

## Enrichment Programs for Secondary Science Students

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A study in 1975 by the American Institute of Research dealt with the follow-up of a sample of persons who participated in Project Talent while attending high school in 1960. They were asked what they remembered, what they used, and what they thought was worth learning in their high school curriculum. With very few exceptions, these individuals, then in their 30's, replied that the only things they remembered and thought worthwhile in their high school courses were those that they used in their work (e.g., mathematics in engineering, English composition in newspaper reporting, home economics in the operation of a business) or those other subjects in which they were deeply interested. Science was listed as a subject of such deep interest by very few who were not then engaged in occupations that utilize science (8).

How can we improve the understanding of science by the majority of our students who do not become scientists or engineers? To do this, I believe we must balance *content* and *process* in our classes, but we must not just *tell* students about science. We must lead them through simple experiments that demonstrate logical thought and give them more and more responsibility for their learning.

Eventually, we should involve most students in independent scientific research with an emphasis upon written and oral presentation of their findings. There are many good books and articles available to assist teachers and students who wish to improve in this area (2).

Students must recognize that learning is a life-long activity, not just something to do to mark time until one reaches age 16, or 22 and then terminates formal education. Our students must also understand that those who pursue a career in a scientific or technical field can expect to devote more than 40 hours to work each week. Hopefully, they will enjoy most of what they will do in that field.

Today, we face many very difficult problems in education at all levels in these United States. Many of us who have worked hard to do a good job of educating our youth for many years have become discouraged and disillusioned by the paucity of interest demonstrated by our society and even our students in our chosen field of education. This is especially true in science education. We need to attract bright young students to teaching science, mathematics and computer science. Such service may be for just a few years, or it may be for many decades. We need such involvement for as long as we can get it! Teaching is a very important job!

It is very difficult to work hard to do a good job of teaching under the conditions which exist in many, if not most, of our schools today. But I want you to keep trying! Don't become disillusioned! There are many organizations willing and anxious to help you and your students to learn about the products and the processes of science. The Indiana Academy of Science is one of these; the Hoosier Association of Science Teachers is another.

There are signs that the lot of science education will improve very soon, but I cannot say how much improvement we can expect. I am very encouraged by what is beginning to happen around the country. In Indiana, we have many problems, but we also have many good things working for us. I consider this

Academy a sleeping giant in this regard. We have a great wealth of talent in our ranks, but we need to become more involved in education at both the state and national levels if we are to meet some of our pressing needs in Indiana.

Let me describe now some of the programs in which you and your students might become involved this year or next year. I think you will find such involvement very rewarding and very stimulating. Even if it involves begging or granting extra credit to your students, *please* give some of these programs a try in your school (3).

*WESTINGHOUSE SCIENCE TALENT SEARCH—NATIONAL COMPETITION* (for High School *SENIORS ONLY*). Science scholarships totaling more than \$89,000 are provided for 40 students selected to attend the Science Talent Search in Washington, D.C., each spring. The Search fosters the education of potential scientists and focuses attention on the need for perfecting scientific research skills and knowledge. Honors Group status, earned by the top 300 students who complete entries, is evidence of high science ability and interest which is taken into consideration by colleges and universities in decisions regarding admissions and granting of scholarships. Studies involving vertebrate animals are usually not permitted. In 1981-82, only 950 students entered this competition. The deadline for submitting materials is December 15. Teachers should request application materials and the brochure, "Science Talent", which contains additional information, including the name and address of each state director from:

Mrs. Dorothy Schriver  
Science Service  
1719 N Street, N.W.  
Washington, D.C. 20036

*SCIENCE TALENT SEARCH—STATE COMPETITIONS*. In Indiana, each entrant must submit a data form along with *two* copies of his or her research report. If selected as a finalist, he or she will be interviewed by a panel of research scientists which chooses the state winners. The Indiana competition is open to both juniors and seniors, with emphasis upon the excellence and completeness of the student's investigation. Studies which involve vertebrate animals are permitted only if humane and scientifically acceptable procedures are employed. Although group entries are acceptable, individual entries are strongly recommended. The deadline for submitting materials is December 15, and the Honors Weekend for finalists is held in March at the Medical Center Union Building in Indianapolis. Currently, two scholarships in the amount of \$1,000 each from Kappa Kappa Kappa Sorority are available each year for the top male and female entrants. In Indiana, write:

Director, Indiana Science Talent Search  
Education Building 253, Indiana University  
Bloomington, Indiana 47405

In Table 1, winners in the Westinghouse Science Talent Search from 1942-1982 are tabulated by state and territory (6). Residents of New York, Illinois and California have been very successful in gaining recognition for themselves and their schools. Students from Indiana have not fared nearly so well, but they have placed Indiana in twelfth place with a total of 38 winners in the WSTS. Considering the population of Indiana and of those states ranked number 1-11, Indiana residents have done very well. However, we have the potential to do much better.

TABLE 1. *WSTS Winners By State/Territory (1942-82)*

State	Totals	Rank	State	Totals	Rank
New York	502	1	Iowa	10	29
Illinois	223	2	Hawaii	9	30
California	220	3	Kansas	9	30
Pennsylvania	81	4	Montana	9	30
New Jersey	66	5	Alabama	9	30
Ohio	66	5	Kentucky	7	34
Massachusetts	54	7	Louisiana	7	34
Florida	51	8	Rhode Island	7	34
Virginia	40	9	Maine	6	37
Texas	40	9	South Carolina	6	37
Wisconsin	40	9	Idaho	5	39
Indiana	38	12	New Mexico	5	39
Maryland	34	13	Mississippi	4	41
Oregon	25	14	North Carolina	4	41
Connecticut	25	14	South Dakota	4	41
Arizona	21	16	Wyoming	4	41
Oklahoma	20	17	Alaska	3	45
Minnesota	19	18	Arkansas	3	45
Georgia	19	18	Nevada	2	47
Michigan	17	20	North Dakota	2	47
Colorado	16	21	Utah	2	47
District of Columbia	16	21	Delaware	1	50
Tennessee	16	21	Vermont	1	50
West Virginia	16	21	Overseas American Schools	1	50
Missouri	16	21	Puerto Rico	0	53
Nebraska	15	26			
New Hampshire	12	27			
Washington	12	27			

Modified after a report from Science Service (6).

In comparing the data of Table 2, Figure 1 and Figure 2, it is clear that

1. total participation in the national Westinghouse Science Talent Search (WSTS) for senior students decreased by more than one-half between 1969 and 1971 (from 2361 to 1110);

2. between 1972 and 1982, participation in the WSTS has decreased slightly (from 1133 to 950);

3. participation in the Indiana Science Talent Search has declined between 1969 and 1982 (from 75 to 49), but since 1973, it has experienced a net increase, while participation in the WSTS has decreased.

There are many possible reasons for these declines. Perhaps the greatest reason for the drastic decline between 1969 and 1971 was the new regulation that vertebrate animal studies would not be considered in the Westinghouse Science Talent Search beginning in 1970-71. That regulation is still in effect today. In the Indiana STS between 1970 and 1982, 156 of 278 finalists (56.1%) submitted studies of a biological nature. Of these, at least 61 (39.1%) involved the use of vertebrate animals under the supervision of properly trained adults.

Other high achievers who study science and mathematics prior to grade twelve would benefit from conducting research and they should be encouraged to do this. The prospects of travel, recognition and financial aid associated with the WSTS, state searches, science fairs and other competitions can lead to broader participation in these activities. Successful participation can provide new purpose to the study of science and mathematics courses while in high school. They are also more

TABLE 2. *Comparison of the Indiana Science Talent Search and the Westinghouse Science Talent Search (1969-82)*

