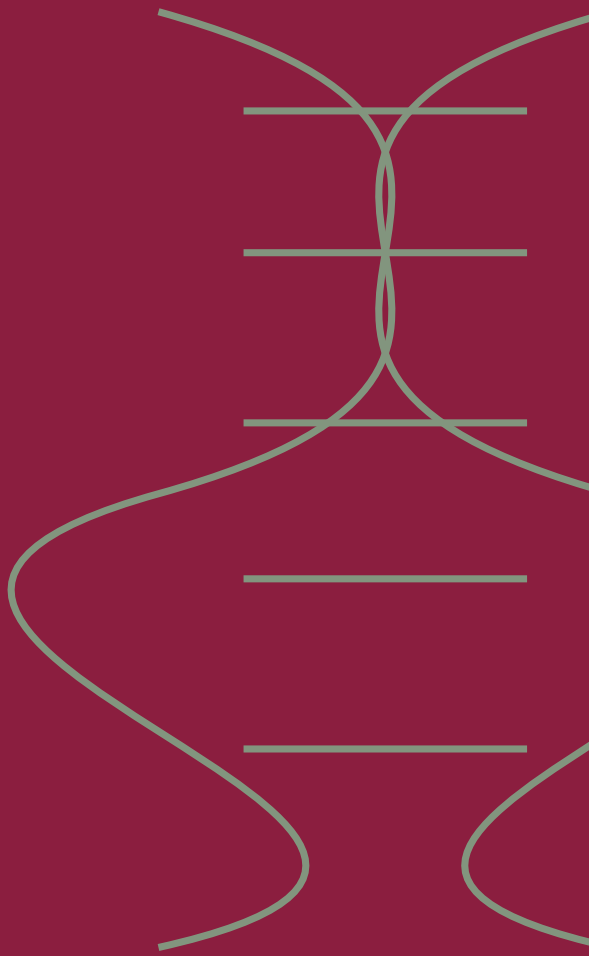
EXAM READY BIOLOGY

Exam Ready Biology

GRADE 11

Study Guide, Worked Examples and Practice Tests for the Grade 11 Examination



✓ 6 units with clear key ideas, worked examples and “Watch out!” boxes
✓ 140 worked examples and 281+ practice questions at three levels
✓ 120 unit-quiz questions and 3 full mock exams (60 MCQ each)
✓ Diagnostic test · Key Facts Sheet · Top 20 Mistakes · teacher notes

Follows the units and order of the Ethiopian Grade 11 Biology textbook

ERMIAS WEDAJE TEGBARU

Exam Ready Biology

Grade 11 · Study Guide, Worked Examples and Practice Tests

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This is an independent study guide. It follows the units and order of the Ethiopian Grade 11 Biology student textbook, but it is not published or endorsed by the Ministry of Education. All explanations, examples and questions are original. Keep your textbook and your teacher's notes beside this book.

The answers were calculated and checked before printing, but no book is free of errors. If you find a mistake or disagree with an answer, please tell the author on Telegram (@Ermias_Wedaje) and it will be reviewed for the next edition.

How to Use This Book

Each unit follows the same pattern, so you always know where to look.

Key ideas
The rules and facts of the section, short and clear.

Worked examples
Step-by-step solutions. Cover the solution and try first.

⚠ Watch out!
The mistakes students make most often, and the right way.

Practice
Level 1 Basic · Level 2 Standard · Level 3 Challenge.

Unit quiz
20 multiple-choice questions in the style of the national examination.

For the Teacher
Timing, starters, misconceptions, activities and assessment.

For students

- Begin with the Diagnostic Test. It shows which units need the most work.
- Read the key ideas, then study each example with the solution covered.
- Do Level 1 and Level 2 practice for every section; try Level 3 when you are ready.
- Take each quiz in 30 minutes, mark it, and redo every question you got wrong.
- In the last weeks, learn the Key Facts Sheet and the Top 20 Mistakes page, and sit the three mock exams. Their answer keys show which unit each question comes from.

For teachers

- Each unit follows the textbook sections, so the book can sit beside your lessons.
- The “For the Teacher” page gives timing, starters, misconceptions and activities.
- The quizzes and mock exams can be used as class tests; every answer has a short reason.

For parents

- Ask your child to explain one worked example to you each day. Teaching is the best way to learn.
- Look at the quiz score after each unit, and celebrate progress, not only high marks.

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Diagnostic Test · Where Should I Start?

