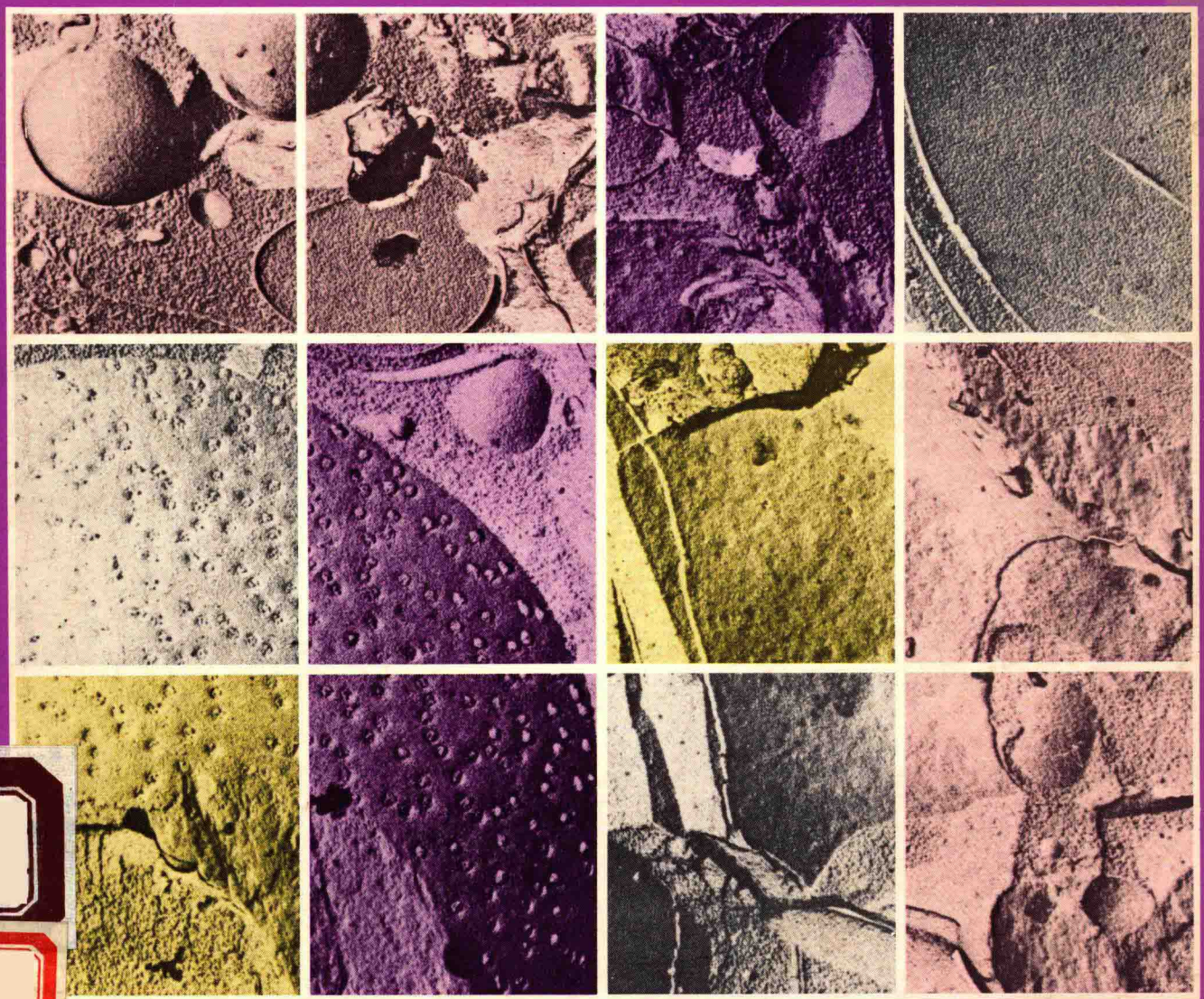
BIOLOGY

an inquiry approach

Teachers' Resource Book

Part 2

Man Shek Hay



BIOLOGY

an inquiry approach

Teachers' Resource Book

Part 2

Man Shek Hay
B.Sc.(Hons), M.Phil., Cert.Ed.

FEDERAL PUBLICATIONS
Hong Kong · Singapore · Kuala Lumpur

Units 903-905, Tower B, 9/F,
Hunghom Commercial Centre,
37, Ma Tau Wai Road,
Hung Hom, Kowloon.
Tel: 3-342421 (6 Lines)

First Published 1986
04 0182 9

Printed in Hong Kong by
Allion Printing Co., Ltd.

Preface

This teachers' resource book has been written to help teachers in using the course book and the workbook in their teaching. It is important to realize that not only the content but also the presentation will affect the learning process of students. The inquiry approach has been used in the course book. It is clearly undesirable for teachers to approach this course in a non-inquiry manner. A laboratory is absolutely necessary for the course to be conducted smoothly. Throughout the course, emphasis is mainly on the concepts, which can only be acquired firmly by students when they take an active part in the learning process.

