School biology for child and society

European Communities Biologists Association

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HEALTH EDUCATION AND SCHOOL BIOLOGY
SCHOOL BIOLOGY FOR CHILD AND SOCIETY

The views of the European Communities Biologists Association on the requirements for biological education in Europe

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Aims of the **European Communities Biologists Association**

1. To represent the professional interests of biologists in the European Community.

2. To ensure the professional competence of biologists within the European Community.

3. To facilitate the exchange of information on professional matters relating to the work of biologists within the European Community.

4. To facilitate free movement of biologists within the European Community.

5. To promote exchange of those teaching biology in all classes of educational establishment.

6. To promote co-operation and exchange of information between the national biological societies about their activities throughout Europe.

7. To advise the EEC and the public in general on biological matters having implications for society.

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INTRODUCTION

The European Communities Biologists Association, founded in 1975, has amongst its aims to provide advice on biological matters which affect society. Thus, as the result of a Workshop in Salzburg under the Chairmanship of Professor G Schaefer, it has produced this booklet to put to governments, administrators and the public its views on how biology might best be treated in schools. The teaching of biology to all pupils in the secondary school range (11 - 16 years) is considered to be essential so that in adult life all citizens have the basic biological knowledge needed to understand the problems they or their governments will meet and need to solve. ECBA's recommendations for achieving this are given on page 8.

THE NEEDS OF SOCIETY

The major problems that affect the future of civilisation, including population growth, the production and distribution of food and the well-being of the individual, society and the environment are essentially biological and cannot be understood properly without a background of knowledge of life in all its forms, how living forms react with the environment and the time scale involved.

Every pupil needs a basic biological education in preparation for adult life as a parent, a wage-earner and a citizen. In addition a small proportion of pupils will need to have a greater knowledge of biology in order to provide society's requirements for health care (e.g. doctors, nurses, dentists, research biologists) for abundant and safe food (e.g. agronomists, research biologists, food hygienists) and for a healthy environment (e.g. ecologists, toxicologists, biologists for pollution control). These specialists will need to have studied biology at school to a higher level than the rest of the pupils. They will also need a good knowledge of chemistry, physics and mathematics in order to take university courses in medicine, agriculture and biology. Those taking university courses in biology will be available for posts in research, government departments concerned with advice and control, and the teaching of biology in schools and universities.

THE NEEDS OF **THE PUPIL**

The pupil and his development

The first contacts of a child with his living and non-living environment is normally through his parents and the family. At this early stage things can go right or wrong and the attitudes of the parents towards their environment have a

profound effect on the way they introduce the world to the child and the child to the world.

Nowadays many children in different countries, though not in all, go to kindergarten. It is there that they meet children of the same age, and it is there that the circle of their contacts with other people as well as with living organisms is enlarged. Therefore it is necessary that teachers at the kindergarten-level themselves are people who are sensitive to the world: to other people as well as to the natural environment. In principle the relation of the child with nature is already present: a young child is interested in "moving things", in the behaviour of pet-animals, of birds and of insects and in the growing and flowering of plants and trees.

Developing skills and appreciation of science

Biology is a subject which cannot be understood without contact with the things studied. Observing living systems in the wild, handling and breeding insects or small animals in the school or home and the setting up of simple experiments in the school laboratory will give the pupil a basic experience of 'life' which will be useful throughout his life. Those who do not go on to higher education based on biology will be prepared for a greater enjoyment of leisure, something likely to increase in industrial societies. Also the insight into scientific methods given on a school biology course can be of use to individuals in understanding what are sound answers to such problems as energy conservation and disease control.

The need for continuous training in biology

The continuous teaching of biology is necessary throughout school life. Whereas in the first years of organised education (kindergarten and primary school) the contacts of the child with individual living organisms, centred on positive attitudes towards life, should be the major issue, in the later classes of the primary school this can be continued with approaches through special knowledge and skills. Simple experiments (preferably to be conducted by the children themselves) open the field of skills and concrete biological concepts and give the children a first analytical insight in the structure of living things.

At the level of 11 - 16 continuity in the teaching of biology is needed for two main reasons:

a) In a general sense, the pupils of this age are in a period of increased self-discovery and of orientating themselves as becoming individuals in the world around. Both the discovery of oneself and the environment are strongly related with biological subjects

b) Individuals develop at different rates intellectually, as they do physically. Hence were biology to be taught for say only two years in the years 11 to 16 a good proportion of the pupils would not have the chance to benefit from biological education at the time most appropriate to them.

HOW BIOLOGY SHOULD BE TREATED IN SCHOOLS

The central core of a syllabus for biology teaching must give as much emphasis to attitudes and skills as to knowledge of facts. Of course there has to be a minimum of knowledge needed to solve problems of biological relevance met either in private life or as members of society.

When selecting essential knowledge attention must be paid to the different social situations that exist in Northern and Southern European countries. With the present rural exodus and the expansion of towns, it is important that teachers should use the rural and agricultural background which the parents of some of the pupils still have. Teachers should try to prevent the knowledge and attitudes towards plants, animals and nature in general becoming lost, as happened in Northern Europe about a century ago. However since in Northern countries many people are either leaving towns to live in the country or are taking a greater interest in growing their own food, this can be taken into account in the selection of subject matter for lessons.

