

PALI WORKSHOP, CA USA: Associated with San Diego Congress 2005

Penelope Hansen¹ and Ann Jervie Sefton²,

Co-Chairs, Education Committee, IUPS 2001–2004²

¹Faculty of Medicine, Memorial University, St John's, Newfoundland, Canada A1B 3V6; ²Faculty of Medicine, University of Sydney, New South Wales 2006, Australia.

Abstract

Hansen, Penelope A., and Ann Jervie Sefton. International Union of Physiological Sciences Teaching Workshop, April 7–10, 2005, Pali Mountain, California. Published in *Adv Physiol Educ* 289: 216–226, 2005.

Fifty-six physiologists from 14 countries participated in the sixth International Union of Physiological Sciences Teaching Workshop. The four-day program included a poster session, a debate on integrative versus disciplinary curricula, and interactive lectures on evidence-based education, inquiry laboratories, and student preparation for physiology courses. Participants worked in small groups on one of four topics: developing free web-based laboratory resources, information technology, curriculum planning and design, and other issues in classroom teaching.

Report

This International Union of Physiological Sciences (IUPS) Teaching Workshop was organized as a satellite meeting associated with the XXXV IUPS Congress in San Diego, CA, USA. It is the sixth in a series of workshops associated with IUPS Congresses that began in 1985 at Jenolan, Australia, and continued in 1989 at Kuopio, Finland, in 1993 at Inverness, Scotland, in 1997 at Repino, Russia, and in 2001 at Lincoln, New Zealand.



Lunch on the bus trip to Pali

Fifty-six physiologists from fourteen countries in five continents participated in the sixth workshop. These were Australia, Bahrain, Brazil, Canada, Chile, Czech Republic, Great Britain, India, Indonesia, Japan, Nigeria, Pakistan, Turkey, and the United States. Twenty-one people had participated in previous Teaching Workshops, and they were delighted to

welcome thirty-five "newbies." We travelled by bus and lunched al fresco). The workshop was held at the Pali Mountain Resort, where participants lived and worked in rustic buildings surrounded by a beautiful pine forest at 7,000 ft of elevation. To the delight of some, snow fell one night and revealed bear tracks on the property the next morning. Everyone enjoyed a get-acquainted party on the first evening, games and conversation around fireplaces on the second, and a farewell party in traditional or ethnic costume on the final evening .

The program included five plenary sessions with the following talks: Evidence-based education, Ann Sefton; Evidence-based education; Marsha Matyas; Are your students prepared to learn physiology?, Rob Carroll; Integrative vs. disciplinary curricula: a debate, Joel Michael and Arif Siddiqui. There was a poster session and ten hours of small group work, for which participants chose one of four discussion tracks. Summaries of their work follow.



Participants at Pali

Group Reports

1. Laboratory resource project

Co-Chairs: Dee Silverthorn and Joel Michael

Participants: Elaine Brubaker, Kim Henige, Daniel Hodyc, Meri Krerojky, Chris Ladipo, Nikki McDaniel, James Marker, Marsha Matyas, Minama Siagian, Baara Skuladottir, Sanjay Kr. Sood, Thad Wilson, Amie Yenser

Background

This project will bring together a diverse group of physiology teachers from around the world to adapt two existing but out-of-date sets of laboratory experiments. The final product will be a collection of educationally effective, simple to do, and economical ideas for laboratory exercises. This new sourcebook will be available for free, on-line access from an American Physiological Society website.

This project is being funded by a grant to Dee Silverthorn (PI), Joel Michael (Co-PI) and Marsha Matyas (Co-Investigator) from the National Science Foundation.

Work at Pali Mountain

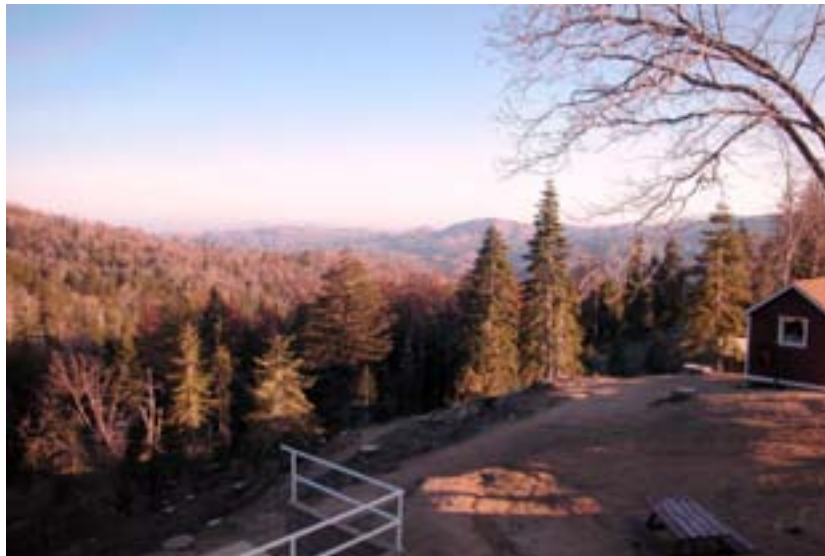
We first reviewed the history of this project. In brief, the Teaching Committee of IUPS produced “A Source Book of Practical Experiments in Physiology Requiring Minimal Equipment” in the early 1990’s. This sourcebook was commercially published, but it is very difficult to locate now and it is quite out-of-date. Ann Sefton, the present Co-Chair of the Teaching Committee, proposed that an updated version be prepared, and Dee Silverthorn and Joel Michael wrote a proposal (“Physiology for the 21st Century: A Sourcebook of Effective and Economical Experiments”) that was submitted to NSF and approved. Funds from this grant provided partial support for the IUPS Teaching Workshop in April, 2005.

The group then discussed the issue of which of the “old” experiments, if any, should be excluded from the new sourcebook. Experiments using human subjects comprise the bulk of the “old” experiments, although some of them involve procedures such as drawing blood that probably can not now be done at North American schools. Similarly, there are “old” experiments that use vertebrates (rats, rabbits) that are increasingly expensive (everywhere) and that often generate strong opposition (at least in the US and Europe). It was decided that we would include ALL educationally sound experiments, thus making it possible for individual physiology teachers to pick those experiments that can be done in their particular institution.

