BLG114-L/1/2007–2009

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DEPARTMENT OF LIFE SCIENCES

BIOLOGY

Only study guide for BLG114-L

GENERAL INFORMATION

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general information:

BIOLOGY

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Introduction

This is a practical module and this study guide is intended to be used as an aid when you are preparing for the practical work session, as well as during the session. The study guide was written with reference to the prescribed textbook and should be used in conjunction with it.

In this practical module, you will have an opportunity to see and handle the organisms that you study in the theoretical modules. The practical should, therefore, lead to a better understanding of the theory.

The programme for the practical work is extensive and a great deal of work has to be covered within the limited days available. However, we are sure that you will enjoy the work, as well as the opportunity to communicate with lecturers and other students. The lecturers will do their best to make the practical tuition effective. Please make use of this opportunity to discuss any problems you may have with any of the biology modules with the lecturers.

THEORETICAL WORK

The theoretical work for this course is discussed in depth in the three theoretical modules, BLG111–H, BLG112–J and BLG113–K. This means that you have to register for these theoretical modules before you can complete the practical module (BLG114–L). Therefore, please make sure that you have registered for the theoretical modules and that you have received the necessary tutorial matter.

The theoretical modules serve as an introduction to the practical module. A good theoretical background is essential if you want to pass the practical module.

No theoretical work is dealt with in this tutorial letter. The purpose of this module is to demonstrate, in practical, the work done in the theoretical modules.

ASSIGNMENTS

No assignments need to be done for this module, since the submission of assignments for the theoretical modules and the earning of a certain number of credit points for those assignments, are requirements for admission to the practical work session.

PRACTICAL WORK SESSION AND ADMISSION THERETO

The practical work may only be done at the North-West University at Potchefstroom (Biological complex). The practical session will be held in September or October, and will be for approximately 2 weeks. You will be informed of the dates and times in tutorial letters or by UNISA. Practical sessions will be presented every day, **including Saturdays** and **public holidays**, but excluding Sundays. All the days must be attended by all students, because NO alternative dates are available. The practical work will not be repeated and there will be no supplementary examination after the official practical period. Practical classes will start at exactly 08:00.

It is essential that you complete all the assignments for the theoritical modules satisfactorily, this will prepare you for the practical work session.

PRACTICAL EXAMINATION AND ADMISSION TO THE EXAMINATION

The examination for the practical module will be held at the North-West University immediately after completion of the practical work session. If you attend the practical session and complete it satisfactorily, you will be admitted to the examination. Certain drawings, assignments and experiments must be completed during the practical session and the results must be processed and recorded in a practical workbook (A4 size). During the practical session, you will have the opportunity to purchase workbooks for part 1 and part 2.

For the purposes of the practical examination, you must be able to give the following information on each microscope slide and/or organism, or any other material supplied:

1. complete identification
2. classification
3. clear and complete drawings or line diagrams
4. brief explanatory notes.

You will not be expected to do any of the plant physiology experiments during the practical examination. It is important, however, that you know the theoretical principles and methodology of each experiment. In addition, you must be able to conduct analyses (calculations, graphical presentations etc.) of results given to you in the examination paper.

PRESCRIBED AND RECOMMENDED TEXTBOOKS

Not all the work for this module is dealt with in sufficient detail in your prescribed textbook, and you will therefore also have to make extensive use of a number of recommended textbooks that will be supplied during the practical. You are required to study the different drawings in the textbooks on your own, and then decide which drawings are the most complete, according to the principles laid down in this tutorial letter. In the case of the plant physiology experiments, it is essential that you have a thorough knowledge of the theory regarding respiration, photosynthesis, water potential and the uptake/transport of water in plants BEFORE you attend the practical work session. Also study the relevant sections in the prescribed textbook.

COMPOSITION OF THE MODULE

The practical work session, which is conducted over several days, is divided into two parts. Part 1 deals with animal biology, that is, the theoretical work covered in BLG113–K. Part 2 deals with plant biology, that is, the theoretical work covered in BLG112–J, and some of the theoretical work covered in BLG111–H.

GENERAL

Students should take the opportunity provided by the practical work session to ask questions about any aspect of the work, to study the laboratory materials supplied and, especially, to apply their theoretical knowledge.

