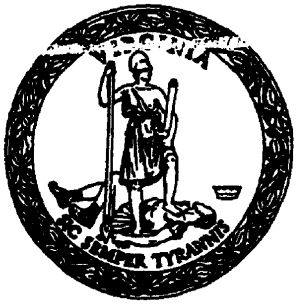
REPORT OF THE
DEPARTMENT OF EDUCATION

A Study of Tracking and Ability Grouping in Mathematics and Science Courses in Virginia's Secondary Schools

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA



HOUSE DOCUMENT NO. 58

COMMONWEALTH OF VIRGINIA
RICHMOND
1992

EXECUTIVE SUMMARY

This study was conducted to determine the status of tracking and ability grouping for mathematics and science courses in the public secondary schools of Virginia as required by House Joint Resolution No. 358. The team sought to integrate the results of current research on the impact of tracking and ability grouping on student achievement with the actual achievement of female, minority and low socioeconomic status students in Virginia's secondary schools. Furthermore, the study team identified incentives which would encourage students to enroll in higher level science and mathematics courses and developed strategies and initiatives to increase the academic achievement of underrepresented students in academic and advanced academic science and mathematics courses.

PROCEDURES

The study team carefully examined the Standards for Accrediting Public Schools in Virginia as an indication of the will and intentions of the State Board of Education and the General Assembly. The study team was guided by the philosophy and direction of the Standard's section on Instructional Program (1988, p. 7, 9). The standard states in part:

> "3. Each secondary school shall offer options for students to pursue a program of studies in several academic and vocational areas. These options shall include the following:
>
> a. Vocational education choices that prepare the student with a marketable skill in one of three or more occupational areas;
> b. Academic choices that prepare the student for technical or professional programs of higher education;
> c. Liberal arts choices that prepare the student for college-level studies in the arts and sciences;
> d. Access to at least two Advanced Placement courses or two college-level courses for credit....
>
> 9. Each middle and secondary school shall provide for the early identification and enrollment of students in a college preparation program with a range of educational and academic experiences that will motivate disadvantaged and minority students to attend college.
>
> 10. Each school shall have a program designed to improve the academic achievement and aspirations of culturally disadvantaged students."

The study team sought to determine if the practice of tracking and

ability grouping could negatively influence a school's ability to fully implement the letter and spirit of the Standard.

The team first undertook a literature review to ground its study in the current thinking on tracking and ability grouping. The most prevalent type of tracking and ability grouping is known as tracked homogeneous grouping. In this type of grouping, students with similar abilities are assigned to the same classes or tracks. This assignment results in a class or track with very little, if any, diversity of student ability. The literature review indicates that tracking and ability grouping which assigns students to an inflexible set of courses and instructional practices based upon the students' perceived ability creates students who are labelled as slow and disinterested learners.

Major criticisms by the national researchers of the tracking and ability grouping issue are the quality of instruction, segregative tendencies, and expectations of students. Their research has shown that students grouped in low ability classes receive instruction which is not comparable to the quality of instruction that students in higher level classes typically receive. Tracking is also viewed as a force which separates students by race and class. Finally, teacher expectations of low ability students is diminished by the inflexibility of the tracking system and the difficulty of moving between tracks.

After a thorough analysis of the literature, the study team developed a Student Enrollment Survey form to collect data from the school divisions in Virginia regarding enrollment and offerings. Other extant data from the Department of Education were also analyzed for the study. Finally, organizations and agencies which have a stake in the education or employability of students were asked for their positions and/or ideas regarding tracking and ability grouping.

FINDINGS

The study of tracking and ability grouping in Virginia's secondary schools revealed that black students and low socioeconomic status students were unable to achieve the level of preparation necessary to attempt the challenging advanced academic courses. Opportunities to enroll in the advanced academic courses were limited. All students need access to the prerequisite courses and/or the advanced academic mathematics and science courses. The limited number of offerings in advanced academic courses, particularly in rural divisions of the state, specifically reduces the possibility of a larger number of students acquiring the skills and abilities taught in those courses. According to the findings of this study, tracking and ability grouping appears to have a negative influence on access and achievement for black students and low socioeconomic status students. Consensus indicates that these two groups overlap to a large extent. This compounds the adverse effect for these

students.

RECOMMENDATIONS

On the basis of the findings of this study, the following recommendations are presented.

- The Department of Education should determine the extent of the need of those local education agencies which do not offer a varied selection of academic and advanced academic mathematics and science course offerings and provide the assistance necessary to make the appropriate adjustments to their current course offerings. Assistance could take a variety of forms such as the electronic classroom, financial subsidies, and consortium arrangements with neighboring local education agencies and area institutions of higher learning.

- It is recommended that the Department of Education increase opportunities for the enrollment of black and low socioeconomic students in science and mathematics courses through an investigation of tracking and ability grouping practices in elementary and middle schools. These practices may be a strong contributor to the lack of student preparedness for academic and advanced academic mathematics and science courses in high school.

- The Department of Education should establish a team to examine the current methods of assigning students to academic and advanced academic mathematics and science courses. The DOE should also establish strategies for the consistent assignment of students to the most challenging courses they can handle. The team should include Department of Education personnel, school administrators, guidance counselors, teachers, and parents. These strategies should be imparted to the local education agencies through a variety of methods such as teacher training, staff development, and in-service workshops.

PREFACE

This report of tracking and ability grouping was conducted by the Department of Education in response to House Joint Resolution No. 358. An interdisciplinary team of Department of Education staff members and a staff member from the State Council of Higher Education developed this report. The team members were:

Dr. Don Ayers
Associate
Guidance

Sandra Ball
Associate
Special Education

Valerie Barrett
Associate
Gifted Education

Harvey Carmichael
Lead
Social Studies

Timothy W. Cotman, *Team Leader*
Associate
Science Education

Winfred Fitzgerald
Assistant
Information Systems

Ruth Grimes-Crump
Associate
Chapter I

Dr. V. Wendell Hylton
Principal
Equity

Susan Parsons
Associate
Mathematics Education

Dr. Lissa Power-Cluver
Principal
Policy Analysis

Dr. Carol Rezba
Lead
Mathematics Education

Dr. Emmett Ridley
Associate
Policy Analysis

Dr. Cora Salzberg
Coordinator of Better Information
& Retention Programs,
Council of Higher Education

This study was developed and conducted with the support, assistance, and supervision of the following:

Dr. Ida J. Hill
Deputy Superintendent
Student Services

Dr. Helen R. Stiff
Division Chief
Pre- and Early Adolescent

ACKNOWLEDGMENTS

The Board of Education gratefully acknowledges the assistance of the Virginia school divisions and the following agencies which provided information and additional resources:

- The Virginia Community College System
- The State Council of Higher Education
- Department of Labor and Industry
- Governor's Employment and Training Department
- Association for Women in Science
- Virginia Middle School Association
- Virginia School Boards Association
- Virginia Education Association

A STUDY OF TRACKING AND ABILITY GROUPING IN MATHEMATICS AND SCIENCE COURSES IN VIRGINIA'S SECONDARY SCHOOLS

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INTRODUCTION

The purpose of this report was to determine the status of tracking and ability grouping as practiced in the public secondary schools of Virginia and to assess the impact of those practices on female, minority, and low socioeconomic status students. Furthermore, the study team sought to identify incentives which would encourage students to participate in higher level mathematics and science courses and to develop strategies and initiatives to increase students' achievement.

The Report of the Governor's Commission on Educational Opportunity for All Virginians (1991, p. 48) found that, in a sample of 26 Virginia public school divisions surveyed, 54 percent tracked middle school students and 95 percent tracked high school students. In addition, the Commission report noted that "while some studies indicated that separate instruction for high-achieving students results in enhanced learning for those students, there is strong evidence that ability grouping retards academic progress and lowers the self-esteem of low- and middle-ability students because it:

- places children in a caste system, often as early as kindergarten;
- can create low expectations for those children in the lower tracks; and
- can result in unintentional segregation and stereotyping of students."

The report called for further study of tracking and ability grouping as practiced in Virginia public schools.

As directed by House Joint Resolution No. 358, the State Board of Education was charged with developing responses to the following questions related to minority, female and low socioeconomic status students: What mathematics and science courses are offered in Virginia? How are those courses distributed throughout the state? What are the qualifications of instructors assigned to teach those courses? What impact does tracking and ability grouping have on student enrollment and achievement? Finally, how can the enrollment of minority, female, and low socioeconomic status students in mathematics and science be increased through the development of incentives, initiatives, and strategies?

PROCEDURES

The Standards for Accrediting Public Schools in Virginia were carefully studied as an indication of the will and intentions of the State Board of Education and the General Assembly. The study team was guided by the philosophy and direction of the

Standard's section on Instructional Program (1988, p. 7, 9). Standard C-3 states in part:

3. Each secondary school shall offer options for students to pursue a program of studies in several academic and vocational areas. These options shall include the following:

    a. Vocational education choices that prepare the student with a marketable skill in one of three or more occupational areas;
    b. Academic choices that prepare the student for technical or professional programs of higher education;
    c. Liberal arts choices that prepare the student for college-level studies in the arts and sciences;
    d. Access to at least two Advanced Placement courses or two college-level courses for credit....

9. Each middle and secondary school shall provide for the early identification and enrollment of students in a college preparation program with a range of educational and academic experiences in and outside the classroom, including an emphasis on experiences that will motivate disadvantaged and minority students to attend college.

10. Each school shall have a program designed to improve the academic achievement and aspirations of culturally disadvantaged students.

The study team sought to determine if the practice of tracking and ability grouping could negatively influence a school's ability to implement fully the letter and spirit of the standard.

The study team adopted the following approach to explore the current practice of tracking and ability grouping in Virginia. First, the current literature on the subject was reviewed. Second, a Student Enrollment Survey was developed and sent to the 530 guidance directors in the middle, high, and combined public schools in the Commonwealth. Third, the following Department of Education data were collected and analyzed:

- 1990-91 Teacher Daily Assignment Reports
- Virginia School Division Report of Student Eligibility for Free/Reduced Lunch
- Student Enrollment Survey Form
- 1990-91 Program of Studies by Course Code Report
- 1990 Report of Virginia graduates and type of diploma earned/awarded
- 1990-91 Teacher Certification Report in Virginia

Some of the data utilized for this report were collected at the school level and some were collected at the division level. Fourth, other sources of data were also examined:

- 1990 National Assessment of Educational Progress Trial State Assessment Test - Mathematics, grade 8 Results for Virginia and the Nation
- Responses from organizations and Agencies in Virginia

LIMITATIONS

The scope of this study was limited to tracking and ability grouping in Virginia's public secondary schools and focused on mathematics and science programs in grades 9-12 and Algebra I in grade 8. For the purposes of this study, information on minority students was limited solely to black students because of the amount of information available on a number of issues related to black students. Course enrollment and distribution data were collected at the division level on the Student Enrollment Survey developed by the study team. Because of the limited time frame for the completion of this study, primary use was made of data already collected but of use within this study. The study team was unable to make extensive interpretations or establish all of the necessary controls.

DEFINITION OF TERMS

Several definitions or descriptions are necessary to provide an understanding of the terms discussed within this study. Although tracking and ability grouping have distinguishing characteristics, for the purposes of this study, the terms were used interchangeably.

- **Tracking and Ability Grouping**: Grouping of students homogeneously by ability determined by performance on tests, previous school performance, and/or perceptions of teachers.

- **Course Type**: Courses which are approved by the Standards for Accrediting Public Schools in Virginia for grades 9-12, for example, Applied Earth Science, Astronomy, and Chemistry I.

- **Course Levels**: Three course levels are referred to in this study: Applied/General, Academic, and Advanced Academic.

- **Applied/General Courses**: Courses designed for students perceived to be of lower ability or to lack the appropriate preparation for higher level courses.

- **Academic Courses**: Courses designed for students perceived to be of average to high ability.

- **Advanced Academic Courses**: Courses designed for students perceived to have high ability.

- **Socioeconomic Status**: (For the purposes of this study), the percent of students approved within each school division for participation in the free and reduced lunch program.

REVIEW OF LITERATURE ON TRACKING AND ABILITY GROUPING

Tracking and ability grouping are terms often used interchangeably to describe the clustering of students based on an identified attribute. These terms, however, can be differentiated. Specifically, ability grouping may be defined as "the selection or classification of students for school, classes, or other educational programs based on differences in ability or achievement" (Thesaurus of ERIC descriptors, 1990). Slavin (1990) defines ability grouping as any school or classroom organizational plan that intends to reduce the heterogeneity of instructional groups. In contrast, tracking or a 'track system' is "a system whereby students of the same chronological age or grade level are assigned to different classes, programs or schools on the basis of perceived ability, achievement level, career/vocational choice, etc." (Thesaurus of ERIC descriptors, 1990). While ability grouping can occur in isolation, if tracking occurs, the students are automatically assigned by ability group.