We then turned to a discussion of how the “new” experiments should be formatted. Silverthorn and Michael had proposed a template to be used and this first draft was circulated. In the abstract it proved very difficult to know whether the proposed version would work or not. We then looked at a single “old” experiment that Joel Michael had reformatted using the template. It was agreed that we would have to try using the template to actually re-do a set of experiments before we could usefully consider alterations to it.

We then divided into working groups each of which selected one experiment from the “old” sourcebook to re-write. Four groups started work on the following experiments: CV responses to cold, exercise, CV experiments on *Daphnia*, and . . . (there were at least two other experiments written up, but requests for help on the listserv have not yet yielded descriptions of the others). Silverthorn, Michael and Matyas facilitated the activities of the working groups.

When first drafts of the “new” experiments were completed copies were distributed to the entire group. After reading the experiments, there was discussion of three different kinds of issues.



View on arrival

With actual examples of the template in use, we discussed changes to it that would be needed to make possible a product that would be most useful to physiology teachers. A number of significant changes were proposed and ultimately adopted. It was also acknowledged that we might need to make additional changes to the template as further experiments were re-done and further deficiencies are identified.

We then critiqued the experiments that had been produced. This process proved to be very valuable in clarifying what information was needed in each of the slots in the template.

Next we discussed plans and procedures for our post-workshop efforts. It was generally agreed that working together in groups to re-do an experiment was helpful in that it brought to bear on the task diverse interests, knowledge and experiences. However, this was not intended to discourage solo efforts by those who prefer to work that way.

All working documents (files for the “old” labs, the template, re-written labs) will be posted to a website at the University of Texas maintained by Dee Silverthorn. All files to be posted should be Word documents. They must emailed to Dee who will actually put them on the website. Files on the website can be easily downloaded (go to <https://webspace.utexas.edu/xythoswfs/webui/unglaub/iups-labs?>).

To ensure economy of effort, we decided that only one group should work on one of the “old” experiments. A “sign up” sheet will be on the website so that groups can indicate what experiment(s) they will be working on.

Once a “new” experiment is posted on the website it is fair game for criticism and commentary. Feedback should be directed to the author or team that produced the experiment. **CHANGES TO A POSTED EXPERIMENT WILL ONLY BE MADE BY THE ORIGINAL PRODUCERS OF THE EXPERIMENT.**

A listserv for communication about this project is being set up that will initially contain the email addresses for all of the IUPS teaching workshop attendees (iups-labman@lists.cc.utexas.edu). If attendees have no interest in being involved in this project they can unsubscribe.

Once final drafts of an experiment have been written they will be submitted to the project editorial board for final vetting. When approved they will be prepared as web pages and then posted on the APS website.

Following this discussion, the groups started working on second drafts of their first experiments.

At least two groups began a second set of experiments, with each group selecting another of the “old” experiments to modify. We thus left Pali Mountain on Sunday with a workable (if not necessarily final) template and seven experiments in varying stages of development.

Post-workshop plans

We will continue to recruit additional physiology teachers to participate in this project. We will continue to re-write experiments and prepare them for posting on the APS website.



Workshop plenary session

Track 2. Information Technology in Physiology Education

Facilitators: Tom Nosek and Usha Nayar

Participants

Jiri Kofranek, Osamu Matsuo, Sally Gauci, Jodie Krontiris-Litowitz, Adrianta Suradhana, Adam Watts, Dewi Irawati Soeria Santoso, Reonna Slagell-Gossen, Jeff Osborn, Nancy Pelaez, Melinda Lowy, Mariam Farmer, and Joyce Ono

Day 1

The participants in this track represented a diverse group of faculty working at both private and public institutions from around the world teaching undergraduate preprofessional/science students, undergraduate nonscience students, dental students, nursing students, master degree students, pharmacy students, MD students, and PhD students.

Access of students to computers varied widely: 1) all students are either provided with notebook computers or required to purchase a specific model computer and ubiquitous

wireless access to the Internet; 2) there is adequate access through computer laboratories and in the library (the most common mode of access) with personal computer purchase NOT required; or 3) there is inadequate access (e.g., one computer with Internet access in the department office).

We discussed three expectations that are made possible by computer technology.

Information on demand.

Information on demand included the following:

1. Course/subject information available 24 h/day, 7 days/week, and 365 days/yr.
2. Ability for students to utilize multiple intelligences.
3. Does this personal access to information encourage or discourage student-student interaction and student-faculty interaction?
4. Does this capability enable faculty to do something different with lecture/class time? This will put more pressure on faculty.
5. This will enable faculty to teach in a problem-based manner, freeing faculty to help students solve problems rather than giving them bits of information.
6. Students must be prepared for active learning in class, having reviewed the preparatory material before class. Student assessment of other students and peer pressure will assure students to come to class prepared.
7. Assessment of learning objectives will have to change. This resource makes possible open-book/open-world examinations.
8. Availability of such large amounts of information can lead to information overload. There is a need for learning objectives to help focus the students' activities.
9. Students must be taught to evaluate the quality of the information that they have available to them.
10. Copyright issues.
11. Cost of student and faculty access could be an issue as we strive toward equity of access.

Information just in time.

Information just in time included the following:

1. Retrieve information just in time to solve a problem. A faculty member could propose a problem and give students 15 min to work together, using ALL available resources, to solve the problem. This requires equity of access: all students must have computers and access to all learning resources.
2. Students must be taught the skill of quickly and efficiently finding pertinent information.
3. Faculty can focus on process rather than content. Make sure that the students have the tools needed to learn and turn information into knowledge.
4. If faculty cannot teach every fact, they must concentrate on what is important. Do we know what is important and what we should focus our teaching on? Is there a limited number of concepts/topics that we should assure understanding of rather than a large body of facts?
5. What is the cost of access to up to date information? Will this be a limiting factor for creating an "Informatics Culture?"

Teaching physiology by laboratory experiences.

Teaching physiology by laboratory experiences included the following:

1. It was agreed that there is no substitute for "real," wet laboratory, physiological experiments for optimal student learning. However, there are obstacles to conducting these laboratories: a. Cost b. Ethical objections in killing animals for teaching purposes c. Some experiments are too complicated to ever allow a large number of students to experience in a wet laboratory environment
2. Computer simulations can be used to prepare students for optimal use of "real," expensive, and resource-intensive laboratories. These simulations can be introduced before clinical skills exercises are held.
3. Computer simulations save time; they do not require extensive setup time.
4. Computer simulations can allow the manipulation of variables that are impossible to change in a "real" laboratory environment.
5. Computer simulations allow students to explore procedures that are not appropriate in a "real" laboratory setting but that, nonetheless, are excellent learning experiences.
6. Faculty should define exactly what they want the students to get out of a laboratory experience. Then, it can be decided whether or not a computer laboratory or a "real" wet laboratory will satisfy those objectives.
7. "Real" laboratories lend excitement to the study of physiology. Ideally, both "real" laboratories and computer simulation laboratories (incorporating stochastic characteristics) would be part of the study of physiology.