You will be required to purchase certain articles for the practical work session (see tutorial letter 101 for BLG114–L for further instructions).

LECTURERS:

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CHAPTER 1

The microscope

Many organisms and biological structures are too small to be seen with the unaided eye. To observe such specimens, biologists often use a *light microscope,* which is a coordinated system of lenses arranged to produce an enlarged, focusable image of a specimen. A light microscope *magnifies* a specimen, which means that it increases the *apparent size* of the specimen.

During the practical session you will learn how to use a compound light microscope properly. You will also use a dissecting (stereo) microscope.

CHAPTER 2

Drawings and other illustrations

2.1 GENERAL

Most of the subject matter in the biology course (especially the practical part) is easier to understand with the aid of drawings and diagrams or schematic representations. You are advised to use drawings and/or other illustrations in your study of all material for this course. In the practical session you will be expected to make precise drawings or line diagrams of all cells, tissues, organs and organisms. Note the following important points:

1. Make large and neat drawings (about half an A4 page per drawing) but draw only what you see under the microscope or during dissection, and not from your textbooks.
2. Decide whether your drawing will be a high or low magnification drawing according to the amount of detail required. For identification purposes, you will find it very useful to begin by making a low magnification drawing for each microscope slide, whether or not you are able to show much detail. Then you can make a second drawing at higher magnification, to show the details requested.
3. Make sure that you draw cells and other objects in the correct proportion to one another.
4. Each drawing or illustration should have a complete title (at the bottom) and the scale of magnification should be stated.
5. Every cell has a specific shape and its own cell wall or cell membrane. Cells are attached to one another in a certain pattern and are clearly demarcated.
6. Keep both your eyes open when looking through the microscope. This may seem difficult or even impossible at first, but with practice you will soon be able to observe the specimen while continuing with the drawing.
7. Use a sharp drawing pencil (HB or B).
8. Plan how you will arrange the drawing on the blank page in your practical workbook.
9. In a detailed drawing only a representative segment of each tissue type or part of an object need to be given. Between five and ten adjoining cells of each tissue type are usually sufficient.

2.2 DRAWINGS

A drawing is a representation in which all possible detail is given clearly and correctly. Drawings and lines linking labels to the drawings must preferably be in pencil, and labels must be printed in ink. The drawing must be placed on the left-hand side of the page and the labels should appear on the right-hand side. The label lines should end neatly one under the other. Drawings should be large and clear, and they should have a title and an indication of the scale of magnification. The drawings you make during the practical session, are important aids when you do revision before the examination.

2.3 OUTLINE DRAWINGS

An outline drawing is a representation of a structure in which the boundaries between different parts are indicated by lines only. No details, for example of cells, are given in an outline drawing. It is important that the relationship between the different parts, especially in respect of location and size, should be carefully indicated. Requirements regarding labels, label lines and the title are the same as for drawings.

2.4 SCHEMATIC REPRESENTATIONS

A schematic representation is a diagram in which a succession of events or phenomena is represented schematically. Unless it is specifically stated that drawings or other representations should be included in the diagram, only arrows between the various organs, phases or chemical compounds are required. Schematic representations should have labels and a title. A schematic representation that includes drawings between the phases is often referred to as a diagrammatic representation.

2.5 STUDY PROCEDURE

For each microscope slide or other specimen you have to study, the following procedures should be followed:

1. Read the name of the specimen in the tutorial letter.
2. Study the figures of the particular specimen in the prescribed and recommended textbooks.
3. Study the object.
4. After making sure that you have thoroughly studied the object, do the following:
   - Make drawings or outline drawings of the object (not from the drawings in the textbooks), following the procedures described in this tutorial letter.
   - Label the different parts on the drawings or line diagrams.
   - Look at other examples of the same objects and compare them with your drawings or line diagrams.

PART 1

Animal Biology

CHAPTER 3

Animal cells and tissues

Eukaryotic animals are multicellular organisms with specialised cells grouped into tissues, which make up functional units called organs. Prepare the theory in **Campbell & Reece, Chapter 40, pp. 820-841, Chapter 42, pp. 867-883** and **Chapter 46, pp. 973-984.** In this practical you will be investigating the different cells and tissues that form part of all major organs.

