EXAM READY BIOLOGY

Exam Ready Biology

GRADE 10

Study Guide, Worked Examples and Practice Tests for the Grade 10 Examination



- ✓ 6 units with clear key ideas, worked examples and “Watch out!” boxes
- ✓ 154 worked examples and 248+ 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 10 Biology textbook

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Grade 10 · 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 10 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. The study of plants is called
   A. mycology B. zoology C. botany D. ecology
2. The study of insects is
   A. herpetology B. ichthyology C. ornithology D. entomology
3. Plants make their own food by
   A. respiration only B. digestion
   C. fermentation D. photosynthesis
4. Pine trees are
   A. mosses B. angiosperms C. gymnosperms D. ferns
5. The universal solvent is
   A. alcohol B. ether C. oil D. water
6. Calcium ions are needed for
   A. bones and teeth B. digestion of fat
   C. sugar storage D. vision only
7. The cell cycle has two main parts: interphase and
   A. fertilisation B. digestion C. cell division D. respiration
8. During G_1 the cell
   A. grows and makes proteins B. copies DNA
   C. forms gametes D. divides
9. The organ that makes bile is the
   A. liver B. stomach C. gallbladder D. pancreas
10. Pepsin works best in
    A. neutral conditions B. boiling water
    C. alkaline conditions D. acidic conditions
11. Producers form the
    A. first trophic level B. second trophic level
    C. decomposer level D. third trophic level
12. A food web is
    A. a cycle of water B. a single chain
    C. linked food chains D. a pyramid
13. The study of how body parts work is
    A. physiology B. taxonomy C. cytology D. anatomy

Unit 1 · Sub-fields of Biology

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

- name the three major branches of biology and the sub-fields based on the organism, structure and process studied
- classify fields of biology as pure or applied
- describe the contributions of great biologists such as Aristotle, Leeuwenhoek, Linnaeus, Darwin, Mendel, Pasteur, Koch, Watson and Crick
- explain how biological discoveries (microscope, medicines, germ theory) benefit society and the environment
- describe the contributions of Ethiopian biologists such as Dr. Aklilu Lemma and Prof. Gebisa Ejeta

Before you start — check yourself. (a) What is biology? (b) Name two living things you know that are plants and two that are animals. (c) What is a microscope used for? (d) Name one disease caused by a germ.
Answers: (a) the study of living things (b) e.g. maize, coffee; cow, hen (c) to see very small objects (d) e.g. malaria, tuberculosis

Key words: zoology · botany · microbiology · anatomy · physiology · taxonomy · pure biology · applied biology · biotechnology · germ theory

How this unit is examined

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

- Branches and sub-fields of biology
- Pure and applied fields of biology
- Major discoveries that revolutionised biology
- Contributions of biological discoveries and Ethiopian biologists

1.1 Branches and Sub-fields of Biology

Key ideas

- **By the organism studied: zoology** (animals), **botany** (plants), **microbiology** (microbes such as bacteria, archaea, protists, viruses, microscopic algae and fungi).
- **Sub-fields of zoology:** herpetology (reptiles), ichthyology (fish), mammalogy (mammals), ornithology (birds), entomology (insects). **Of microbiology:** bacteriology (bacteria), mycology (fungi), virology (viruses), phycology (algae).
- **By the structure studied: morphology** (external form), **anatomy** (body structure by dissection), **histology** (tissues), **cytology** (cells), **cell biology** (cell parts and functions), **molecular biology** (DNA, RNA, informational molecules).
- **By the process studied: physiology** (normal functions, e.g. digestion), **embryology** (development from zygote), **ecology** (organisms and environment), **taxonomy** (identification, naming, classification), **paleontology** (fossils), **evolution** (change over generations), **genetics** (heredity and variation), **exobiology** (life in the universe).
- Biology is linked to **chemistry** (cell membrane, enzymes, pH), **physics** (water transport by cohesion, adhesion and capillarity) and mathematics (statistics).

Example 1.1 — Match the field

Name the field that studies (a) birds; (b) tissues; (c) fossils; (d) heredity.

Solution. (a) **ornithology**; (b) **histology**; (c) **paleontology**; (d) **genetics**.

Example 1.2 — Branch by organism

Under which major branch do mycology and bacteriology fall?

Solution. Microbiology: fungi and bacteria are microscopic organisms.

Example 1.3 — Anatomy or morphology?

A student studies the shape and texture of leaves. Which field is this?

Solution. Morphology (external form).

Example 1.4 — Exam Booster · Link with other sciences

Which science explains why water rises in the xylem by capillary action?

Solution. Physics (cohesion, adhesion, surface tension).

Example 1.5 — Exam Booster · Scientific name

Which field gives the name Homo sapiens to humans?

Solution. Taxonomy: Homo is the genus and sapiens is the species.

⚠ Watch out!

