CAMBRIDGE
UNIVERSITY PRESS & ASSESSMENT

A Level

Biology

Session: 1967
Type: Syllabus
Code: 557

BIOLOGY

At Advanced Level (H.S.C. Principal Subject) papers will be set as follows:

(*a*) Paper I and Paper II, each of 2½ hr. and based on any part of the syllabus. In each, candidates will be required to answer five out of nine questions.

(*b*) A 3 hr. Practical Examination (see p. 49).

The Special Paper (G.C.E. only) will be a 2½ hr. written paper containing harder questions and candidates will be required to answer four out of nine questions.

The syllabus for the Special Paper does not differ from that for Advanced Level but candidates offering the Special Paper will be expected to show a deeper knowledge than Advanced Level candidates.

The teacher's aim should be to prevent the biology syllabus from falling into two imperfectly related parts of elementary zoology and elementary botany, and to treat the subject as one great branch of science. From the point of view of general education, there is much to be said for introducing the student to the whole range of living organisms rather than to botany or zoology alone, or as separate subjects. The importance of considering biology as a whole and not as two separate components of zoology and botany does not imply that accounts of the organization of an animal and of a plant should be inter-mixed. It would not be satisfactory to teach the detailed structure of a vertebrate animal and of a flowering plant simultaneously, any more than it would be right to mix the accounts of the anatomy of a vertebrate animal and of an insect. In either case, there would be unnecessary confusion. It is obvious that there are distinct classes of living things in the world and an understanding of these is most easily gained if they are first examined separately, and then their inter-relations brought to light.

The aim is to inculcate some of the basic principles of biology, taking advantage of the natural interests of the student, beginning with the study of the human being and a flowering plant. Some understanding of the organization of animals and plants must precede an appreciation of the significance of their relation to each other in the world. It is important that the student should learn to apply his biological knowledge of the problems of everyday life and not to keep his ideas on the subject in a watertight compartment. Most students have, in fact, a strong natural interest in problems of economic biology when they come in contact with them. Since applications and contacts with everyday life arise from almost the whole field of biology no attempt has been made to segregate particular instances in a separate section, although it will be noted that section (6) (Relations of organisms to disease and decay) is specially important in this way.

Great importance is attached to the observation of living

organisms as far as possible under natural conditions, and projects for individual observation on Natural History subjects are thought to be of special value. Teaching throughout the course should be linked with field and garden work wherever possible.

It is emphasized that only an elementary treatment of the topics mentioned in the following syllabus is required. The examiners regard the teaching of biology in schools less as preparation for specialized university training, than as an important part of a full education for life.

Facilities for biological study vary greatly, and it is recognized that not all schools are able to study all parts of the syllabus with equal thoroughness. A choice of questions will therefore be set, except in the practical examination. All the papers, theoretical and practical, will include questions on both plant and animal biology.

Where the detailed syllabus is identical with that of the subjects botany and zoology, the standard of knowledge assumed will in general also be the same. Some items in this syllabus are expressed in similar terms to corresponding items in the Ordinary level Biology syllabus, but it should be understood that Advanced level candidates are expected to show a deeper knowledge of such items.

DETAILED BIOLOGY SYLLABUS

1. THE MAMMAL. (90 *periods*.) The external features and elements of the structure and physiology of a mammal exemplified where necessary by the study and dissection of the rabbit (or rat or mouse) and with special reference to man. As an introduction to the dissection of the rabbit (or rat or mouse) the frog should be dissected to show the general anatomy of a tetrapod vertebrate.

(*a*) The skeleton (without details of the skull except the teeth); the general relation of muscles to the skeleton in producing movement. Names of muscles and details of the chemistry of muscle action are not required.

(*b*) The skin; hair, nails or claws. Sweat and sebaceous glands. Temperature control.

(*c*) The digestive system; the constituents of a balanced diet; enzyme action.

(*d*) The vascular system and the circulation, composition and functions of blood and lymph.

(*e*) The respiratory organs. The mechanism of breathing. Gaseous interchange in the lungs and tissues. Internal (tissue) respiration, without biochemical details.

(*f*) The excretory system. The kidneys, with a simplified account of the action of urinary tubules.

(*g*) Hormones. The function of the endocrine system as exemplified by the production and effects of adrenalin. Brief reference should be made to the existence of other endocrine glands. Details of histology and biochemistry will not be required.

(*h*) The nervous system, limited to the main regions of the brain, the spinal cord, the autonomic system, sense organs, reflex actions and a simple study of behaviour, play, and learning.

(*i*) The reproductive system and an outline of the development and care of the young.

(*j*) The defences of the body against injury and infection.

[See note to section 1 of the Zoology syllabus, p. 33.]

2. THE FLOWERING PLANT. (110 *periods.*) (*a*) The elements of the structure of a flowering plant such as sunflower or wallflower with sufficient microscopical detail to make clear the development and functions of the root system, the stem and the leaf.