Pay special attention to the following figures in **Campbell & Reece**:

- 40.5 The structure and function of epithelial cells
- 40.5 Connective tissue
- 40.5 The basic structure of a neuron
- 40.5 Vertebrate muscle
- 42.15 Composition of mammalian blood
- 46.12 Structure of the testis and epididymus
- 46.11 Ovary

CHAPTER 4

Kingdom Protista (Subkingdom Protozoa)

Protists are eukaryotic and diverse organisms that vary in structure and function. Prepare the theory in **Campbell & Reece, Chapter 28, pp. 555–556** and **564** and pay special attention to the following figures of the organisms you will study during the practical:

- 28.24 *Amoeba*
- 28.11 *Plasmodium*

CHAPTER 5

Kingdom Animalia

5.1 ACOELOMATA AND PSEUDOCOELOMATA

Prepare the theory in **Campbell & Reece, Chapter 33, pp. 643–645, p. 648** and **pp. 655–656.** During the practical you will study examples of acoelomate and pseudocoelomate animals, namely the phylum Cnidaria (acoelomate), phylum Platyhelminthes (acoelomate) and phylum Nematoda (pseudocoelomate). Refer to your tutorial letter (BLG113-K) for more information on acoelomate and pseudocoelomate body plans.

Pay special attention to the following figures in **Campbell & Reece:**

- 33.5 Polyp and medusa forms of cnidarians
- 33.12 Anatomy of a tapeworm
- 33.25 & 33.27 Nematodes

5.2 COELOMATA: PROTOSTOMIA

Prepare the theory in **Campbell & Reece, Chapter 33, pp. 653–654** and **pp. 656–658.** During the practical you will investigate the phylum Annelida (class Oligochaeta as an example) and phylum Arthropoda (class Insecta as an example). Specific examples of the animals to be investigated during the practical, include the earthworm, cockroach, locust and bedbug.

Pay special attention to the following figures in **Campbell & Reece:**

- 33.23 Anatomy of an earthworm
- 33.29 External anatomy of an arthropod.

5.3 COELOMATA: DEUTEROSTOMIA

During this practical you will investigate the rat as an example of a deuterostome coelomate. Refer to your tutorial letter (BLG113-K) for more background information. You will study the digestive system, circulatory system and urogenital system (both male and female) of the rat.

Pay special attention to the following figures in **Campbell & Reece, Chapters 41** and **42.**

- 41.15 Digestive system of a mammal
- 42.5 Circulatory system of a mammal

PART 2

Plant Biology

CHAPTER 6

Plant structure, growth and development

During the practical you will have the opportunity to study the morphology of the three basic plant organs, namely roots, stems and leaves. Read the introductory paragraph in **Campbell & Reece, Chapter 35, p. 713**.

6.1 THE PLANT BODY HAS A HIERARCHY OF ORGANS, TISSUES AND CELLS

Read the introductory paragraph in **Campbell & Reece, Chapter 35, p. 712**.

6.1.1 The three basic plant organs: roots, stems and leaves

6.1.1.1 Roots

Prepare the theory in **Campbell & Reece, Chapter 35, pp. 713–714**. During the practical session you will study a tap root system and an adventitious root system. Look in your immediate environment for some weeds to uproot. Look at their root systems. Study the root systems of a eudicot plant and a monocot plant (such as a grass).

You will also study examples of modified roots during the practical. Prepare the theory in **Campbell & Reece, Chapter 35, p. 714**. The following examples of modified roots will be provided during the practical session:

Prop roots (example: *Zea mays*, maize), storage roots (example: *Daucus* sp., carrot) and pneumatophores (example: *Bruguiera* sp., mangroves). Some of these examples can be found in your immediate environment. Find and study them beforehand as preparation for the practical session.

6.1.1.2 Stems

Prepare the theory in **Campbell & Reece, Chapter 35, p. 715**. During the practical session different stems will be given to you. Look for examples in your immediate environment and study material of stems as preparation for the practical session. Determine where the axillary buds are located on each stem.

