CONFERENCE REPORT

ABSTRACTS FROM WORKSHOP ON TEACHING PHYSIOLOGY

These abstracts are of talks and poster sessions presented at the Workshop on Teaching Physiology held in Inverness, Scotland, UK, July 25–31, 1993 in conjunction with the 32nd Congress of The International Union of Physiological Sciences. A report on the recommendations arising from the workshop was published in this journal in June 1994.

Physiology education in a community-based curriculum
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Omdurman is one of the three cities (Khartoum, Khartoum North, and Omdurman) comprising the capital of the Sudan, located on the west bank of the river Nile. Omdurman is a city of about two million people. Founded in 1912, OIU has now ~14,500 undergraduate students in eleven different faculties, of which the faculty of medicine and health science was established in 1989. The medical school is adopting community-oriented problem-based medical education, which is modified according to the facilities and local conditions. It is a full member of the network of community-oriented education institutes for health sciences.

The curriculum of the OIU Medical School is comprised of five years of study, divided into three phases. Phase I is of one-year duration and is designed for studying science and technology in relation to medicine (8 wk), identification of health problems (8 wk), and introduction to basic medical sciences, in which physiology hours are 16 (16 wk). OIU requirements include Islamic sciences and Arabic and English languages. Phase II is a two-year system in which the five basic medical sciences and community medicine are taught in an integrated way, weighing ~80% together, with an introduction to clinical sciences of ~20%. This phase also includes other longitudinal courses such as medical ethics, history of medicine, growth and development, nutrition, and basic skills. Total teaching hours for physiology approximate 250 and for community medicine 140. Practical physiology sessions are based on applied physiology, where students gain basic skills like hemoglobin, blood cell count, or blood pressure measurement or lung function test. These skills are used in their field work visits in summer community courses, the hours of which are not included here. Phase III is two years long and consists mainly of clinical subjects (~80%) together with some basic medical sciences (~20%). These would include rural medicine, community medicine, and training in primary health care center practice.

Group learning in a computer-supported human physiology project
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The Human Physiology Project is a student-led group-work component of a laboratory-based integrative Physiology Module (12 wk, half-time) that is taken at the start of the penultimate (Junior Honors) year of a four-year degree program. It is a core component in the Department’s undergraduate curriculum, taken primarily by those intending to graduate in Physiology or in Human Life Sciences. The course was developed in conjunction with the University’s Enterprise in Higher Education Scheme; it has been shared with other UK higher education institutions through BioNet. (BioNet is a project funded by the UK University Funding Councils’ Teaching and Learning Technology Program. The Department of Biomedical Sciences at Aberdeen is a lead site.)
The application of computing is an integral part of the course. Every student must reach a specified level of competence to complete the subject matter. Thus students with little or no experience of information technology must be brought to an acceptable level of competence before proceeding to the project, completion of which itself depends on acquisition of several transferable skills, thereby fostering high levels of discipline and organizational ability.

The students receive a grounding in the use of personal computers (MS-DOS, spreadsheet, and word processing packages) alongside other course work in the early part of the module. At this stage the spreadsheet component is tailored to solving a short physiological problem. This aspect can be adapted readily to suit individual course requirements. For our own purposes, we have selected a specific problem from our Tutorial Software (details of which are available upon application) so that students can consider the advantages and disadvantages of "manual" vs. "spreadsheet" approaches. Spreadsheets and word processing are used extensively in the Human Physiology Project and in later modules.

The project incorporates a wide range of enterprise skills. Since these skills are discipline independent, the actual nature of the project would be determined by local resources and requirements. Maximal use is made of software packages that are used most commonly in industry, science, and commerce. The essence of the approach is to allow students to work in an environment resembling that of an operational research laboratory and thus to develop their understanding of physiology by formulating and testing hypotheses. To this end it is important to select topics that are not overprescriptive but which permit reasonable conclusions to be reached in the time available. Examples of topics and student work are displayed in the poster.

The criteria for assessment are discussed with the students. Formative assessment is employed throughout the course: individual and group progress is monitored continuously because progression itself entails the successful completion of each subtask. Summative assessment is derived from both discipline-related and transferable-skills elements, ~30% of the total being derived from the latter. It is emphasized that the development of computing and group work skills must be seen in perspective: they are not ends in themselves but provide for more effective performance by students in their subsequent course work and careers.

**How do we evaluate innovation in curriculum?**

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To evaluate any curriculum, one should first have an objective on which to base it. Then it is necessary to decide on a method that will lead to this objective. The next step is to decide on the content of the course. One should ask the question whether teaching the subject will make a better nurse, doctor or professional, and how much of the subject should be taught to achieve this. The teacher then should not only assess the amount of knowledge acquired by the students as a result of his/her teaching but also ask student opinion and thus evaluate the course. A simple questionnaire is always practical and produces reliable results. A followup is necessary for the next few years. Distributing a questionnaire to both students and teachers will show whether the objectives were met by the curriculum. A statistical analysis will give solid results.

**A comparative study of the effectiveness of classical and active methods in teaching physiology in a school of nursing.** A three-year study was conducted in the search for a better and effective method of teaching physiology to nurses. First, the Physiology course, which is given to the first-year students, was conducted solely in lecture form without laboratories or seminars. Students were asked to evaluate the course by completing a questionnaire translated and adapted from the one prepared by The All India Institute of Medical Science. The second year, laboratory and seminars were added, and the course was evaluated by the students who came unprepared for an active teaching method. The third-year students took Anatomy the first semester, which was conducted, for the first time, in the same way as Physiology. Therefore
students who took Physiology the second semester were familiarized with this active method. Student acceptance and accomplishment were compared statistically with the results of previous years. Nursing teachers were asked to state their opinion as to the difference of student achievement in their classes and clinical work. Teachers were asked to compare those who took Physiology taught by the lecture method with those who were taught by the active method. All results were evaluated statistically. The results show that this active teaching method is more successful in providing basic scientific knowledge to be applied to nursing, better achievement in clinical work, and self-confidence in problem solving.

The unseen forces stimulating the evolution of physiology teaching
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Medical education in North America is in a state of flux. Medical school curricula, which have never really been stable, are undergoing extensive evaluation and revision. The call for change in teaching medical students is not new. Major reports detailing deficiencies in the preparation of medical students seem to appear at 10- to 20-year intervals. Successful strategies for addressing these deficiencies, however, are rare. Currently, problem-based learning (PBL) approaches are one suggested solution to improve medical education (See the ACME-TRI report, Educating Medical Students: Assessing Change in Medical Education—the Road to Implementation, of the AAMC, Washington, DC, and the World Health Organization’s Changing Medical Education: An Agenda for Action.).

One consequence of medical research is that we now know better how people learn and retain information. Educational approaches such as PBL draw heavily on learning theories proposed over the past 15 years. Knowles has proposed a model of learning that differentiates adult from child learners. The medical student population exhibits characteristics of adult learners. Application of Knowles’s principles, then, can be used to enhance the learning environment.

Adults need to know the reason to learn. The motivation to learn is internal rather than external. Knowledge of normal body function is seen as an essential component of understanding disease. Medical students want to learn the information necessary for their future practice. Teachers should spark this self-motivation with clinical correlations rather than relying on the threat of course and licensing examinations.

Adults learn best when the material is tied to prior experiences. Students enter medical school with personal history of medical encounters and other experiences with their own body that can be used to facilitate learning physiology. Instructors should use these experiences and incorporate exercise, sweating, eating, and similar common events into teaching whenever possible.

