

SCIENCE IN INDIA

ACHIEVEMENTS AND ASPIRATIONS

75 Years of the Academy

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SCIENCE OLYMPIADS

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INTRODUCTION

The Olympiads, like the Olympics, are international competitive events. However, these are related to academics and not sports and the Olympiad events are organized annually and separately for each subject. Teenage students, reputedly the best young minds of their nation, from across the globe, assemble for about ten days at a pre-determined location every year. They are presented with challenging problems of sterling academic standards. In many ways the Olympiads represent a celebration of the best in high school and pre-college science.

The Olympiads for Physics, Chemistry, Biology, Mathematics and Senior Astronomy are pitched at the higher secondary school level while the Junior Astronomy Olympiad is open to high school students. There are age limits and conditions that the participating students should not have entered the University system. Based on their performance they are awarded medals: gold, silver, bronze or some honours/special prizes. The science and mathematics Olympiads are conducted in a very democratic and transparent way. All the participating countries have equal rights in the international jury sessions for approving the tests just before they are administered to the students.

India made a late entry into the Olympiads. It started participating in the International Mathematics Olympiad from 1989 whereas the event has its beginnings in Eastern Europe in 1959. The involvement with the Science and Astronomy Olympiads began a decade later: in physics from 1998, in chemistry and astronomy from 1999, in biology from 2000 whereas these events have been organized since 1967, 1968, 1998 and 1990 respectively. The Homi Bhabha Centre for Science Education (HBCSE) is the nodal centre for the Olympiads and the effort leading to international participation is organized mainly from HBCSE. The first

stage of the Olympiad programme is, however, organized by a well-known voluntary teacher association – the Indian Association of Physics Teachers (IAPT). HBCSE houses special Olympiad laboratories in physics, chemistry, biology and astronomy, where new experiments are continually designed, developed and standardized. These innovative experiments can be valuable inputs in improving undergraduate science laboratories of the country. The early successes of Indian teams have helped in the rapid consolidation and strengthening of the programme. India has hosted the International Olympiads in Mathematics (1996), Chemistry (2001), Astronomy (2006) and Biology (2008).

THE SELECTION PROCESS

The Olympiad selection procedure at HBCSE has now been standardized. Briefly, for science and astronomy Olympiads, it consists of a five stage process. IAPT conducts the first stage with support from emerging teachers associations in Chemistry and Biology, and till 2006 the National Council of Science Museums (NCSM). This stage, called the National Standards Examinations (NSEs), conducted in over 900 centres all over the country, has mainly objective type questions. The second test conducted at about 15 centres, is descriptive with subjective problems of high difficulty level comparable to the international Olympiads. This constitutes the Indian National Physics/ Chemistry/ Biology/ Astronomy) Olympiads Examinations (INPhO, INChO, INBO and INAO), respectively. While the participation in the first test runs into almost a hundred thousand (in the year 2007, about 36,000 in Physics, 28,000 in chemistry, 10,000 in biology and 15,000 in astronomy), approximately the top 300 students in each subject participate in the second test. About forty students in each subject are selected from the Indian National Olympiad examinations and are invited for Orientation-Cum-Selection Camps (OCSC) held at HBCSE. Students appear for several rigorous theoretical and experimental tests leading to the selection of Indian Teams for the International Olympiads. The selected teams for international Olympiads again go through about two weeks of pre-departure training (IO-PDT) at HBCSE. Table I summarizes the selection process for the Science and Astronomy Olympiads.

Table I: The Road to the International Olympiads

Stage.	Exam	Duration	Date	Participants	Association
I	NSE P/C/B/A	~ 2 hours each	November	36,000/ 28,000/ 10,000/ 15,000	IAPT
II	INO P/C/B/A	~ 4/4/2/2 hours	January end	300 each	HBCSE
III	OCSC	2 weeks	May-June	40 each	HBCSE
IV	IO-PDT	2 weeks	June	5/4/4/6	HBCSE
V	IO	10 hours over 10 days	July	100 – 400	International Olympiad host country

The symbol ‘~’ means “approximately”. The symbol P/C/B/A stands for ‘Physics / Chemistry / Biology/ Astronomy’. The other acronyms are described in the text. The participation numbers are for the year 2007. Except for Stage I the remaining stages of the Mathematics Olympiad are similar to the description in the above Table.

A similar pattern of selection and training is followed by HBCSE in mathematics under the aegis of the National Board of Higher Mathematics. The first stage of the program consists of the Regional Mathematics Olympiad (RMO) where a centrally designed test is conducted at about 24 regional centres in India. The remaining stages are similar to the stages described in Table I.