Local environment

Various topics identified for further discussions:

1. Does the use of information technology (IT) enhance student achievement? Research must be conducted in this area and made available to other faculty and administrators.
2. Technology equity is an issue. Ideally, ALL students should have a notebook computer and access to the Internet. This would change the nature of large & small group classes.

3. If students have access to Internet resources, how do we prevent plagiarism and manage copyright issues?
4. How can we create learning/teaching resources that are made available to faculty outside the creating institution? Can the APS be a repository of these resources?
5. How are faculty changing what they do as a result of IT?*
6. How are students changing what they do as a result of IT?*
7. How must assessment of student performance change as a result of IT?*
8. The group was divided into subgroups of four people each to discuss these last three topics (marked by asterisks), and they reported back to the group.

How are faculties changing as a result of technology OR how must faculty change to use technology in teaching?

Barriers for undergraduate education include money (infrastructure and maintenance), infringement on faculty research time, and the need to impart change in methodology and pedagogy for use in the curriculum.

Methods and examples for change implementation include the following:

1. Summarize and/or list IT examples for use in curricular courses, e.g., identify available activities for course implementation.
2. Provide credit for promotion and tenure processes.
3. Must have research data to document what IT methods work in the classroom.
4. Develop collaborations with other faculties of universities and internal departments. Get the expertise that is needed and don't reinvent any wheels, e.g., mathematics, computer science, educational psychology, curriculum and instruction, and multimedia art designers.
5. Develop shared contact lists for those choosing to include IT in their curriculums.
6. Utilize interested senior and/or retired faculty as resources.
7. Infuse departmental change by example; collect and obtain the data to document success.
8. Encourage IUPS to provide funding in technology implementation.

Develop alternative technology uses that ease changes in faculty teaching. Examples are hand-held interactive devices for large classroom teaching and the development of on-line/in-class data collection techniques to improve teaching pedagogy.

How are students changing as a result of technology?

Educators must find the lowest common denominator, in both technology and student skill level, to operate effectively. Considerations include access to all material and software, usability, current software, and special needs students. Technology can change or affect students' learning styles. Be aware of the consequences of labeling a learning style. Having a particular learning style should not be used as an excuse for not learning the material.

Positive aspects that were identified include:

- * Information on demand. Flexibility. Instant access. Students would engage with the material the way they want it, when they want it.
- * Easily available to many current resources.
- * Dynamic resources.
- * Accessible to different learning styles.

- * Learning tools.
- * Facilitates more student-centered learning.
- * Virtual community of distance learning.
- * Allows introverts to "speak up;" requires all students to participate.
- * Deeper learning due to longer time frame of thinking to respond to chat for example.
More reflection.
- * Easier editing of reports by the students.
- * Can be more anonymous; may prevent intimidation.
- * More interactive.
- * Allows for students to assume more responsibility for their learning.
- * May cater for special need students, i.e., those hearing or visually impaired.
- * May improve communication skills (writing) and other generic skills
- * Technical skills, e.g., emailing, using software, surfing, and advanced searches.



Audience at plenary session

Negative aspects include:

- * For some students can mean laziness or nonattendance.
- * Less engagement.
- * More unreliable resources available. Disadvantages students who cannot critically evaluate.
- * Easy to copy and paste from the internet; plagiarism.
- * Surface learning for some students; no synthesis.
- * Too overwhelming.
- * Student may demand or expect more from educators. More "edutainment" with more resources, e.g., cell phones, games, and chatting. Not in touch with reality.
- * False impression of what is acceptable.
- * Remove face-to-face teaching, resulting in isolation.

- * Prevents quick thinking.
- * Has the potential to inhibit original thinking.

How must assessment of student performance change as a result of IT?

The following questions arose during discussion: Can we assess the value added using technology? Can we use IT for assessing student learning (competence levels)? How can IT be used for assessing skills, behaviors (e.g., student study behaviors), and attitudes (confidence)? How can IT be used to evaluate and provide feedback to the teacher about teaching performance? and What is the merit of IT as an assessment tool?

The group concluded that the merits of using IT for assessment of learning include the following items:

- * Person-to-person contact will always be the best assessment. The role of technology is to make assessment more efficient and support the human-to-human interactions. In a high-tech world, assessment without technology is disconnected from a students' real world.
- * If the assessment is recorded, it can serve as documentation of the teaching process and provide the opportunity for reflection, evaluation, and improvement.
- * Immediate feedback is available.
- * Collaborative efforts across distance and time can be pulled together.
- * Versatility: the technology presents many opportunities for multiple dimensions and increased complexity. Because of its multiple dimensions, it improves the way humans assess (e.g., you can stand "next to" a student during a patient interaction in a way that would be inappropriate for a face-to-face format).
- * Time management.
- * Sharing of efforts: material created by one faculty member can shared, replicated, and improved by others without additional cost.
- * It closely represents what the student will find and use professionally and so it prepares them better for their future technical skills.
- * Formative feedback: the same material can be examined from different perspectives multiple times.
- * Peer review and self-assessment (the progress test).
- * Technology helps you correlate performance outcomes with your planned objectives and get a better idea about whether the goal was met to make adjustments.
- * It supports your evolution throughout the teaching process, including improvement of assessments.
- * Limitations were also identified. Plagiarism can be a problem. Careful design of assessment tasks is needed to encourage students to construct and synthesize meaning instead of simply copying information from the web. No system will reach universality, i.e., there is no technology equality. Human beings must design assessments that IT can do.



Main buildings after snowfall: a novelty for many

Day 2

Day 2 of the IT track of the Workshop started with a discussion of the properties of an ideal physiology curriculum given the capabilities of IT.

