Report

REFRESHER COURSE ON INTERDISCIPLINARY APPROACHES IN BIOLOGY

A Refresher Course on ‘Interdisciplinary Approaches in Biology’ for postgraduate college and university teachers was held at the Centre for Cellular and Molecular Biology, Hyderabad for a two-week period during 25 May – 8 June 2005.

Biological research today has reached a very exciting stage. Traditionally specializing in a particular field has been the rule. Now a "biologist" not only requires a wide repertoire of knowledge in different fields of biology, it also helps to have a fairly strong background in physics, chemistry, mathematics, and some aspects of engineering. Additionally it facilitates collaborating with other scientists who were trained in different disciplines, if one learns to communicate with its practitioners at an early stage in their careers and appreciate the contributions that each discipline can make to biology.

Modern biology uses concepts and methods from other sciences to elucidate the working of life processes. Measurement and analyses of biological data employ quantitative methods from physics, chemistry, engineering, information technology, mathematics and statistics. Prediction and description of life processes also make use of concepts from other disciplines. This course was envisaged to introduce biology teachers to some of these aspects in relation to specific biological problems. The aim was to expose them to the interdisciplinary nature of modern biology with lectures, tutorials, hands-on problem-solving sessions, and laboratory demonstrations.

This Refresher Course attempted to prepare the biology teachers at the postgraduate level (who train our future generation of biologists) for teaching the new biology that is increasingly becoming interdisciplinary encompassing many fields within and outside biology. The hope is that the course has been able to transfer at least some of the excitement of interdisciplinary studies in modern biology to the participants who in turn would be able to pass on the same through their teaching to their students.

1. About Selection and Participants:

We received 112 applications, and finally selected 31, i.e., 28% of the total. About 40% of the applications were from Tamil Nadu, and only one from the North-East India.
The three primary criteria for selection were - (i) age below 45 (except one local participant), (ii) all India representation, and (iii) representation of a variety of topics in Biology taught by the participants. Of the 31 teacher participants selected, 23 were males and 8 females. The age ranged from 47 to 27 years, with an average of 37 years. Finally 27 teachers registered (Male - 20, and Female - 7). Of the 27 participants more than 50% belonged to the age group of 36-40. *Enclosure 1* gives the list of participants with address and email ID.

The following two Tables give the summary of the participation from (a) different states of India and (b) the subjects taught by them.

(a) **Geographical distribution of the Participants:**

50% participants were from the Southern States.

<table>
<thead>
<tr>
<th>Andhra Pradesh</th>
<th>Tamil Nadu</th>
<th>Karnataka</th>
<th>Kerala</th>
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* 4 local participants.

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(b) **Participants’ fields of teaching**

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<th>Biotechnology</th>
<th>Plant Biology</th>
<th>Microbiology</th>
<th>Zoology</th>
<th>Computational Biology</th>
<th>Biostatistics</th>
<th>Biophysics</th>
<th>Chemistry</th>
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<th>Cell Biology</th>
<th>Molec. Biology</th>
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2. **Accommodation, Food and Special Programmes**

All out-station participants were housed in CCMB guest house on twin-share basis from May 24 to June 9, 2005. There were four local participants, one of whom stayed in the CCMB guest house as she was finding it difficult to travel everyday. Breakfast, and special lunch and dinner were arranged by the CCMB Canteen. Tea, coffee and biscuits were given 3 times a day (11AM, 4PM, and 6PM) in between the sessions. Special high tea were organised twice - after the inaugural session and before the valedictory session. One Special Dinner was organised on June 6th where the participants met all those who helped in the organisation and the local faculty members.
On the request of the participants, a meeting was organised with the present Director Dr. Lalji Singh and another with Dr. P.M. Bhargava, former director, CCMB. The participants enjoyed discussing many scientific topics starting from IPR to scientific temper to social obligations of the teachers and scientists. There were two Sundays in this period, but one Sunday (May 29th) was devoted to the Bioinformatics classes. After the whole day session, CCMB Club organised a one-hour cultural programme featuring dance, music and other entertainment by the CCMB staff children. A whole-day city tour was organised on the next Sunday (June 5).

Given the background of the teacher-participants, we decided to spend some effort and contacted Oxford (OUP), Cambridge (CUP) and Universities Press (UP) to display their scientific books through a renowned local book-seller, and organised a scientific book exhibition-cum-sale at CCMB Central Court on June 3, 2005. The participants were allowed to choose books from there and we supported their purchase up to the amount allowed by the Academy. This was a great success as the participants were very happy to get what they wanted and not what we wanted. Of course, we all at CCMB also enjoyed browsing through books and buying for ourselves.

3. Material given during Registration and later:

Given the nature of the topic, we planned to give sufficient reading material related to the course to the participants. We gave the participants a bag with copies of "Resonance", IAS flyers about journals, one past issue of Current Science that had a special section on "Modelling Biological Systems", the annual report of CCMB, copies of the Hindi science magazine "Jigyasa" brought out by CCMB, one 5 subject note book and a pen. We also gave a 325 page Workbook entirely designed, printed, photocopied, and spiral-bound at CCMB. This Workbook contained material given by the faculty (see Enclosure 2 for the contents). They were requested to give lecture notes, reading material, web addresses where teaching and learning resources may be available, and list of books and related journals. Most responded positively but some did not. We also made CDs of the Workbook for those who wanted it in that form. We also made a CD containing the lectures of those who allowed us to take copies of their slides, a short profile of the faculty along with their address, list of emails of the participants, and some experimental details on how to culture Drosophila easily in the laboratory for demonstration. At the end of the course we gave this CD and a copy of the Group Photograph along with the Participation Certificate to all. These were presented to the
participants by Prof. Subhas Chaturvedi, member, IAS Education Panel on the Valedictory session.

