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ABSTRACT

Fifth and eighth grade students in New York City participated in a citywide science survey for the fourth consecutive year in 1987. These surveys were designed to assess overall achievement in the pre-high school grades and to provide school, district and citywide summary information about student performance in basic areas of the science curriculum. Another purpose was to facilitate staff development in areas of greatest instructional need. The content areas included were biology, earth science, physics, chemistry, and process skills, plus geology, weather, and astronomy in grade eight. This document contains discussions of the process, administration, findings, reliability and validity of the test. Tables include: (1) percentages of students reaching mastery in general science; (2) citywide results by subtest and total test in both general and special education; (3) summary of students tested citywide; and (4) mean p-value by district. (CW)

Research Report
Office of Educational Assessment
Research and Development Section
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Citywide Results of the New York City 1987 Science Survey Grades 5 and 8

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SUMMARY OF THE CITYWIDE RESULTS OF THE NEW YORK CITY 1987 SCIENCE SURVEY

GRADES 5 AND 8

Students in grades 5 and 8 took citywide science surveys in May 1987 for the fourth consecutive year. These surveys are designed to assess the overall level of science achievement in the pre-high school grades and to provide school, district and citywide summary information about student performance in basic areas of the science curriculum. The purpose for collecting these data is to facilitate staff development in areas of greatest instructional need.

In grade 5 students have shown steady improvement in science from 1985 to 1987 as measured by the percent of students meeting the mastery criterion. The content areas included were biology, earth science, physics, chemistry and process skills.

In grade 8 a new earth science curriculum was introduced citywide in the 1986-87 year. The areas included in the new curriculum were geology, weather and astronomy. Because this was the first year of the new curriculum and the new content in the survey measuring it, no meaningful comparison with 1985 or 1986 performance is possible. The survey on the whole proved to be difficult which may have resulted in part from unfamiliarity with the new curriculum.

	1985	1986	1987
Grade 5[a]			
		General Science	
% of Students Reaching Mastery	49.8	51.5	59.8
% Items Correct for Mastery	65.0[b]	58.0[b]	65.0[b]
Mean % Items Correct	63.5	57.9	67.8
Grade 8			
		General Science	Earth Science
% Students Reaching Mastery	38.3	41.9	NA[c]
% Items Correct for Mastery	65.0[b]	65.0[b]	NA[c]
Mean % Items Correct	58.2	60.1	47.5

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[a] Excludes students in District 10 because of a breach in test security.

[b] Represent comparable levels of performance as determined by test equating studies.

[c] No mastery criterion was set because this was the first year of the new citywide earth science curriculum and survey.

DISCUSSION OF PROCESS AND RESULTS

The Board of Education believes that testing and learning are integral parts of the same curriculum and instructional effort. Tests must validly reflect curriculum in order that student achievement of that curriculum be adequately measured and areas of strength and deficiency identified. Such identification is necessary to target instructional needs so that appropriate action can be taken. Because no published test adequately reflected objectives in the New York City and New York State science curricula, customized tests were developed in-house by the Division of Curriculum and Instruction in cooperation with the Office of Educational Assessment. Grades 5 and 8 were chosen as the target grades because they were considered to be crucial points in the sequence of science instruction. It is particularly important to identify possible problem areas in science instruction at these grades because problem areas not remediated at these points carry over into the next school administrative organizational level: intermediate or junior high and high school. This can seriously interfere with the instructional program at the succeeding level.

The tests were designed primarily to provide group data in order to pinpoint schools or districts that may have instructional or staff development needs in their science programs. Although 1987 individual student scores were reported to schools and districts, there was no intention that such scores be reported to the individual students.

Because it was not possible to measure all the science objectives with one test, an advisory committee consisting of representatives from the community school districts was asked to identify and select appropriate important objectives for inclusion in the test at each grade. Items were then written to measure each objective. All items were reviewed for readability and vocabulary level, lack of ambiguity, elimination of possible bias, and to ensure that the item measured the objective and had one and only one correct answer. This procedure was followed in constructing the surveys at grades 5 and 8.

The Spring 1987 grade 5 survey consisted of 60 items from the 1985 test. The grade 8 earth science survey consisted of 60 items; some were taken from the 1986 earth science pilot test, some were revised pilot test items and others were developed specifically for the 1987 survey.