14 questions · 15 minutes. Take this test before you start the book. There are two questions on each unit. Your score only shows you where to spend your time.

1. Biomimicry means
   A. cloning animals
   B. copying people's work
   C. breeding crops
   D. copying designs from nature to solve problems

2. The Japanese bullet train nose was modelled on the
   A. shark skin
   B. owl wing
   C. kingfisher beak
   D. whale fin

3. Animals are
   A. prokaryotes
   B. autotrophs
   C. single-celled
   D. multicellular heterotrophs

4. Which group is the largest in the animal kingdom?
   A. mammals
   B. reptiles
   C. birds
   D. arthropods

5. Enzymes are
   A. minerals
   B. biological catalysts
   C. carbohydrates
   D. lipids

6. The place where the substrate binds is the
   A. active site
   B. nucleus
   C. coenzyme
   D. membrane

7. The scientists who proposed the double helix model were
   A. Watson and Crick
   B. Mendel and Darwin
   C. Hershey and Chase
   D. Griffith and Avery

8. Guanine and cytosine are joined by
   A. one covalent bond
   B. three hydrogen bonds
   C. four ionic bonds
   D. two hydrogen bonds

9. Muscle that is striated and voluntary is
   A. smooth
   B. cardiac
   C. all muscle
   D. skeletal

10. The ion needed to start muscle contraction is
    A. iron
    B. sodium chloride
    C. iodine
    D. calcium

11. A population is
    A. a community
    B. all species in an area
    C. one individual
    D. individuals of one species in an area

12. A dispersion where individuals are evenly spaced is
    A. linear
    B. random
    C. clumped
    D. uniform

Unit 1 · Biology and Technology

By the end of this unit you will be able to:

- explain how living things have inspired technology (learning from nature)
- describe how biology contributes to technology and how technology is used in biology
- discuss the positive and negative impacts of biology and technology on society and the natural world
- explain the ethical issues in the treatment of plants and animals in biological studies

Before you start — check yourself. (a) Name one use of a microscope. (b) What is a vaccine used for? (c) Name two products made by fermentation. (d) Why should experiments on animals be avoided when possible?
Answers: (a) to see very small things (b) to protect against a disease (c) bread, yoghurt, beer (d) to avoid causing pain and harm

Key words: biomimicry · biotechnology · genetic engineering · vaccine · microscope · ethics · bioremediation · biofuel · informed consent · conservation

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Learning from nature
- Biology and technology
- Impacts on society and the natural world
- Ethical issues in biology

1.1 Learning from Nature

Key ideas

- **Biomimicry** (or **bionics**) is the design of materials, tools and systems by **copying** structures and processes found in living things.
- **Examples: Velcro** was invented from the hooks on burdock seeds; **aircraft wings** and gliders copy the wings of birds; **sonar and radar** copy the echolocation of bats and dolphins; **the lotus effect** (a self-cleaning surface) inspired water-repellent paints and glass; **shark-skin** patterns reduce drag on swimsuits and ships; **termite mounds** inspired natural air-cooled buildings (such as the Eastgate Centre in Harare).
- **Why it works:** living things have been tested by **natural selection** for millions of years, so their designs are efficient and use little energy.
- **Steps in the process:** observe the organism → identify the useful feature → understand how it works → copy the idea in a new design → test the design.

Example 1.1 — Identify the model

Which organism inspired (a) sonar, (b) Velcro, (c) self-cleaning paint?

Solution. (a) **Bats** (echolocation). (b) **Burdock seeds** (hooks). (c) The **lotus leaf**.

Example 1.2 — Explain the benefit

Explain why copying termite mounds can reduce the cost of cooling a building.

Solution. The mound has channels that move warm air out and let cool air in by natural convection, so little electricity is needed for air-conditioning.

Example 1.3 — Exam Booster · Suggest an idea

A kingfisher dives into water with a very small splash because of its long, pointed beak. Suggest a use of this idea.

Solution. The shape of a **high-speed train nose** (to reduce noise and air resistance) was designed from the kingfisher's beak.

Example 1.4 — Exam Booster · Why copy nature?

Give two reasons why biomimicry is useful.

Solution. The designs have been improved by natural selection, so they are efficient; and they usually use less energy and cause less pollution.

⚠ Watch out!

× Wrong	✓ Right
Biomimicry means growing living organisms in the laboratory.	It means copying designs from nature.
Only animals can inspire technology.	Plants (lotus leaf, burdock) have inspired designs too.
Biomimicry always copies the whole organism.	It copies a useful feature or process.