The attitudes, skills and knowledge required by pupils

It should be stressed that biology plays its role among other disciplines, contributing to the development of the individual attitude, skills and knowledge. Biology teaching helps in the education of attitudes e.g. openness for co-operation and team work; for sensory experience; for demands of one's own body; and a readiness for self-criticism, decision-making and continuous learning and relearning. Biology teaching also leads to an integration of other knowledge.

In so far as biology itself is concerned, the abilities needed are:-

Attitudes

Awareness that biological objects are highly complex and have a long evolution and thus cannot be treated just like inanimate matter (attitude of scientific modesty)

General cautiousness toward influencing or changing biological systems

Skills

Application skill (ability to apply biological knowledge to problems of everyday life, e.g. family, working-place, use of leisure)

Skills of biological investigation of plants and animals (dissecting, using a microscope, analysing chemical composition etc.)

Skills of breeding and maintenance (plants, insects and domestic animals)

Knowledge

Familiarity with the local flora and fauna

Biology of selected animals and plants, including micro-organisms

Acquaintance with the major phyla and classes of plants and animals

Structure and function of cells and their organelles

Reproduction, growth and development

Energy conversion in biological systems, including photosynthesis

Animal and human ethology (patterns of behaviour, e.g. habitat selection, territorial behaviour, aggression)

Human biology, including questions of nutrition, health, diseases, sex and population problems

Ecology, including problems of pollution, conservation, recycling

Genetics and principles of evolution, from the origin of life up to Man, including variability (e.g. human races) and its physical and social components

Special topics from other school subjects related to biology (physics, chemistry, geology, mathematics, history, social sciences, psychology, philosophy, religion)

Central **core** of knowledge

The central core described above should be used as a frame syllabus of all types of school all over Western Europe and biology teaching should proceed as a continuous process during the whole period of education. Apart from the central core that should be studied by each pupil, a considerable amount of freedom should be left to teachers, who may introduce some additional topics of importance. Also the variation between regions of Europe will mean that the emphasis on sections of the core will differ from one country to another.

Discussion of, and then agreement on, the central core of the syllabus for each country should be undertaken by groups of relevant people, including teachers, educational associations, universities, parents, employers and government.

The central core as formulated here should be compulsory for all pupils, independent of their country and the type of school which they attend. The national syllabuses will need to follow continuing developments in the educational field and be revised every 10 years. Biology teaching should proceed as a continuous process during the whole period of education. The options additional to the central core to be studied by each pupil, should be left to the choice of teachers, who may include new topics including those dealing with the applications of biology.

IMPLICATIONS FOR GOVERNMENTS

The acceptance of the foregoing core of biology and of the teaching of biology to all pupils throughout the school life has implications for teachers and for governments which provide the means.

As the result of discussions at the Salzburg Workshop and subsequent consideration by its Steering Committee, ECBA puts forward the following recommendations on how teachers should be trained and how biology can best be taught in schools.

Teacher training

As biology is a central subject and is closely related to other subjects it is essential that biology teachers have a shared responsibility for the planning and teaching of such borderline fields as Health education, Social biology and Environment education. Pre-service training should ensure that teachers have a sufficient competence in these fields, and in-service work will be needed to bring knowledge up-to-date. The basis of all subject-bound studies in biology should be a way of thinking which has been described as "inclusive thinking" at the Salzburg Workshop* and which will give the teacher both the capability and the courage to accept ever new aspects of life. Teachers of biology need a knowledge of earth sciences, physical sciences and mathematics (Vice versa: teachers of other subjects should also have a good understanding of the principles of biology).

Although this report is mainly concerned with secondary school biology, as taught by biologists, the primary school teacher has a special role in the biological education of children and needs not only some training in biology, but also in the special methodology of teaching biology to young children.

* Report of meeting on "Biology in Secondary Schools" held by ECBA at Salzburg, 1980

Pre-service training

It is obvious that the qualified biology teacher should have studied biology at university level and that his instruction in teaching should have been based ori the practical pedagogic foundations of psychology and sociology in direct contact with children. In addition the biology teacher must be trained in the skills and techniques of science and in the organisation and management of laboratories and practical classes. Training should also develop a sensitivity to living things and an awareness of the relationships between man and his environment. Teachers should encourage and motivate pupils to develop investigational techniques and scientific methods: pupils should be encouraged to use their own senses to investigate things both living and inanimate rather than rely upon interpretations by teachers. During training the emphasis should always be on classroom experience so that a young teacher is able to be effective in the early years of his or her career. The first year of teaching should be a "probation" year during which the teaching load is less than normal and where an experienced fellow-teacher can act as a tutor and guide.