TEST ADMINISTRATION

On May 19, 1987 the grade 5 and 8 New York Citywide Science Surveys were administered. At grade 5, 56,772 students took the survey. (This excludes about 3,000 students in District 10 where a security breach was considered to have rendered test results invalid.) Of the 56,772 students tested, 4,739 were Special Education students. Administration of the English version included 1,644 limited-English-proficient students while 1,089 students took the Spanish version. At grade 8, 51,275 students took the new earth science survey. Of these tested students,

4,208 were from Special Education. Administration of the English version included 693 limited-English-proficient students while 698 students took the Spanish version.

FINDINGS

The results of the 1987 science survey administration are reported in Tables 1 through 3. Tables 1A, 1B and 2 report overall citywide results for grades 5 and 8, while Tables 3A and 3B report results by district. Tables 1A and 1B present comparisons of 1987 with 1986 data whereas Tables 2, 3A and 3B present data for 1987 only.

Table 1A reports 1987 performance for general education students in grades 5 and 8. In grade 5 in 1987 students performed better on the science survey than they had in 1986. In 1987, 59.8 percent of the students met or exceeded the mastery criterion compared with 51.5 in 1986. In 1987 the grade 5 citywide average of 67.8 percent correct of the 60 items was above the criterion level of 65 percent correct. This also is an indication of improved performance over 1986 where the citywide average of 57.9 percent correct of the 50 items was right at the criterion level of 58 percent correct[a]. It is interesting to note that as shown in Table 3A in grade 5 the 1987 average percent of items correct met or exceeded the criterion in 20 districts as compared with 17 districts in 1986.

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[a] It should be noted that the grade 5 mastery criterion changed from 58 percent correct in 1986 to 65 percent correct in 1987 because different tests (with somewhat different levels of difficulty) were used in the two years. The two tests were equated to adjust for the difference in item difficulty, using Rasch procedures.

Because of the extensive nature of the change in the grade 8 science curriculum and consequently in test content, it was not possible to make any comparisons between performance in 1986 and 1987. Also because of these changes it was considered inappropriate to estimate in advance a mastery criterion. Therefore, none was set. However, of the 60 items in the 1987 grade 8 survey, the average was 47.5 percent of the items correct.

It is of interest to look at the subtest data for each grade. As shown in Table 1A, in grade 5, except for chemistry where general education students had an average of 57 percent correct, the citywide performance on the other four subtests ranged from 68 to 71 percent of the items correct. This poor performance in chemistry relative to the other areas was also true of every district in grade 5 both in 1987 and 1986. As shown in Table 1A, grade 8 students had 50 percent of the items correct in the area of weather which was somewhat better than the 46 and 45 percent correct in geology and astronomy, respectively.

Citywide, boys performed somewhat better on the surveys than did girls. In grade 5 boys got 70 percent of the items correct and girls got 67 percent correct, while in grade 8 the percent of items correct was 50 for boys and 46 for girls. The New York City sex differences of 3 and 4 percentage points in grades 5 and 8, respectively, are somewhat less than the sex differences of 6 percentage points in grades 5 and 9 as reported for the 1983 Second International Science Study.[a]

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[a] The Newsletter of Teachers College/Columbia University. Spring 1985 Volume 13 Number 2. Office of Public Relations. Teachers College/Columbia University New York 10027.

RELIABILITY AND VALIDITY

The reliability and validity of the New York City Science Surveys were assessed. The 1987 test was a reliable measure of science achievement at each grade, as indicated by reliability coefficients[a] for the total test of .90 at grade 5 and .84 at grade 8. These figures indicate that the tests are homogeneous, and that the tests produce consistent results.

Content validity, how well the content of the test is matched to curriculum content, is crucial to a measure of achievement such as the science survey. This was ensured by test development procedures at each grade. Objectives relevant to the science curriculum were identified and items constructed to measure these objectives. After item-editing to ensure appropriate measurement of each objective, items were pilot tested. Analyses of the item data were conducted and appropriate items were selected for inclusion in the survey at each grade. Final test item selection was based upon content mix that reflected the curriculum and desirable psychometric characteristics of the items.