It is advisable to follow the sequence in each chapter. When dealing with less able students the teachers should restrict their explanation to its simplest pattern. Simple, short and sharp sentences should be used. The students should be told to read the description in the book afterwards for consolidation purpose. The summary at the end of each chapter reflects the requirement of the HKCE Biology examination.

Objectives A teacher needs to clearly understand the objectives of teaching each chapter. Thus objectives are stated to help teachers know what students should achieve at the end of each chapter. It is hoped that the teacher will gain feedbacks from students to check that such objectives are being attained clearly.

Apparatus, chemical and material list In view of a large number of experiments included in this course, this section has been included to assist teachers and laboratory technicians in the preparation of experiments. The teacher will save much time when giving instructions to the technician. When doing experiments, the group size should be as small as possible so that each student has the chance to take part in the experiment actively. It is educationally sound to involve the students in apparatus collection, correct handling and subsequent cleaning wherever possible.

Teaching points Some experiments/parts of each chapter are difficult to perform or introduce. A few experiments should be done as demonstration. Suggestions are made to assist the teacher in this respect. The author hopes teachers will find the suggestions useful as guidelines.

Man Shek-hay
B.Sc. (Hons); M. Phil.; Cert. Ed.

Contents

Section IV Processes of Life

14 Support and Movement

It is desirable to introduce support and movement by allowing the students to examine various supporting structures and how they work. It is also advisable to use various models to help students understand various supporting systems. Students should be allowed to observe how an insect moves, a fish swims etc in addition to verbal description.

The need for support in both simple and complex organisms should be clearly introduced. It is also important to distinguish between locomotion and movement.

Support in unicellular organisms, individual plant and animal cells is achieved by cell turgidity. This should be related to osmosis introduced previously in Chapter 13: Water and Organisms.

Three supporting systems in multicellular animals were introduced: hydroskeleton in annelids, exoskeleton in arthropods and endoskeleton in vertebrates. Emphasis should be placed on exo- and endoskeleton.

It is not necessary for students to memorize individual skull bones, pectoral and pelvic girdles. Details of the structure of each vertebra are also not required. It is important to make sure that students understand that bones can only move when muscles act on them at joints, and muscles, bones and joints form various lever systems in a vertebrate body. Avoid detailed discussion on types of joints but place emphasis on the relationship of different components at a joint and how they work. Since students often mix up tendon with ligament, it is advisable to clarify these two structures carefully to avoid confusion. Details of mechanical principles of bones and lines of stress in bones are not required.

It is educationally desirable to allow students to have some knowledge of how to protect their supporting system. Thus description on posture and care of the supporting system was included for the benefit of the students.

Students should be guided to distinguish nastic, nutational movement and tropism in plants. Emphasis should be placed on tropism. The physiological basis of tropism involving auxins will be dealt with in Chapter 15: Integration and Behaviour.

Objectives

The average student should acquire the

1. awareness that living organisms need to support themselves
2. knowledge that protozoa and young plants support themselves by cell turgidity
3. knowledge that earthworms support themselves by a hydroskeleton
4. knowledge of the exoskeleton of arthropods

5. knowledge of the endoskeleton of mammals
6. awareness that bones are made up of living bone cells with heavy deposition of calcium and phosphorus salts
7. knowledge of the structure of the mammalian supporting system
8. knowledge of the structure of some mammalian joints
9. awareness that animals need to move from one place to another
10. knowledge of amoeboid movement
11. basic knowledge of swimming in a fish and flying in a bird
12. knowledge of the distribution and function of xylem vessels and sclerenchymatous tissues in flowering plants
13. knowledge of geotropism, hydrotropism, phototropism, nastic movement and nutational movement in plants.

Experiment 14.1 Models imitating the supporting systems of animals

Material (per group)

balloon
metallic shower hose
umbrella
bat (preserved specimen)
earthworm
millipede

Teaching points

1. This experiment allows students to understand the three supporting systems in animals through the examination of the three models.
2. Earthworms can be collected from good garden soil.
3. Millipedes can be collected from the underside of large rocks in woodland. As some millipedes will bite, it is advisable to use preserved specimens instead of living specimens.
4. A preserved bat specimen with its wings extended should be used so that the students can see the forelimb bones clearly.

Experiment 14.2 Strength and diameter

Apparatus (per group)

plasticine (30g)
straw x 16
100g weight x 20

Experiment 14.3 Strength and length

Apparatus (per group)

straw x 4
spring balance
clamp and retort stand x 2
thread

Teaching points for Experiments 14.2 and 14.3

1. These two simple experiments allow the students to understand two basic mechanical principles of bones.
2. After doing these two experiments, it is desirable to allow the students to examine leg bones of a chicken, a rabbit and a pig for discussing how the principles apply to the animals.