You will also study examples of modified stems during the practical. Prepare the theory in **Campbell & Reece, Chapter 35, p. 715**. The following examples of modified stems will be provided during the practical session:

Stolon (example: *Fragaria* sp., strawberry, or *Duchesnea sp.,* wild strawberry), bulb (example: *Allium* sp., onion), tuber (example: *Solanum tuberosum*, potato) and rhizome (example: *Iris* sp.).

6.1.1.3 Leaves

Prepare the theory in **Campbell & Reece, Chapter 35, pp. 715–716**. During the practical session you will have the opportunity to study simple and compound leaves. Look in your immediate environment for examples and study the morphology of different leaves as preparation for the practical session. See if you can recognise the leaf blade and petiole and determine whether different leaves in your garden are simple, compound or doubly compound.

You will also study examples of modified leaves during the practical. Prepare the theory in **Campbell & Reece, Chapter 35, p. 716**. The following examples of modified leaves will be provided during the practical session:

Tendrils (example: *Pisum sativum*, garden pea), spines (example: *Opuntia* sp., prickly pear), storage leaves (example: *Carpobrotus* sp. or other succulent leaves) and reproductive leaves (example: *Kalanchoe* sp.). Most of these examples can be found in your immediate environment. Try to find and study them beforehand as preparation for the practical session.

6.1.2 The three tissue systems: dermal, vascular and ground tissues

Study the theory in **Campbell & Reece, Chapter 35, pp. 717** carefully. During the practical session you will look at microscope slides where you will have to identify dermal, vascular and ground tissues.

6.1.3 Common types of plant cells

Study the common plant cell types in **Campbell & Reece, Chapter 35, pp. 717–719** extremely well before you come to the practical. During the practical session you will look at microscope slides with parenchyma cells (example: *Allium* sp., onion, leaf epidermal cells), collenchyma cells (example: a petiole of *Apium* sp., celery) and sclerenchyma cells (example: free or separate fibres in macerated tissue of wood of *Platanus* sp. and sclereids or stone-cells in the fruit of *Pyrus* sp., pear), cells of the xylem (macerated and sectioned stems) and phloem (sectioned stems). These cells must be studied with a microscope and you will not be able to study them at home. You must however, prepare the theoretical work well before attending the practical session.

6.2 MERISTEMS GENERATE CELLS FOR NEW ORGANS

Read the theory in **Campbell & Reece, Chapter 35, pp. 720–721** for the necessary background knowledge for the practical. Go to **p. 73** and pay particular attention to the summarising sentence under **Concept 35.2**.

6.3 PRIMARY GROWTH LENGTHENS ROOTS AND SHOOTS

During the practical session you will study the structure of a winter twig (refer to **Campbell & Reece, Fig. 35.11**) and a root tip as seen in a longitudinal section (refer to **Campbell & Reece, Fig. 35.12**). Although you cannot prepare the section of the root that you will study with a microscope, you can pick a winter twig and study the parts before attending the practical session.

6.3.1 Primary growth of roots

Prepare the theory in **Campbell & Reece, Chapter 35, pp. 721–723**. During the practical session you will study the structure of the root of a eudicot (example: *Ranunculus* sp., buttercup), as well as that of the root of a monocot (example: *Zea mays*, maize) as illustrated in **Campbell & Reece, Fig. 35.13**. You will be expected to list the similarities and differences between the two root types during the practical session.

6.3.2 Primary growth and tissue organising of shoots

Prepare the theory in **Campbell & Reece, Chapter 35, pp. 723–724**. During the practical session you will study the structure of a young eudicot stem (example: peduncle of *Dimorphotheca* sp., Namaqualand daisy) as seen in a cross section (refer to **Fig. 35.16a** in **Campbell & Reece**). You will also study a slide of a cross section through a stem of *Zea mays* (maize), a monocot plant (**Fig. 35.16b** in **Campbell & Reece**). Although you will not be able to study these before attending the practical session, you must prepare well beforehand by studying the above-mentioned figures.

6.3.3 Tissue organisation of leaves

Prepare the theory in **Campbell & Reece, Chapter 35, p. 724**. During the practical session you will study the structure of a eudicot leaf (example: leaf of *Ligustrum* sp., privet) as seen in a cross section. The different tissues shown in **Campbell & Reece, Fig. 35.17**, will be visible on the microscope slide provided. You will have to be able to recognise each one, list its characteristics and name its functions. Prepare the theoretical work well before attending the practical session.