(*b*) The elements of the physiology of the green plant: viz. photosynthesis; respiration; uptake of minerals; uptake, conduction, and loss of water; growth and tropistic response. The water-relations of the cell and absorption of solutes: turgor-pressure, suction-tension and plasmolysis.

(*c*) Reproduction by seed: the structure of two simple flowers, e.g. buttercup and bean; pollination, the differences between wind and insect-pollinated flowers; fertilization; formation of fruits and seeds and their dispersal. No details of development of ovary. embryo-sac, and stamens are required. Germination (of sunflower and wheat) with changes taking place in stored food.

(*d*) Perennation and vegetative reproduction, and their importance in nature and cultivation. Food storage in perennating organs; specialized storage organs—rhizome, tuber, corm, bulb, modified root. Seasonal changes in herbs and woody plants, including seasonal changes in secondary growth, the microscopic features of this secondary growth being treated in simple outline only. The work on perennation and vegetative reproduction should be closely linked with field and/or garden studies.

[Flowering plants play a preponderant role in the vegetation of the world and largely determine the environment of most animals, including man. They are not only the source of important products such as timber, cotton, and rubber, but by virtue of their photosynthetic powers are the ultimate source of most of the food-supply for the human race and many other animals. Practically the whole of our food-crops come from flowering plants. Students should be made to realize that the practice of agriculture, horticulture and forestry can be related to our knowledge of the physiology and biology of the flowering plants.

A range of interesting and important observations can be made on the biology of wild and crop-plants without need either of microscopic technique or elaborate experiments. Furthermore these plants can most conveniently be employed in schools in physiological experiments, which form such a good introduction to the experimental study of living organisms. Lastly, some of the most interesting fields of biology which concern the interrelations of plants and animals demand a general knowledge of flowering plants; e.g. pollination and dispersal mechanisms, food-relationships in general, and of plant disease. The following points should, as far as possible, be demonstrated by experiments:

Photosynthesis: formation of carbohydrates and liberation of oxygen; essential factors. Removal of carbohydrates from an attached darkened leaf.

Water-uptake and transpiration: effect of external factors on rate of water-loss (by weighing methods); use of cobalt chloride paper; use of potometer.

Germination: conditions required.

Geotropism: in root and stem. Phototropism in stem and leaf. Perception, conduction and response, an outline of the mechanism.

Respiration: absorption of oxygen, and production of carbon-dioxide and heat. Anaerobic respiration.

Turgor; plasmolysis, recovery, wilting.]

3. THE VARIETY OF ORGANISMS. (95 *periods.*) A general study of the following organisms but with special reference to the points indicated after each, with dissection where appropriate, and observation of living specimens where possible.

(*a*) *Euglena:* nutrition, movement, comparison of animals with plants.

(*b*) *Amoeba:* protoplasm, nutrition, irritability, movement, action of contractile vacuole, life-history.

(*c*) *Spirogyra:* the green plant cell contrasted with the animal cell; reproduction including conjugation.

(*d*) *Mucor:* structure, nutrition, reproduction (asexual and sexual). *Puccinia:* parasitic habit. *Yeast:* respiration (aerobic and anaerobic); fermentation of sugar; economic importance.

(*e*) *Fucus:* differentiation, adaptation, sexual reproduction.

(*f*) A liverwort, e.g. *Pellia* (or a moss, e.g. *Funaria*): microscopic structure, life-history, and adaptations to conditions of life of both generations.

(*g*) *Hydra:* differentiation and specialization of cells, reproduction (asexual and sexual). Behaviour.

(*h*) *Ascaris* (or *Oxyuris* or *Ankylostoma*): life-cycle and parasitic habit.

(*i*) Earthworm: specialization of tissues into organs; the body-cavity, vascular system, alimentary canal, nutrition, central nervous system, behaviour, reproduction and life-history, economic importance.

(*j*) Insects: omitting internal structure; feeding without details of individual mouth parts; ecdysis, types of metamorphosis. Cockroach: external features, respiration, life-history. Butterfly: life-history. Honey-bee: social life and economic importance. Mosquito: life-history and economic importance. An Aphid: e.g. bean aphis: annual life-cycle, parthenogenesis and economic importance. Housefly (or blowfly): life-history and economic importance.

(*k*) A fish: external features and gills only.

(*l*) Frog: external features, respiration, transition from aquatic to terrestrial life, life-history omitting embryological details.

[The object of this section is to introduce the student to other important types of living organizations in the world and their relationships to each other. The various aspects of the interrelations of these organisms are considered in subsequent sections of the syllabus.

The study of *Amoeba* gives information about protoplasmic structure and animal at a minimum of permanent structural organization; it ought not to be considered as an example of a primitive animal. *Euglena* is included as an example of a type of organization from which both plants and animals can be derived. Bacteria should be dealt with very simply as suggested in section 6.]