1. IT allows multiple approaches to teaching a particular topic, customized to accommodate all learning styles.
2. IT has the capability of motivating students to want to learn the material.
3. Hyperlinking to background material is possible, providing remedial material and review material for students who need it.
4. Use of resources such as WebQuest, which allows for on-line discussions of results.
5. Continuous formative assessment is possible.
6. Asynchronous, self-paced learning is possible, with summative assessment when each student is prepared for it.
7. Information is at your fingertips due to the capabilities of IT. However, information is not knowledge. IT skills are necessary for life-long learning to be realized.
8. Some of the skills that must be acquired by the students are PubMed searching, Web searching, graphical representation and interpretation, statistical analysis, and simulation analysis of systems.

We introduced a model of teaching physiology that could be conducted either locally or via distance education.

1. Students are introduced to topics by lecture. Learning objectives are provided to the students.
2. Learning of the topic takes place by completing exercises and conducting experiments on physiologic simulations either alone or in small groups. The time allotted for these activities varies by the topic and extent of the learning objectives.
3. Formative quizzes are available for students to assess learning.
4. Students come together to discuss the results of their exercises and simulations. Faculty make sure that the learning objectives are achieved.
5. Summative assessment is done at the completion of each block.



Bill Galey and Rob Carroll enjoying the snow

The large group broke into three subgroups to propose learning models for the future, all or part of which may be adopted by various courses at various institutions:

Group 1 proposed the scientific study of various aspects of the model of using IT in education. Their research questions were as follows:

1. Value of using physiological simulations/models to understanding physiological processes [either using large-scale mathematical modeling (Czech model) or simulation/animation modeling (Melbourne model)]. a. Student happiness/satisfaction/inspiration for further study. b. Performance on equivalent of the National Board on that topic; internal examinations. c. Bank of higher order/applied/transference of information. d. Effect on retention throughout the course/medical training.
2. Do running experiments with simulations and requiring students to graph the data and statistically analyze it increase their graphical/statistical skills?
3. Will making these simulations "Open Source" lead to greater use and increased sophistication?
4. How well do students perform working at their own pace? Are required formative experiences necessary to keep students on schedule?
5. Are the "nodal" points where faculty and students physically come together an essential element? Is the value dependent on the content of these physical meetings?
6. The syllabus for this modeled course would be web based. It would contain exercises that require the students
 - (a) to conduct a PubMed search of the current literature
 - (b) Find and evaluate the appropriate websites.
7. Do these exercises enhance the students' ability to conduct literature searches and find and evaluate the appropriate websites?

8. Does the use of hyperlinking within the on-line syllabus enable students with background deficiencies to perform better in the course?
9. How involved does the professor need to be with the students between "nodal points" for the course to be effective? Are office hours/chat groups/blogs/threaded discussions (either physical or electronic) necessary?

Group 2 decided that the time has come to initiate research projects to guide us for further use of IT in a more rational and cost-effective manner (considering the costs in terms of both time and equipment). Approaches include the development of evidence-based IT use by studying the ways IT facilitates the teaching and learning process and identifying the negative aspects. The group decided to develop a questionnaire to survey the Pali Mountain faculty about the following questions:

1. What are the concerns people have about use of IT in physiology education?
2. IT is not being used by many faculty members. What are the attributes of IT-supported education that should be recognized by all faculty?
3. In physiology, what are people doing with IT to facilitate learning and assessment? Document the best practices.
4. How does IT-based instruction change the learning environment
5. How does IT help students learn things in physiology they could not learn without IT?
6. How does IT influence student attitude and their approach to learning?
7. What uses of IT help students become independent learners?
8. What uses of IT help students judge their own progress toward instructional goals?
9. Can we develop a (taxonomy) classification of domains (sphere of influence, realms) where IT supports for the educational process (the Pali Mountain taxonomy).
10. Is it true that IT facilitates learning? Retention, willingness to spend time, attitude...

The group hopes to collect data to construct the taxonomy from teachers of physiology from around the world. The following questionnaire was developed:

Please answer the following questions to help in the development of a taxonomy (classification) of domains (spheres of influence, realms) where IT best supports the physiology education process.

1. How do you use IT to facilitate learning or assessment? List your three best uses.
2. How has IT-based instruction changed the learning environment in your classes?
3. What are the attributes of IT-supported education that you value most? List and explain.
4. Do you use a course management system? If so, state which one and tell how you use it in physiology education. Is it required and has it been effective?
5. Has IT helped your students learn things in physiology that they could not learn without IT? If yes, please give an example. If not, explain the reason.
6. How does IT influence student attitude (satisfaction, motivation, confidence, and wanting to know more)?
7. How does IT influence your students' approach to learning?
8. Does IT help your students become independent learners? Explain.
9. In what ways do you feel that your use of IT helps students judge their own progress toward instructional goals?
10. What are your concerns about the use of IT in physiology education?

Nancy J. Pelaez (College of Natural Science & Mathematics, California State University, Fullerton, CA) has put the taxonomy on the web at <http://scied.fullerton.edu/PaliMtTechSurvey.htm>.



Unexpected excitement one morning: bear tracks in the snow...

Group 3 asked how embedding IT into the physiology learning process impacts student learning. They concluded the following:

- * One cannot develop a generic model.
- * Technology should be utilized to enhance learning, not just because it is there.
- * Technology needs to be embedded in the curriculum, not just "bolted" on.
- * One cannot find a common standard to judge everyone.
- * IT has to make sense in your own objectives ("constructive alignment").
- * An assessment task is needed with each activity or usage of technology.

Track 3. CURRICULUM PLANNING AND DESIGN

Facilitators: Beatriz Ramirez and Bill Galey

Participants: This track was attended by 13 individuals from 7 different countries.

This is a report of the main points discussed over the course of the workshop. Essentially, all final conclusions were the consensus of those present. While it is difficult to accurately convey the course of discussion, the subtleties of meaning, and the mood of the discussions, we hope this rough outline provides the reader a sense of the exciting discussions that took place.

After an initial brainstorming session, five main topics were identified for further discussion. These were the following:

1. Learning objectives
2. How do we teach to achieve our learning objectives?
3. Assessment of students and out teaching
4. Is physiology an independent discipline?
5. Strategies for changing a curriculum

Although we are unable to reconstruct the complete sequence and content of the discussion, we outline here the principle issues discussed and general conclusions reached within each of the five topics. They are presented here in the order in which they were discussed.

Learning objectives.