According to the literature, the most prevalent type of tracking and ability grouping is referred to as tracked homogeneous grouping or between-class ability grouping. Students with similar ability are assigned to classes or tracks, which as a result of the grouping assignments, do not represent the full range of student abilities. In high school, for example, different courses within a subject area are offered within tracks at a given grade. In mathematics for example, a Geometry class would contain only accelerated ninth graders, while other ninth graders in an academic track might take Algebra I. Ninth graders perceived to have the lowest ability level might be grouped into General Mathematics 9. The Geometry, Algebra I, and General Mathematics 9 classes would each have a distinct curricular composition which sets it and the students apart from the other two classes and groups of students.

Characteristics of tracked homogeneous grouping include:

- judgment of student ability based upon a general achievement or ability measure (Slavin, 1988);
- classes or groups assigned with labels that reflect the expectations for the students in each group (Slavin, 1988);
- class labels which influence the performance level and self-esteem of the students (Slavin, 1988);
- hierarchically designed classes which are not considered equally valuable (Oakes, 1985); and
- student experiences which vary based on the expectations, classroom climate, and instructional methodology of the ability group (Slavin, 1988).

Researchers documented that during the whole of the educational experience, tracking affected both what students learned and in what future programs they were eligible and/or qualified to participate. Students in a General Mathematics 9 course, for example, may find it difficult to switch tracks in future years as lower level courses often do not teach the prerequisite concepts and skills essential for successful achievement in advanced academic programs. Oakes (1990, p. 6-7) indicated that students in different tracks had "access to very different types of knowledge - those in the high-track classes are more likely to study rich and meaningful topics and skills, while those in low-track classes get low-level curriculum dominated by exercises, workbooks, and commercially produced basic-skills kits."

Researchers assessed the quality of instruction between different course levels and found that low ability grouped classes receive instruction that is significantly lower in quality than classes of students in high ability groups. Several factors influenced the quality of instruction in low ability grouped classes. These factors included:

- the lower level of expectations for the low ability students (George, 1988);
- the qualifications of the teacher in terms of effectiveness, certification to teach the course, and ability to manage students (George, 1988);
- the amount of material taught in a low ability grouped class (Oakes, 1985); and
- the amount of time low ability grouped students are engaged in learning compared to the amount of time they are off task (Evertson, 1982).

Oakes' research also indicated that instructional time was used differently in low ability classes than in high ability classes. Teachers in low ability classes spent more time on discipline, routine activities, and socializing. In high ability classes, however, students were provided a variety of learning activities and expected to complete greater amounts of homework than students in low ability classes.

The literature shows that researchers who have documented the effects of tracking and ability grouping on student achievement concur in their assessment that tracking and ability grouping benefits high ability students significantly more than it benefits average or low ability students. In her study of 700 schools, Oakes (1990, p. 6) found that tracking "does not work well for students in the low- and middle- ability groups who experience clear and consistent learning disadvantages." Allan (1991) indicated, however, that when students of high ability were

tracked over a period of several years, they experienced increased achievement. Gamoran and Berends (1987) found these results particularly true in mathematics, where students in high tracks achieved significantly more than students in low tracks. The research on the effects of tracking compared the achievement gains made by students between tracks - the high ability groups compared to the low ability groups. In between-class ability grouping where students have been compared between tracks, researchers found that after "controlling for ability level, socioeconomic status, and other control variables, being in the top track accelerates achievement and being in the low track significantly reduces achievement" (Slavin, 1990, p. 474).

Kulik and Kulik (1982) used a meta-analysis technique on 52 studies of between-class ability grouping in secondary schools to determine the benefits of tracking and ability grouping. The results of their analysis indicated that the benefits of comprehensive grouping/tracking were very small. When they analyzed the benefits of programs for talented or gifted students, however, they found that the achievement benefits were positive but moderate in size.

A different result was noted in the effect of tracking and ability grouping on self-esteem: high ability students did not reflect the same improvement in their self-esteem as did lower ability students. Kulik (1985) synthesized the research of 85 studies on ability grouping with respect to achievement and self-esteem: 40 studies at the elementary level and 45 studies at the secondary level. Her findings indicated that ability grouping may improve the self-esteem of the low ability students but that it has little effect on the self-esteem of average students. In an analysis of research on grouping and the gifted, Allan (1991, p. 65) found that in the general population, the effects of grouping on self-esteem are difficult to ascertain. For low ability students, there were "small but positive" effects of grouping on self-esteem. For average and high ability children, however, there were "slightly negative" effects on self-esteem as a result of grouping.

Researchers determined that the effects of tracking and ability grouping on race and ethnicity appear to be more pernicious than originally thought. Slavin wrote that "tracking is a principal source of social inequality in society and that it causes or greatly magnifies differences along the line of class and ethnicity" (1990, p. 474). As a result of Oakes' extensive research on tracking and ability grouping, she also reported that tracking is segregative. She stated that it was well established that tracking separated students by race and social class. African-American and Hispanic students were disproportionately assigned to low-ability classes and to non-college preparatory high school programs, as were students from low-income families (Oakes, 1990, p.6).

The general consensus of researchers was that, regardless of the type of tracking and ability grouping used in either the elementary or secondary grades, the grouping of students resulted in differentiated learning opportunities. Teachers were shown to have different expectations for their low ability students and therefore adjusted their teaching strategies. The quality of instruction offered to low ability students was also called into question. Student self-esteem improved for low ability students but remained the same for average students. High ability students benefited significantly more from tracking and ability grouping than average or low ability students.

FINDINGS: BACKGROUND ON TRACKING AND ABILITY GROUPING IN VIRGINIA'S SCHOOLS

The National Assessment of Educational Progress (NAEP) (1990) indicated that there was a distinct correlation between a student's exposure to a subject and the level of achievement in that subject. A variety of factors affect this exposure including: (a) the extent and kinds of courses offered in the program; (b) the content and rigor of the courses; (c) the prerequisites for various courses; and (d) the extent to which students take advantage of the available course opportunities. Tracking and ability grouping significantly affect these four factors. For example, Oakes (1990) reported that lower socioeconomic status schools and predominantly black schools grouped students in average and low ability courses. Mathematics and Science course offerings in those schools were minimal as students did not receive the preparation nor did they enroll in the prerequisite courses for advanced academic coursework. Conversely, Oakes (1990) reported that higher socioeconomic status schools tended to offer only courses for average, above-average, and high-ability students. Many students in these schools were able to complete the prerequisites that enabled them to participate in advanced academic mathematics and science courses because the courses were available, they had been prepared for the programs, and did take advantage of the offerings.