4. ELEMENTS OF STRUCTURE AND PHYSIOLOGY. (67 *periods.*) Sufficient knowledge of the following to permit appreciation of physiological processes: acids, bases and salts; carbohydrates, fats and proteins; chemical change, catalysis; enzymes; solutions, colloidal systems, diffusion, permeability of membranes, osmotic pressure.

The cell, nucleus and cytoplasm, mitosis, cell-division. Cell differentiation and tissue formation, including vascular tissues of

the flowering plant and the histology of blood, cartilage, pavement epithelium, ciliated epithelium, and striated muscle.

Characteristics of living organisms; similarities and differences between plants and animals, including the energy relations. Holophytic, holozoic, saprophytic and parasitic nutrition. The nutrition of micro-organisms compared with that of higher plants and animals.

[This section is meant to give opportunity for a generalized treatment of fundamental features of physiology, structure and behaviour of living organisms, commencing with the features common to most organisms and indicating the differences emerging with differentiation of plant and animal types, and with the various modes of nutrition. It should be indicated in what way all the primary distinguishing features of plant and animal life relate to the basic differences in their nutrition. Simple experiments, e.g. on osmosis, should be included if these have not been covered in some other subject.]

5. THE SOIL. (20 *periods.*) The soil in relation to plant and animal life; origin and structure; humus, mineral and water-content; natural and artificial manures; activities of soil organisms; carbon and nitrogen cycles; rotation of crops.

[In view of the teeming life of the soil, the role it plays as the determinant of plant and animal communities, and the importance of soil fertility to food-production, it is desirable to call separate attention to it in biological teaching. It is suggested that simple experiments upon soil should be included in the practical work.]

6. RELATIONS OF ORGANISMS TO DISEASE AND DECAY. (26 *periods.*) A brief mention of bacteria in relation to the circulation of substances in nature, and to disease and industrial processes. Brief reference to other pathogenic agents such as viruses, Protozoa. Parasitism. *Puccinia* as a parasitic fungus. *Ascaris* (or *Oxyuris*) as an example of an animal parasite. Brief mention should be made of parasites of economic importance, e.g. *Phytophthora infestans* (potato blight), 'eel-worm' in agriculture, hookworm. Animal vectors and their control. Housefly (or blowfly). Mosquito. Louse.

Control of disease in relation to elementary hygiene and public health.

[This section includes topics suitable to very advanced and extensive treatment, but the small allocation of periods (26) which is proposed will indicate the nature of the treatment expected. In many instances this will be more a presentation of the biological problems raised by certain issues of great importance to the life of the world, than an exposition of present scientific knowledge. In some instances, of course, simplified explanations can and should be given.]

7. REPRODUCTION, HEREDITY, AND EVOLUTION. (22 *periods*.) Variation. Outlines of Mendelian inheritance for not more than two pairs of characters.

A simple outline of the behaviour of the nucleus in the maturation of the germ-cells and in fertilization. The place of meiosis in the life-cycle. Students should realize the importance of the pairing and subsequent separation of homologous chromosomes, but a detailed study of meiosis is not required.

Outline of the concepts of evolution and natural selection, and the nature of the evidence for them without consideration of specific theories of the mechanism of evolution.

[Attention should be directed to the fact of evolution; controversies over the details of how it has come about should only be touched upon lightly. The arguments which it is desirable to present to the student are such as are found in the earlier chapters of the *Origin of Species*.]

8. NATURAL HISTORY: ORGANISMS IN RELATION TO HABITAT. (20 *periods plus spare time*.) The natural history in some detail of the plants and animals within two well-defined habitats chosen from the following: the seashore; woodlands; moorland; heath or chalk down; freshwater ponds and streams; hedgerow and waste ground; grassland; swampy ground (marsh, fen, or bog). Attention should be given, wherever possible, to the observation and record of the interrelations between the plants and animals, and of the influence of soil, climate, human and other biotic factors. Candidates in the United Kingdom who are specially interested in natural history may offer Field Work as an additional item for examination (see p. 52).

[Great importance is attached to the encouragement of individual field work. It should be stressed that this subject does not necessarily call for teaching of ecological concepts and nomenclature, but rather for a direct stimulus to students, individually or in classes, to make their own observations in the field upon the intimate biology of the species they encounter, and upon the relations between such species themselves, and between them and the environment. It is suggested that the teacher should help the student by displaying to him lines along which such studies can be made, that the student should be encouraged to pursue such work on his own according to his personal interests, and that field study should not be systematized into a regular course of teaching.

There is in this field the most stimulating opportunity to develop an approach of intrinsically 'biological' character, when the study is not one merely of plant or animal life, but of the integrated activity of the organisms in the natural community.]