The International Olympiad is spread over seven to ten days. It is held annually and in a different location every year. It is the obligation of the host country to provide hospitality to the participants. Keeping in mind that the assembled students are likely to be the future scientific leaders of the country the host country showcases its best in terms of its culture, cuisine and science. Our students are accompanied by two delegation leaders. For the past few years an additional observer has accompanied the team. The leaders and the observer are subject experts and provide guidance and counseling to the students. They also act as jury members and partake in deliberations on the competitive tests as well as in policy matters. The students in the Science and Astronomy Olympiads have to take both theoretical as well as experimental tests typically stretching for several long hours. The tests are of exceptionally high quality and designed to test competence and creativity. Unlike many competitive tests in India these are not “speed” tests.

THE INDIAN PERFORMANCE

The students who are selected for the OCSC are some of the brightest in the nation. They are often the toppers of the board and the professional (engineering and medical) entrance exams. It is worth mentioning that despite our late entry into the Olympiads almost all participating students in the Science and Astronomy Olympiads have won medals at the international Olympiads including the coveted gold medals. Like the sports Olympics, nations are not officially ranked in the Olympiads. However, based on aggregate scores, India is generally among the top ten nations in the Physics, Chemistry, Biology, and Astronomy Olympiads. Table II encapsulates the medals tally of the Indian teams since 2000.

In the year 2007, India ranked 6th among 70 nations in International Physics Olympiad, 8th among 68 nations in International Chemistry Olympiad, 5th among 49 nations in International Biology Olympiad, 3rd among 24 nations in International Astronomy Olympiad and 25th among 93 in International Mathematical Olympiad. It is difficult to quantify the cumulative performance. Even so, a cumulative performance index

for physics was proposed by Waldemar Gorzkowski, chairperson, International Physics Olympiad Committee. According to this cumulative index, India ranks seventh in physics olympiad performance worldwide.

Table II: INDIAN PERFORMANCE IN OLYMPIADS

2000 - 2007

	2000					2001					2002				
	G	S	B	HM	Nations	G	S	B	HM	Nations	G	S	B	HM	Nations
Physics	2	-	2	1	64	3	2	-	-	65	1	4	-	-	67
Chemistry	-	2	2	-	55	1	3	-	-	60	2	-	2	-	56
Biology	-	1	3	-	38	1	3	-	-	38	-	2	2	-	41
Astronomy	2	3	-	-	8	2	2	1	-	7	4	1	1	-	13
Maths	-	5	1	-	82	2	2	2	-	83	1	3	2	-	84

	2003					2004					2005				
	G	S	B	HM	Nations	G	S	B	HM	Nations	G	S	B	HM	Nations
Physics	2	-	1	2	54	1	2	2	-	71	2	2	1	-	77
Chemistry	2	2	-	-	61	1	1	2	-	60		3	1	-	59
Biology	1	2	1	-	43	-	3	1	-	45	1	-	3	-	50
Astronomy	4	2	-	-	14	4	-	1	-	19	5	2	1	-	18
Maths	-	4	1	1	82	-	4	2	1	85	-	1	1	3	85

	2006					2007				
	G	S	B	HM	Nations	G	S	B	HM	Nations
Physics	2	-	3	-	89	2	2	-	1	70
Chemistry	1	2	1	-	67	2	1	1	-	68
Biology	-	3	1	-	53	1	3	-	-	49
Astronomy	5	1	1	-	19	3	2	1	-	24
Maths	-	-	5	1	90	-	3	-	3	93

THE POSITIVE FALLOUT OF THE OLYMPIAD PROGRAMME

Experimental science is the Achilles heel of science education in India. Recognizing this and its crucial role in the International Olympiads, HBCSE over the years has been involved in developing challenging laboratory tasks and problems in physics, chemistry and biology. A large repertoire of challenging experiments now exists at HBCSE. The experimental expertise has proved useful in a number of ways. The

National Initiative on Undergraduate Science (NIUS) launched by HBCSE in 2004, the recently launched national institutes of science education and research, and several undergraduate teaching programs such as the Chennai Mathematical Institute's physics program have benefited from this programme. The theoretical program too has had spin-offs. Olympiad resource persons have been involved in authoring the NCERT textbooks at the higher secondary school level for a decade. Several Olympiad related pedagogical publications in Scientific Indian Journals (e.g. Resonance and Physics Education) have been authored by Olympiad resources persons.