	INDIANA STS										WESTINGHOUSE STS				
	NUMBER OF ENTRANTS	NUMBER OF FINALISTS	NUMBER OF WINNERS	JUNIOR FINALISTS	FINALISTS ONLY						TOTAL ENTRANTS FOR THE U.S.	INDIANA RESIDENTS	INDIANA FINALISTS (OF TOP 300)	PERCENTAGE OF FINALISTS FROM INDIANA	NATIONAL WINNERS FROM INDIANA (OF 40 IN U.S.)
					BIOLOGY TOPICS	CHEMISTRY TOPICS	PHYSICS TOPICS	ENGINEERING	MATH/COMPUTER	ALL OTHER TOPICS					
1969	75	28		—	9	7	6	1	2	3	2361	86	7	2.33	1
1970	43	23	12	—	9	7	3	0	2	2	2075	56	3	1.00	0
*1971	38	18	10	—	7	5	2	0	2	2	1110	38	7	2.33	0
1972	17	12	9	—	6	0	2	2	1	1	1133	24	5	1.67	1
**1973	29	19	9	1	12	2	2	0	1	2	1105	25	5	1.61	1
1974	30	16	9	2	10	1	1	1	3	0	1104	24	7	2.33	0
1975	49	24	13	1	15	5	3	0	0	1	1118	30	7	2.33	0
1976	57	22	11	1	15	4	2	0	1	0	1013	26	9	3.00	1
1977	43	24	13	4	12	1	3	4	0	4	1009	23	8	2.67	2
1978	38	22	13	4	12	2	2	6	0	0	967	21	10	3.33	0
1979	34	23	13	4	11	3	3	2	0	4	980	20	10	3.33	0
1980	41	24	15	4	16	3	0	4	0	1	950	27	12	4.00	1
1981	46	25	14	4	15	3	1	3	0	3	993	22	7	2.33	0
1982	49	26	13	7	16	4	1	2	2	1	950	21	7	2.33	1
TOTALS (1969-1982)	589	306	154	32	165	47	31	25	14	24	16868	443 (2.6%)	104 (2.5%)	2.47	8 (1.4%)

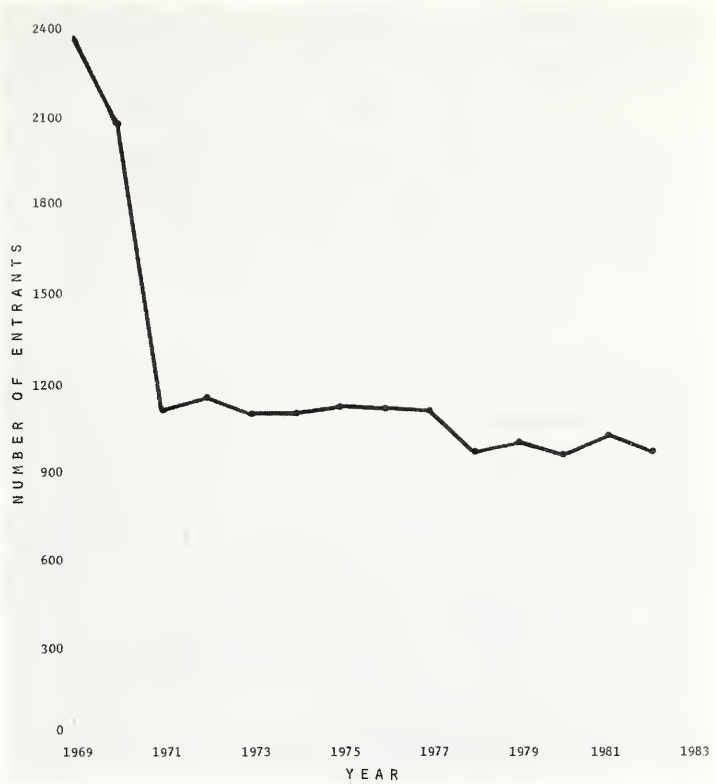
\*The First year that vertebrate animal studies were not permitted in Westinghouse STS.

\*\*The First year in which eleventh grade students were permitted to enter the Indiana Science Talent Search, modified after a report by Science Service (6).

likely to pursue a career in science, mathematics or engineering as a result of such successes. Teachers who have not experienced the frustrations and the joys of working with students as they develop research projects are missing a great deal. The author would be happy to discuss this with teachers and students. Those who wish to learn of schools which have students successfully involved in scientific research year after year are invited to contact the author who will identify those schools and the key teachers involved there.