CONCLUSIONS

The 1987 science survey yielded useful information concerning the current level of science achievement in grades 5 and 8. First and most important is that the results show that science achievement in grade 5 has improved over that of 1986. This improvement is reflected in the increase in the percent of

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[a] The Kuder-Richardson Formula 20 was used to measure test reliability.

students reaching the mastery criterion: 51.5 percent in 1986 and 59.8 percent in 1987.

The survey was designed to pinpoint areas of school and district strength and deficiency among the areas that constitute the basis of the science curriculum. In grade 5 these areas consisted of biology, earth science, physics, chemistry, and process skills. The results showed that citywide and by district performance was poorest in chemistry. Because the objectives to be measured and the items measuring these objectives had been judged to be of appropriate difficulty for the students to be tested, the relatively poor performance in chemistry appears to result from lack of student knowledge in this area. Results of the 1987 science survey at grade 5 were used to plan instructional and staff development activities.

At grade 8, however, because of the new curriculum and test content, it was impossible to make any meaningful comparison of student performance in 1987 with that of previous years. The 1987 survey proved to be difficult with students getting an average of only 48 percent of the 60 items correct. As was true at grade 5 the objectives measured and the items measuring these objectives had been judged to be of appropriate difficulty for grade 8 students. While this relatively low level of performance may have resulted in part from unfamiliarity with the new curriculum, it also suggested that the objectives and items be reviewed. The results of the 1987 science survey at grade 8 were used to plan instructional and staff development activities.

TABLE 1A

New York Citywide Science Surveys: 1987
Citywide Results by Subtest and Total: Grades 5 and 8

General Education Results

Test	No.of Items	Raw Score Mean	Raw Score S.D.	% Total Items Correct	KR20
		Grade 5 - N = 52,033[a]			
Biology	9	6.25	1.86	69.5	.54
Earth Science	15	10.34	2.86	69.0	.69
Physics	18	12.83	3.25	71.3	.71
Chemistry	9	5.15	2.23	57.2	.65
Process Skills	9	6.12	2.21	68.0	.70
Total	60	40.69	10.08	67.8	.90
59.8 % of students reached criterion (65% of items correct)					
		Grade 8 - N = 47,067			
Geology	15	6.89	2.51	45.9	.51
Weather	29	14.39	4.63	49.6	.71
Astronomy	16	7.23	3.27	45.2	.69
Total	60	28.51	8.87	47.5	.84

[a] Excludes students in District 10. Because of a breach in security District 10 test results for grade 5 were considered invalid.

TABLE 1B

New York Citywide Science Surveys: 1987
Citywide Results by Subtest and Total. Grades 5 and 8

Special Education Results

Test	No.of Items	Raw Score Mean	Raw Score S.D.	% Total Items Correct	KR20
		Grade 5 - N = 4,739[a]			
Biology	9	4.20	1.98	46.7	.49
Earth Science	15	6.50	2.95	43.3	.64
Physics	18	8.04	3.81	44.7	.74
Chemistry	9	2.97	1.86	33.0	.48
Process Skills	9	3.54	2.12	39.4	.60
Total	60	25.25	9.93	42.1	.87

11.2 % of students reached criterion (65% of items correct)

		Grade 8 - N = 4,208			
Geology	15	4.94	2.10	32.9	.31
Weather	29	9.86	3.71	34.0	.56
Astronomy	16	4.51	2.39	28.2	.47
Total	60	19.31	6.24	32.2	.69

[a] Excludes students in District 10. Because of a breach in security District 10 test results for grade 5 were considered invalid.

TABLE 2
New York City Science Survey 1987
Summary of Students Tested Citywide
Grades 5 and 8