In-service training

The modern biologist is faced with frequent changes in the content of his science, in teaching and learning techniques and in the relation between biological education and society. It is essential that an in-service programme is developed to enable the teacher to up-date his knowledge and develop his professionalism in teaching his subject. It is recommended that a minimum of one week's in-service training each year is required to allow for both up-dating in fields such as genetics and ecology and for dealing with safety in laboratories, assessment techniques and new subjects for projects. The most effective method is to have collaboration between experienced school teachers and biologists working in universities and research institutes. Associations of professional biologists exist in all EEC countries and will be important because of their competence and experience can help governments over in-service training, especially if funds are made available to support particular collaborative efforts.

Countries have experience of different models of in-service education (e.g. evening classes, day courses, residential work, use of T.V. and circulation of printed materials, etc.). Information should be more widely circulated about the success of these in-service methods.

Methods of teaching in schools

Pupils should have a wide experience of practical work and participate in laboratory investigations giving an insight into scientific method. Teachers need the time and

freedom to develop interesting and topical ideas and thus it is necessary that the amount of compulsory knowledge as prescribed by syllabuses should be kept to the minimum. An increase in the flexibility of the syllabus would lead to all teachers obtaining more enjoyment and satisfaction in their profession and developing into better teachers and pupils would then benefit.

It is strongly recommended that school biology should become the study of living organisms: pupils should have responsibility of caring for living animals and plants. The local environment should be regarded as an extension of the biology classroom with the teacher leading pupils in field studies.

Particular age groups

Age range 5-11

All teaching of science in this period should include biology as an essential component both because of the childs interest in himself and the living world.

Age range 11-16

Every pupil should study biology to meet the following needs:

understanding his own physiological and psychological development (e.g. matters of health, nutrition, sex, aggression, social life)

understanding living things other than Man which are relevant for mankind (e.g. micro-organisms, fungi, insects, forest plants, weeds, crop plants, cattle)

understanding living things of special personal interest (wild flowers, pet animals)

understanding the living community in an ecosystem

understanding the dependence of man on nature and also that of nature on man.

BIOLOGY'S PLACE IN THE SCHOOL CURRICULUM

The whole school curriculum may be considered to consist of five main groups of subjects:

1. Mother tongue, arts, music
2. Foreign languages
3. Biology, chemistry, physics, geology
4. Mathematics, philosophy, religion
5. Subjects of social life e.g. history, geography, sociology, sports

It seems reasonable to regard these five blocks of education as equal in importance: thus ECBA considers that each of the five groups of subjects should have an equal number of units* per week. In most European countries about 30 units are included in each week and thus the sciences should have 6 units per week.

RECOMMENDATIONS

ECBA proposes that the 20% of time available for the sciences should be arranged at the different age levels as follows:

Age 11 to 13

Of the time for sciences:

half for biology and geology (i.e. 3 units per week)
and
half for physics and chemistry (i.e. 3 units per week)

Age 13 to 16

Of the time for sciences:

two-thirds for biology with geology and chemistry and physics (i.e. 2/1/1 units per week for individual subjects) or 4 units per week for General Science
and
one-third for one of biology or geology or chemistry or physics (i.e. 2 units per week)

The understanding of biology requires chemistry and if this is not taught by the same teacher there will be a need for co-ordination between the biology and chemistry teachers.

Age 16 to 19

All those staying after the compulsory age (16) should have 2 hours per week, linking biology with other subjects and relating it to human affairs. Suggested themes are: "human ecology (e.g. use of latfd for food or recreation, problems of urbanisation); uses of renewable resources (e.g. solar energy, biomass); use of micro-organisms and genetic manipulation for production of foodstuffs and pharmaceutical substances.

* a "unit" being a period of instruction of at least 45 minutes and preferably one hour.

In addition those going on to higher education in a subject based on biology (biology itself, medicine, pharmacy, etc.) should have extra time for biology at least as much as the 2 hours provided for all students. This extra biology would deal with aspects of biology likely to be relevant to their university studies, e.g. genetics, biochemistry. (This group will also require courses in chemistry, physics and mathematics.)

Practical work

Commencing with the kindergarten the teaching of biology requires pupils to have direct contact with nature both through visits to parks and through active work by children within the school.

Schools for children aged 11-19 should have laboratories, gardens, audio-visual equipment and laboratory technicians. To enable teachers to carry out effective practical work a school should have a technician to assist in the laboratories for chemistry, physics and biology. Technicians would prepare material, maintain stocks of living material and service audio-visual and other equipment, preferably in co-operation with pupils, under the direction of a teacher.

Because learning through doing is more effective than being told facts, practical work is essential for developing biological understanding. However, it will only be effective if the size of a class is much smaller than 30 pupils in order to facilitate: close contact between teacher and pupil; helpful exchanges between pupils; and sufficient attention being given to safety.

The ideal size of a group for practical work in a laboratory or for undertaking field work would be 15, but the maximum number for effective instruction by participation would be 20. (A possible way to achieve groups of 15 would be to combine two classes and then divide the children into 3 groups.)

Textbooks and material

ECBA would not support the production of school textbooks on a European basis but the exchange of books and material between countries at teacher training level would be useful and should be encouraged. Care is needed to avoid school textbooks being used by weaker teachers to give set model lessons. ECBA intends to promote contact between editors of journals and bulletins in the member countries to increase the awareness of material produced in other countries to help biology teachers in their work.

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