Adults learn best in a nthreatening environment. This is best achieved in a small-group peer setting where the faculty member facilitates, rather than dominates, the learning process. Reliance on self-assessment of learning, however, is problematic. This characteristic is difficult to achieve in medical education, where examinations are a necessary component of the licensing process.

Adults learn better by participation than by observation. When possible, active learning processes, in which the students participate or direct the learning environment, should be employed.

As a group, these characteristics can be components of traditional courses (such as wet labs). The PBL approach attempts to maximize the adult learning characteristics, with moderate (but not total) success. Some schools are adopting hybrid curricula, with lecture support of the PBL environment.

Physiology teaching is influenced by forces outside the physiology community. Understanding of these forces may enhance the teaching effectiveness of the physiology community.
Integrating clinical and physiology instruction for nursing students
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The nursing profession has undergone some fairly revolutionary changes. There have been substantial changes in the roles of nurses. Increasing independence has been assumed by nurses in almost every role. Nursing requires the assessment of and intervention in human responses to potential or actual problems. Knowledge of pathophysiology is basic to the understanding of any human responses.

Pathophysiology can be defined as the study of physiological and biological manifestations of disease. Its study provides the students with knowledge of the way in which alterations in structure and function disrupt the human body. Integral to the study of pathophysiology is an understanding of how the human body uses its adaptive powers to maintain the steady state. In health, the body utilizes negative feedback patterns that allow return to the normal or steady state. Some pathological processes establish positive feedback patterns that will result in death.

Integration of physiology with clinical instruction should be emphasized for nursing students. Teaching pathophysiology could be one of the means to reach the integration of clinical and physiology instruction. Therefore pathophysiology should be included in the curriculum of nursing students. The content of pathophysiology would blend the conceptual and systems approach; the overall mechanisms of disease would be introduced and described first to set the stage for coverage of specific disease processes within each system.

Use of a foreign language in medical instruction
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On the basis of my teaching experience at a medical school in the USA for a number of years and in an Asian country for two years, neurophysiology as taught in the two countries is compared.

In both medical schools, neurophysiology is being taught as part of Neuroscience, a course that is separate from Physiology. The Neuroscience course offered in the American medical school is highly integrated so that each functional component of the nervous system is presented with appropriate elements of neuroanatomy, neurochemistry, neurophysiology, neuropharmacology, and clinical correlation. Instruction of neurophysiology within such an integrated framework not only provides students with logical steps in understanding the functions of nervous system but also helps students to appreciate its overall picture. Such an approach also motivates students better, because they can easily appreciate the necessity for the various kinds of information being presented. The Neuroscience course offered by the Asian school, on the other hand, is not integrated. Although the title of the course implies an integrated course, it consists exclusively of neuroanatomy in the first period, followed by neurophysiology in the latter part of the course. The failure to establish a well-integrated course in the Asian medical school seems primarily due to a lack of departmental support and coordination among course committee members.

From the above comparison of courses offered by two selected schools, it is emphasized that neurophysiology is better taught in the format of a truly integrated Neuroscience course. Essential steps for the establishment of such a Neuroscience course include 1) recruitment of dedicated teaching members from various disciplines, 2) departmental support, 3) intimate coordination among teaching members, and 4) constant improvement of the course based on feedback from students.
of study, remembering and applying knowledge, overloaded curriculum, and lack of motivation are frequently reported in literature as common problems with students (see C. R. Coles, Helping students with learning difficulties in medical and healthcare education, in *Med. Educ.* 24: 300–312, 1990). However, in medical schools where instruction is in a second or foreign language, one of the causes for these difficulties in academic performance success is probably the language used for instruction. As students enter medical school, they are expected to be equipped with skills to listen, read, write, and speak subjects that use language unique to their content area. Although research shows that many factors other than language proficiency are important to academic achievement, there may be a minimum level below which lack of sufficient proficiency in language contributes significantly to lack of academic success (see J. G. Graham, English language proficiency and the prediction of academic success, in *TESOL Q.* 21: 505–521, 1987). There is a need for greater emphasis on this issue in medical schools where medium of instruction is in a foreign language. This presentation will briefly summarize some of the study problems of students who need to learn medicine and language simultaneously as they enter medical school after secondary school education in the national language. Identification of these problems and appropriate actions by the curriculum planners can reduce much frustration for both students and instructors.

**Restructured and modified teaching methods in graduate and postgraduate physiology in medical colleges of Assam, India**  
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In teaching undergraduate and postgraduate medical students in Assam, India, need for change has been felt in the curriculum. The traditional teacher-oriented teaching is being restructured toward a more self-learning and self-evaluative process. The structure, organization, and presentation of courses in various disciplines are made relevant to the realities of contemporary medical practice. The students imbibe the essential information, acquire fundamental skills, and learn to apply themselves for management of health care issues. The medical curriculum is integrated, community oriented, and clinically applied. The teaching concept is interdisciplinary and aims to make biological organ function relations clear and relevant to disease processes and health care.

The lack of sophisticated instruments and modern techniques is compensated by comprehensive theoretical training and practical skills imparted by locally available devices. The curriculum is oriented toward training students to be capable of looking after the preventive, promotive, curative, and rehabilitative aspects of medicine.

The guidelines of the World Health Organization for integrated teaching in the basic sciences of human reproduction, family planning, and population dynamics are being followed.

The postgraduate teaching program, however, is aimed at the fulfillment of a pressing need of the country in attaining self-sufficiency in producing teachers and research workers in the field of physiology.

**Teaching neuroscience in a BSc course**  
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Neuroscience courses for undergraduates must be developed with three questions in mind. First, what students will be served? Most undergraduate student populations are quite diverse. In addition to those interested in careers in the health professions or biological research, there will be many with career interests quite distant from neuroscience. Second, what are the needs of these students? Not only do they need necessary background information; they also need a broadly based introduction to the entire field of neuroscience, one that includes an introduction to the main concepts, principles, facts, and methods of neuroscience. Finally, how can these needs be met? Two elements should be of overriding importance. First, broad coverage should include topics like neuroendocrinology and developmental biology, not just cellular and molecular neurophysiology. We shortchange our students by not introducing them to the enormous diversity of
the field. Second, the emphasis of the course should be on principles and concepts first, and facts second. Facts alone have little meaning and are soon forgotten. Concentrating on principles and concepts allows facts to be presented in a context that makes them easier to remember and more understandable. This in turn makes the course much more satisfactory for everyone.

**Team teaching using a problem-based approach in nursing education**

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A problem-based approach to teaching multidisciplinary courses such as Nursing has several advantages. As practitioners, nurses must be able to draw on a substantial knowledge base to interpret information from both clients and other health professionals to produce appropriate diagnosis and interventions. Students who are skilled in problem-solving can easily adapt their inquiry processes in the workplace. The process of gathering information, deciphering that which is immediately relevant, and synthesizing rationales and interventions is already rehearsed and developed. Where deficits in actual knowledge exist, these can be readily rectified by consultation with an appropriate expert for advice. Failing this, written resources may be used with confidence in obtaining relevant information quickly. The most obvious benefit to student nurses and graduates alike is that they become self-sufficient while they also learn how to act as team members via consultation and interaction with academic and clinical staff.