Experiment 14.4 Examination of a leg bone

Apparatus (per class)

electric saw

Material (per class)

femur or humerus of a pig (available from a butcher)

Teaching points

1. The bone should be sawn into two halves beforehand. The electric saw is dangerous and students should not handle it. It should be handled by a qualified technician.
2. The teacher should guide the students to observe various components of the bone.

Experiment 14.5 Do flowering plants have skeleton like animals?

Apparatus (per group)

beaker (500 ml)
glass rod
water trough
sponge
glass plate
tripod
Bunsen burner

Chemical (per group)

sodium carbonate (5g)
sodium hydroxide (7g)
household bleaching solution

Material (per group)

leaves of White Jade Orchid tree *(Michelia alba* 白蘭 *)*

Teaching points

1. This is an experiment which will be welcome by the students as they can prepare leaves as book marks. This experiment can also be an activity of the Biology Society so that the students can have more time to prepare more leaves.
2. The leaves can be stained red (safarin, eosin), blue (methylene blue) or green (fast green) by adding appropriate stains.
3. Leaves of other plants may also be used but those of White Jade Orchid tree are by far the best.

Experiment 14.6 The lever in our body

Apparatus (per group)

Nil

Teaching points

1. The teacher should ensure that the students realize the relative positions of effort, load and fulcrum in each case.
2. Additional examples may also be included at the teacher's discretion.

Experiment 14.7 A model imitating the forearm

Apparatus (per group)

a forearm model

Teaching points

1. A forearm model can be constructed easily by referring to Fig. 14.27 in the textbook.
2. The teacher should ensure that the students understand the opposing actions of the antagonistic muscles at the elbow joint.

Experiment 14.8 To study the action of tendons in limbs

Apparatus (per group)

a pair of forceps

Material (per group)

chicken leg

Teaching points

1. This experiment enables students to realize the action of tendons in a chicken leg. The tendons act as long cables in transmitting the pull of the contracting movement of the muscle to the bones at a distance.
2. There is a tendon which causes the toes to grip tightly. This is an adaptation for the bird to hold firmly to a branch of a tree when it sits.

Experiment 14.9 To study movement in a millipede and a cockroach

Apparatus (per group)

pin
glass trough

Chemical (per group)

a bottle of ether (for slowing down the movement of the cockroach)

Material (per group)

millipede
cockroach
cotton wool

Teaching points

1. Cockroaches can be obtained by placing a cockroach trap (available from most supermarkets) in a dark corner of the laboratory. Cockroaches would be caught when they enter the trap to eat the bait.
2. As some millipedes will bite, students should be told to handle the animals carefully and should not touch them with their hands.
3. Experiments 14.9 and 14.10 enable students to look at moving animals. Observing animals in motion is desirable in this chapter.

Experiment 14.10 To study the movement of an earthworm

Apparatus (per group)

beaker (for holding water to moisten the earthworm)

Teaching point

In order to show that there are hair-like structures on the body of an earthworm, put the earthworm in a paper tube. Listen to the sound made by the earthworm as it moves inside the tube.

Experiment 14.11 Which kind of shape passes through liquid fast?

Apparatus (per group)

plasticine
large measuring cylinder or long glass tube
stop watch

Chemical (per group)

methyl cellulose

Teaching point

In addition to the shapes suggested in the textbook, students should be encouraged to make objects having other streamline shapes for comparison.

Experiment 14.12 Growth movement at the tip of a shoot

Apparatus (per group)

retort stand and clamp x 2
adhesive tape
glass plate x 2
Indian ink

Material (per group)

a pot of sweet pea seedlings

Teaching point

As it takes several hours to finish this experiment, the teacher should make arrangement for the students to go to the laboratory to take down results.

Experiment 14.13 Does gravity affect the growth movement of plants?

Apparatus (per group)

moist cotton wool
petri dish x 2
marking pen

foam rubber (polystyrene) board
clinostat

Material (per group)

some germinating pea or mung bean seeds

Teaching points

1. The word geotropism should be introduced after doing this experiment. The teacher should then train the students to use appropriate terms to describe the response of the shoot and root towards gravity so that the students can apply this knowledge immediately in the following experiments.
2. Since some students may find it difficult to understand the effect of the clinostat on the growth response of the plant, the teacher should spend some time in clarifying this.

Experiment 14.14 Does water affect the growth movement of plants?

Apparatus (per group)

plastic container (for growing seedlings)
clay pot
baked garden soil or commercial potting mix

Material (per group)

pea or mung bean seedlings

Teaching points

1. The word hydrotropism should be introduced after doing this experiment.
2. The students should be guided to use appropriate terms to describe the response of the root to water (i.e. positively hydrotropic).

