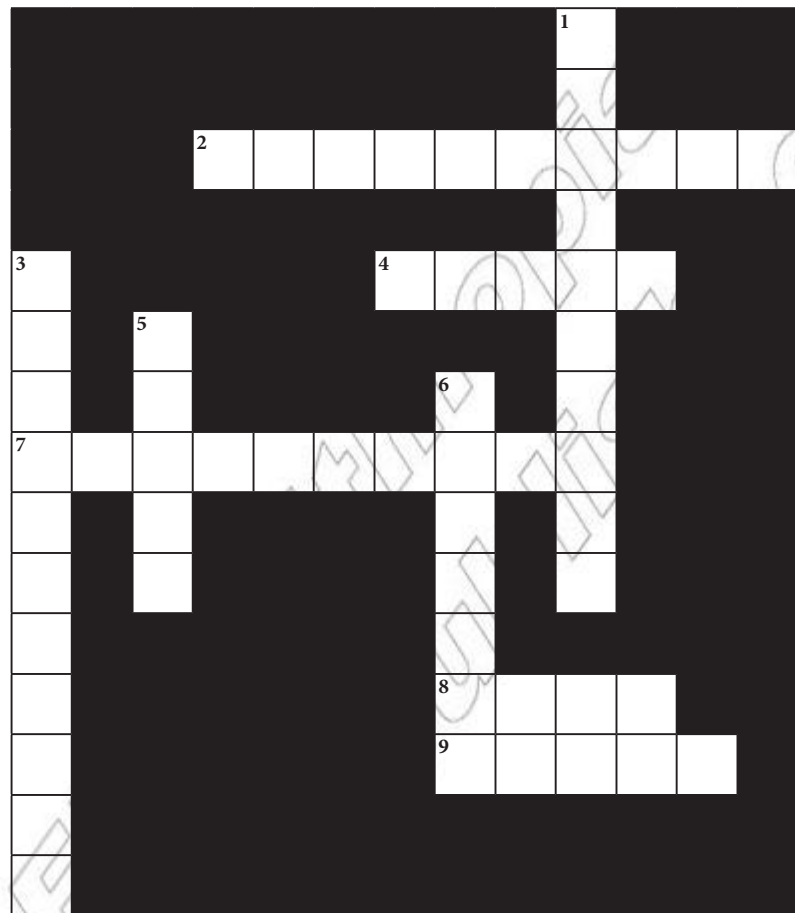
In this unit you have learnt that:

- Biology is the study of life and living organisms.
- Scientific research is based on the ideas of scientists. They design experiments to test these ideas. Results of these experiments are published in peer-reviewed journals, which are read by scientists around the world.
- Ethiopia has some renowned biologists whose work is known both in Ethiopia and internationally. They include Dr Aklilu Lemma, Professor Tilahun Yilma, Professor Yalemtehay Mekonnen, Dr Melaku Worede, Dr Legesse Woldeyes, Dr Gebissa Ejeta, Dr Berhane Asfaw, Professor Legesse Negash, Professor Mogessie Ashenafi, Professor Ensermu Kelbessa and many others.
- Most biological research is linked to a research institution that has the facilities which are needed. There are a number of well-known Ethiopian biological research institutions.

End of unit questions

1. a) Name *two* Ethiopian biologists who have made internationally recognised contributions in their field.
b) Describe the main work of both of the biologists you have chosen and explain why it is so important.
2. What are the main advantages of using Endod in the battle against bilharzia?
3. Why is Professor Yalemtehay Mekonnen internationally renowned?
4. What is rinderpest?
5. Why is the work of Dr Gebissa Ejeta so important?
6. Why are scientific institutions important to biological research?
7. a) Name *three* institutions involved in different types of biological research in Ethiopia.
b) Summarise the areas of biological research carried out by each institution.

Copy the crossword puzzle below into your exercise book (or your teacher may give you a photocopy) and solve the numbered clues to complete it.



Across

- 2 Professor Tilahun Yilma developed a vaccine against this disease (10)
- 4 The Ethiopian scientist who has helped make food more available with his new breeds of sorghum is Dr Gebissa ***** (5)
- 7 What type of trees are planted in Ethiopia by Professor Legesse Negash? (10)
- 8 The Armauer Hansen Research Institute (4)
- 9 The surname of the Ethiopian scientist who discovered a way to prevent bilharzia (5)

Down

- 1 A new scientific idea (10)
- 3 What is studied at the EIAR (IAR)? (11)
- 5 What is the name of the plant which kills the snails which cause bilharzia? (5)
- 6 What do we call a special magazine where scientists publish their research? (7)