Biosciences Degree Programme

Biological Organisation

Unit Guide 2007/8

SMK-1-301

Teaching team:

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This unit guide is designed to help you structure your learning by providing an indicative structure and content for the unit. It is a guide and not a definitive statement of what you will be taught. We will try to follow this published schedule as far as possible, but there may be some variation as the unit develops and as we try to match the pace and content of our teaching to student needs.

Introduction

This unit introduces you to current thinking on how biological systems are organised. It seeks to introduce the ways by which living systems are being investigated today.

You will find this quite different from traditional approaches to teaching biology.

A system consists of a number of elements which interact with each other and which persist together - cells, organisms, and populations are all ***systems***. We are all familiar with the systems within a body - the circulatory system or the digestive system, for example - but systems work at all levels, from the subcellular to the ecosystem. A cell is a system comprising the nucleus, ribosomes, mitochondria and so on; a population is a system composed of individuals which together reproduce to increase their numbers. Communities comprise species that interact with each other within ecosystems.

Most important are the interactions which keep a system together and organised. So, in this unit we will describe how the complex systems of an adult organism develop from a simple zygote. We describe how an embryo develops, how cells differentiate and how the complex systems of a multicellular animal are constructed. In the same way we can observe the growth of a plant and the regular way in which it produces leaves, branches and flowers. Repeating patterns tell us also how ecosystems and communities are organised and regulated.

Our aim is to extend your biological horizons. These concepts are important in stem cell research, in cloning, in gene therapy and a host of biotechnologies. Understanding these interactions helps in the protection of endangered species. How ecosystems fix and transfer energy will be critical for the long term survival of our own species and our efforts to tackle climate change.

The unit begins by introducing the major groups of plants and animals and familiarizes you with the scientific names of the most important groups. You also learn about the classification system which is central to understanding the phylogenetic relationships between species.

One important aim of this unit is to develop your problem-solving skills. We use a series of exercises and workshops to get you thinking about the complexity of living systems and introduce you to different ways of analyzing them.

You will derive the most benefit from this unit if you are prepared to read around the subject and follow the directed reading we give you. Note that many of the standard textbooks only make passing reference to some of these topics. We suggest some popular titles at the end but there is no standard textbook for the whole unit. Nevertheless, you are about to be introduced to some of the most exciting areas in modern biology.

Aims and outcomes

This unit aims:

- To provide a working knowledge of the principles of taxonomy and classification
- To introduce the concepts of pattern and process in biological systems
- To show how simple mathematical and other recurrent processes can produce repeatable patterns in biology
- To provide an analytical review of pattern as a method for describing regulatory controls at various levels in biological systems
- To develop an appreciation of the significance of simple control processes in biological regulation

Indicative Content

1. **Pattern and control in biology**

- Development in early plant and animal cell differentiation
- Symmetry and architecture in the plants and animals
- Pattern generators and genetic information
- Cost-benefit analysis in reproductive strategies

2. **Systematics and taxonomy**

- The major plant and animal groups.
- Rules and conventions in naming species
- Introduction to cladistics
- Speciation and competition.
- Behavioural strategies in plants and animals

3. **Regulation and control in biological hierarchies**

- Species-Area relationships
- Species interactions
- Energy transfer and the organisation of ecosystems
- Simple population growth
- Global patterns of biodiversity

Learning Outcomes:

By the end of this unit, the student will be able to:

1 Use accurately, the principles of taxonomy and classification and the proper citation of scientific names

2 State the principle stages in early mammalian development, up to the neurula stage

3 Describe the role of simple regulators in the development of recurrent patterns in vertebrate locomotion and tree architecture
4 Describe the adaptive significance of different types of plant and animal architecture
5 Explain a range of animal behaviour in terms of costs and benefits
6 Describe the adaptive significance of different reproductive strategies
7 Explain the process of speciation as a consequence of niche separation
8 Describe the relationship between the number of species and area and its use in predicting species number
9 Discuss the range of processes that regulate the abundance and distribution of organisms
10 Describe the principle mechanisms that organise communities and ecosystems

Key Skills

In addition to the above, you should improve your skills in several general areas:

Cite properly scientific names and make proper use of zoological and botanical keys for identification
Apply simple mathematical models to biological processes and interpret them
Use simple graph-drawing techniques
Argue logically with appropriate terminology and use of the scientific literature
Analyse simple systems to identify key regulatory elements
Research information and use this to answer specific questions

Remember to include a commentary on these basic skills in your PDP folder. This unit is designed to give you feedback on these skills and to ensure that they are in place for the following units in your course. Note important points in your folder – for example, ensure that you are fully aware of what is required to present a scientific graph properly and completely. This unit requires you to think logically and to analyse several complex questions. Make sure that you understand the feedback you receive and retain this in your PDP file.

Please retain all of your coursework.
This is collected in at the end of the unit for external examiner scrutiny.

Lecture sequence

This unit consists of 12 two-hour lecture sessions, usually separated by a one hour tutorial or exercise. The tutorials consist of exercises that test your understanding of the topics covered in the lectures; the workshops are assessed and comprise the assessment for the unit. Most tutorials or workshops require you to prepare in advance for the exercise. You can also use the tutorials to clarify your thinking about any of the lecture material.

WEEK NO.	TOPIC	LECTURER
1	Pattern and process in living systems	AB
2	a. Review of systematics and taxonomy	A-MB
	b. Introduction to cladistics	A-MB
3	The animal kingdom	AB
4	The plant kingdom	A-MB
5	a. Plant growth strategies	A-MB
	b. Pattern generators in plant development	A-MB
*6**	*Assessed exercise – Sex in the tropics*	*A-MB*
7	Speciation	AB
	Species-area relations	AB
8	Global patterns of biodiversity in time and space	A-MB
	Plant architecture in different communities	A-MB
9	Energetics of plant communities	A-MB
	Species interactions governing community structure	A-MB
10	Patterns in early mammalian development; cloning	AB
11	Evolution of sex	AB
	Cost-benefit analysis in animal behaviour	AB
12	Simple population growth	AB

**Please note that there is no teaching this week since the main teaching staff are on a field course. You have to complete a worksheet that asks you to search out information in the library or on the net. This forms one of your assessed workshops and has to be handed in week 9 (see following section).*