Directors of fifteen state science talent searches responded to a questionnaire prepared by this author in 1981. The results of that survey in terms of participation by young men and young women are given in Table 3. It is interesting to note that for the period of 1979-1981, the percentage of women participants in the Indiana Science Talent Search (44.8%) was greater than that of all other states which responded (34.3%) and greater than that of women's participation in the Westinghouse Science Talent Search (29.7%). In this connection, we in Indiana compare very favorably. But in terms of involving most young women in meaningful scientific research during

FIGURE 1. *Participation in the Westinghouse Science Talent Search Nationwide (1969-1982)*



the high school years, we in Indiana and the rest of the nation have much room for improvement.

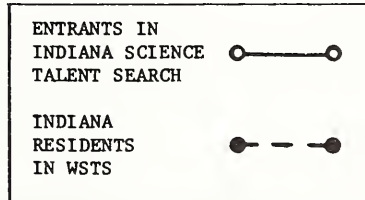


FIGURE 2. *Participation in the Indiana Science Talent Search and the Westinghouse Science Talent Search by Indiana Residents (1969-82)*

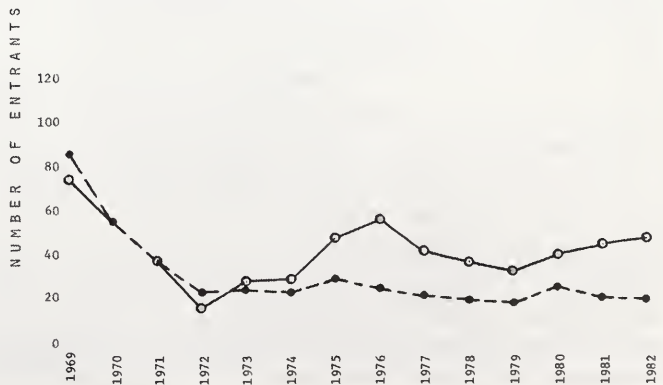


TABLE 3. *Westinghouse Science Talent Search Entrants by Sex*

State	1979-80		1980-81		For 2 Yrs (1979-81)		% Women
	Women	Men	Women	Men	Women	Men	
Alabama	16	24	17	20	33	44	42.9
Colorado/Wyoming	6	8	5	6	11	14	44.4
Florida	16	43	9	24	25	67	27.2
Indiana	14	27	25	21	39	48	44.8
Iowa	2	1	4	14	6	15	28.6
Kansas	3	6	2	3	5	9	35.7
Maine	Not	Known	—	—	—	—	—
Mississippi	1	3	2	6	3	9	25.0
Montana	2	3	2	3	4	6	40.00
Nebraska	Not	Known	—	—	—	—	—
North Dakota	0	1	0	2	0	3	0.0
Utah	1	4	2	2	3	6	33.3
Virginia	Not	Known	—	—	—	—	—
Washington	Not	Known	—	—	—	—	—
West Virginia	Not	Known	—	—	—	—	—
Totals (Entrants in 15 state searches)					129	221	36.9%

All Entrants in WSTS (Not Compiled; Estimated to be About 33% Women)

	Women	Men	% Women
Honors Group, WSTS (1978-79)	80	220	26.7%
Honors Group, WSTS (1979-80)	100	200	33.3%
Honors Group, WSTS (1980-81)	86	214	28.7%
Honors Group, WSTS (1981-82)	90	210	30.0%

Totals (WSTS) 4 Years                      356              844              29.7%

Based upon a survey of selected state science talent searches (1).

*SCIENCE AND ENGINEERING FAIRS—REGIONAL* (Usually grades 7-12, but some regional fairs accept elementary school students). These competitions are open to any public or parochial student within a designated region of a state. Usually, two winners from each regional fair are selected to attend the International Science and Engineering Fair. Other awards include ribbons or medals, books, cash prizes, hand calculators and recognition certificates. The student must display an exhibit of his or her investigation. For information, see your science teacher or guidance counselor.

*SCIENCE FAIRS—LOCAL, DISTRICT, SCHOOL* (Grade levels vary). These are competitive exhibitions open to students within a particular district, county, township or school for the purpose of selecting regional science fair entrants and to award local prizes. For information, see your science teacher or guidance counselor.