CHAPTER 7

Plant phylogeny and systematics

Systematics is the study of biological diversity in an evolutionary context. Systematics includes taxonomy, which is the identification, naming and classification of species and groups of species. Taxonomy employs a hierarchical system of classification that includes the following taxa: kingdom, phylum (division), class, order, family, genus and species. The hierarchy of taxa should also reflect the branching nature of phylogeny (evolutionary relationships). The naming of organisms is based on the binomial system of nomenclature developed by Linnaeus in the mid-18th century in which the species is the basic unit of classification. According to binomial nomenclature, the name of each species has two parts: the genus name and the specific epithet. For example, the scientific name of the human is *Homo sapiens*, and that of the sweet thorn tree is *Acacia karroo*. Take note of the specific way of writing down species names in the examples as determined by the International Code of Botanical Nomenclature (ICBN) and make sure that you follow it.

On a higher level of classification, five kingdoms (Monera, Protista, Fungi, Plantae and Animalia) are recognised. Several problems have, however, been pointed out with this traditional five-kingdom scheme based on molecular studies. Some of the challenges to the five-kingdom system include the acceptance of a three-domain system that indicates two distinct lines in the prokaryotes as well as revelations that the Protista is not a monophyletic grouping, in other words they do not derive from a common ancestor, but can de divided into five or more kingdoms. Taxonomy at the highest level is definitely work in progress.

CHAPTER 8

Prokaryotes

Read the overview in **Campbell & Reece, Chapter 27, p. 534**. It is also important to study the most common shapes of prokaryotes as indicated in **Fig. 27.2**.

Nowadys bacteria often make the newspaper headlines. Many institutions and private companies have made major investments in generic engineering, which may benefit agriculture, medicine and industry.

It is important that you realise that all bacteria are prokaryotic organisms and that their size and structure differ completely from that of eukaryotic organisms. During the practical session you will study the three most common shapes of bacteria, namely cocci (singular — coccus), bacilli (singular — bacillus) and spirilla (singular — spirillum). Find out, before the practical, what each of the abovementioned terms implies.

CHAPTER 9

Protists

Read the overview in **Campbell & Reece, Chapter 28, p. 549**.

9.1 EUGLENIDS

Example: ***Euglena* sp.**

Prepare the theory in **Campbell & Reece, Chapter 28, p. 554**. Pay particular attention to **Fig. 28.8**.

Euglenids are unicellular organisms belonging to the kingdom Protista. They exhibit both plant and animal characteristics. They are usually green in colour and are predominantly found in fresh water. They serve as a food source for fish and other aquatic animals.

During the practical session you will be able to study the movement and morphology of living *Euglena* cells. You will also study the internal structure of the cell as illustrated in **Fig. 28.16**.

9.2 DIATOMS

Prepare the theory in **Campbell & Reece, Chapter 28, pp. 559–560, Figures 28.15** and **28.16**.

During the practical you will study different shapes of diatoms. Diatoms form a unique, beautiful and diverse group of organisms with great economic importance.

9.3 GREEN ALGAE

Example: ***Chlamydomonas* sp.**

Prepare the theory in **Campbell & Reece, Chapter 28, pp. 557–569** before you come to the practical. Pay particular attention to the morphology of *Chlamydomonas* sp. illustrated in **Fig. 28.31**.

The green algae are the second largest and most diverse group of algae. Although the organisms belonging to the green algae may vary from unicellular to colonial and filamentous organisms, *Chlamydomonas* sp. is often used as an example to illustrate the morphology of the basic green algal cell.

During the practical session you will study living material as well as permanent microscope slides of *Chlamydomonas* sp. in order to understand its morphology. You will aso study the swimming movements performed by the cells.

CHAPTER 10

Plant diversity I: How plants colonised land

10.1 BRYOPHYTES (MOSSES)

Prepare the theory of mosses in **Campbell & Reece, Chapter 29, pp. 580–583.** Pay special attention to the life cycle of mosses as illustrated in **Fig. 29.8, p. 581.**

Bryophytes were the earliest true plants, as suggested by fossil evidence. Although they are non-vascular plants, primitive food and water conducting cells are present. These (and other reasons) place the group phylogenetically between the algae (with no water conducting cells) and the ferns (where vascular tissues are present).

