# SPS4

## Effective Teaching and Learning of Astronomy

*Chairperson:* J.R. Percy

*Editor:* J.R. Percy (Chief-Editor) and J. M. Pasachoff

https://doi.org/10.1017/S1539299600017998 Published online by Cambridge University Press

*Highlights of Astronomy, Vol. 13*
*International Astronomical Union, 2003*
*O. Engvold, ed.*

# A Short Overview of Astronomical Education Carried Out by the International Astronomical Union (IAU)

Syuzo Isobe

*National Astronomical Observatory*
*2-21-1, Osawa, Mitaka, Tokyo, Japan*
*E-mail: isobesz@cc.nao.ac.jp*

## 1. IAU Commission 46 "Astronomy Education and Development"

The IAU is a union of professional astronomers who produce new astronomical results and who make the frontiers of astronomy expand. However, the IAU cannot stand by itself but needs the support of governments as well as the people. This is one reason why the IAU set up Commission 46 – originally called "Teaching of Astronomy" and renamed "Astronomy Education and Development" with much wider mandate in 2000 – to cover astronomy education from the level of beginners to that of post-doctoral students.

There are currently 9 "program groups" (PGs). Because of the limited budgetary resources of the IAU, it is hard to cover all the fields which our Commission would like to target. The "National Liaison" PG communicates closely with the Organizing (Executive) Committee members as well as the regular members by producing national reports from individual countries every three years. All the commission activities and some related activities are communicated to the members and other people interested in astronomy education mainly through electronic mail but in some special cases in print, by the "Newsletter" PG.

The "Solar Eclipse" PG holds public lectures related to each individual total or annular solar eclipse and informs people how to look at the eclipse safely. For a country and especially a developing country intending to develop astronomy and astronomical education it is important to have at least one but preferably several science (mainly physics) professors in that country who have a strong motivation to develop it. The "Worldwide Development of Astronomy" PG tries to find such professors through different channels. Once this PG identifies some specific country, such information is sent to the "Teaching for Astronomy Development" PG which starts to send lecturers to that country for several weeks or months, and to invite students from that country to an institute in a developed country carrying out high-level astronomical research. Those students are expected to promote astronomical education in their countries when they return.

In developing countries, there is only one or a few professors, and their astronomical fields are very limited. To give graduate students and young astronomers a wider perspective, the "International Schools for Young Astronomers" PG organizes schools in each region. The schools started in 1967 and 26 schools had been held by 2003. If a young astronomer wishes to do research at a specific institute in another country, the "Exchange of Astronomers" PG supports his/her travel costs. Since the Commission's budget is limited, the "Collaborative Group" PG seeks ways to carry out activities in collaboration with other

organizations. The "Exchange of Books and Journals" PG arranges to send surplus books and journals to developing countries where they can be used.

Unfortunately, our PGs do not directly include astronomy education in school. I, as the Commission 46 President on July 25 2003, hope this special session will be a trigger for a future new program group.

## 2. To Whom Should Astronomy Be Taught?

In recent decades, the development of astronomy has been so rapid, and because of new interesting discoveries many people seem to have an interest in astronomical phenomena. However, in most cases they are interested in this information but, because of a shortage of astronomical and physical knowledge their understanding may not be correct.

Over 10 years ago, I presented a diagram showing what fraction of people was interested in what level of astronomy for the case of Japan (Isobe 1991). There are 7 categories: (A) Approximately 100 people produce useful astronomical data; (B) Approximately 1000 people observe frequently; (C) Approximately 10,000 people observe occasionally; (D) Approximately 100,000 people read astronomical magazines; (E) Approximately a million people read general science magazines; (F) Approximately 10 million people read science articles in newspapers; (G) Approximately 100 million people have no interest in science at all. Our target is certainly not a case of a totally opposite distribution to the Japanese case, but one in which most people will read astronomical and scientific magazines. It is difficult to have such a large fraction of people interested in astronomy through public education, but it should be taught through education in schools where nearly everyone studies.

Frequently, I hear from good amateur astronomers, and from school teachers who are interested in astronomy, that one should watch stars because of their beauty. It may be true for them, and for specific pupils, but there are people who on one hand love stars but others, on the other hand, love the beauty of a flower. What we should understand is that it is a matter of hobby for individual people to say "I love and/or enjoy watching stars or flowers" but this is not the same as real understanding of sciences such as astronomy and biology. If one can train people to understand sciences, especially physical sciences, those people often have the ability to understand and evaluate environmental issues.

## 3. How Should Astronomy Be Taught?

There are several types of countries in the teaching of astronomy. In some countries, astronomy is compulsory in the school curriculum, but in other countries pupils can choose from physics, chemistry, biology and earth science. For the latter case only a small fraction of pupils (less than 10%) choose earth science including astronomy. The third way is to teach integrated sciences by considering that all daily phenomena cannot be explained without combining different kinds of sciences.

In order to go the third way, I proposed to teach stories connecting all the related sciences, depending on pupils' grade and ability (Isobe 2000). As an example we can show areas and volume in physics, explosion energy in chemistry,

evolution of life in biology, and asteroids in earth science; under a story title of "dinosaurs" we can produce different stories. To proceed this way in an effective manner, it is important to include some number of well-prepared exercises. Otherwise pupils just listen to the teacher's stories but can seldom catch the stories' target from a scientific point of view.

As such examples, we developed two exercises; the first one is evaluation of light energy loss (Isobe et al. 2001) and the second one is asteroid detection software (Isobe et al. 2002).

One other important issue to be carefully considered is that the development of science, especially astronomy, is so rapid. Therefore, depending on those new discoveries and also those expositions in newspapers, pupils' interest is changeable and we have to develop new stories continuously. This is somewhat complex and time-consuming work, but is inevitable work for future generations.

There are different national and international studies such as by the United Nations and the Organization of Economic Cooperation and Development to compare pupils' achievement, especially physics and sciences within different countries. However, nearly all the participating countries use those results to improve their ranking, and try to introduce an educational system which is carried out in countries with high ranking without deep consideration of differences of culture, history, and nationality.

## 4. Conclusion

Education systems are different from country to country and even if a good education system may be introduced in some countries its real results will emerge only after several decades. Therefore, at each time, we have to communicate with each other closely. I repeat that I hope that this special session will be a trigger, and that a number of participants will try to set up a new PG of Commission 46 to communicate more extensively with other education organizations.

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