	Grade 5[a]			Grade 8		
	General Education	Special Education	Total	General Education	Special Education	Total
Answer Sheet Received						
Tested[b]	52,033	4,739	56,772	47,067	4,208	51,275
Absent	3,533	732	4,265	6,671	1,342	8,013
Exempt LEP	1.670	24	1,694	1,270	18	1,288
Exempt SE	0	179	179	0	108	108
Excused	11	6	17	4	3	7
No Score (no reason)	270	99	369	904	105	1,009
TOTAL	57,517	5,779	63,296	55,916	5,784	61,700
Language Group						
English Version						
English Prof.	49,418	4,621	54,039	45,832	4,052	49,884
Lim.Eng.Prof.	1,556	88	1,644	566	127	693
TOTAL	50,974	4,709	55,683	46,398	4,179	50,577
Spanish Version	1,059	30	1,089	669	29	698
TOTAL	52,033	4,739	56,772	47,067	4,208	51,275
Sex						
Males	28,293	4,086	32,379	27,536	4,056	31,592
Females	28,950	1,648	30,598	28,053	1,694	29,747
Miscodes	274	45	319	327	34	361
TOTAL	57,517	5,779	63,296	55,916	5,784	61,700

[a] Excludes students in District 10. Because of a breach in security, District 10 results for grade 5 were considered invalid.

[b] Basis for school, district, citywide reports.

TABLE 3B
New York Citywide Science Survey 1987
Mean P-Value[a] by District

Grade 8 - General Education

	Subtests			Total Test	N
	Geology	Weather	Astronomy		
No. of Items	15	29	16	60	
District					
1	41	45	42	43	781
2	51	56	52	54	1,224
3	42	44	40	43	740
4	43	45	40	43	992
5	43	45	38	42	690
6	41	44	39	42	1,592
7	41	44	40	42	1,001
8	45	48	43	46	1,563
9	40	43	37	41	1,745
10	43	47	42	45	2,468
11	56	60	55	58	1,773
12	40	44	38	41	749
13	47	46	42	45	1,191
14	41	46	43	44	1,258
15	43	47	43	45	1,138
16	40	44	36	41	628
17	41	44	38	42	2,274
18	50	52	49	51	1,419
19	43	47	43	45	1,674
20	47	51	47	49	2,076
21	49	53	51	52	1,723
22	51	55	51	53	1,669
23	41	42	35	40	938
24	49	53	49	51	2,161
25	53	57	56	56	1,610
26	45	54	48	50	616
27	46	50	45	48	2,227
28	51	55	52	53	1,378
29	45	49	45	47	1,859
30	45	51	48	49	1,531
31	49	54	51	52	2,873
32	44	49	43	46	1,176
33	55	59	57	58	319
78	37	43	34	39	11
Total	46	50	45	48	47,067

[a] Mean p-value is the percent of items answered correctly.

TABLE 3A
New York Citywide Science Survey 1987
Mean P-Value[a] by District

Grade 5 - General Education

	Subtests					Total Test	N
	Elc.	E. Sc.	Phys.	Chem.	Pr. Sk.		
No. of Items	9	15	18	9	9	60	
District							
1	64	63	68	49	62	62	854
2	74	73	75	61	73	72	1,487
3	66	63	66	50	62	62	954
4	64	63	67	49	60	62	1,060
5	66	63	64	47	61	61	923
6	61	62	64	48	60	60	2,140
7	63	63	67	47	60	62	1,123
8	70	68	68	58	63	66	1,682
9	63	62	64	47	59	60	2,292
10							b
11	73	77	76	64	70	73	1,883
12	63	61	66	49	59	61	1,350
13	68	69	73	57	68	68	1,450
14	70	68	71	54	66	67	1,533
15	68	67	71	56	68	67	1,749
16	71	69	70	56	66	67	974
17	64	65	68	53	63	64	2,645
18	72	75	77	63	74	73	1,598
19	64	64	68	49	62	63	2,224
20	73	75	76	67	74	74	1,861
21	70	71	73	60	71	70	1,515
22	76	74	77	64	74	74	2,214
23	64	63	67	52	62	63	1,120
24	71	72	73	59	71	70	2,127
25	78	76	77	67	78	76	1,745
26	80	81	81	72	81	79	1,072
27	71	69	72	58	70	69	2,444
28	71	71	73	61	71	70	1,671
29	72	71	73	61	70	70	1,980
30	71	74	76	62	72	72	1,884
31	77	74	75	66	77	74	2,999
32	62	61	64	49	60	60	1,397
33	73	75	81	74	81	78	83
Total	70	69	71	57	68	68	52,033

[a] Mean p-value is the percent of items answered correctly.

[b] Because of a breach in test security, test results for District 10 were considered to be invalid.