It was agreed that general and specific learning objectives must be included in each course's curriculum. However, every course will have different specific objectives determined by the interests and needs of the students enrolled in the course (biology, zoology, dentistry, medicine, etc.) or their academic level (basic, professional school, graduate, postgraduate, etc). However, it was concluded that there are some general principles that should be found in all physiology courses. While not all of the objectives were addressed completely, the following general objectives were considered essential for any physiology course:

1. Learning should be applicable to the students' daily life or career. (This increases comprehension and facilitates the learning process.)
2. Understanding the main (basic) themes (basic concepts such as homeostasis and control of processes must be learned by all students).
3. Understanding that body systems are not functionally isolated is also core to all physiology courses. Despite usually being studied sequentially and separately, they function as an integrated whole to maintain body homeostasis.
4. Students must be challenged to learn to process and integrate information because useful learning in physiology is more than an accumulation of information. Participants discussed how students must process the new information and integrate it with their previous knowledge to construct their own understanding as to how the body functions.
5. Every physiology course should provide opportunities to analyze and evaluate both learned information and physiological data. It was agreed that data analysis provides a different learning modality than the evaluation and integration of the conceptual information. Searching for useful information in the literature, in one's own fund of knowledge, or in other resources that are relevant to a challenging physiological problem was not only considered a unique learning tool but also an exercise worthy to be considered a course objective.

How do we teach to accomplish our learning objectives?

The main target for an effective learning process is the intellectual engagement of the student. Among the approaches discussed that were believed to achieve that goal were active or student-centered methodologies such as problem-based learning (PBL), inquiry, and self-directed learning. A more unusual but exciting approach is the development of models to explain sets of physiological observations. It was also agreed that it is particularly useful to use examples in lecturing that are applicable to students' daily lives as was helping students to consolidate their understanding by posing interesting problems (questions) that require the use and integration of their knowledge.

The participants agreed that engagement of students can be attained through a great variety of teaching modalities, including lectures, practical laboratories, group-based/peer learning, case-based/PBL, tutorials, consultation time, computer-aided learning, and one-on-one interactions. Not one of these approaches was rejected. Moreover, it was considered that "mixed teaching modalities" are good for maintaining the interest (and also the engagement) of the students over a long period of time. However, it was emphasized that active participation of the students was a "must," even in lectures. In this connection, lecturers should recognize that after few minutes of even the most engaging lecture, the audience's concentration decreases. Therefore, lecturers should apply teaching tools to maintain the students in an "active learning" state throughout the lecture period.

The group hopes to collect data to construct the taxonomy from teachers of physiology from around the world. The following questionnaire was developed:

Please answer the following questions to help in the development of a taxonomy (classification) of domains (spheres of influence, realms) where IT best supports the physiology education process.

1. How do you use IT to facilitate learning or assessment? List your three best uses.
2. How has IT-based instruction changed the learning environment in your classes?
3. What are the attributes of IT-supported education that you value most? List and explain.
4. Do you use a course management system? If so, state which one and tell how you use it in physiology education. Is it required and has it been effective?
5. Has IT helped your students learn things in physiology that they could not learn without IT? If yes, please give an example. If not, explain the reason.
6. How does IT influence student attitude (satisfaction, motivation, confidence, and wanting to know more)?
7. How does IT influence your students' approach to learning?
8. Does IT help your students become independent learners? Explain.
9. In what ways do you feel that your use of IT helps students judge their own progress toward instructional goals?
10. What are your concerns about the use of IT in physiology education?

Nancy J. Pelaez (College of Natural Science & Mathematics, California State University, Fullerton) has put the taxonomy on the web <http://scied.fullerton.edu/PaliMtTechSurvey.htm>.

In laboratory experiences, active participation of the students was recognized as mandatory, and the use of "cookbook" exercises where students merely follow a series of instructions was rejected as they do not usually engage the minds of the learners. The utility of good laboratories for the acquisition of skills (particularly analysis and evaluation of data) and appreciation of research was recognized but was considered by the discussion participants as

essential for only some courses. Therefore, a careful evaluation of the cost/effectiveness relationship of laboratories was recommended before incorporating them in a course.



At the traditional last night party: featuring national dress

It was suggested that, when available, an assessment of the students' preferred learning styles (such as VARK) in any particular class can be useful in selecting the most effective teaching techniques for the class.

Assessment.

It is well known that learning is generally driven by assessment. Therefore, the assessment of student learning must be aligned with the learning objectives of the course. There are several types of assessments that can be made and each serves a particular purpose. These assessments include the following:

- * Baseline knowledge assessment to test starting knowledge of the learners.
- * Formative assessment, which provides feedback to students as to how well learners are mastering course objectives and allows them to improve their performance
- * Summative assessment to document and certify the achievement of the learners in the course.

The discussion participants recognized that it is not always easy to answer the question "What should be assessed?" because knowledge, competence, behavior, and skills (mental, manual, and communication skills) can all be submitted to assessment. It was concluded that 1) assessment depends primarily on the learning objectives of the course, 2) all the objectives should be evaluated, and 3) the education processes used by the instructor of the course should also be evaluated. It was concluded that not only should student performance be evaluated utilizing a variety of tools but also the effectiveness of course itself should be evaluated.

With respect to the course evaluation-utilizing questionnaires, it was proposed that it is often useful to obtain anonymous student opinions before final student assessment as the results of the evaluation may be biased by the perceived difficulty of the assessment. In addition to student opinion, other systems of assessment of the course should be used. These include peer

evaluation by other teachers, follow-up of the student's performance, inquiry of employers or subsequent teachers, and comparing student performances with national averages on standardized examinations. The accreditation process that is currently being done in some countries for accreditation of departments (teaching and research facilities), teaching faculties, universities, and professional careers was also identified as a type of evaluation for physiology curricula.

Physiology as an independent discipline.

The question was raised as to whether physiology should be taught as a unique course of study or integrated with other courses in medical schools. This is of particular interest and importance as modern medical education has moved (in many countries) toward simultaneous, integrated teaching of all the basic medical sciences. It was generally agreed that the importance of physiology as the primary integrative biomedical science and its relevance to pathobiology and medicine means that the adoption of an integrated curriculum is not generally detrimental to the presentation of physiology. However, strong advocacy is needed on the part of physiologists to ensure that the important unique physiological principles such as those mentioned above are incorporated into the core curriculum and not assumed to be covered due to the pervasive nature of the discipline in the integrated biomedical sciences. Furthermore, physiologists should be vigilant to ensure that the multisystem nature of the human body's responses be appreciated in what are commonly individual organ system organized curricula. Discussants agreed that it is currently not possible to separate physiology from other disciplines such as biochemistry, cell biology, or histology, because all use the same technologies (molecular biology, proteomics, genomics, etc).