In a team-teaching approach to problem-based learning, the benefits of problem-solving by students is enhanced over more traditional teaching methods. Team-teaching refers to a unit team consisting of approximately six academic staff members from several disciplines who are responsible for teaching a unit in the nursing course. Among the academic staff are nurses, physiologists, microbiologists, sociologists, psychologists, and consultants in law and ethics. Rather than each discipline providing material independently or singly to the students, two or more disciplines may combine for group discussion or tutorial sessions. In this way issues that cross disciplines can be dealt with by the appropriate expert at the time, and the students can interrelate the information regarding their client or case history under discussion.

To illustrate this method of using problem-based learning, a scenario dealing with cardiopulmonary disease will be presented. (See the following abstract by Francis et al.).

**A didactic case: care of a client with an oxygenation deficit: respiratory and cardiovascular dysfunction**

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This case history is aimed at second-year nursing students with at least a basic knowledge of human anatomy, physiology, and some microbiology.

A client called Normal Slack is introduced with his personal history and current medical condition, namely vascular disease and chronic bronchitis. The nursing and physiological issues pertaining to the client are discussed. Norman develops symptoms of right-sided heart failure and progresses to congestive cardiac failure. This introduces the concept of a chronic condition becoming acute (converse to many situations). Because of poor nursing and medical care, Norman dies of a pulmonary embolus from a missed deep vein thrombosis.

Throughout this case history many aspects of diagnosis, observation, documentation, rationale development, counseling, and interventions are considered. At appro-
appropriate times the impact of this disease state on other bodily functions, and daily living activities are studied. Also the psychological and sociological impact of Norman’s condition on both him and his family are discussed.

**Problem-based learning for nursing students: the inquiry process vs. the technological dream**

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Considerable investment of money, time, and resources is made in the education of our youth to be professionals of the future. This cost, however, can be adapted to the availability of funds of the institution and society. Rather than focusing on Western technology and scientific advancements in teaching physiology, it is far more important to develop inquiry skills and research techniques in the students. Following this, students need to be encouraged to synthesize their body of knowledge into appropriate strategies to deal with a specific problem. Such strategies can be very simple and inexpensive while being entirely effective and appropriate for solving the problem.

Case histories, used to teach the process of health and disease in clients, should be carefully constructed so that the interventions from health professionals can be met, regardless of socioeconomic status of the society or the individual. Hence one should be able to alter the diagnostic and intervention processes to fit in with the normal practice of the society concerned. However, more elaborate methods can be alluded to as a source of inspiration for future health professionals in more financially viable times.

The experience of the student can be completely rewarding with as little as a few textbooks and access to their teachers (facilitators) to discuss areas of interest. From my experience, given appropriate guidance, the students can learn a great deal from relatively few, inexpensive, and appropriate resources.

**The effect of academic support programs in physiology for disadvantaged students**

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The challenges facing tertiary education institutes, and universities in particular, in South Africa are vast and diverse. The South African situation is unique in the problems it presents. These problems include a developed sense of community awareness, the spirally increasing student numbers, and concomitant heterogeneity in the student body. In addition, perhaps the greatest factor influencing university education is the enormous difference between the secondary schooling levels of admitted students. As a curative measure, universities and individual academic departments, including Physiology, have embarked on academic support programs (ASP) for students who are academically disadvantaged. The purpose of this study was to assess quantitatively the effect of ASP in Physiology for academically disadvantaged students.

The June and November examination results of students who volunteered and attended Physiology ASP were compared. There were 109, from a possible total of 207 students, that attended > 80% of 10 ASP sessions covering a general range of topics, with emphasis on a basic level of understanding of physiological concepts. The effects of ASP and of ASP attendance on both group and individual results were assessed.

The effect of the ASP students as a group was compared with previous years’ results. The individual effect of ASP was assessed by considering the interquartile mark differences in the ASP volunteer group. The lower quartile improved their mark from June to November by an average of 6%; the middle two quartiles improved by 9%, and the upper quartile improved by 14%. The mean mark change of the volunteers was also correlated against the number of ASP sessions attended ($r = 0.79, P < 0.05$).

In conclusion, ASP is beneficial in improving group marks and is effective in improving individual marks.
The individual gaining the most benefit from ASP appears to be the stronger student. This may be a case of “missing the mark,” inasmuch as ASP is largely provided for the weaker student. Perhaps a different approach is needed that would involve preventative rather than curative measures of aiding academically disadvantaged students.

**Teaching of neuroscience in the third world, Calcutta**

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The course of Neuroscience as a special paper in the MSc program (Physiology) in Calcutta University began in 1989 with five seats. It is the advanced study of the brain and behavior. It is assumed that the students have already been exposed to most of the general principles of the nervous system. The course is intended for understanding neuroscience at the biobehavioral level, with experimental foundation for experiencing the excitement of the dynamic state of neuroscience research and its application for the behavioral disorder correction.

This course consists of one theoretical paper, derived from reading assignments, lectures, and a review of recent literature for discussion, and a practical paper for experimentation, together with a project or a dissertation.

The course is intended for ten students with an insight of neuroscience and good training in various neuroscience techniques. Our aim is to increase the present number of seats, but with present limited resources, the aim remains a plan for the future.

**The place of pathophysiology in the medical curriculum**

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Pathophysiology bridges the gap between basic medical sciences and clinical training by discussing the picture of disease as physiological dysfunction. In some countries it is included in the regular curriculum of pregraduate medical teaching as a subject separate from other disciplines. Elsewhere it belongs among the courses on clinical physiology or general pathology. In several places there is no desire to teach pathophysiology as a separate subject, the respective material being included in other branches of medical science.

The course of instruction in pathophysiology usually consists of lectures, seminars, and practicals; tutorials and clinical demonstrations are added at some faculties. Experiments on live animals are still carried out and make the main body of the practical training in a number of countries. In Western Europe and North America, animal experimentation is more often banned from medical teaching; video pictures and computer-assisted learning programs are proposed to replace experimental training that requires the use of animals.

The view is generally taken that pathophysiology is an essential part of medical education. Its status at medical faculties, however, varies throughout the world.

**Homeostasis of teaching: maintaining a high set point for learning physiology**

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All physiologists are familiar with the concepts of homeostasis, including feedback loops controlling variables such as core body temperature or arterial blood pressure. The loops all have the same components: 1) a sensor or monitoring mechanism for the variable; 2) integration of afferent information, with comparison of the variable to a set point; 3) an effector mechanism controlling the variable. There are striking parallels between these components and the process of teaching and learning.

The controlled variable in education is the student’s learning, his or her acquisition of new knowledge and skills, and development of desirable attitudes and behaviors. The learning objectives constitute a “set point” against which student learning is compared. The monitoring aspect of education consists
of measurement of student performance and determination of students' and teachers' perceptions of the educational process. These products of evaluation are then integrated with the teacher's knowledge of the subject and with the established learning objectives. The efferent arm of the process is the creation of the pedagogical strategy: what modes of instruction will be most effective? how will student performance be assessed? The effector mechanism refers to the teacher's interaction with students in the lecture theatre, seminar room, or laboratory. The teacher's communication skills, interpersonal skills, and attitudes are important in this component.

It is essential to "close the loop" of activities in teaching and learning, just as it is for maintaining physiological homeostasis of the body. The most common deficiency among novice teachers is to interrupt the cycle of activities in the monitoring arm: they often do not apply the results of evaluation to improve their subsequent teaching. Physiologists are in a unique position to appreciate the nature of feedback loops; we should take advantage of our understanding to help our graduate students, junior colleagues, and ourselves to become more effective, more scholarly teachers.