*SCIENCE AND ENGINEERING FAIR—INTERNATIONAL*. This is a competitive exhibition open to any public or parochial student in grades 9-12 who has been selected through regional fair competition (two from each region). Two senior division winners from each of about 200 regional fairs with their teacher sponsors and many fair directors will spend 5 to 6 days in the host city with all of their expenses paid. Student mixers, tours of scientific facilities and award banquets are provided. After the students' research investigation and exhibits are evaluated, winners receive scholarships, opportunities to work in government research laboratories, cash awards, trips and nationwide recognition. For information, write:

Director, International Science & Engineering Fair  
Science Service  
1719 N Street, N.W.  
Washington, D.C. 20036

A list of possible science projects is available at \$1.00 each (5), and a very good booklet which includes guidelines for student research is available from Moore Publishing Company (4).

*SCIENCE STUDENT TRAINING PROGRAMS.* Summer science training programs at various colleges and universities are open to those students who have completed the 10th or 11th grade. These programs last from one to ten weeks. Most offer in-depth instruction in one or more subjects such as astronomy, biology, chemistry, mathematics or physics. Many allow participants to participate in scientific research; some include college credit. While some are for commuters only, many involve residence on the college or university campus which adds another dimension to this experience. In most cases, funds are available to assist students whose families cannot afford the total cost of the program.

Today, seven students from the 1982 High School Science Student Institute at Indiana University are presenting the results of their research in four divisions of the Senior Academy, and at least four other participants in this Institute are presenting papers today in the Junior Academy of Science.

Information may be obtained by requesting the "Directory of Science Training Programs for High Ability Senior and Junior High School Students" (7) from:

Science Service  
1719 N Street, N.W.  
Washington, D.C. 20036

The new directory should be available in January. The deadline for return of applications to the project director is usually March 15 or April 1. Students should apply early.

*JUNIOR ACADEMY OF SCIENCE.* This is an affiliate organization of the Academy of Science of most states, open to science clubs at the junior or senior high school level. Students interested in student-research are encouraged to form a research group or science club and ask their sponsor to apply for club membership in their state. Primary emphasis is upon presentation of research papers for peer evaluation with opportunity for discussion with members of the senior Academy of Science as well.

In Indiana, contact: Leota Skirvin Smith, Director  
Indiana Junior Academy of Science  
State Road 46 S  
Nashville, Indiana 47448

In other states, contact:

American Association for the Advancement of Science  
Association of the Academies of Science  
1515 Massachusetts Avenue, N.W.  
Washington, D.C. 20005

*JUNIOR ENGINEERING AND TECHNICAL SOCIETY (JETS).* This competition involves *teams* of students in grades 10-12 in biology, chemistry, English, graphics, mathematics and physics. Team trophies and individual awards are presented to the outstanding performers. In Indiana, contact:

Lester J. Harris  
State Coordinator, JETS  
2918 East Eighth Street  
Anderson, Indiana 46012

*NATIONAL JUNIOR SCIENCE AND HUMANITIES SYMPOSIUM.* Students in Indiana and Eastern Illinois who have been nominated by their schools will be invited to attend and describe their research during a three-day meeting to be held at Indiana State University in Terre Haute, Indiana, each April. From this group, finalists will be selected to present papers at the national symposium which is usually scheduled for May. For more information, write:

Dr. Kenneth Uhlhorn  
Science Teaching Center  
Indiana State University  
Terre Haute, Indiana 47809

Students outside Indiana may contact Barbara Osbourn (see address below).

*INTERNATIONAL YOUTH SCIENCE FORTNIGHT.* This program consists of a two-week conference held each summer in London, England, involving approximately 450 students from 20 to 25 countries who have been selected from various national junior science and humanities symposia. The aim of the fortnight is to provide a deeper insight into science and its applications for the benefit of mankind and to develop greater understanding between young people of all nations. The program includes lectures by eminent scientists, demonstrations, visits to research laboratories and industry, panel discussions and social activities. For information, write:

Barbara Osbourn, National Coordinator  
Junior Science & Humanities Symposium  
Duke University, East Campus  
Durham, North Carolina 27708