Try to find mosses in moist places in your own environment and compare the plants with the drawings on **p. 581**. Try to identify the rhizoids, stem-like and leaf-like structures. See if you can see long filamentous structures without any leaves growing on the green, photosynthesizing plants. These structures are the sporophyte generation in the life cycle that lives on the gametophyte plants and that depend on them for nourishment.

During the practical session in Potchefstroom you will study living material of mosses, as well as permanent microscope slides of different stages of the reproduction process. You will also dissect the sporangium of a moss plant and study its structure.

10.2 FERNS AND OTHER SEEDLESS VASCULAR PLANTS

Before attending the practical, study **Campbell & Reece, Chapter 29, pp. 584–588**. Pay particular attention to the pictorial life cycle of a fern as illustrated in **Fig. 29.12**. Use this figure to guide your study.

Examine living specimens of ferns in your own environment. Most of the body of the fern is made up of leaves. The leaves arise directly from the horizontal rhizome, which is beneath the soil. There are no aerial (above-ground) stems. When young, the leaves are coiled and often called ''fiddleheads''. Each leaf consists of a blade or lamina that is subdivided into smaller parts. A stalk attaches the leaf blade to the rhizome. Adventitious roots grow from the rhizome.

During the practical you will study living material of ferns. You will look at different types of ferns, each with different ways of carrying spores. You will also study the structure of, amongst others, the sporangia (part of the sporophyte plant) and the prothallus (gametophyte plant).

CHAPTER 11

Plant diversity II: The evolution of seed plants

11.1 GYMNOSPERMS

Before attending the practical, read **Campbell & Reece, Chapter 30, pp. 591–597** and **p. 606 (Concepts 30.1** and **30.2)**. Pay particular attention to **Concept 30.2** dealing with gymnosperms and the pictorial life cycle of a pine as illustrated in **Fig. 30.6**. Use this figure to guide your study.

Examine living specimens of pines in your area. Take note that the reproductive structures in the pine consist of male (pollen) and female (ovulate) cones and seeds. Seed plants can be divided into two natural groups, namely the gymnosperms and the angiosperms. Pines represent one of four phyla in the gymnosperms. The life cycle of a pine demonstrates the key reproductive adaptation of seed plants contributing to their success as terrestrial organisms, namely the continued reduction of the gametophyte, the advent of the seed and the evolution of pollen.

During the practical you will study living material of the vegetative parts of the sporophyte plant of the pine as well as living material and microscope slides of sections of male and female cones and whole mounts of pollen.

11.2 ANGIOSPERMS

Before attending the practical, read **Campbell & Reece, Chapter 30, pp. 598–601**. Pay particular attention to the structure of the flower as illustrated in **Fig. 30.7** and the life cycle of an angiosperm as depicted in **Fig. 30.10.** Use these figures to guide your study.

Study flowers in your environment. Take note that the reproductive structures in flowering plants consist of flowers and fruit. Flowering plants represent different lineages. In the past, flowering plants were divided into two main classes, namely the monocots and the dicots. Recent research initially based on DNA, has upheld the monocots as a natural group. The traditional dicots, however, appear to consist of different lineages. One of these lineages (the eudicots) includes the majority of traditional dicots. The life cycle of an angiosperm is a highly refined version of the alteration of generations common to all plants.

During the practical session you will study flowers of a representative of the monocots and eudicots.

Study the paragraphs dealing with fruits in **Campbell & Reece, Chapter 30, pp. 598–599** and **Campbell & Reece, Chapter 38, pp. 778–779** before you attend the practical. In **Campbell & Reece,**

Chapter 38, p. 779 you will find **Fig. 38.9** that summarises the classification of fleshy fruit. Study this figure carefully. During the practical you will be studying an example of each of the following fruits: a simple fruit (the legume of *Phaseolus* sp), an aggregate fruit (the apple, *Malus* sp.) and a multiple fruit (the pineapple, *Ananas comosus*). Make sure that you understand the difference between these three fruit types.

CHAPTER 12

Fungi

Read the overview in **Campbell & Reece, Chapter 31, p. 608.**

12.1 ZYGOMYCETES

Example: ***Rhizopus* sp**.