The Foreign Faculty Fellowship Program of the Educational Commission for Foreign Medical Graduates
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The Foreign Faculty Fellowship Program (FFFP) was established by the Educational Commission for Foreign Medical Graduates (ECFMG) in 1983 to help enhance teaching skills of basic science faculty in medical schools outside the USA. The program also aims to strengthen basic science departments in those schools. Among other qualifications, a prospective fellow is expected to be a full-time faculty member in a medical school outside the USA. He/She is also expected to possess a minimum of 3 years of teaching experience in a basic medical science discipline. The fellowship lasts for one year, with the ECFMG providing full financial support.

Thus far, 116 fellowships have been awarded to teachers in 81 medical schools from 40 countries. The program is well managed and is beneficial to those teachers who wish to make a career in the basic medical sciences.

Use of some physiological clinical parameters of fish blood in biomonitoring the aquatic environment and as a tool in laboratory experimental demonstrations
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Blood is called a mirror of life. This is not only a literary phrase but also a physiological truth of living vertebrates. As a consequence, we all know that the hemato-biochemical estimations rank first in interest and importance in the routine health care and diagnosis of disease of all birds and mammals, humans being no exception. However, use of fish blood parameters as diagnostic tools is not yet popular in most of the Asian countries, although the most critical problems of population explosion and malnutrition exist in this continent. The last two decades have witnessed rapid increase in the inland pisci-culture and mari-culture of fishes, and with it have increased instances of piscine epidemics spreading in various parts of our country.

The hematological and biochemical studies of the blood of fishes are found to reveal the real status of fish health under all sorts of normal, abnormal, altered, polluted, diseased conditions, besides showing sex-, season- and age-related specific variations. It has been now established that fish blood parameters can be fully trusted to assess not only the health of the fish but also its ambient environment. In fact the various blood parameters can be effectively used as a biological indicator in the monitoring of the aquatic environment.

The present lecture includes a number of such studies on a number of freshwater fishes from the Indian subcontinent, which convince us that use of fish blood parameters must be incorporated as an effective tool in the curriculum of fishery management.
The Fiji experience
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The Fiji School of Medicine (FSM) introduced a two-tier, problem-based learning (PBL) curriculum in February 1991 to meet better the challenges and needs of Fiji and other Pacific Island countries. Students first complete a diploma in primary health care (3 years), followed by a one-year supervised primary health care internship, before embarking on their final two years of hospital-based learning leading to the M.B.B.S. degree.

During the first two years of the course, students are grounded in the techniques of problem solving. The underlying principle is that individuals who are skilled in defining and solving problems are best able to deal with whatever situation confronts them. Students develop the ability to formulate and obtain answers to appropriate questions.

The course is arranged in three consecutive “spirals”: etiologies of disease, organ systems, and management. The students are required to give a public presentation of what they have learned while studying the problem in order to develop and polish their skills in presentation. Each problem normally takes two weeks to research. Sample problems are presented and discussed.

Of primary importance to PBL are the roles played by the tutors. They both guide the self-directed learning of the student and assist the students in their community-based clinical training. At FSM the clinical training and the tutorial process are firmly linked. Moreover, the tutors are not well established, highly qualified faculty staff. Rather, they are junior members of medical professions. The tutors do, however, work closely with more senior discipline experts in the formulation and working through of the problems. Thus there is not the perceived need, which many have, that PBL requires the resources that only institutions in the developed world possess. Although physiology as a separate identifiable discipline may not be apparent in PBL, the understanding of how the body works is certainly gained in our PBL curriculum. It is my opinion that students gain a much better understanding of the importance of physiology and the other basic sciences in medicine using this approach.

Teaching physiology in Calcutta: a report and a proposal
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In addition to medical education, the teaching of physiology in Calcutta may be classified into three categories on the basis of courses of studies: B.S. (Pass), B.Sc. (Honors), and M.Sc.

Compared with the other science subjects, the study of physiology is still very prestigious in Calcutta. In my 11-year experience in teaching physiology in an undergraduate college affiliated with Calcutta University, I have seen the physiology students (at least those from our college) rank at the top in almost every year. The average ratio of the students getting first class (Physiology-Chemistry-Physics-Botany-Zoology = 6:2:2:1:1) is much higher in Physiology in the B.Sc. (Honors) examination. Thus we should not blame our teaching methods, but rather the lack of opportunities for the physiology students seeking jobs. Even the scope of research is very limited nowadays; only 20% of the graduating students can get research fellowships every year.

Opportunities for physiologists may vary from country to country, but it is true that many of the promising physiology students not getting proper chances have to seek other options. To eliminate the problem, a career-oriented school of “Applied Physiology” may be established. Besides scope in research, this career-oriented program will ensure a physiologist an opportunity for practicing physical medicine. Such a so-called physiologist may be entrusted with 1) public health and hygiene; 2) prescribing diet for normal persons and for patients suffering from diseases; 3) family planning; 4) therapeutic exercises, especially, Indian “Yoga,” physiotherapy, and massages; 5) physical fitness through “sports physiology,” especially in the case of young people; and/or 6) preventing the random use of drugs and medicines among the common people.
The motto of the physiologists should be to make a person mentally and physically fit without applying any drugs. I do hope that, like other “specialized institutions” such as schools of medicine, art, and music, if a school of applied physiology could be established, it would definitely create tremendous social impact. It would minimize the use of drugs and medicines.

I would like to add that such a school of applied physiology would attract the brightest students from all over the world. The mission and mores of such schools must be carefully reviewed.

Four years after Kuopio: retrospective and results of Kuopio recommendations on development and evaluation of curriculum in physiology in the development countries
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The curriculum development committee, set up at the teaching workshop held in Kuopio, Finland four years ago, recommended that “any plan for a curriculum must be a dynamic one. It must have an inherent ability to evolve adaptively.” Dynamicity implies a continuous exercise to judge the merit or worth and some expression of values contained in the curriculum. “Evaluation” not only detects the problems in the way the plan of the curriculum works but also recommends the remedial actions. It is now well known to the curriculum planners that mismatches occur between the “on paper,” “in action.” and what the students “experience.” Clearly, the aim of the planning and evaluation exercises should be to maximize the overlap among these three facets. The committee in Kuopio recommended that, in designing a curriculum in physiology, a clear demonstration of integrated physiological controls in action should be emphasized so that the students can critically integrate the building blocks into larger coherent systems. At the University of Papua New Guinea (UPNG), the introduction of a larger block of single-lecturer introductory sessions since 1991 has proved to be a step in the right direction. A students’ questionnaire and other methods of inquiry have confirmed this finding. Kuopio recommendations also urged formulation of strategies to encourage students to explore the subject imaginatively and for themselves, ensuring a confidence in their ability to resolve problems. Some of the carefully designed computer teaching software programs demonstrated at Kuopio, which made a clear distinction between logical responses and physiological data, were introduced at the UPNG Medical Faculty. This has also resulted in improved performance by the students. On the basis of the retrospective and results of implementation of the Kuopio recommendations, the IUPS should consider increased production and setting up of a distribution pool of meaningful indigenously produced audio-visual aids, continue production of books like the IUPS practical manual, increase availability of review journals such as News in Physiological Sciences, and find ways to share the resources.