Practice 1.1

Level 1 — Basic

1. Define biomimicry.
2. Which animal inspired the design of aircraft wings?
3. Name one product inspired by the lotus leaf.

Level 2 — Standard

4. What feature of shark skin is copied in swimsuits?
5. Give an example of technology copied from a plant.
6. Why is the Eastgate Centre in Harare called an example of biomimicry?

Level 3 — Challenge

7. Choose a living thing near your home and suggest a technology that could be inspired by it.
8. Explain why nature is a good teacher for engineers.

1.2 Biology and Technology

Key ideas

- **Technology** is the use of scientific knowledge to solve practical problems. **Biotechnology** uses living organisms or their parts (cells, enzymes) to make products or improve processes.
- **Benefits of biology to technology: food** (bread, injera, yoghurt, cheese and beer by fermentation); **medicine** (antibiotics, vaccines, insulin from bacteria); **agriculture** (improved crop varieties, genetically modified crops, biological pest control); **environment** (bioremediation, sewage treatment, biogas and biofuels); **industry** (enzymes in detergents and leather).
- **Uses of technology in biology: microscopes** (light and electron) to see cells; **PCR** and **gel electrophoresis** to study DNA; **imaging** (X-ray, ultrasound, MRI) to see inside the body; **computers** and **bioinformatics** to store and analyse data; **GPS and satellite tracking** of animals; **centrifuges** to separate cell parts; **cameras and drones** for wildlife counts.
- **Genetic engineering:** a gene is moved from one organism to another, for example the human insulin gene into bacteria, which then make insulin.

Example 1.5 — Name the technology

Which technology is used to (a) see a cell, (b) track the migration of an animal, (c) copy a small sample of DNA?

Solution. (a) **Microscope**. (b) **GPS or satellite tag**. (c) **PCR** (polymerase chain reaction).

Example 1.6 — Biotechnology products

Give three foods and one medicine that are made with the help of microorganisms.

Solution. Foods: **injera/bread (yeast), yoghurt (Lactobacillus), cheese**. Medicine: **antibiotics** (e.g. penicillin from a fungus) or **insulin** from genetically engineered bacteria.

Example 1.7 — Exam Booster · Insulin

Explain how bacteria are used to make human insulin.

Solution. The human insulin gene is cut out and put into a bacterial plasmid. The bacteria multiply in a fermenter and make large amounts of insulin, which is purified.

Example 1.8 — Exam Booster · Bioremediation

What is bioremediation?

Solution. Using living organisms (bacteria, fungi, plants) to clean polluted soil or water, for example bacteria that break down oil spills.

Unit 2 · Animals

By the end of this unit you will be able to:

- describe the characteristics of animals and classify invertebrates and vertebrates
- describe asexual and sexual reproduction in animals, and metamorphosis in insects
- describe reproduction in the frog, crocodile, bird and rat
- explain the beneficial and harmful effects of insects
- describe the types and patterns of animal behaviour
- explain homeostasis: thermoregulation, osmoregulation and blood-sugar regulation

Before you start — check yourself. (a) Name the five groups of vertebrates. (b) What does a mosquito carry? (c) What is the normal human body temperature? (d) Name one hormone that controls blood sugar.
Answers: (a) fish, amphibians, reptiles, birds, mammals (b) the malaria parasite (c) about 37 °C (d) insulin

Key words: invertebrate · vertebrate · metamorphosis · fertilisation · instinct · imprinting · homeostasis · thermoregulation · osmoregulation · negative feedback

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Characteristics of animals
- Invertebrates and vertebrates
- Reproduction in animals
- Insects: benefits and harm
- Animal behaviour
- Homeostasis in animals

Unit 3 · Enzymes

By the end of this unit you will be able to:

- define enzymes and describe their properties and function
- describe the levels of protein structure
- explain the lock-and-key and induced-fit models, and the transition state
- explain how enzymes are regulated (inhibition and feedback)
- classify enzymes into six classes
- explain how temperature, pH, substrate and enzyme concentration and inhibitors affect enzyme action
- interpret enzyme kinetics (V_{max} and K_m), and describe industrial uses of enzymes and malting

Before you start — check yourself. (a) Name the building blocks of proteins. (b) What is a catalyst? (c) What happens to a protein when it is boiled? (d) Name one food that is made by fermentation.
Answers: (a) amino acids (b) a substance that speeds up a reaction without being used up (c) it is denatured (d) yoghurt, injera or beer