It was recognized that although physiology is currently not as "fashionable" as molecular biology or cell biology, its importance to the understanding of medicine is clear and that the application of the new findings of modern biology will require their integration into the physiological knowledge base. Although it was a recognizably biased group, the participants were optimistic about the future of physiology as a discipline both in teaching and research.

Strategies for changing a curriculum.

Before a fundamental change in a curriculum can be initiated, whether for a course, a series of courses, or professional training, the need for that change must be justified. Even if the need for change can be demonstrated, the likelihood of success of new curriculum must be carefully evaluated. It is important to consider many aspects of the proposed change including administrative support, adequacy of facilities, teaching skills of the teachers, consensus for change (colleges, students, and administrative authorities), and financial resources available to accomplish and sustain the curricular modifications. In any case, inadequacies of the current curriculum should be identified to define how to improve it.

It was generally agreed that changes should be supported if they increase student participation in the learning process (increase active learning or student engagement). Any curriculum should be constantly evaluated so that it can be adjusted to the needs of students, faculty, employers, and society. If there is a need to change, the new objectives of the course should be clearly defined. Also, teaching methods and student assessment should be aligned with the new objectives.

In summary, the curriculum should be periodically evaluated and modified accordingly to meet any reasonable changing need.



Party-goers in national dress

4. Issues in classroom teaching

Miriam Frommer, Joyce Ono, Rob Carroll, Britt Wilson, Ian Kay, Iain Coleman, Ian Sefton, Mary Anne Rokitka, Dave Woodman, Yasu Kawai, Rob Kemm, Kirsten Farrand, Barb Goodman, Luke Butler, Adrianta Surjadhana, Jackie Rojas, Sunday Ogwuche

Facilitated by Barb Goodman and Kirsten Farrand.

During introductions, the group shared their interest in participating in this group.

The student-oriented interests were how to:

- engage students
- improve student learning
- retain students in the sciences
- deal with diversity of student expectations for their own learning
- teach students to conduct research

The faculty-oriented interests were how to:

- train effective teaching faculty
- align assessment to learning objectives and pedagogy
- train faculty to facilitate workshops
- train faculty to facilitate PBL sessions
- train future faculty to be good teachers
- “cover” the material with more active learning included

The faculty and student oriented interests were how to:

make lecture classes more active
help students learn how to learn
design and use student evaluations

How do we engage students?

Students are very diverse in what they want out of your class, i.e., some students just want to pass and some seek deep understanding. How can you change student attitudes (by removing grades, designing assignments that are student-driven (more likely to accept the task) and not stick-driven)?

Use VARK (www.vark-learn.com) for students to self-assess their learning styles and best ways to study and explain to the students why you teach the way you do

Using canned interactive learning packages like Brainstorm improved by adding a concept map or summary diagram for the students to synthesize and organize what they learned

Computer-aided learning to complement lectures

10 minute problem in the middle of the lecture to introduce next concept in the lecture – if not graded then it is relatively safe

Use the 30 second rule when asking thought questions in lecture (wait 30 seconds for a response)

Call on students by name but use at least 3 names at a time

Use random attendance checks with some reward as formative assessment

Replace one lecture a week with a case or problem-based activity

During your lecture, give students an experimental question and have them come up with the experimental design and predicted results and how to analyze the results by incorporating potential graphs for the data

Use Princeton style shotgun seminar design – where the students are given a problem or case and told to be ready to present whereby one person is selected at the next class session to present

Other ideas of active learning during lecture time: compare and contrast activities, puzzles and problems, and breaking complex questions into simpler steps and soliciting answers

Can we incorporate student-directed learning by having Powerpoints and textbooks available and have students in a workshop setting answer pre-designed faculty questions?

Engage students by incorporating case analysis from diseases.

Do we value different learning preferences?

Medical students are more homogeneous than undergraduate students and the designing of a class for undergraduates should include more recognition of multiple learning preferences. Thus students can be sent to www.vark-learn.com and report their preferences back to the class. One needs to understand how the students think and design the course appropriately.

How do we use handouts?

Handouts were discussed and how they are used. Are they passive vs active, details vs summaries or outlines? Some give Powerpoints before lecture and annotated Powerpoints after lecture. How do we get the students to realize that taking notes themselves is a good learning technique?

How do we choose and use a textbook?

Do we assign readings from the textbook and how do we encourage the students to do the readings (carrot vs. stick?) Should highlighters be banned!? In the PBL setting if students

have different textbooks, it is good because they share their information in different terminology and learn better from each other.

How do we deal with student retention?

Why do students leave during first year and what is an acceptable percentage failure for first-year biology courses? How do we convince our business offices that the students should be failing and/or dropping out at a rate of 20-30% in introductory biology courses? First-year seminar courses are designed to help the students adjust to college life. For social adjustment they can live in community or faculty can form working groups in the courses. Some institutions allow trying out a course before final enrollment. Observe students in action and what they are doing and how they are learning. There needs to be some linking of K-12 requirements to post-secondary requirements. Survey students early in course to see what their career goals are and design activities to address. Low end science students are where we need to increase engagement. Determine how the course is relevant to them: use cases, use articles and graphs from the current news and current ethics issues related to them, be sure to allow the students to argue from all sides in biomedical ethics activities and have in class discussions of others opinions or online discussions, use humor to increase the comfort level of the class, in choosing lab activities, be sure to choose labs that teach concepts that are relevant to student career choices (clinical emphasis for med students) or real-life research to teach the process of scientific investigation.



Party-goers

At Adelaide University (Australia) students do a mini-research project including a presentation, using themselves as human subjects during year 2 and work in a research lab for an entire year during year 3 and then if honors students work an additional year doing an honor's thesis – this can be a major problem with logistics and staffing and reasonable time requirements should be established. After more formalized teaching of research skills, one can give an exam where the student needs to design an experiment and predict results. Wherever possible lab activities should be correlated with lecture (the K of VARK: Visual, Auditory, Read-write, Kineasthetic; introduced to participants in Lincoln). Begin development of research skills with guided inquiry. Labs (practical exercises) can be very useful with little equipment but you still need space and staff. Learning outcomes should include both content-led and process-driven knowledge and skills, one should also evaluate problem-solving skills.

How do we train Teaching Assistants?

