The module is based on the prescribed text (Biology: The Dynamic Science, 3rd edition, Russell, Hertz, McMillan). The numbers in brackets represent the relevant pages in the book. Information from other sources will be specified accordingly.

**ECOLOGY: MODULE OUTLINE**

**Lecture 1:** Introduction and concepts – Definitions; climate (Chapter 51)

**Lecture 2:** Terrestrial and aquatic biomes of the World (Chapter 51)

**Lecture 3:** South African Biomes (Lecture notes)

**Lecture 4:** Population Ecology- Population growth and life history (Chapter 52)

**Lecture 5:** Population Ecology- Population growth and life history continued (Chapter 52)

**Lecture 6:** Community Ecology- Communities and interactions and niches (Chapter 53)

**Lecture 7:** Community Ecology- Communities and interactions and niches continued (Chapter 53)

**Lecture 8:** Ecosystems and Nutrients: energy flow, chemical cycles, trophic levels (Chapter 54 & 53.5-6)

**Lecture 9:** Ecosystems and Nutrients: energy flow, chemical cycles, trophic levels continued (Chapter 54)

**ECOLOGY: STUDY OBJECTIVES**

Following your study of this module you should be able to:

1. Get a broad overview of ecology.
2. Describe the properties of populations.
3. Understand important aspects of population dynamics.
4. Understand how we can assess populations that are changing.
5. Understand how species interactions shape communities.
6. Understand the concepts of the niche (fundamental vs realised) and habitat.
7. Know about the classic experiments by Connell (rocky shore ecology) and Gause (*Paramecium*).
8. Understand the principles of resource partitioning and competitive exclusion.
9. Describe how to detect competition.
10. Understand the different ways in which species in communities can interact with one another, and how these interactions can have important evolutionary outcomes.
11. Understand interactions among ecological processes.
12. Be familiar with biogeochemical cycles and understand the consequences of their disruption.
13. Understand trophic levels within food chains and how species at different trophic levels may interact.
14. Understand basic global patterns of diversity and relate the variety of hypotheses used to explain these patterns.
15. Understand how and why climate shapes the character of ecosystems.
16. Describe key features of the major global biomes (terrestrial) and aquatic ecosystems.
17. Describe key features of the primary South African biomes.

**DIVERSITY OF PLANTS: MODULE OUTLINE**

This module gives an overview of plant diversity and is based on Chapters 24, 27, 28 and 29 of the prescribed textbook (Russell et al. 3rd Ed).

**Lecture 1** – Phylogeny and the tree of life, interpreting phylogenies (Chapter 24.2-24.7, pp530-549)

**Lecture 2** – Protist biology, algal diversity – Euglenozoa, Stramenopila, Rhodophyta (Chapter 27.1-27.2 pp588-600)

**Lecture 3** – Algal diversity – Glaucophyta, Chlorophyta, ecological & economic importance of algae (Chapter 27.2 pp600-608)

**Lecture 4** – Embryophytes, adaptation to life on land (Chapter 28.1 pp611-617)

**Lecture 5** – Non-vascular plants, bryophyte diversity, moss life cycle (Chapter 28.2 pp618-621)

**Lecture 6** – Seedless vascular plant diversity – ferns and whisk ferns (Chapter 28.3 pp621-626)

**Lecture 7** – Seedless vascular plant diversity – horsetails and clubmosses (Chapter 28.3 pp621-626)
Lecture 8 – Gymnosperm diversity – evolution of the seed, conifers, cycads, Ginkgo, gnetophytes
(Chapter 29.1 pp631-636)

Lecture 9 – Angiosperm diversity, flowers and fruit
(Chapter 29.2 pp637-642)

DIVERSITY OF PLANTS: STUDY OBJECTIVES

Upon completion of this module you should be able to:

1. Discuss plant-like and non-plant-like characters of the main algal groups
2. Discuss the relationship between green plants and the green algae.
3. Understand and discuss the division of the plant kingdom into 12 phyla.
4. Discuss the adaptation of plants to a life on land.
5. Have a good overview of the plant life cycle, and be able to explain how the plant life cycle differs from that of animals and fungi respectively.
6. To explain what is meant by the following: gametophyte generation, sporophyte generation, haploid, diploid, spore, gamete, mitosis, meiosis.
7. To understand what distinguishes the three bryophyte divisions from the 9 vascular plant divisions.
8. Discuss the diversity of the bryophytes.
9. Have a good overview of the general morphology, sexual reproduction and diversity of the phyla Bryophyta, Hepatophyta and Anthocerophyta.
10. Discuss the economic importance of the bryophytes.
11. Discuss the diversity of vascular plants.
12. Have a good overview of the general morphology, sexual reproduction and diversity of the phyla Pteridophyta, Psilotophyta, Lycophyta and Equisetophyta.
13. Discuss the economic importance of the seedless vascular plants.
14. Discuss the diversity among the seed plants.
15. Distinguish between the gymnosperms and angiosperms.
16. Explain the following terms: androecium, antheridium, archegonium, gynoecium, heterosporous, homosporous.
17. Have a good overview of the general morphology, sexual reproduction and diversity of the phyla Coniferophyta, Cycadophyta, Gnetophyta and Ginkgophyta.
18. Write an essay on the life cycle of *Pinus.*
19. Understand the origins and distinguishing characters of the angiosperms.
20. Distinguish between monocots and eudicots
21. Write an essay on the life cycle of the angiosperms.
22. Define and discuss the following terms: pollen grain, stamen, anther, filament, pollination, carpel, ovary, pistil, stigma, integument, micropyle, nucellus, double fertilization, endosperm, seed, testa.
23. Discuss the main evolutionary trends and adaptations in the plant lineage.