Computers in the teaching and learning of physiology: an overview
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Several issues relevant to the decision to begin using computers in the classroom will be discussed.

1) There are two broad classes of programs being used to support different aspects of teaching and learning. Tools for scholarly work include such programs as word processors, spread sheets, data bases, graphics and animation programs, and data acquisition programs. Although these are playing an increasingly important role in the lives of teachers and students, they will not be discussed today. Computer-assisted instruction (CAI) programs provide students with learning resources to help them master well-defined aspects of physiology. A variety of type of CAI programs will be briefly described, and many will be demonstrated today and will be available for personal inspection throughout the week.

2) The benefits and the costs of using CAI programs are many. Among the most important benefits is the fact that the computer can free both teacher and student from the tyranny of the clock and the calendar; the computer can be used whenever the student is ready for the experience. The computer
can also provide students with experiences that cannot be readily provided in other ways. Finally, the computer can provide active learning and cooperative learning experiences that can lead to greater mastery of the discipline.

The costs of using the computer are, of course, largely financial (which is not to minimize their significance). However, computers are getting cheaper, and in many settings they provide resources that cannot be provided in any other way. Although the cost of developing teaching software is significant, the growing availability of programs from commercial and professional sources makes it unnecessary for most users to also be developers.

3) Just as we all must evaluate textbooks for possible use by our students, we must similarly evaluate the software we use. This is perhaps most difficult to do, as there are more factors to be considered. Not only must we assess the scientific accuracy of the software (its content), but we must also ask whether the nature of the program and the kinds of interactions it produces will meet the objectives set for its use in our course. Finally, we must decide whether the program makes appropriate use of the computer media, given what the program seeks to accomplish.

4) The world of computing is still experiencing a "cold war" between the advocates of Macintosh computers and those favoring the use of PC (DOS-based computers). Each has certain advantages, but increasingly there is teaching software available for both types of computers. It also appears that efforts are underway to increase the compatibility of software between these two different platforms. Ultimately, one’s choice of a type of computer may have to be made on pragmatic grounds.

Self-educaction and self-assessment
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There has been a global concern to reorient education of health professionals in tune with the health needs and resources of the community. The traditional teaching in medical sciences is criticized for being largely didactic, information ridden, and assessment driven. The purpose of the paper is to examine the need for a self-directed approach to learning and assessment, especially in physiology, and to explore ways and means of achieving the same in the context of developing nations.

Speaking of India, during the postindependence period we have witnessed a phenomenal growth in the enrollment of medical students. Dearth of teachers has rendered the traditional style of teaching highly inadequate. Furthermore, the availability of multimedia technology makes a strong case for self-learning resource materials.

However, self-learning materials are not a poor substitute that may be employed to overcome the shortage of competent teachers. Self-learning is the most effective form of learning. The greater the effort on the part of the student, the better the learning. Elements of self-learning should be informally introduced even in traditional lectures and textbooks. More formal devices of self-learning include programmed texts, tape or slide programs, video films, computer-aided learning, and various combinations of these.

At the All India Institute of Medical Sciences (AIIMS), the Centre for Medical Education and Technology has delineated the list of essential skills required by a medical graduate. The objectives of undergraduate teaching in physiology have been clearly documented. In collaboration with a Consortium of Medical Colleges in India, a core curriculum has been identified that classifies various topics into three categories: “must know,” “good to know,” and “need to know.” The next logical step is to prepare self-learning materials: video films, tape slide programs, and computer-based simulations.

Self-assessment is an integral part of self-learning. Besides ensuring the efficacy and improving the quality of learning, it boosts the confidence of the student. In our Department of Physiology, we have been giving an objective structured practical examination for 10 years. We have a question bank that we propose to computerize so that the student can interact with it and assess himself whenever he likes.
Our experience at AIIMS has shown us that, despite several difficulties that are inevitably associated with change, the philosophy of self-education and self-assessment can be implemented, and it is especially relevant to developing nations.

Teaching of neuroscience: where to begin?
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Learning and teaching of the physiology of the nervous system calls for knowledge and skills in diverse fields such as biophysics, biochemistry, mathematics, and computer science. As a teacher of physiology I always asked myself, where do I begin? It no longer remains teaching merely of a system in physiology. In recognition of a wide spectrum of approaches to study the entire gamut of the functions of the nervous system, beginning with molecular neurobiology and continuing to the higher mental functions, we deal with the issues involved under a separate discipline, “neuroscience.”

I always found the learning as well as the teaching of neuroscience much more interesting if I began with the graphic details of Sperry Rogers’s experiments on split-brain patients. It is always easier to relate oneself with the functions of human brain and its laterality in terms of structure and function rather than with the sodium-potassium currents across a membrane. This approach to understanding the nervous system through the “black box,” i.e., the human brain, becomes an adventure. All learners evince far greater interest in trying to solve the “mystery.” I have experienced that the teaching of neuroscience becomes more effective and more rewarding if one begins with the brain and ends with the neuron. This is true with the graduate students as well as the teachers of neuroscience who are undergoing a refresher course. Will the future textbook writers of neuroscience take note of this?

The teaching of physiology in South Africa
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Most of the universities in South Africa that teach physiology are attached to a medical school. A large proportion if not all of the lecturers in these physiology departments are medically qualified and do not have degrees in physiology. Such persons are only willing to teach physiology on a part-time basis because they do not find a full-time position financially viable. The University of Stellenbosch has two physiology departments, one attached to its medical school and the other for teaching physiology to degree students. The latter makes use of lecturers qualified in physiology as well as veterinarians. The University of the Western Cape and the Potchefstroom University do not have medical schools and also make use of qualified physiologists as lecturers. Only the University of Pretoria, at its Onderstepoort campus, teaches veterinary science. All other universities that have physiology departments attach them to the medical schools. From the above, one can see that we have a problem obtaining suitably qualified lecturers in physiology.

Practical training is becoming more and more of a problem. Certain physiological principles can be demonstrated by making use of the student; however, other experiments must rely on laboratory animals. Laboratory animals are becoming scarce and very expensive, and therefore other means must be explored. One very exciting method is the use of computers as physiological tutors in the practicals.

The use of computers as physiological tutors.
Because of the shortage of laboratory animals, as well as the versatility of computers, we are introducing them as a powerful tool in the practical demonstration of physiological principles.

A usual practical is performed, such as an electrocardiogram or a simple muscle twitch of the frog. When the computer is booted, the menu appears and one can choose: electrocardiogram, electromyogram, blood pressure, vector diagram, stimulator voltage, or isotonic contraction. The couplers are linked with the computer, and the results can be viewed on the computer screen. These results can now be stored on disk. During the practicals the students can now use the data to do the necessary calculations without having to dissect a laboratory animal. Alternatively only one animal need be killed, and the
data obtained can then be fed to the whole class. Each student can then perform a specific task with the results, or the whole class can perform the same task.

Teaching physiology by distance education: application for developing countries
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Athabasca University, Canada’s oldest open university, specializes in distance education. A Human Physiology course has been offered since 1985. The course is targeted toward students who already have nursing diplomas but are working toward obtaining their post-RN Bachelor of Nursing degree. Nevertheless, over the years, students from many different disciplines and backgrounds have successfully completed this 6-credit course. At any given time, ~400 students are enrolled in the course, which is transferable to any accredited university in Canada.