*SPACE SHUTTLE STUDENT INVOLVEMENT COMPETITION.* The purpose of the Space Shuttle Student Involvement Project, sponsored by the National Aeronautics and Space Administration (NASA) and the National Science Teachers Association (NSTA), is to stimulate interest in the science and technology of space by students in grades 9 to 12 in the U.S. and its territories. Up to 20 regional winners will be selected in each of ten regions; from these, up to 20 students will be selected for national honors. Regional winners and their teacher-sponsors will be invited to participate in a conference in the spring at one of the NASA research facilities with expenses paid. Each entry should be a typed proposal of not more than 1000 words describing an experiment or demonstration which could be performed by astronauts in the course of a space shuttle mission. The proposals should be received by the regional director by February 1. Entry



materials, rules booklets and a listing of the regional directors may be requested by teachers from:

Space Shuttle Student Project  
National Science Teachers Association  
1742 Connecticut Avenue, N.W.  
Washington, D.C. 20009

*INDIANA ACADEMY OF SCIENCE SPEAKERS' BUREAU.* The Indiana Academy of Science provides a list of scientists and engineers who are willing to speak on scientific and engineering matters to schools, clubs and other community organizations. For information, write:

Walter Cory, Director of Public Relations  
Indiana Academy of Science  
Education Building 253  
Bloomington, Indiana 47405

*FUNDS FOR HIGH SCHOOL STUDENT RESEARCH.* In addition to these examples, you might contact other organizations for possible support.

1. The American Heart Association, Indiana Affiliate, annually provides twenty-three \$100.00 cash awards and certificates to high school students for research under the T. A. Kleckner Science Grant Awards Program. The research investigation need not be related to the heart or circulatory system. Awards are provided through a state-wide competition open to any high school student. Applications must be in the offices of the Indiana Heart Association no later than October 29. Winners are announced by about November 15. For further information write:

David Livengood  
American Heart Association, Indiana Affiliate  
222 South Downey Avenue  
Indianapolis, Indiana 46219

2. The American Lung Association of Indiana Research Grants and Scholarships offers students in grades 10-12 an opportunity to compete for eight research grants of \$150.00 each, one scholarship of \$1,500.00 and one of \$500.00. The school sponsoring the top scholarship award recipient will also receive an award. The program, which began in 1974, has been very successful. Proposals to support pulmonary-circulatory research are due October 22. Detailed information may be obtained from:

Managing Director  
American Lung Association of Indiana  
30 East Georgia Street, Room 401  
Indianapolis, Indiana 46204

3. The research grants committee of the Indiana Academy of Science provides funds for research investigations by secondary students. Science club activities of an investigative nature will be considered as well as those of individual members. A brief description (200-500 words) of the project's budget and objectives is required. Requests, ranging from a minimum of \$50 to a maximum of

\$250, must be made by a sponsoring teacher of the club and be signed by the principal or superintendent of the school system. Proposals from junior schools and senior high schools in Indiana only should be submitted before June 15. Science clubs and individuals who receive activity grants are required to submit a report of their activities to the Youth Activities Committee Chairperson by May 1 of the following year. Address all inquiries and proposals to:

Dr. Ernest Campaigne, Chairman  
IAS Research Grants Committee  
Department of Chemistry  
Indiana University  
Bloomington, Indiana 47405

#### Literature Cited

1. CORY, WALTER A., JR., 1981. Survey of selected state science talent search directors, unpublished.
2. CORY, WALTER A., JR., 1982. "A comprehensive bibliography on scientific and technical writing", *Journal of College Science Teaching* 11(6): 351-355, May.
3. CORY, WALTER A., JR., 1982. Opportunities for the secondary science student, Bloomington, Indiana, 9 pp.
4. LYON, LAURIE A., 1980. Guidelines for high school students on conducting research in the sciences, Moore Publishing Co., Durham, N.C., 47 pp.
5. Science Service, 1971. Thousands of science projects, Washington, D.C., 63 pp.
6. Science Service, 1982. Listing of winners and honors group in the 1981-82 Westinghouse Science Talent Search, Washington, D.C.
7. Science Service, 1982. Directory of science training programs for high ability senior and junior high school students, Washington, D.C., 16 pp.
8. TYLER, RALPH W., 1982. "Integrated research, development, dissemination and practice in science education", in Proceedings of the National Science Foundation project directors meeting for 1981, NSF, Washington, D.C., pages 1-13.

Note: The efforts of previous coordinators for school science programs at Indiana University and others who contributed to the programs described here are gratefully acknowledged.