Since 2004 HBCSE has hosted over twenty resource generation camps in which teachers, scientists and HBCSE personnel gather for a week to prepare lecture notes, devise innovative problems and design new experiments. The camps provide exposure to school and college teachers to state of the art laboratory environment and advanced theoretical problems. At the same time some of India's leading scientists get exposed to the problems of school and college science education. HBCSE personnel routinely visit various parts of the country to give talks and run short camps for students and teachers. A noteworthy aspect is that several of these camps have been held in non-metropolitan and even in rural schools.

The Olympiads have generated tremendous excitement among the meritorious students in the country. They have triggered the formation of the Indian Association of Chemistry Teachers and a similar association of teachers in biology, along the lines of IAPT leading to grassroots support for science. They have also invigorated the Centre as a whole and strengthened its links with leading scientific institutions in the country.

Recently, with a view to extending the programme to younger secondary school students, HBCSE has made exploratory efforts to initiate Junior Science Olympiad (JSO). This is likely to culminate in a strong National Junior Science Olympiad programme.

For completeness, we should like to mention that besides Olympiads, there are two notable programmes of talent search and nurture. These are the National Talent Search Scheme (NTSS) of National Council of Educational Research and Training (NCERT) and the Kishore Vaigyanik Protsahan Yojana (KVPY) of Department of Science and Technology (DST), implemented by the Indian Institute of Science (IISc) – Bangalore. The Olympiad programme of HBCSE complements these programmes but is unique in several ways. Firstly, it focuses on subject specific talent and competence (Physics, Chemistry, Biology, Mathematics and Astronomy); secondly, it involves (in the third stage) rigorous testing and orientation in experimental science – a feature absent in all other talent search and nurture schemes at that level in India; and thirdly, perhaps most importantly, it is not an entrance programme for admission nor a selection scheme for scholarship. The only incentive, as far as the HBCSE is concerned, is to offer students an academic challenge of the highest order suitable at their level, the challenge to go higher and ever higher in terms of subject competence, with a possibility for some to represent India at the international Olympiads and bring glory to

our country. The existence of several credible schemes of talent search and nurture (NTSS, KVPY, and Olympiads) is, of course, a healthy feature of our educational scenario, since they tap different aspects and dimensions of talent in young students.

CONCLUSION

The Olympiad programme is expected to grow from strength to strength in the future. It is expected to expand and include other Science and Mathematics related Olympiads. The Olympiad programme run by HBCSE has had the generous and consistent support of the Government of India through the Department of Atomic Energy (Board of Research in Nuclear Sciences), Department of Science and Technology, Indian Space Research Organization, National Board of Higher Mathematics and Ministry of Human Resource Development. The role of voluntary bodies such as the IAPT and the emerging new teacher associations in chemistry and biology has been important in providing an all India reach and grassroots support. Except for a nominal fee for first stage examination all other expenses including travel and stay at HBCSE, foreign travel to the international Olympiad events etc are borne by funds provided by the Government of India. Yet despite its success, the outreach of the science and mathematics Olympiads needs to expand further since the Olympiad effort stands in sharp and shining contrast to the rote learning culture and routine examinations which largely characterize the Indian school science education.

Further information on the national Olympiad programme can be obtained from the following website: <http://www.hbcse.tifr.res.in/olympiads>

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List of Acronyms

BRNS	–	Board of Research in Nuclear Sciences
DAE	–	Department of Atomic Energy
DST	–	Department of Science and Technology
HBCSE	–	Homi Bhabha Centre for Science Education
IAO	–	International Astronomy Olympiad
IAPT	–	Indian Association of Physics Teachers
IBO	–	International Biology Olympiad
ICHO	–	International Chemistry Olympiad
IISc	–	Indian Institute of Science
INAO	–	Indian National Astronomy Olympiad Examination
INBO	–	Indian National Biology Olympiad Examination
INChO	–	Indian National Chemistry Olympiad Examination
INPhO	–	Indian National Physics Olympiad Examination
IO	–	International Olympiad
IOAA	–	International Olympiad in Astronomy and Astrophysics
IPhO	–	International Physics Olympiad
ISRO	–	Indian Space Research Organization
KVPY	–	Kishore Vaigyanik Protsahan Yojana
MHRD	–	Ministry of Human Resource Development
NCERT	–	National Centre for Educational Research and Training
NCSM	–	National Council of Science Museums
NSE	–	National Standard Examinations
NSEA	–	National Standard Examination in Astronomy
NSEB	–	National Standard Examination in Biology
NSEC	–	National Standard Examination in Chemistry
NSEP	–	National Standard Examination in Physics
NTSS	–	National Talent Search Scheme
OCSC	–	Orientation cum Selection Camp
TIFR	–	Tata Institute of Fundamental Research