Study the theory in **Campbell & Reece, Chapter 31, pp. 613–615.** Pay special attention to the life cycle of *Rhizopus* sp., as illustrated in **Fig. 31.12** on **p. 614**.

The genus *Rhizopus* is very important in the manufacturing of organic acids. Lactic acid, which is widely used as flavouring in food and in the manufacturing of adhesives and pharmaceuticals, is synthesised by a species of *Rhizopus.* Another *Rhizopus* species is grown for its production of fumaric acid, which is used in the manufacturing of plastics and varnishes.

Rhizopus sp. is commonly known as the black bread mold and is easy to study at home. Besides bread as a substrate, this fungus also grows well on fruits and vegetables and causes spoilage during storage. At home, take a piece of bread (preferably homemade or without a fungus growth inhibitor), moisten it and leave it in a dark cupboard for a few days. Observe the black growth of *Rhizopus* sp. on the bread after a few days. Take a magnifying glass, look at the growth (mycelium) of *Rhizopus* sp. and try to distinguish black dots. These dots are the sporangia, which are formed during asexual reproduction. Inside each sporangium are vast amounts of spores. By the time the sporangia form, the lightly pigmented mycelium has grown for at least several days and has thoroughly penetrated the bread. (You may want to remember this the next time you discard a moldy slice of bread and are about to eat the next slice in the loaf!)

During the practical you will be able to study living material of *Rhizopus* sp. as well as permanent microscope slides of different stages in the life cycle. It is therefore important to prepare well before attending the practical.

12.2 BASIDIOMYCETES

Examples: *Agaricus* sp. and *Coprinus* sp.

Make a study of **Campbell & Reece, Chapter 31, pp. 618–619.** Pay special attention to the life cycle of a mushroom-forming basidiomycete as illustrated in **Fig. 31.20** on **p. 619** (it is not necessary to memorise the life cycle for the practical examination for BLG114-L).

When you buy mushrooms (especially black mushrooms — *Agaricus* sp.) from the grocery store again, make sure you choose a packet with a few mushrooms with a membranous ring around the stalk. Before you fry, bake or roast them, carefully study them for a few minutes. What you are looking at, is the fruiting body of the mushroom — known as the basidiocarp. The basidiocarp consists of different parts. The stalk is called the stipe. Situated on top of the stalk is a hat-like structure, which is called the pileus, and at the bottom of the pileus are structures that resemple the gills of fish. They are called the lamellae. The membranous ring surrounding the stipe, is called the annulus. Make sure that you see all these different parts on the basidiocarp of the mushroom. You are now ready to prepare the mushrooms! (They are delicious with garlic, a white sauce and topped with some cheese!)

During the practical you will not only study the structure of the basidiocarp, but you will also look at a microscope slide of *Coprinus* sp. On this slide you will study different layers in the lamellae and you will understand where the spores are formed and released.

CHAPTER 13

Plant physiology

13.1 INTRODUCTION

The practical work for the plant physiology section will be in the format of a number of hands-on laboratory experiments and demonstrations by your lecturer and practical assistants. To understand and successfully complete the various experiments, it is of utmost importance that you have a good knowledge of the plant physiology sections in the theory modules BLG112-J and BLG111-H (only respiration). There are no prescribed or recommended books for the actual experiments, because all the instructions that you require to complete each experiment will be provided in the practical workbook that you have to purchase when you attend the practical work session. The practical assistants will provide you with the relevant laboratory equipment and chemicals before you conduct each experiment. The lecturer will then give a short lecture about the theoretical principles and procedure (methodology) of each experiment. Due to time constraints no detailed theory lecture will be given, and it is therefore important that you study the theory sections in **Campbell & Reece** (see section 13.4 below) before attending the practical work session. Your lecturer and practical assistants will be available on a continuous basis throughout the practical work session to provide you with assistance.