- regular tutor-training meetings on a weekly basis
- workshops on ethics of research and potential class problems
- an induction session of a full week before classes start
- on the job observation and feedback or a practice teaching session with videotape
- specific training for the lab
- how to ask effective questions and not be an imparter of knowledge

All those teaching in a certain curriculum should have regular casual meetings to share ideas and problems related to teaching informally and this should be counted as teaching time. At www.the-aps.org there are numerous resources for skill training for future faculty and for approaches to education at all levels.

How do we deal with student expectations as to what should be in the course and how demanding it might be?

It is helpful if the faculty member is of the chosen profession of the student or knows about the requirements of the profession so that students feel more confident in what they are learning (med school faculty member teaching premeds).

Do faculty who use active learning shine with the students and do colleagues notice?

New faculty and grad students should be encouraged to observe other faculty to glean teaching ideas. Institutions have some required peer evaluation of non-tenured faculty like East Carolina where 3 times during the non-tenure period two senior faculty observe teaching and give constructive criticism – report is put in tenure packet. Peer evaluation visits may be announced or unannounced. Faculty can also do self-evaluation of videotaped lecture which may be very painful!

How do institutions recognize the scholarship of teaching and educational research?

It is helpful if the promotion and tenure guidelines have a broad definition of scholarly activity still one needs to submit an evidence-based teaching portfolio that incorporates educational research and grant-writing not just innovative curricular design. One should add reflections and responses to suggestions from students to one's teaching portfolio with references that document one's understanding of the educational literature, recognition outside one's institution is also helpful (or being involved in the IUPS Teaching Workshop in a leadership role), and certificates are also useful.

How are student evaluations used?

Students can be asked to evaluate courses and individual faculty.

Student evaluation feedback issues for faculty evaluations:

- value of individual student criticisms is often overemphasized by deans
- online vs. paper
- ask for input on specific components/activities in the course
- standardized vs. flexible
- let students know that changes have been made as the result of evaluations
- use multiple forms of evaluation

There are major cultural differences in acceptance by faculty of student evaluations of their teaching. Bribe students with pizza to fill in evaluations. Use of Participant Perception Indicator (see Nancy Pelaez) that allows students to evaluate pre, post, and mid in a course based on the objectives of the course.

Student Assessment of Learning Gains survey available on the web from the University of Wisconsin at Madison. Formative evaluation should be used frequently with feedback to the

students. Student self evaluations may be useful in formative evaluations. When should evaluations be scheduled and how to get them filled in? Consider giving significant time during the course (15 min) BEFORE the lecture starts. Use WebCT and do not release the student's grade until the evaluation is done.

How do we help other faculty become more effective teachers?

Informal discussions around a meal. Involvement of administrative or course director support to change way of teaching or be removed from the course. Have course directors evaluate teaching of all members of faculty team and evaluate student learning on systems via a shelf standardized exam. How do we give credit to faculty for participating in faculty development (particularly in teaching). Signing up for IAMSE webinars at www.iamse.org – monthly internet seminars available for teachers of medical students.



The traditional historical record: Jenolan (1983) Survivors

Note: the tradition of a lively party has been established on the last night of each teaching workshop: celebrating the participants' commitment and achievements. Photographs at Pali record those who attended each of the earlier workshops. Jenolan Caves (NSW Australia) was the first. The photographs provide an enduring record of loyal contributors and lasting friendships.

How are PBL facilitators trained?

PBL facilitator training includes: how to facilitate and ask probing questions, specific problems that might occur with the case, complete tutor guides, lots of role-playing of various levels of PBL groups. In addition, faculty can be encouraged to use resources from Centers for Teaching and Learning to strengthen their skills in teaching. Use of videos about small group management with good and bad facilitation can be useful to introduce to faculty. Who can facilitate PBLs? clinicians, basic scientists, PhD students, retired faculty, advanced students – when tutors are paid then they are more likely to participate and be prepared. Best way to learn how to do PBL is to visit an institution where it is being done and observe the groups in action, PBL facilitators are REQUIRED to attend the training. Maybe there should be a PBL demo on the stage at FAOPS and there should also be a keynote presentation to all participants on educational theory to show how it works.

How do we deal with assessment?

Use of multiple choice vs. essay questions, evaluate generic skills like critical thinking with short answers and essays, analytical writing, presentations, models; 10% questions on exam never seen before for naïve problems, assessments should match the question format that the students are familiar with, marking calibration workshops for the TAs prior to grading assignments for a course, have an outside expert analyze the exam for accuracy and relevance to the field, have the students revise and resubmit papers, use student peer marking – use Calibrated Peer Review through the UCLA website or faculty need to look over peer reviews by students, use standardized exams that are externally constructed and nationally calibrated, rewrite original articles from popular press, students should get a chance to practice answering exam questions like the clinical vignettes of the USMLE Part I, oral interviews would be useful but are currently rarely used, self assessment tools and exams help students know areas of strength and weakness and the limits of their knowledge, in-class quizzes do the same, pre/post test for evaluating student learning in each section of the course.

Other than exams what other techniques are used: poster presentations, other types of presentations on web or for the community, contributions to the PBL group, literature reviews, lab reports, community service reports, job experience

How do we determine what content to include and what not to include?

If no external curricular guidelines, depends on skills and interests of the faculty, what is fun for the faculty and students, relevance to the student career goals, sacrifice rote facts for concepts so that students are told to learn certain facts on their own, use common diseases and more difficult concepts to present to the students, list objectives at the beginning and again at the end of the lecture, follow core curricula if one is available and use it as a good quality control for the curricula.

3. CURRICULUM PLANNING AND DESIGN

Facilitators: Beatriz Ramirez and Bill Galey

Participants: This track was attended by 13 individuals from 7 different countries.

This is a report of the main points discussed over the course of the workshop. Essentially, all final conclusions were the consensus of those present. While it is difficult to accurately convey the course of discussion, the subtleties of meaning, and the mood of the discussions, we hope this rough outline provides the reader a sense of the exciting discussions that took place.

After an initial brainstorming session, five main topics were identified for further discussion. These were the following:

1. Learning objectives
2. How do we teach to achieve our learning objectives?
3. Assessment of students and out teaching
4. Is physiology an independent discipline?
5. Strategies for changing a curriculum

Although we are unable to reconstruct the complete sequence and content of the discussion, we outline here the principle issues discussed and general conclusions reached within each of the five topics. They are presented here in the order in which they were discussed.