The course material issued to each student consists of a commercially produced textbook, a study guide (containing the objectives which the students are required to cover for each system of the body), a student manual (containing administrative information, telephone numbers, and other information that a student may require), and an assignment booklet (containing quizzes and exercises that the students are required to complete as they work through the course). Each student is assigned to one of five “telephone tutors.” The telephone tutors are part-time employees of the university who work from their own homes, answering questions from the students related to the course and marking assignment materials.

The advantages to the students are many: they need not relocate from small towns or remote areas of the country; they can work at their own pace at times that are convenient for them; many of the usual costs associated with normal university attendance, such as transport, parking, and baby-sitting fees, are eliminated. On the other hand, students are unable, at the present time, to do any laboratory work related to the course. There are obvious advantages for the university as well: there is no need for lecture theaters or offices for instructors.

The cost-effectiveness of distance education courses and the ability to reach and effectively educate people in remote communities should make this approach to education of interest to educators in developing countries. A Human Anatomy and Physiology course is currently being designed for use by the Open University of Sri Lanka. Although it is modeled on the course being used by Athabasca University, some changes have been made to accommodate the local situation. A course manual is being designed that will replace both the textbook and the study guide. This manual will contain all the information that the students will need to complete the course. It is based on a textbook that will be available at learning centers located at various places around the country. Telephone tutors will not be available, and exam materials will be marked at the university.

Problem-solving as an aid to student learning.
Cooperative learning in small group workshops
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Many studies have shown that students learn relatively little in the lecture hall, where they are passive learners, compared with what they can learn in settings where they are active learners.

Problem-solving in “workshops” and computer-based exercises is used as an aid to assist students in organizing and integrating their physiological knowledge. Both settings share important characteristics: 1) students are actively involved, 2) activities are centered about solving problems, 3) students work cooperatively in small groups, 4) students create or work with visual representations that show relationships, and 5) instructors function as learning facilitators.

Active involvement maintains student interest and is essential to their meaningful learning. Working in groups enables peer teaching and significantly improves students’ ability to apply their knowledge to solve problems. Instructors model problem-solving
processes and, acting as learning facilitators, they contribute significantly to students’ improved mastery of larger relationships.

Students are encouraged to create visual representations of the systems that are involved in each problem. These “concept maps” help students to organize their knowledge and provide a basis for formulating causal, mechanistic explanations of physiological phenomena.

Here we describe a new format that we use in our workshops. Workshops are small-group problem-solving sessions. The problems that are used vary, some being quantitative ones that involve using equations, others being qualitative and presented as clinical cases (pathophysiology problems). In the workshop students are shown how to solve problems, and they are given the opportunity to practice solving problems themselves.

A new protocol for our workshops has been designed to take advantage of peer teaching. It employs a combination of activities that generates cooperation between students but at the same time creates a competition to excel. In the workshop, the teacher has the role of learning facilitator, resource person, and advisor.

Software demonstration: GASP, a computer program for teaching the chemical control of ventilation
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The respiratory system regulates two parameters, arterial Po2 and O2, by varying tidal volume and breathing frequency and hence alveolar ventilation. The number of causally related parameters that vary as the system carries out its function is large, and students find the sheer number of parameters, the presence of two reciprocally responding negative feedback pathways, and the intimate involvement of chemical “components” to be quite confusing.

To assist students in learning to make qualitative predictions about the responses of the system to perturbations, we have written a computer-assisted instructional program called GASP. Like its companion that dealt with the baroreceptor reflex (CIRCSIM), GASP requires the students to make qualitative (increase/decrease/no change) predictions about a set of parameters, checks that these predictions conform to certain physiological relationships that must always hold, and then displays for the students the actual response. The program then shows the student a comparison of his or her predictions and the actual outcome of the experiment. Any prediction errors that are present are flagged and then used to trigger text intended to remedy the presumed cause of the student errors.

Two features of GASP deserve special note. The predictions table contains an ordered arrangement of the eleven parameters to be predicted, an arrangement that is intended to help the student systematically think about (make predictions) the causally related clusters of parameters. The first procedure takes the students one at a time through a sequence of predictions in an order that also stresses the causal relationships that need to be considered. At the completion of this procedure the program then builds, step by step, a diagrammatic representation of the reflex mechanism regulating the respiratory gases.

Software demonstration: ABASE, a multifunctional computer program to teach acid-base regulation
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To understand acid-base (AB) regulation, students must know the actions of the component subsystems, have a way to represent the events that occur after some disturbance, and practice applying these to the solution of problems. ABASE assists students to do these things. The program consists of four lessons that interactively review: buffers; respiratory and renal compensation and the Davenport nomogram; and seven “problems,” situations that cause acute and/or chronic AB changes. Lessons may be done to review background material or material accessed from a problem. To “solve” a problem, students predict the qualitative changes (increase, decrease, or no change) that occur to five AB variables: 1) in the direct response to the
disturbance, 2) by the effect of respiratory compensation, 3) the AB state of the subject after respiratory compensation, 4) by the effect of renal compensation, and 5) in the final state of the subject. ABASE evaluates the predictions and gives instruction when the student makes errors. The student then traces the time course of the AB response on a Davenport nomogram. ABASE has a dictionary of terms and an authoring tool with which teachers can modify existing lessons or problems.

Demonstration: a new teaching concept, function models of molecular physiology (automatic and personal computer controlled or easy to manufacture): hemoglobin
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Today's research incorporates the investigation of the molecular basis of biological functions through which the dramatic dynamics of intramolecular function mechanisms are revealed. A new teaching concept shows the structure and especially the function of macromolecules in large-scale format models that are automatic and personal computer controlled. The principle of protein structure and function is shown by the example of hemoglobin discovered by Max F. Perutz. The model enables the student to tackle scientific questions in the field of molecular biology and gives him a thorough understanding of the subject at an early stage. The model is interdisciplinary and links the subjects of molecular biology, physiology, and biology.

The hemoglobin model reproduces molecular architecture and movement. The primary, secondary, tertiary, and quaternary structures are demonstrated. The model gives a step-by-step concrete representation of the mutually evoked oxygen absorption and simultaneous discharge of CO₂, H⁺ and Cl⁻ ions, and 2,3-diphosphoglycerate (2,3-DPG). Hemoglobin (Hb) bears a porphyrin ring (Hb disk), with iron as the central atom in each of the four protein chains. This is realized in the model, likewise the doming of the Hb disk when it is deoxygenated. Flashing lights indicate the oxygenation of the Hb. This oxygenation, i.e., flattening at the HB disk, produces mechanical tension in the molecule by lifting of the central iron atom of the Hb disk. This tension is demonstrated in the model by flickering lights, likewise the lifting of the iron. The mechanical tension breaks weak bonds. With the weak bonds missing, H⁺, Cl⁻, and CO₂ and (last, not least) 2,3-DPG can no longer be retained and fall out of the molecule as the result of the four oxygenation steps. The 15° turn in the case of transition from R to T state is also demonstrated (allostery). The model's capabilities are enhanced by the introduction of a personal computer. The ~600 amino acids are represented by lighted diodes directly controlled by computer. The helical structure may also be visualized by running lights. The hemoglobin model aims to bridge the known chemical structure of genetically defective hemoglobins and the known clinical symptoms of associated diseases.

Teaching practical experiments in physiology in Indonesia
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To know the general picture of the teaching of practical experiments in physiology in Indonesia, we performed a survey among the medical faculties, consisting of the topics of the practical experiments, the number of the students, the departments of physiology, and the time available to perform the practical experiments.