4. The Programme:

Much thought went into designing this course for biologists. Trained as a physicist and working in a modern biology laboratory instigated me into doing this refresher course as I realised that even though biology today uses concepts and methods extensively from other sciences, the students being trained in biological disciplines are still far from having an interdisciplinary outlook. It is clear that measurement and analyses of biological data employ quantitative methods and experimental methods make use of concepts from other disciplines through high end instrumentation and technology. We felt that it is the teachers who have to impart the interdisciplinary outlook to their students and hence this Refresher course.

The course was divided into five modules -

(i) Evolution, Ecology, Biostatistics, Biomathematics, Bioinformatics
(ii) Genome Organisation and Genomics
(iii) Protein Structure, Function and Proteomics
(iv) Development
(v) Special topics

We requested the faculty to plan their lectures keeping in mind the background and activity of the participants. We specifically told them that these should not be research talks and should aim towards enhancing the value of teaching the subject. The Faculty were also expected to highlight the use of multiple disciplines in describing a biological concept and in related methods and instrumentation. The programme (Enclosure 3 and 4) was planned with four major sessions. The morning two sessions were for lectures on the topic and two afternoon sessions were for laboratory demonstration, computer hands-on training and follow-up lectures. Generally the participants continued after 6PM and also came back later after dinner to download material from the web and practice what was taught on that day.

All lab sessions were done in the respective scientists' laboratories, and the computer sessions were held in a training area in the Bioinformatics Section of CCMB where we had rented 15 computers (Pentium IV machines with high speed internet connectivity). The participants were divided into 13 groups (two each). The training area had projection facility and white board useful for teaching. The computer facility was
managed by Dr. C. Suguna, Scientist with a team of 8 students who assisted the participants in their hands-on sessions also (as many biologists were not very easy with computers).

All classes were held to completion and there was no absence from both the faculty and participants side. Few of the faculty who could not give the reading material in time, distributed them before their classes. The Special topics were chosen based on the contemporariness of the area and the role of many disciplines in its advancement. There are still many topics that should have been covered (e.g., Nanobiology, Spectroscopy, Infectious diseases, Mathematical modelling). There were 12 Fellows and one Associate among the faculty. Enclosure 5 gives the list of faculty and their addresses.

The mathematical, computational and experimental techniques that were demonstrated and hands-on experience were imparted in groups were -

1) Biostatistics,
2) Simulation and plotting using simple software (EXCEL),
3) Bioinformatics, 4) Transgenic laboratory, 5) Microarray facility,
6) Software for Phylogenetic Analysis,
7) DNA Sequencing facility and software,
8) Protein purification and Mass Spectrometer,
9) Structure Determination Methods and X-ray Crystallography facility,
10) Drosophila culture and mutant screening methods.

Over and above these, the participants themselves arranged to visit the Pisciculture facility and the Fluorescence Activated Cell Sorting (FACS) facility.

The formal lectures of the Refresher Course ended at 4PM on June 8th. The Valedictory function was held after that where Prof. Subhash Chaturvedi, Education Panel member of the IAS addressed the Participants about the different programmes in the Education Initiative of the IAS, and then presented the Certificate of Participation to them. Dr. Lalji Singh, Director, CCMB was also present in the programme, and addressed the participants. One representative from the participants gave their comments about the Course. The Course was closed with thanking all those who made the course a success (see Enclosure 6).

The participants were paid their TA on June 7th and their feedback obtained about the course. The general feeling was that the experience has given them tremendous benefit, as now they understand what they teach much better after seeing the techniques and understanding the concepts behind them. The good thing about choosing younger
participants was that they were very eager to learn and had lot of energy to work almost continuously for two weeks. They were quite interactive and were impressed by the faculty who made it a point to answer all their questions and interact a lot with them during off hours.

**Comments**

There is general concern in academia about the standards of teaching and the quality of the syllabus in Science. Dozens of reports have been published on educational reform in recent years all over the world. But publishing reports is not enough. The Indian Academy of Sciences (IAS), Bangalore has made several important steps towards this through its Education Initiatives. This Refresher Course on *Interdisciplinary Approaches in Biology* was sponsored by the Academy. The Centre for Cellular & Molecular Biology (CCMB), a national laboratory under the CSIR, is a premier multi-disciplinary research organisation committed to do both research in modern biology and train people in advanced areas of biology by providing exposure to its excellent facilities. CCMB took the responsibility of organising this course and provided all its facilities for the teacher-participants with the hope that the exposure to the frontier areas of research would add to their teaching and laboratory skills. Though two weeks is not enough for learning all that was included in the Refresher Course, our hope is that this will act as catalyst to some teachers to teach biology with a different perspective. My general feeling is that all the Institutes, Research Centres, and Departments, which have good facilities and expertise, should utilise those once in a year to share the knowledge with the teachers and students from lesser-equipped places. That would be some fair utilisation of the resources that scientists and researchers are endowed with government funds.

_Somdatta Sinha_

(Somdatta Sinha)  8/7/2005

Course Director

*REFRESHER COURSE ON INTERDISCIPLINARY APPROACHES IN BIOLOGY*

Centre for Cellular & Molecular Biology

Uppal Road, Hyderabad 700 007, AP
## Enclosure 3

### Short Programme

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<td>D. Balasubramaniam</td>
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<td>J. Nagaraju</td>
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<td>Lalji Singh</td>
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<td>Closing Ceremony (Subhas Chaturvedi)</td>
</tr>
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</table>
Enclosure 5

Course on
Interdisciplinary Approaches in Biology

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C. Suguna, K. Thangaraj
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