DESCRIPTION OF COURSE LEVELS

This section of the report addresses the levels of mathematics and science courses offered by Virginia public schools. The distribution of offerings throughout the Commonwealth is presented.

Three basic levels of mathematics and science courses are offered in the secondary schools: applied/general, academic, and advanced academic. These levels are differentiated on the basis of content. The differentiation results in a continuum of offerings with varying complexity in the presentation of the material. Applied/general courses are designed for students perceived to be of lower ability. General information is stressed for these students who are not prepared for higher level courses. These courses earn credit toward the standard twenty-one credit diploma only. Students who successfully complete any of these courses have the option of discontinuing their mathematics and science study after completing the minimum requirements, continuing to enroll in applied/general courses, or enroll in academic mathematics and science courses. The content of applied/general courses, however, does not meet the prerequisites for academic and advanced academic courses.

The sequence of applied/general mathematics courses includes General Mathematics, Basic Algebra, Informal Geometry, Algebra I parts I and II, and Consumer Mathematics. Students who begin their mathematics sequence by successfully completing applied/general courses have the opportunity to move to the academic track by pursuing the beginning course of the academic sequence. The sequence of applied/general courses for science includes Applied Earth Science, Applied Biology, Applied Physical Science, Consumer Chemistry, and Applied Physics. Students who begin their sequence of courses with applied/general courses such as Applied Earth Science in Applied Biology will find it necessary to take the academic course in the same topic in order to move from the applied/general track to the academic track.

Most students, once they have entered the applied/general track, do not switch to the academic track. Although applied/general courses in the last two years of secondary school that relate to student experience or vocational interests are valuable, General Mathematics taken in the first year of high school tends to place students in a track from which there is little, if any, opportunity to exit.

The academic course is designed for the average student. The complexity of the course content is further increased at the advanced academic level for students perceived to have high ability. These courses apply toward credit for both the standard and the advanced studies diploma.

Advanced academic mathematics and science courses are provided for students who progress through a developmental sequence of courses beginning with the academic course(s) in the specific topic. As an example, students who desire to pursue Advanced Placement Biology or Biology II will complete academic Biology 1 as the beginning course in the sequence. Since academic courses are prerequisites to advanced academic courses, a student who only completes applied/general science courses will not have completed the prerequisites for advanced academic courses in science.

A critical course for some high school students is Calculus, often described as a "gatekeeper" course, since it is a prerequisite for entry into most mathematics, science, and technology-related majors in college. Students who do not have calculus in high school must begin college by taking remedial calculus classes, thus making it difficult to obtain a mathematics or science-related baccalaureate degree in four years. In order to take Calculus in the senior year of high school, a student must progress through the necessary academic and advanced academic mathematics courses (Algebra I, Geometry, and Algebra II/Trigonometry, in addition to an advanced course in Mathematical Analysis (e.g., Analytic Geometry and Elementary Functions)) and must have taken Algebra I in the eighth grade.

In addition to the Calculus course, Algebra I and Geometry are also referred to as gatekeeper courses. Students who take these two courses in eighth and ninth grades will be able to enroll in the necessary courses to prepare for twelfth grade Calculus. Students who complete applied/general mathematics courses such as General Mathematics and Basic Algebra will not have completed the prerequisite courses for enrollment in advanced academic mathematics courses.

COURSE OFFERINGS

Information on course offerings in Virginia public secondary schools was derived from the Student Enrollment Survey Form in mathematics and science courses. Data for course offerings were based on evidence of enrolled students. There may be schools that offered a particular course, but had no students who enrolled in the course. For purposes of this study, a course was considered an offering only if there was a record of enrolled students.

Another issue which may influence the use of tracking and ability grouping is the multiple diploma system which includes an advanced studies diploma, a standard diploma, and a certificate. An advanced studies diploma is offered for students who pursue the most rigorous course of studies, requiring a minimum of three mathematics and three science courses from the academic and advanced academic course listings, and a total of 23 course credits. The course of studies leading to the standard diploma may include applied/general level courses, requires a total of five science and mathematics courses, and a total of 21 course credits. Certificates are offered for special circumstances and have no specific requirements.

Receipt of an advanced studies diploma is predicated upon taking the required mathematics and science courses from the academic and advanced academic course list. Opportunities to begin taking the appropriate prerequisites begin in the eighth grade with the introductory courses. Students in the nine school divisions with no enrollment in advanced academic mathematics courses would have a more difficult time fulfilling the requirements for an advanced studies diploma. The distinctions between the standard and the advanced studies diploma are noteworthy because the course requirements for these diplomas may contribute to the continuance of tracking in Virginia secondary schools.

Data from the Department of Education Report, Program of Studies by course code, were analyzed to determine the distribution of course offerings, as reflected by student enrollment in courses for the 1990-91 school year. The findings are presented as follows:

- In the area of advanced academic mathematics courses, of the 131 reporting school divisions, 23 divisions offered four or more courses; 42 divisions offered three courses; 32 divisions offered only one course; and eight divisions did not offer any advanced academic mathematics courses.

- The state average per school division for the number of advanced academic mathematics courses offered was two courses.

- For academic mathematics course offerings, of the 131 school divisions reporting, 49 divisions offered seven or more courses; 47 divisions offered five courses; and 20 divisions offered four or fewer courses.

- The state average per school division for the number of academic mathematics courses offered was six courses.

- For advanced academic science courses offered, of the 131 school divisions, 35 divisions offered three or more courses; 69 divisions offered two courses; 34 divisions offered one course; and 25 divisions did not offer any advanced academic science courses.

- The state average per school division for the number of advanced academic science courses offered was two courses.

- For academic science courses offered, of the 131 school divisions, 125 divisions offered four courses and six divisions offered three courses.

- The state average per school division for the number of academic science courses was four courses.

The profile of course distribution in mathematics and science in Virginia reveals that there is a variation in the number of course offerings. It is important to note that eight divisions did not offer an advanced academic mathematics course and 25 divisions did not offer an advanced academic science course.