Key words: enzyme · substrate · active site · denaturation · induced fit · inhibitor · cofactor · optimum · malting · V_{max}

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- What enzymes are and how they work
- Protein structure
- Enzyme–substrate models
- Regulation and types of enzymes
- Factors affecting enzyme action and kinetics
- Industrial uses and malting

Unit 4 · Genetics

By the end of this unit you will be able to:

- describe the structure and function of DNA and RNA and the process of DNA replication
- describe mitosis and meiosis and explain their significance
- explain transcription and translation in protein synthesis
- solve monohybrid and dihybrid problems and use test crosses
- explain sex determination and sex-linked inheritance
- describe codominance, incomplete dominance, multiple alleles, the Rh factor and environmental effects
- interpret pedigrees and describe genetic disorders, genetic testing and counselling, and gene therapy
- describe breeding methods and the basics of bioinformatics

Before you start — check yourself. (a) Name the four bases of DNA. (b) How many chromosomes are in a human body cell? (c) What are alleles? (d) What fraction is 1/2 × 1/2?
Answers: (a) A, T, G, C (b) 46 (c) different forms of a gene (d) 1/4

Key words: DNA · RNA · gene · allele · genotype · phenotype · dominant · mitosis · meiosis · codon

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- DNA, RNA and replication
- Cell division
- Protein synthesis
- Mendelian inheritance
- Sex determination and non-Mendelian inheritance
- Pedigrees and genetic disorders
- Genetic testing, gene therapy, breeding and bioinformatics

Unit 5 · Human Body Systems

By the end of this unit you will be able to:

- describe muscle types, the sliding filament model, the skeleton and joints
- describe the male and female reproductive systems and gametogenesis
- explain the menstrual cycle and its hormonal control
- describe fertilisation, pregnancy and birth
- describe contraception, infertility and sexually transmitted infections
- identify harmful traditional practices and the benefits of family planning
- describe the effects of alcohol, khat and other drugs

Before you start — check yourself. (a) Name the three types of muscle. (b) Where are sperm made? (c) How long is the usual menstrual cycle? (d) What does HIV stand for?
Answers: (a) skeletal, smooth, cardiac (b) testes (c) about 28 days (d) human immunodeficiency virus

Key words: skeletal muscle · joint · testis · ovary · ovulation · fertilisation · placenta · contraceptive · STI · family planning

How this unit is examined

Question types that appear again and again in Ethiopian model examinations:

- Musculoskeletal system
- Reproductive systems and gametogenesis
- Menstrual cycle
- Fertilisation and pregnancy
- Contraception, infertility and STIs
- Harmful practices and family planning
- Alcohol, khat and drugs

44. The ion needed to start muscle contraction is

A. iron
B. sodium chloride
C. iodine
D. calcium

45. The number of bones in the adult skeleton is

A. 206
B. 300
C. 150
D. 180

46. The shoulder is a

A. ball-and-socket joint
B. fixed joint
C. pivot joint
D. hinge joint

47. A ligament joins

A. bone to bone
B. skin to bone
C. muscle to muscle
D. muscle to bone

48. The biceps and triceps are

A. synergists
B. both flexors
C. tendons
D. an antagonistic pair

49. Testosterone is made in the

A. urethra
B. prostate
C. testes
D. epididymis

50. The site of sperm storage is the

A. uterus
B. bladder
C. epididymis
D. ovary

51. A population is

A. a community
B. all species in an area
C. one individual
D. individuals of one species in an area

52. 1 200 trees on 40 hectares. The density is

A. 3 per hectare
B. 1 240 per hectare
C. 48 000 per hectare
D. 30 per hectare

53. If a mark–recapture study marks 25, catches 40 and recaptures 5 marked, N =

A. 100
B. 200
C. 125
D. 8

54. A dispersion where individuals are evenly spaced is

A. linear
B. random
C. clumped
D. uniform

55. The population in a year: start 1 000, births 90, deaths 40, in 20, out 10. End =

A. 1 140
B. 1 060
C. 1 040
D. 1 090

56. J-shaped growth occurs when

A. resources are unlimited
B. resources are limited
C. K is reached
D. death rate is high

57. A population that levels off at K shows

A. logistic growth
B. exponential growth
C. migration only
D. decline

58. A population that grows from 800 to 880 has a growth rate of

A. 11%
B. 10%
C. 9%
D. 8%

59. The doubling time at 7% growth is about

A. 35 years
B. 70 years
C. 7 years
D. 10 years