13.2 GENERAL LABORATORY RULES

Before you enter the laboratory, please take note of the following general laboratory rules that must be adhered to at all times:

1. Please select silent mode on cellular phones or switch them off.
2. Wear your laboratory coat to prevent staining of your clothes.
3. Please leave the laboratory neat and tidy after the practical work session. Make use of the refuse bins at the end of each laboratory bench. Place all dirty glassware at the place indicated next to the washbasins at the back of the laboratory.
4. Please handle all laboratory equipment and glassware with care. Report any broken glassware immediately. Broken glassware will be disposed of in a special waste container. **Never put broken glassware in the refuse bins!**
5. Please clean any spillage of water or reagents immediately. Paper towels are provided for this purpose.
6. Smoking and eating in the laboratory are strictly prohibited.
7. Please be careful at all times, especially when you handle electrical equipment.

13.3 EXPERIMENTAL REPORT

For each experiment you must complete an experimental report in your practical workbook (a special laboratory workbook will be supplied). You do not have to submit the experimental reports to your lecturer. The reports are for your own use and will greatly facilitate preparation for the practical examination. The procedure (materials and methods) for the completion of each experiment is already provided in the laboratory workbook. You are required to supply the additional information set out below to complete each experimental report.

1. Introduction

The introduction must contain a well-defined aim of the experiment, as well as the underlying theoretical principle on which the experiment is based.

2. Results

The results that you obtain during each experiment must be supplied in the format of calculations, tables and graphs (as specified for each experiment). Remember that tables and graphs must be provided with a self-explanatory superscript and subscript respectively. Remember to add units to all values that you calculate.

3. Discussion

The results obtained must be discussed in relation to the main aim of the particular experiment and the underlying theoretical principles on which the experiment is based. Any questions about the experiment, as specified in the laboratory workbook, must be answered in full.

13.4 EXPERIMENTS

During the practical work session you will do the following experiments:

Experiment 1: Determining the rate of respiration in germinating pea seeds

In this experiment you will determine the rate of respiration in germinating pea seeds by using a volumeter. Prepare for this experiment by studying **Chapter 9 (pp. 160–165)** in **Campbell & Reece.** Also try to answer the following questions:

(a) Why do we use germinating seeds in this experiment?
(b) What method would you follow to determine the rate of respiration of green plant tissues?

Experiment 2: The effect of light intensity on the rate of photosynthesis

In this experiment you will investigate the effect of light intensity on the rate of photosynthesis in an aquatic plant. You will again use a volumeter for this purpose. Prepare for this experiment by reading **Chapter 10 (pp. 181–195)** in **Campbell & Reece.** Based on the energy requirements of carbon fixation, why do you think light intensity will influence the rate of photosynthesis?

Experiment 3: The process of osmosis

In this experiment you will study the process of osmosis by means of laboratory osmometers constructed from dialysis tubing and filled with sucrose solutions of two different concentrations. To fully understand the process of osmosis and the concepts of water potential, solute (osmotic) potential and pressure potential, it is important to study **Chapter 36 (pp. 740–742** and **Figures 36.5 & 36.6)** in **Campell & Reece**. Define the following terms: osmosis, water potential, osmotic potential, pressure potential, turgid and flaccid cells, turgor pressure.

Experiment 4: Determining plasmolysis of epidermis cells

In this experiment you will study plasmolysis in the epidermal cells of *Rhoeo discolor.* The concept ''plasmolysis'' is explained in **Chapter 7, pp. 132–133**. Study the latter section carefully and pay special attention to **Figures 7.13** and **7.14**. Also try to answer the following questions:

(a) When will cells take up water from their environment?
(b) When will cells lose water to their environment?
(c) Define the terms plasmolysis, flaccid and turgid.

The following two experiments will be demonstrated to you. Although you do not have to do these experiments, you must still complete an experimental report for each.

Experiment 5: Transpirational pulling force in plants

In this experiment the pulling force generated by transpiration will be demonstrated to you. To understand this experiment, you must study the transport of xylem sap discussed in **Chapter 36 (pp. 746–749** and **Figures 36.12 & 36.13)** in **Campbell & Reece.** Also try to answer the following question: How is the process of transpiration involved in the generation of a pulling force in the xylem?

Experiment 6: The influence of environmental factors on the rate of transpiration

In this experiment a potometer will be used to demonstrate the influence of certain environmental factors (for example light and wind) on the rate of transpiration. Study **Chapter 36 (pp. 749–751)** in **Campbell & Reece** that deals with the control of transpiration in plants.