× Wrong	✓ Right
Anatomy and morphology are the same.	Anatomy studies internal structure (often by dissection); morphology studies external form.
Cytology studies the whole body.	Cytology studies cells.
Microbiology only studies bacteria.	It includes bacteria, archaea, protists, viruses, microscopic algae and fungi.

Practice 1.1

Level 1 — Basic

1. Name the three major branches of biology.
2. What does ichthyology study?
3. What does entomology study?

Level 2 — Standard

4. Define physiology.
5. Which field studies the interaction of organisms with their environment?
6. What does mycology study?

Level 3 — Challenge

7. Explain how chemistry helps to explain digestion and gas transport in the body.
8. Distinguish embryology from genetics.

1.2 Pure and Applied Fields of Biology

Key ideas

- **Pure (basic) biology** studies how life works in nature (structure, behaviour, reproduction, evolution) to **gain knowledge**. Examples: morphology, taxonomy, cytology, physiology, embryology, histology, evolution, paleontology, molecular biology.
- **Applied biology** uses biological knowledge to **solve practical problems** and manage life. Examples: agriculture, horticulture, forestry, agroforestry, poultry, animal husbandry, apiculture (bees), sericulture (silk), pisciculture (fish farming), pathology, pharmacognosy, biotechnology.
- The link is like **anatomy and surgery**: pure science gives the knowledge; applied science uses it.
- **Biotechnology** uses living organisms or their products for human welfare (e.g. genetically improved crops, vaccines, yoghurt). **Bioinformatics** uses computers to store and analyse biological data such as DNA and protein sequences.

Example 1.6 — Classify

Classify as pure or applied: taxonomy, apiculture, cytology, forestry.

Solution. Pure: **taxonomy**, **cytology**. Applied: **apiculture**, **forestry**.

Unit 3 · Biochemical Molecules

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

- explain the properties of water and its importance for life
- describe important inorganic ions (Na^+, K^+, Ca^{2+}, PO_4^{3-}, Cl^-, Fe^{2+}, I^-) and the effects of their deficiency
- describe the structure, types and functions of carbohydrates and lipids
- describe amino acids, the peptide bond, protein structure and functions
- describe the structure of nucleotides, DNA and RNA
- carry out food tests (iodine, Benedict's, biuret, emulsion)

Before you start — check yourself. (a) Name the three main food groups that give energy. (b) Which mineral is needed for strong bones? (c) What is the chemical formula of water? (d) What is DNA?
Answers: (a) carbohydrates, fats and proteins (b) calcium (c) H_2O (d) the genetic material

Key words: polar molecule · hydrogen bond · inorganic ion · monosaccharide · polysaccharide · triglyceride · amino acid · peptide bond · nucleotide · enzyme

How this unit is examined

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

- Water
- Inorganic ions
- Carbohydrates
- Lipids
- Proteins
- Nucleic acids and food tests

Unit 5 · Human Biology

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

- describe the structure and function of the digestive system and the enzymes of digestion
- describe the heart, blood vessels, pulmonary and systemic circulation, and the lymphatic system
- explain blood groups, Rh factor and blood donation
- describe common diseases of digestion and of the circulatory system
- describe breathing, gas exchange and the mechanism of inspiration and expiration
- describe the urinary system and the nephron
- describe innate and acquired immunity, antigens, antibodies and immune cells
- appreciate the contributions of Prof. Asrat Woldeyes and Dr. Widad Kidane Mariam

Before you start — check yourself. (a) Name the organ that makes bile. (b) What carries oxygen in blood? (c) Which gas do we breathe out more of than in? (d) Which organ filters blood to make urine?
Answers: (a) liver (b) haemoglobin in red blood cells (c) carbon dioxide (d) kidney

Key words: alimentary canal · enzyme · villi · pulmonary circulation · agglutination · alveoli · nephron · antigen · antibody · immunity

How this unit is examined

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

- The Digestive System
- The Circulatory System and the Heart
- Blood, Lymphatic System and Blood Donation
- Diseases of Digestion and Circulation
- The Breathing System
- The Urinary System
- The Immune System and Ethiopian Physicians

Unit 6 · Ecological Interactions

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

- define trophic level, food chain and food web and construct them from local organisms
- describe the flow of energy and matter and the ecological pyramids
- describe the water cycle and its processes
- describe the carbon cycle and relate it to global warming
- describe the nitrogen cycle, soil fertility and crop rotation
- describe the phosphorus cycle and the role of decomposers

Before you start — check yourself. (a) What is the ultimate source of energy for life? (b) Name a producer. (c) What do decomposers do? (d) Which gas do plants take in?
Answers: (a) the Sun (b) a green plant (c) break down dead matter and return nutrients (d) carbon dioxide

Key words: trophic level · food chain · food web · producer · consumer · decomposer · ecological pyramid · nitrogen fixation · global warming · crop rotation