The data from this survey showed that there was great variation in the practical physiology courses held by various departments of physiology. To improve this condition we need to face several constraints, including limitations in the number of qualified staff, equipment, and also budget. Good cooperation among the departments of physiology is very essential, and in this case the role of the Indonesian Physiological Society is undoubtedly very important.

We would like to raise the following questions regarding practical experiments in physiology: 1) What subject matter or topics in physiology should be performed in practical experiments in accordance with the institutional objectives? 2) What is the optimal number of essential practical experiments to be performed? 3) How do we evaluate the
practical experiment activities done by the students? 
) Is it reasonable to ask the student to design (with instructors' help) simple physiological subjects for their own practical experiments?

Diverse methods of active learning
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Active learning is loosely defined as any activity in which a student engages other than listening to a lecture. Behaviors that characterize active learning include writing (other than lecture-based note taking), reading, discussion, and problem-solving. Students learn best when they use the higher-order thinking skills of analysis, synthesis, and evaluation. Active learning can take place in the classroom (including large lectures and tests), in the laboratory, and outside of formal instructional settings when students work individually, in pairs, or in small groups.

Some active learning methods for lecture are best suited for small classes. One example is the “guided lecture” that combines a formal lecture with in-class small-group work. For large classes, small-class techniques can be used in supplemental discussion sections. Active learning can also be incorporated into the large lecture class. The simplest small-scale activity is interactive questioning between the instructor and student or between student and student. The questions may be factual or may require higher-level thinking. Pathophysiology-based and open-ended questions are examples of the latter. More formalized active learning techniques in large lectures include ungraded writing exercises followed by discussion, “pause technique” lecture design, “feedback lectures,” and “responsive lectures.” Higher-level-thinking questions should be introduced in lecture and practiced before students are tested with them.

“Cooperative learning” is the trendy name given to the active learning that occurs when students work in pairs or in small groups. Exercises for cooperative learning may be formalized and require students to turn in written reports or present oral summaries.

Oral reports presented to small discussion sections allow students in the audience to critique and question the material presented. The grading or group work requires careful thought. On a less formal basis, cooperative learning occurs when students form study groups or study partners to review for tests.

Active learning can be fostered in individual students by teaching them to concept-map material into review sheets. In physiology, flow charts and anatomically based diagrams are also effective mapping techniques. Student poster sessions are a popular substitute for the traditional term paper.

In the laboratory, active learning can be enhanced to some degree by asking students to predict what will occur or to explain why they are carrying out a particular procedure. The most active laboratories are those in which students design, execute, and report on their own experiments.


Active learning: mapping strategies for physiology
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Concept-mapping is a nonlinear way of organizing material, similar to making flow charts. Students can be provided with teacher-prepared maps, but the real benefit of using concept maps occurs when students prepare the maps themselves. A “pure” concept map consists of terms hierarchically ranked and linked by explanatory arrows. Physiology maps may be more useful and informative if they include anatomic diagrams, graphs, or figures. In either case the linking arrows are labeled to explain the type of linkage between the connected concepts (structure/ function, cause/effect). The most important arrows on a concept map are those that connect laterally
and over long distances. Student-constructed maps force the students to organize the materials themselves, look for similarities and differences, and question the relationships between terms. This active processing of information results in a “big picture,” which is retained in long-term memory.

Teaching students how to map concepts is an important part of the process. In the initial instruction I describe the theory and construct a very simple map. I then give the students a familiar topic, such as “the cell,” and ask them to make a map. If the students are at a beginning level, you may elect to give them a non-scientific topic, such as “the city.” I select several student maps for diversity and ask the students to draw them on the chalkboard together. By comparing several different maps, the class can see that 1) there is no “right” way to draw a map as long as the relationships are correct, and 2) maps are as individual as the people who construct them. If a map has errors in it, I ask the students how they would change the map. This removes the instructor from the role of “grader” and makes the process less threatening.

Physiology lends itself to the construction of what I call “system maps.” These are giant maps drawn on a piece of poster board and containing everything of importance about a system such as the cardiovascular system. I tell my students to put everything in their notes somewhere on the map. The system map then becomes a self-contained study guide. Students can see the physiology (and anatomy) of the entire system at a glance and gain an appreciation for the complexity of the relationships between parts and processes.

Students who use mapping consistently are enthusiastic about its usefulness in both science and liberal arts classes. Maps allow them to organize large volumes of material and see complex relationships. Students who use mapping feel that they understand the material better and retain the information longer. In many cases, system maps have become part of a student’s permanent reference material.


**Status of teaching/training of clinical physiology to undergraduate students in India**

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The diagnosis, prognosis, and treatment of diseases are based on identical principles, yet inadequate health and morbidity vary in different parts of the world. Medical education should therefore be designed according to the need of the country. This applies equally to the teaching/training of physiology to undergraduate (UG) medical students, who may need to be oriented to create awareness, interest, and aptitude for clinical application toward health care policies of the country.

The duration of physiology teaching in the UG curriculum is 18 months, which includes classroom teaching of facts given in textbooks and laboratory teaching in hematology, experimental and human laboratories where students perform experiments by themselves. These traditional curricula, courses, and teaching methods need innovative changes commensurate with the needs of society and incorporating developments in science. A built-in inertia and a lack of in-depth planning and will to implement result in inaction.

The design of physiology curricula for developing countries needs to be a shade different from that existing in developed countries. Emphasis is needed for physiological principles related to nutritional disorders, impact of tropical and communicable diseases, population growth, material and child mortality. Besides, a change in teaching methodology from the stereotyped classroom to a need-based clinical orientation is likely to generate interest among students.

Lack of required support to medical education in general and preclinical subjects in particular results in a shortage of modern sophisticated equipment, requiring that teachers impart knowledge with the help of available stereotyped, old, outdated instru-
ments and techniques. This, together with poor pay, limited promotional avenues, and nonrecognition of merit, deters meritorious students from choosing physiology as a career or joining a medical college as teachers.

Video demonstration: ways to relate physiology to clinical sciences in a basic medical physiology course

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Integrating basic science and clinical sciences frequently meets obstacles. Resistance is least when the teacher of physiology is a physician who also has a clinical appointment. This situation has become rare in North America and Europe but is apparently still found in some of the medical schools in developing countries. At my university we have in the past introduced clinical material into the first-year Physiology course by inviting selected clinicians to give so-called clinical correlation conferences, whose topic was coordinated with the Physiology schedule. The success of these depended on the willingness of our clinical colleagues to speak at the first-year level and to concentrate on the pathophysiology (rather than diagnosis and management) of the cases they presented.

More recently Duke University Medical School joined the ranks of the schools using “Problem-Based Learning” as a tool in the first-year curriculum. Groups of students get together for a whole afternoon once a week. They are presented with a clinical case and are given the task to solve and to study all its aspects, including basic and clinical sciences as well as social and psychological problems. The “cases” are fabricated, synthesized from actual clinical material, by the staff of the Department of Family and Community Medicine. One basic science and one clinical teacher is assigned to facilitate the work of each group of students, but the bulk of the work is done by the students themselves. The tasks are divided among the members of the group, who then have three or four weeks to research the library, interview staff, or use any other means to assemble the information. The information is shared at the weekly meetings.

A video tape was presented illustrating the work of one such group.