The data also reveal that most Virginia schools offer a continuum of applied/general, academic, and advanced academic courses in their educational program. The data show no student enrollment, however, in any applied/general and advanced academic courses for a small number of Virginia schools.

Mathematics

All Virginia schools must offer General Mathematics, Algebra I, and two courses above Algebra I to meet accreditation requirements. (See Appendix B for a complete listing of the applied/general, academic, and advanced academic mathematics course offerings.) Currently, there are 23 different applied/general, academic, and advanced academic mathematics courses offered in schools throughout the Commonwealth.

- Applied/General Mathematics

  All school divisions offer applied/general mathematics courses.

- Academic Mathematics

  All Virginia school divisions offer academic mathematics courses.

- Advanced Academic Mathematics

  One hundred twenty-three (of 131) school divisions reported enrollment of at least one advanced academic mathematics course. Thirty-three school divisions have students enrolled in either AP Calculus or Geometry by means of the electronic classroom.

Science

Virginia schools must offer three of the following four courses to meet the Standards for Accrediting Public Schools in Virginia (C-3). Currently, there are 18 different applied/general, academic, and advanced academic science courses offered throughout the Commonwealth. (See Appendix B for complete a listing of applied/general, academic, and advanced academic science course offerings.)

- Applied/General Science

  Thirty-six of 131 school divisions have no enrollment in applied/general science courses.

- Academic Science

  All Virginia public schools offer academic science classes.

- Advanced Academic Science

  One hundred and six (or 81% of) school divisions in the Commonwealth reported enrollment of at least one advanced academic science course during the 1990-91 school year.

DEMOGRAPHIC DISTRIBUTION

Divisions were divided into three groups according to population density for evaluation of the demographic distribution of advanced academic courses in the following manner.

Table 1:

Division Population Density

Population Density (Person/square mile)	**Division Category**
1-100	Rural
101-999	Suburban
1000 and over	Urban

Of the nine school divisions reporting no enrollment in advanced academic mathematics courses, all nine divisions were rural. Of the twenty-five school divisions reporting no enrollment in advanced academic science courses, twenty (80%) were rural, two suburban, and three urban.

TEACHER QUALIFICATIONS

Mathematics

Ninety-eight percent of secondary mathematics courses in Virginia's secondary schools were taught by certified and endorsed teachers. The highest percentage of unendorsed teachers were assigned to applied/general mathematics courses (3%). Students in applied/general mathematics courses were more likely to be instructed by an unendorsed teacher (3% unendorsed) than students in academic mathematics (2% unendorsed) or advanced academic mathematics courses (0.6% unendorsed).

Science

Ninety-three percent of all secondary science courses in Virginia were taught by certified and endorsed teachers. The highest percentage of unendorsed teachers were found in applied/general science courses. Students in applied/general science courses were more likely to be instructed by an unendorsed teacher (11.3% unendorsed) than students in academic (6.9% unendorsed) or advanced academic science courses (2.6% unendorsed).

Teacher certification and endorsement do not appear to be a concern according to the findings of this study. The most notable difference occurred among unendorsed teachers assigned to teach applied/general courses and those assigned to teach advanced academic mathematics courses.

FINDINGS: OPPORTUNITIES FOR ENROLLMENT IN MATHEMATICS AND SCIENCE COURSES

This aspect of the study examined student enrollment in advanced academic mathematics and science courses to determine the extent of participation of black, female, and low socioeconomic status students in these courses. The percentage of enrollment of these selected groups in the three types of mathematics and science courses (i.e., applied/general, academic, and advanced academic) was compared to the mean percentage enrollment by schools in eighth grade Algebra I and in grades 9-12 the sample of grades 9-12.

BLACK AND FEMALE STUDENT ENROLLMENT IN EIGHTH GRADE ALGEBRA I

Students aspiring to take the most advanced mathematics courses available in secondary schools should enroll in Algebra I in eighth grade. Students who do not enroll in eighth grade Algebra I will have little opportunity to take calculus in twelfth grade.

The *Student Enrollment Survey* sample represented 32,083 eighth grade students, of whom 8,654 (20%) were black. Black eighth grade student enrollment in Algebra I was 3.0 percent of the total eighth grade Algebra I enrollment, (Figure 1).

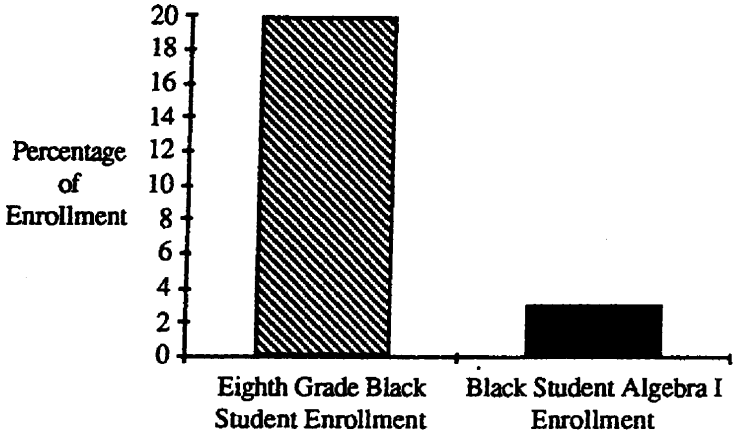

Figure 1: Comparison of the Percentage of Eighth Grade Black Student Enrollment to the Percentage of Algebra I Black Student Enrollment.

The percentage of female students enrolled in eighth grade Algebra I (54%) was slightly greater than the percentage of female students enrolled in the total eighth grade sample (49%), (Figure 2).

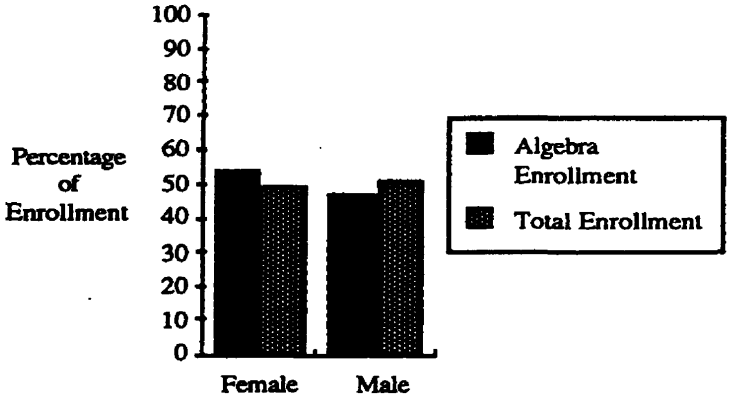

Figure 2: Comparison of Eighth Grade Enrollment By Gender to Eighth Grade Algebra I Enrollment By Gender.