Kuopio (1989) Survivors

Learning objectives.

It was agreed that general and specific learning objectives must be included in each course's curriculum. However, every course will have different specific objectives determined by the interests and needs of the students enrolled in the course (biology, zoology, dentistry, medicine, etc.) or their academic level (basic, professional school, graduate, postgraduate, etc). However, it was concluded that there are some general principles that should be found in all physiology courses. While not all of the objectives were addressed completely, the following general objectives were considered essential for any physiology course:

1. Learning should be applicable to the students' daily life or career. (This increases comprehension and facilitates the learning process.)
2. Understanding the main (basic) themes (basic concepts such as homeostasis and control of processes must be learned by all students).
3. Understanding that body systems are not functionally isolated is also core to all physiology courses. Despite usually being studied sequentially and separately, they function as an integrated whole to maintain body homeostasis.
4. Students must be challenged to learn to process and integrate information because useful learning in physiology is more than an accumulation of information. Participants discussed how students must process the new information and integrate it with their previous knowledge to construct their own understanding as to how the body functions.
5. Every physiology course should provide opportunities to analyze and evaluate both learned information and physiological data. It was agreed that data analysis provides a different learning modality than the evaluation and integration of the conceptual information. Searching for useful information in the literature, in one's own fund of knowledge, or in other resources that are relevant to a challenging physiological problem was not only considered a unique learning tool but also an exercise worthy to be considered a course objective.



Inverness (1992) Survivors

How do we teach to accomplish our learning objectives?

The main target for an effective learning process is the intellectual engagement of the student. Among the approaches discussed that were believed to achieve that goal were active or student-centered methodologies such as problem-based learning (PBL), inquiry, and self-directed learning. A more unusual but exciting approach is the development of models to explain sets of physiological observations. It was also agreed that it is particularly useful to use examples in lecturing that are applicable to students' daily lives as was helping students to consolidate their understanding by posing interesting problems (questions) that require the use and integration of their knowledge.

The participants agreed that engagement of students can be attained through a great variety of teaching modalities, including lectures, practical laboratories, group-based/peer learning, case-based/PBL, tutorials, consultation time, computer-aided learning, and one-on-one interactions. Not one of these approaches was rejected. Moreover, it was considered that "mixed teaching modalities" are good for maintaining the interest (and also the engagement) of the students over a long period of time. However, it was emphasized that active participation of the students was a "must," even in lectures. In this connection, lecturers should recognize that after few minutes of even the most engaging lecture, the audience's concentration decreases. Therefore, lecturers should apply teaching tools to maintain the students in an "active learning" state throughout the lecture period.

In laboratory experiences, active participation of the students was recognized as mandatory, and the use of "cookbook" exercises where students merely follow a series of instructions was rejected as they do not usually engage the minds of the learners. The utility of good laboratories for the acquisition of skills (particularly analysis and evaluation of data) and appreciation of research was recognized but was considered by the discussion participants as essential for only some courses. Therefore, a careful evaluation of the cost/effectiveness relationship of laboratories was recommended before incorporating them in a course.

It was suggested that, when available, an assessment of the students' preferred learning styles (such as VARK) in any particular class can be useful in selecting the most effective teaching techniques for the class.

Assessment.

It is well known that learning is generally driven by assessment. Therefore, the assessment of student learning must be aligned with the learning objectives of the course. There are several types of assessments that can be made and each serves a particular purpose. These assessments include the following:

- * Baseline knowledge assessment to test starting knowledge of the learners.
- * Formative assessment, which provides feedback to students as to how well learners are mastering course objectives and allows them to improve their performance
- * Summative assessment to document and certify the achievement of the learners in the course.

The discussion participants recognized that it is not always easy to answer the question “What should be assessed?” because knowledge, competence, behavior, and skills (mental, manual, and communication skills) can all be submitted to assessment. It was concluded that 1) assessment depends primarily on the learning objectives of the course, 2) all the objectives should be evaluated, and 3) the education processes used by the instructor of the course should also be evaluated. It was concluded that not only should student performance be evaluated utilizing a variety of tools but also the effectiveness of course itself should be evaluated.



1999 Repino Survivors

Physiology as an independent discipline.

The question was raised as to whether physiology should be taught as a unique course of study or integrated with other courses in medical schools. This is of particular interest and importance as modern medical education has moved (in many countries) toward simultaneous, integrated teaching of all the basic medical sciences. It was generally agreed that the importance of physiology as the primary integrative biomedical science and its relevance to pathobiology and medicine means that the adoption of an integrated curriculum is not generally detrimental to the presentation of physiology. However, strong advocacy is

needed on the part of physiologists to ensure that the important unique physiological principles such as those mentioned above are incorporated into the core curriculum and not assumed to be covered due to the pervasive nature of the discipline in the integrated biomedical sciences. Furthermore, physiologists should be vigilant to ensure that the multisystem nature of the human body's responses be appreciated in what are commonly individual organ system organized curricula. Discussants agreed that it is currently not possible to separate physiology from other disciplines such as biochemistry, cell biology, or histology, because all use the same technologies (molecular biology, proteomics, genomics, etc).

It was recognized that although physiology is currently not as “fashionable” as molecular biology or cell biology, its importance to the understanding of medicine is clear and that the application of the new findings of modern biology will require their integration into the physiological knowledge base. Although it was a recognizably biased group, the participants were optimistic about the future of physiology as a discipline both in teaching and research.



Lincoln Survivors

Strategies for changing a curriculum.

Before a fundamental change in a curriculum can be initiated, whether for a course, a series of courses, or professional training, the need for that change must be justified. Even if the need for change can be demonstrated, the likelihood of success of new curriculum must be carefully evaluated. It is important to consider many aspects of the proposed change including administrative support, adequacy of facilities, teaching skills of the teachers, consensus for change (colleges, students, and administrative authorities), and financial resources available to accomplish and sustain the curricular modifications. In any case, inadequacies of the current curriculum should be identified to define how to improve it.

It was generally agreed that changes should be supported if they increase student participation in the learning process (increase active learning or student engagement). Any curriculum should be constantly evaluated so that it can be adjusted to the needs of students, faculty, employers, and society. If there is a need to change, the new objectives of the course should

be clearly defined. Also, teaching methods and student assessment should be aligned with the new objectives.

In summary, the curriculum should be periodically evaluated and modified accordingly to meet any reasonable changing need.



“Newbies”: first-timers to an IUPS teaching workshop