How this unit is examined

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

- Trophic Levels, Food Chains and Food Webs
- Flow of Energy and Ecological Pyramids
- The Water Cycle and the Carbon Cycle
- The Nitrogen and Phosphorus Cycles

6.1 Trophic Levels, Food Chains and Food Webs

Key ideas

- A **trophic level** is the feeding position of an organism in a food chain, in order of receiving the Sun's energy. **Level 1: producers** (green plants, algae; make food by photosynthesis). **Level 2: primary consumers** (herbivores). **Level 3: secondary consumers** (carnivores or omnivores). **Level 4: tertiary consumers** (top carnivores).
- **Decomposers** (bacteria and fungi) break down dead organisms and waste and return nutrients to the soil; they act at every level. **Scavengers** (vultures, hyenas) eat dead animals.
- A **food chain** shows one path of energy: grass → grasshopper → frog → snake → eagle (arrows point in the direction of energy flow, toward the eater). A **food web** is many linked food chains; it is more stable because an animal has more than one food source.
- Feeding groups: **herbivores** (plants), **carnivores** (animals), **omnivores** (both), **detritivores** (dead matter).

Key Facts Sheet

Learn these by heart. Cover the right-hand side and say each fact from memory.

Unit 1 · Sub-fields of Biology

Botany plants ; zoology animals ; mycology fungi

Cytology cells ; histology tissues ; genetics heredity

Pure: knowledge ; applied: solving problems

Hooke: cells ; Jenner: vaccine ; Fleming: penicillin

Watson and Crick: DNA ; Mendel: inheritance

Aklilu Lemma: endod ; Gebisa Ejeta: sorghum

Unit 2 · Plants

Bryophytes, ferns, gymnosperms, angiosperms

Photosynthesis: $CO_2 + H_2O \rightarrow$ glucose + O_2 (light, chlorophyll)

Xylem: water up ; phloem: sugars

Transpiration through stomata

Pollination → fertilisation → seed and fruit

Auxin: tropisms

Unit 3 · Biochemical molecules

Iodine: starch ; Benedict: reducing sugar ; Biuret: protein

Carbohydrates C H O ; proteins amino acids

Lipids: glycerol + 3 fatty acids

DNA pairs A–T and G–C ; RNA has uracil

Fe: haemoglobin ; Mg: chlorophyll ; I: thyroxine

Enzymes are protein catalysts

Unit 4 · Cell reproduction

Cell cycle: G_1, S, G_2, mitosis, cytokinesis

Mitosis PMAT: 2 identical diploid cells

Meiosis: 4 haploid cells, two divisions

Humans: 2n = 46 ; n = 23

Crossing over and independent assortment cause variation

Cancer: uncontrolled division

Unit 5 · Human biology

Digestion ends in glucose, amino acids, fatty acids + glycerol

Heart: 4 chambers ; left ventricle thickest

O: universal donor ; AB: universal recipient

Inspiration: diaphragm flattens, ribs up and out

Nephron: filtration, reabsorption, secretion

Vaccines give artificial active immunity

Unit 6 · Ecological interactions

Producer → primary → secondary → tertiary consumer

About 10% of energy passes up

Energy flows one way ; matter is recycled

Water cycle: evaporation, condensation, precipitation

CO_2: photosynthesis in ; respiration and burning out

Nitrogen fixation: Rhizobium ; crop rotation

Mock Examination 1

60 multiple-choice questions · 90 minutes · one mark each. Circle one answer. Mark with the answer key at the back and use the unit number to see where to revise.

1. The study of plants is called
   A. mycology B. zoology C. botany D. ecology
2. The study of animals is called
   A. botany B. zoology C. virology D. genetics
3. The study of fungi is
   A. entomology B. mycology C. ornithology D. virology
4. The study of insects is
   A. herpetology B. ichthyology C. ornithology D. entomology
5. The study of birds is
   A. entomology B. cytology C. ornithology D. mycology
6. The study of fish is
   A. herpetology B. ichthyology C. ornithology D. zoology only
7. The study of cells is
   A. genetics B. histology C. cytology D. taxonomy
8. The study of tissues is
   A. cytology B. histology C. embryology D. anatomy
9. The study of heredity is
   A. taxonomy B. genetics C. physiology D. ecology
10. The study of relationships between organisms and their environment is
    A. anatomy B. embryology C. taxonomy D. ecology
11. Plants make their own food by
    A. respiration only B. digestion
    C. fermentation D. photosynthesis
12. Mosses and liverworts belong to the
    A. bryophytes B. gymnosperms C. pteridophytes D. angiosperms
13. Ferns are
    A. pteridophytes B. angiosperms C. bryophytes D. gymnosperms
14. Pine trees are
    A. mosses B. angiosperms C. gymnosperms D. ferns
15. Flowering plants are
    A. gymnosperms B. bryophytes C. algae D. angiosperms
16. Monocot leaves have
    A. spiral veins B. no veins C. parallel veins D. net veins