Evaluation of multiple-choice questions

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Multiple-choice questions (MCQ) are still the type of questions most widely used in physiology exams, and this is also the case in Indonesia. However, evaluation of the exams and questions is not routinely performed because of the laborious work and a lack of computer programs to do it quickly and accurately.

During the author’s teaching fellowship in the United States, exams of Indonesian pharmacy students were evaluated for four years for item analysis. Only questions that were identical in all four years were included in this study. For each question the difficulty and discrimination indexes (in %) were calculated.

From the results we could conclude that: 1) The same questions given to pharmacy students during the four-year period showed relatively constant characteristics of difficulty and discrimination. Thus easy questions will be easy questions and difficult questions will be difficult for similar groups of students. 2) Questions that are difficult (with low difficulty index) also showed low discrimination and so should be avoided or reconstructed. 3) “Because type” questions are the most difficult and do not discriminate well; therefore this type of MCQ should be changed to a better type of MCQ. 4) Item analysis, although tedious and time consuming, should always be done after each exam.

Pitfalls in instruction transfer among diverse cultures

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Globally the aim and goals of teaching physiology at the universities are the same, but the levels of preparation and of development differ, so these
aims and goals depend on the culture of each country. As a result, problems are created when developing countries receive visiting personnel from abroad. Coming from a developing country and pursuing my studies in a developed country, I would like to share my point of view and suggest some solutions for these problems.

**Problems.** Because visiting staff come from more developed countries, where the level of education is high and advanced, academic visits are arranged to teach certain disciplines, and most of the staff sent do assume a lot of things and they concentrate more on applied physiology emanating from their own country, forgetting about the basic topics and failing to put themselves in the shoes of the students. They have a plan of what to teach, but they usually do not give priorities to a teaching that suits difficulties that they meet in the future. At the end of the terms, they become surprised when the performance of the students is very low.

Most of the visiting staff are on a project or contract, so they have a limited time; they present their material too fast to cover the program, and they are not always willing to go back and give explanations.

Students, understanding little, memorize topics to pass and are left frustrated instead of being helped. It becomes difficult to apply the knowledge in the future, because they learn only to pass their examinations, and everything ends up in the examination room and on the piece of paper.

Sometimes the failure is because the staff involved went to developing countries because they were attracted by the beauty of that country or by the good income provided to them by the project donors or by the salary in the contract, and as a result, they lack interest in teaching and patience.

The original language is different from the instructing one; during translation the meaning and sense are lost, and the accent is not clear, causing an additional problem to students in lower levels (undergraduates).

**Solutions.** Always try to match the standard and level of education of the countries involved, bearing this fact in mind when planning the topics. When even in developed countries the degrees obtained are not always equivalent because of different educational systems, imagine what the situation is in developing countries.

Try to concentrate on the basic physiology also, and do not forget its link to applied issues.

Be prepared to put oneself into the appropriate level of education and to understand the country of interest with patience, more especially if the original language of instruction is different. This will make it easier and leave the students to struggle only with the difficulty of the subject matter rather than with a combination of many different factors.

Reduce the speed of presenting the material to suit the student’s pace of understanding, because that is the most important thing. It is better to cover little material, making it perfectly understood, than to cover alot and be ill understood.

**Teaching neuroscience at an African medical school**

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Neuroscience education at an African medical school, namely, The College of Medicine, University of Nigeria, Enugu Campus, was discussed. Neurophysiology and Neuroanatomy are taught in a nonintegrated program in the second and third years of the medical career, in the Physiology and Anatomy Departments, respectively. During the three years in the clinics, components of neuroscience education continue in the departments of Pharmacology, Medicine (Neurology), Surgery (Neurosurgery), Ear Nose and Throat (ENT), and Ophthalmology. The merits and demerits of this method have been highlighted. Some of the merits include the feasibility with timetable scheduling and availability of experts in the field within the individual departments. In terms of cost effectiveness, this method also appears to be cheaper than running an integrated program. A major disadvantage with this method is that the students usually lack an immediate clear overview of materials presented. There are
problems like shortage of staff; lack of teaching aids; obsolete, unserviceable, and unworkable laboratory equipment; large class size; and constant interruption of laboratory classes by power failure. Our students are usually those with a very good background in chemistry, physics, and biology, and they cope well in their senior years as well as in international examinations.

Problems with “problem-based learning”
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A major point of difference between didactic lectures and problem based learning lies in their diametrically opposing logical approaches. Didactic lectures tend to be deductive. General principles are enunciated and deductions drawn therefrom, or at least examples are brought forward to illustrate the truth with which the theory can be applied. Problem-based learning depends largely on empiricism.

Problem-based learning: Mount Hope. The approach here is centered on the problem as a means of identifying learning needs and structuring knowledge acquisition. Problems are designed by the tutors, along with a set of Instructional Objectives, which itemize the main learning points intended to be achieved from analysis of the problem. The students appoint a scribe and a group leader, and they set about identifying terms that need definition and issues that need analysis. They thus establish a set of issues or learning objectives during the first session. They must then use the library and other resources to clarify these issues. They then reconvene to pursue the discussions further and to resolve the issues. The objectives identified by the group are fed back to a central controller, who can use this information to assess the degree to which the group has met the set objectives, or to redefine the problem and/or stated objectives in light of the student response.

The role of the tutor is to prevent the discussion from bogging down and to ensure that participation is spread through the group if the group leader fails to do this. The tutor should keep intervention to a minimum. This approach leads naturally to the concept that the tutor need not be a specialist in the area of the discussion but simply a facilitator of the group dynamics. The constraint, particularly for third-world countries, of the scarcity of expert personnel for conducting small-group teaching, is thus removed.

Attendant features of the curriculum include the use of simulated patients for clinical problem-based sessions and the availability of a skills laboratory with training dummies and the like. A concession to the status of students at the entry point was the establishment of a small core of introductory didactic lectures.

Case teaching method. This method emphasizes the careful compilation of cases aimed at exploring particular scenarios that will train potential health managers. Students must first read the problem by themselves, formulate an understanding of the issues, and design their own plan of action. They then meet in small groups, select a recorder, share ideas, and discuss points of view. A general group discussion then follows in which the recorders can present summaries of each small group’s deliberations, the major issues identified, and the actions proposed.

For reference, see V. Naraynsingh and D. C. Ariyanagam, Problem Based Learning at Mount Hope; and Nunes Winsome, Caribbean Cases in Health Management: Teaching Notes. Bridgetown, Barbados, WI: Carib Research & Publications for the Pan American Health Organization, 1990.

The use of videotaped material in place of practicals in a School of Pharmacy
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A videotaped demonstration was compared with conventional laboratory experiments in physiology for first-year pharmacy students. The experiment was concerned with the osmotic behavior of red blood cells. The class was divided into a control group, who performed the experiment themselves, and an experimental group who were shown the videotape and spent most of the time analyzing the
data using a semi-programmed report sheet. After the practical session all students wrote an essay-type report. The short- and long-term gains resulting from practical work were assessed using objective pre- and posttests of cognitive performance. An answer review was given to one-half of each treatment group after the first posttest. The short-term gains were very moderate and were not significantly different for the treatment groups. The long-term gains were significantly higher for the subgroups given the test answer review. Practical exercise did not seem to enhance performance. The findings indicate that the role of practical work in some expensive and time-consuming aspects of physiology needs to be reexamined.

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