MATHEMATICS COURSES

This section addresses the percentage of enrollment in the three levels of mathematics courses as compared to the mean percentage of enrollment in the sample of grades 9-12. In this sample, white students represented an average of 74 percent of the total student enrollment in grades 9-12. Figure 3 indicates that of the students enrolled in academic mathematics courses 76 percent were white, and of those enrolled in advanced academic mathematics courses, 79 percent were white.

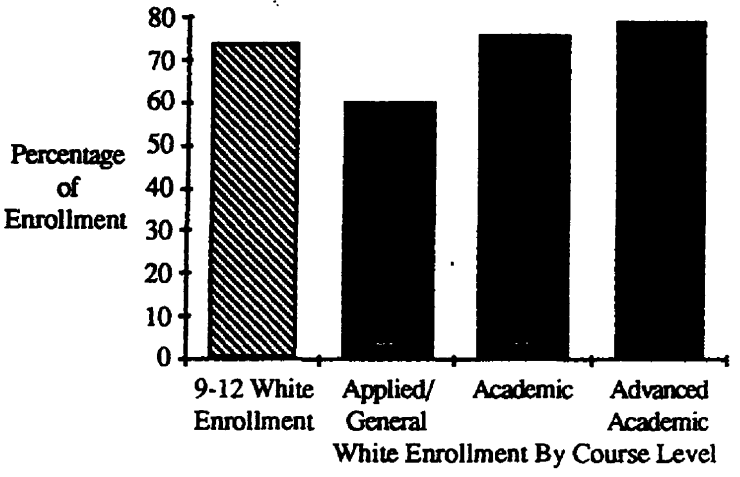

Figure 3: Comparison of Percentage of White Student Enrollment in Mathematics Courses By Course Level to Percentage of White Students Enrolled in Grades 9-12.

These enrollment percentages in college preparatory courses were greater than those of the represented population. Further, of students enrolled in applied/general mathematics courses, 60 percent were white, 14 percentage points less than their enrollment in grades 9-12. These data show that white students were enrolled in academic and advanced academic mathematics courses, the college preparatory courses, at or above the total white student enrollment in grades 9-12.

As indicated in Figure 4, twenty-one percent of the students enrolled in the school sample in grades 9-12 were black students. Figure 4 shows that of students enrolled in academic mathematics courses, 16 percent were black, and of students enrolled in advanced academic mathematics courses, six percent were black. The percentage of black students in these college preparatory courses (academic and advanced academic) was lower than the percentage of black students in this sample. Black students constituted 35 percent of enrollment in applied/general mathematics courses, a percentage that exceeds the percentage of black students in grades 9-12. These data indicate that a higher percentage of black students were enrolled in courses that are often identified as non-college preparatory mathematics courses (applied/general) than in courses identified as college preparatory mathematics courses (academic and advanced academic). Enrollment in applied/general mathematics courses often limits a student's opportunity to study academic and advanced academic mathematics. This situation occurs because the instruction of mathematics is sequential in nature and the level of skills and conceptual understanding taught in applied/general mathematics courses often do not provide students with an adequate foundation for academic courses.

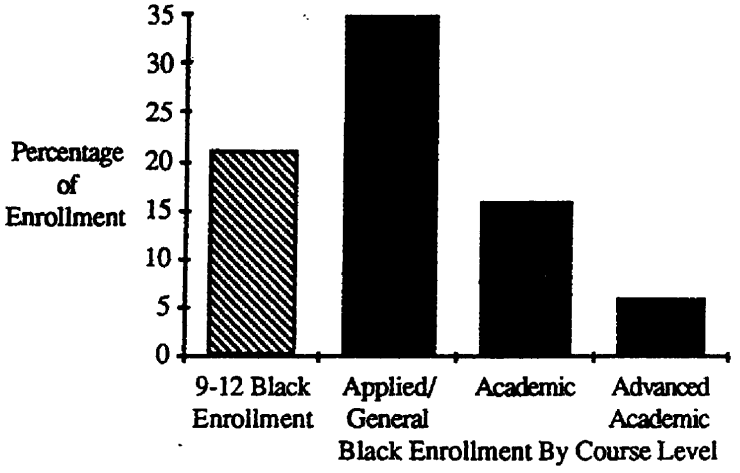

Figure 4: Comparison of Percentage of Black Student Enrollment in Mathematics Courses By Course Level to Percentage of Black Students Enrolled in Grades 9-12.

SCIENCE COURSES

In this sample, white students represented an average of 74 percent of the student enrollment in grades 9-12. Figure 5 indicates that this same percentage (74%) of the white students enrolled in academic science courses. Further, 80 percent of students enrolled in advanced academic science courses were white, a percentage greater than white student enrollment in grades 9-12. Of students enrolled in applied/general science courses, 69 percent were white, five percentage points less than the percentage of white student enrollment in grades 9-12. These data suggest that white students were enrolled in academic and advanced academic science courses, the college preparatory courses, at or above their percentage of enrollment in grades 9-12.

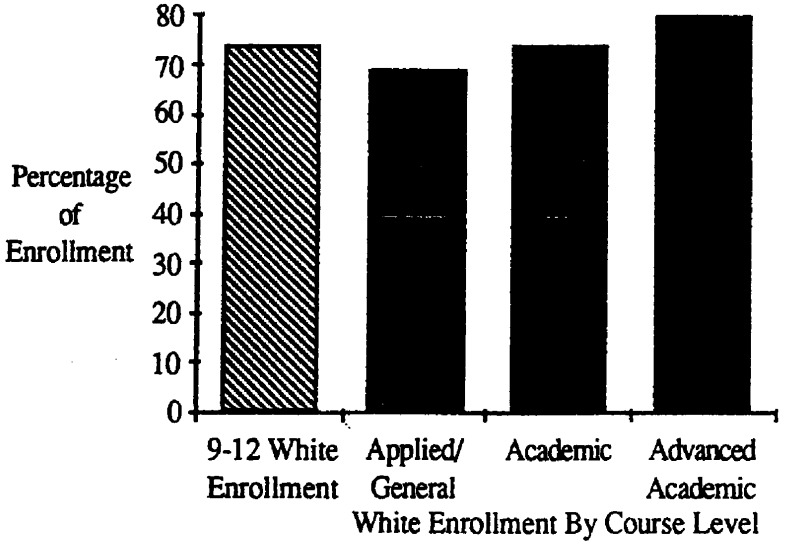

Figure 5: Comparison of Percentage of White Student Enrollment in Science Courses By Course Level to Percentage of White Students Enrolled in Grades 9-12.