Experiment 14.15 Does light affect the growth movement of plants?

Apparatus (per group)

beaker x 2
moist cotton wool
lightproof box made of wood or drawing paper
clinostat

Material (per group)

pea or mung bean seeds

Teaching points

1. The size of the lightproof box should be large enough to hold the beaker and clinostat. If drawing paper is used for making the box, thick, black drawing paper should be used to ensure that the box is lightproof.
2. Having done Experiments 14.13, 14.14 and 14.15, the significance of shoots being negatively geotropic and positively phototropic while roots being positively geotropic, positively hydrotropic and negatively phototropic should be discussed.

Experiment 14.16 ***Which has the greater effect on roots, water or gravity?***

Apparatus (per group)

sieve
moist cotton wool
thread

Material (per group)

pea or mung bean seeds

Experiment 14.17 ***Which has the greater effect on roots and shoots, light or gravity?***

Apparatus (per group)

thread
moist cotton wool
lamp
lightproof box made of wood or black drawing paper x 2
tripod x 2

Teaching point for Experiments 14.16 and 14.17

These two experiments allow the students to study the response of a shoot and a root to two different stimuli at the same time. These two activities are considered to be more difficult and are designed for the more able students.

15 Integration and Behaviour

The first section of this chapter attempts to clarify stimulus, sense organs and response which are considered important in building a concept about irritability, one of the characteristics of living organisms.

Since the eye is the most important sense organ, it receives more attention in this chapter. Besides the eye, ear, tongue and nose, other receptors can also be found in our muscles and internal organs which are responsible for detecting internal stimuli.

The teacher should clearly point out the differences between nervous and chemical co-ordination, their advantages and disadvantages. The teacher should ensure that the students acquire the concept that neurons are separated from the adjacent ones by a small gap and nerve messages travel along neurons in electric form while those across gaps in chemical form.

The physiological basis of phototropism and geotropism involving auxins will be dealt with in section 15.4. The students should be aware that plants also use hormones to co-ordinate their body activities. However, they do not have well defined endocrine glands as in mammlas.

It is important to ensure that the students understand the feedback mechanism in homeostasis.

Objectives

The average student should acquire the

1. knowledge of receptors (sense organs) in a living organism to detect stimuli, and after integration the living organism responds appropriately
2. knowledge of the structure and function of the mammalian skin, eye and ear
3. basic knowledge of the structure and function of the mammalian nose and tongue
4. knowledge of the structure and function of the mammalian nervous system
5. knowledge of the structure and function of the mammalian endocrine system
6. knowledge of the hormonal basis of phototropism and geotropism in plants
7. knowledge of the principle of homeostasis
8. knowledge of the homeostasis of
   (i) water,
   (ii) body temperature, and
   (iii) blood glucose level
   in a mammal
9. basic knowledge of animal behaviour.

Experiment 15.1 Which part of the hand is the most sensitive?

Apparatus (per group)

straw sharpened at both ends

Teaching points

1. This experiment serves to reinforce the concept of stimulus, sense organ and response introduced at the beginning of the chapter.
2. Some of the bright students may ask why shortening the distance between the two ends of the straw causes the feeling of one point only. This is because the two ends stimulate the nerve endings of only one neuron.

Experiment 15.2 Is my skin a reliable sense organ?

Apparatus (per group)

beaker (250 ml) x 3
thermometer
Bunsen burner
tripod

Material (per group)

ice cubes

Teaching point

Although our senses usually give us the correct message, they are sometimes not reliable. This is the major reason of using instruments to measure accurately what we sense.

Experiment 15.3 To look at a cow's eye

Apparatus (per group)

a pair of scissors
a pair of forceps
wax paper
candle

Material (per group)

a cow's eye

Teaching point

This experiment allows the students to observe the upside-down image formed in an eye. In order to obtain good results, a fresh cow's eye with clear and transparent cornea should be used.

Experiment 15.4 ***To study the relationship between the distance of an object, a lens from a screen and the size of the image***

Apparatus (per group)

candle
white cardboard (screen)
thin biconvex lens (focal length = 20 cm)
thick biconvex lens (focal length = 8 cm)
metre rule

Teaching points

1. This experiment aims to show the optical principles of the mammalian eye.
2. The teacher should point out that focusing by changing the thickness of the lens is more convenient than by changing the distance between the lens and the retina.

Experiment 15.5 ***To study the binocular vision***

Apparatus (per group)

pencil
metre rule

Teaching points

1. This experiment allows the students to realize the importance of using two eyes in the judgement of distance and position.
2. The teacher should point out that binocular vision occurs not only in man but also in hunting animals with two eyes setting on the front of their heads.

Experiment 15.6 ***To find out a blind spot in the eye***

Apparatus

Nil