**Diversity of Animals: Module outline**

At the end of this module you should demonstrate an understanding of

1) The hierarchical classification system
2) The characteristics which define animal-like protists.
3) The defining characteristics of the Kingdom Animalia
4) The key innovations that enabled diversification of animals
   a. Body symmetry
   b. Number of germ cell layers
   c. Body cavity
   d. Larval developmental type
5) The advantages that these innovations conferred on each group
6) The phylogeny and classification of animals
7) The major morphological features that unite or define the phyla or clades examined in this course.
8) The diversity within the different invertebrate and vertebrate phyla.
9) The major evolutionary developments among the invertebrates.
   a. What drives these evolutionary changes?
10) The major evolutionary developments among the vertebrates.
    a. What drives these evolutionary changes?

**Lecture 1 - Chapter 27.2 and 31.1 to 31.3**
Protista: Unikonta (Amoebozoans, Choanoflagellates)
Animalia: What is an animal? Key innovations in animal evolution, animal phylogeny and classification

**Lecture 2 - Chapter 31.4 to 31.6**
Parazoa; Radiata; Lophotrochozoan protostomes: Platyhelminthes and Rotifera

**Lecture 3 - Chapter 31.6**
Lophotrochozoan protostomes: Mollusca and Annelida

**Lecture 4 - Chapter 31.7**
Ecdysozoan protostomes: Nematoda; Onycophora; Arthropoda
Lecture 5 - Chapter 32.1 to 32.2
Invertebrate Deuterostomes: Echinodermata; Chordata: overview & invertebrate subphyla

Lecture 6 - Chapter 32.3 to 32.5
Origin and diversification of vertebrates: Agnathans, the evolution of jaws, Chondrychthyes, Actinopterygii and Sarcopterygii (the fishes)

Lecture 7 - Chapter 32.6 to 32.9
The evolution of tetrapods: Amphibia. Amniota: the evolution of terrestrial tetrapods (*reptiles)*

Lecture 8 – Chapter 32.10
Living Archosaurs: birds and crocodilians

Lecture 9 – Chapter 32.11 to 32.13
Mammalia: Monotremes, Marsupials and Placentals; Non-human primates; evolution of humans

**MICROBIAL DIVERSITY: MODULE OUTLINE**

Lecture 1  INTRODUCTION TO MICROBIOLOGY: Characteristics, importance and classification; microscopy (Chapter 5 & 24)
Lecture 2  VIRUSES: Characteristics, morphology, classification, reproduction, bacteriophages, HIV, emerging viruses (Chapter 17)
Lecture 3 & 4  MICROBIAL GROWTH: Microbial growth curves, environmental factors, nutrient requirements
Lecture 5 & 6  BACTERIA: Morphology, diversity & classification, metabolism, growth and reproduction, environmental importance, horizontal gene transfer (Chapter 26)
Lecture 7 & 8  FUNGI: Morphology, reproduction, metabolism, classification, environmental importance (Chapter 30)
Lecture 9  YEASTS: Morphology, reproduction, metabolism, model for eukaryotic genetics, alcohol production (Chapter 30)
Lecture 10  MICROBIAL BIOTECHNOLOGY: Industrial Microbiology (chemical, food & beverage, mining), Medical Microbiology (antibiotics, insulin), Environmental Microbiology (bioremediation, biocontrol) (Chapter 18)

Practical 1  Microbial Diversity
Practical 2  Isolation and control methods
MICROBIAL DIVERSITY: STUDY OBJECTIVES

1. Understand the historical importance of microbial organisms, including important discoveries.
2. Understand the naming and grouping of microbial organisms.
3. Be able to identify the most important differences between prokaryotic and eukaryotic organisms.
4. Know the basic components of light and electron microscopes as well as their applications.
5. Know the most important aspects regarding the morphology and replication of viruses.
6. Be able to name a few diseases caused by viruses.
7. Be able to discuss the replication of bacteriophages (lysogenic versus lytic cycles).
8. Discuss HIV as example of a retrovirus.
9. Be familiar with different methods for determining cell growth (also refer to Practical).
10. Be able to discuss the various environmental factors that can influence microbial growth.
11. Know the groupings of microbial organisms based on their environmental growth requirements.
12. Understand sterilization techniques and the aseptic handling of microbes in a laboratory (Practical).
13. Be able to discuss different methods for the isolation of microbial organisms (Practical).
14. Know the general morphology of bacterial cells and the function of different cellular components.
15. Know the different bacterial cell shapes and groupings (also refer to Practical).
16. Recognise the different nutritional requirements of bacteria (autotrophy, heterotrophy, phototrophy, chemotrophy).
17. Discuss the environmental importance of bacteria.
18. Know the most important aspects regarding the morphology and nutritional requirements of fungi.
19. Be familiar with the groups of fungi and the most important differences between them.
20. Be able to discuss the reproductive cycle of one of the fungal groups.
21. Discuss the basic morphology of *S. cerevisiae*, *S. pombe* and *C. albicans*.
22. Discuss the reproductive cycle of *Saccharomyces cerevisiae*.
23. Discuss metabolism of *Saccharomyces cerevisiae* and its importance in alcoholic fermentations.
24. Name a few industrial applications of microbial organisms.
25. Understand the principles of genetic engineering and its application in insulin production.
26. Understand the role of microbes in environmental management.