An average of 21 percent of the students enrolled in this sample of grades 9-12 were black students. Figure 6 shows that 19 percent of the students enrolled in academic science courses were black, and eight percent of those enrolled in advanced academic science courses were black. Enrollment of black students in these college preparatory courses (academic and advanced academic) was lower than the percentage of black student enrollment in grades 9-12. Black student enrollment in applied/general science courses was 26 percent. This percentage exceeds the percentage of blacks in grades 9-12. These data reveal that a higher percentage of black students are enrolled in courses that are often identified as non-college preparatory courses (applied/general) than in courses identified as college preparatory courses (academic and advanced academic). As applied/general courses do not satisfy the prerequisite requirements for entrance into advanced academic courses, the finding suggests that a disproportionate number of black students (i.e., those enrolled in applied/general science courses) often will not have opportunities to enroll in advanced academic courses.

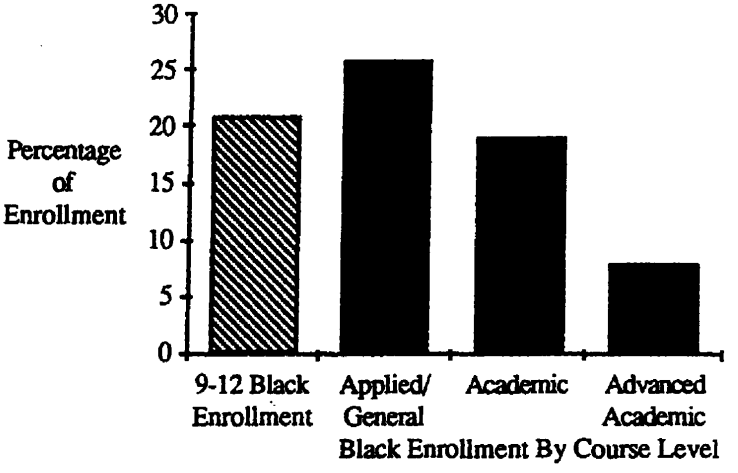

Figure 6: Comparison of Percentage of Black Student Enrollment in Science Courses by Course Level to Percentage of Black Students Enrolled in Grades 9-12.

SUMMARY

Academic and advanced academic mathematics and science courses are courses designed to prepare students for college. White students were enrolled in academic and advanced academic mathematics and science courses at percentages equal to or greater than the enrollment of whites in grades 9-12. On the other hand, black students were enrolled in academic and advanced academic science and mathematics courses at percentages less than the enrollment of black students in grades 9-12. The implication of

this finding is that black students are not enrolled in college preparatory courses at percentages equal to the population percentage of blacks.

Applied/general mathematics and science courses are usually not rigorous and are designed as low-level, non-college preparatory courses. White students were enrolled in applied/general mathematics and science courses at percentages less than the enrollment in grades 9-12. However, black students were enrolled in applied/general mathematics and science courses at percentages greater than the enrollment of black students in grades 9-12. The finding suggests that black students were enrolled in courses that do not provide the preparation that is essential to developing the prerequisite skills for enrollment in advanced academic mathematics and science courses.

COMPARISON OF SOCIOECONOMIC STATUS OF STUDENTS AND ENROLLMENT IN ADVANCED ACADEMIC MATHEMATICS AND SCIENCE COURSES

Advanced Academic Mathematics

The indicator of student socioeconomic status (SES) was the percentage of students on free and reduced lunch. School divisions were categorized into four groups (one forth per group of 131 school divisions in the state) based on the percentage of students receiving free and reduced price lunch as follows:

Group I	3.0-19.0% of students on free and reduced lunch
Group II	19.1-27.5% of students on free and reduced lunch
Group III	27.6-37.0% of students on free and reduced lunch
Group IV	37.1-69.6% of students on free and reduced lunch

A measure of student achievement was derived by determining mean state student enrollment in advanced academic courses. The mean state enrollment in advanced academic mathematics courses was six percent. Data were collected to determine the percentage of school divisions in each group that did not enroll at least six percent (state mean enrollment) of mathematics students in advanced academic mathematics courses.

Figure 7 indicates that 41 percent of school divisions (five of 33) in Group I (3.0-19.0% free/reduced lunch) enrolled less than six percent of mathematics students in advanced academic mathematics courses; 64 percent (21 of the 33 school divisions) in Group II (19.1-27.5% free/reduced lunch) had less than six percent of mathematics students enrolled in these courses; 72 percent (24 of the 33 school divisions) in Group III (27.6-37.0% free/reduced lunch) had less than six percent of mathematics students enrolled in these courses; and 91 percent (29 of the 32 school divisions) in Group IV (37.1-69.6% free/reduced lunch) had less than six percent of mathematics students enrolled in these courses.

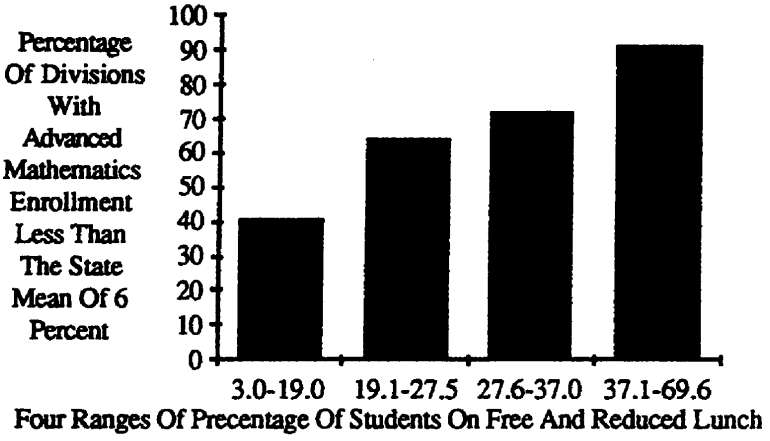

Figure 7: Comparison of Percentage of Students on Free and Reduced Lunch Program by Groups with Percentage of Enrollment in Advanced Academic Mathematics.

This analysis of the data reveals that student enrollment in advanced academic mathematics courses varies with respect to the percentage of students on free and reduced lunch (indicator of SES). School divisions with a high percentage of low SES students had low enrollments in advanced academic courses. This finding suggests that the enrollment of low SES students in advanced academic mathematics courses was lower than that of high SES students in the same courses.

Advanced Academic Science

Twenty-five school divisions across the state reported no enrollment in advanced academic science courses. Figure 8 shows the distribution based on the four groups identified above. Nine percent of school divisions (3 of the 33) in Group I, the group with the lowest percentage of free and reduced lunch, reported no enrollment in advanced academic science courses; 15 percent (5 of the 33 school divisions) in Group II reported no enrollment in advanced academic science courses; 18 percent (6 of the 33 school divisions) in Group III reported no enrollment in advanced academic science courses ; and 34 percent (11 of the 32 divisions) in Group IV, the group with the highest percentage of students on free and reduced lunch, reported no enrollment in advanced academic science courses.

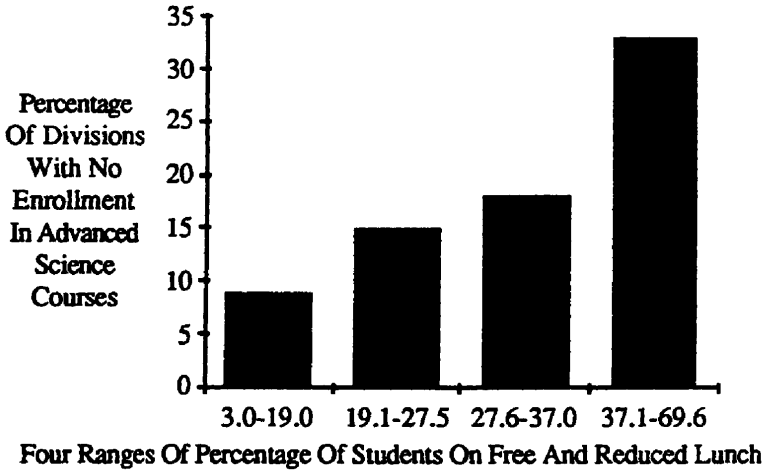

Figure 8: Comparison of Percentage of Students on Free and Reduced Lunch Program by Groups with Percentage of Enrollment in Advanced Science.

SUMMARY

The data in Figures 7 and 8 suggest that a connection existed between the enrollment of students in advanced academic mathematics and science courses and the percentage of students approved to receive free and reduced lunch. These data indicate that the higher the percentage of students approved to receive free and reduced lunch, the lower the percentage of students in advanced academic mathematics and science courses. These findings support the research literature which indicates that socioeconomic status influences opportunities to enroll in advanced academic mathematics and science courses.

Higher percentages of low SES students need enhanced preparation to develop the prerequisite skills to qualify for enrollment in advanced academic mathematics and science courses.

COMPARISON OF MALE AND FEMALE STUDENTS AND THEIR ENROLLMENT IN MATHEMATICS AND SCIENCE COURSES

In the survey sample, males represented 50.4 percent and females represented 49.6 percent of students enrolled in mathematics and science courses in Virginia's secondary schools. In Figures 9 and 10, the enrollment in mathematics courses by level for males and females is presented. Male enrollment in academic mathematics courses was 1.5 percentage points lower than male enrollment in the sample, while female enrollment was 1.5 percentage points higher than the sample enrollment. In advanced academic mathematics courses males were enrolled at 2.1 percentage points higher and females enrolled 2.2 percentage points lower than the respective percentages of the sample. This finding is consistent with results found in the research literature on this topic.

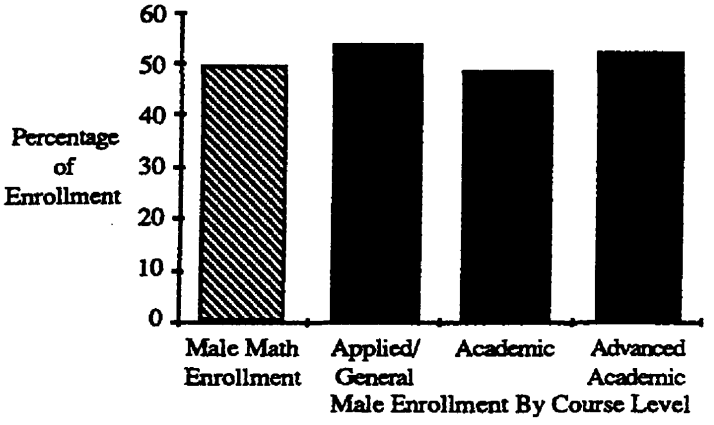

Figure 9: Comparison of Percentage of Male Student Enrollment in Mathematics Courses by Course Level to Percentage of Male Students Enrolled in all Mathematics Courses.

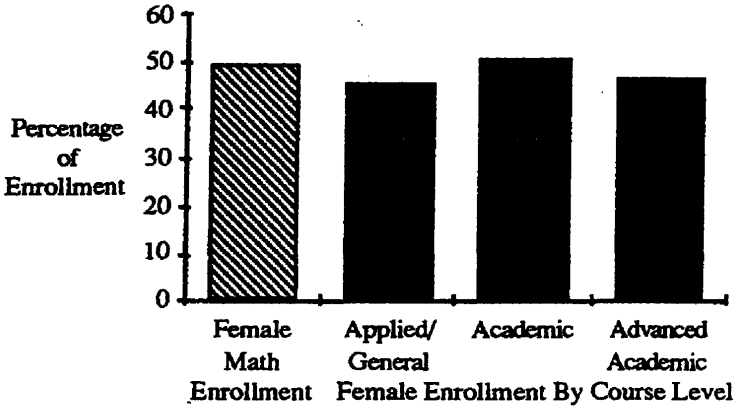

Figure 10: Comparison of Percentage of Female Student Enrollment in Mathematics Courses by Course Level to Percentage of Female Students Enrolled in all Mathematics Courses.

In Figures 11 and 12, the enrollment in science courses by level for males and females is displayed. Male enrollment in academic science courses was 0.6 of a percentage point lower than male enrollment in the sample, while female enrollment was 0.6 of a percentage point higher than the sample enrollment. In advanced academic science courses males were enrolled at 3.4 percentage points lower and females enrolled 3.4 percentage points higher than the respective percentages of the sample. This finding is contrary to reports of low female participation in advanced academic science courses found in the literature.

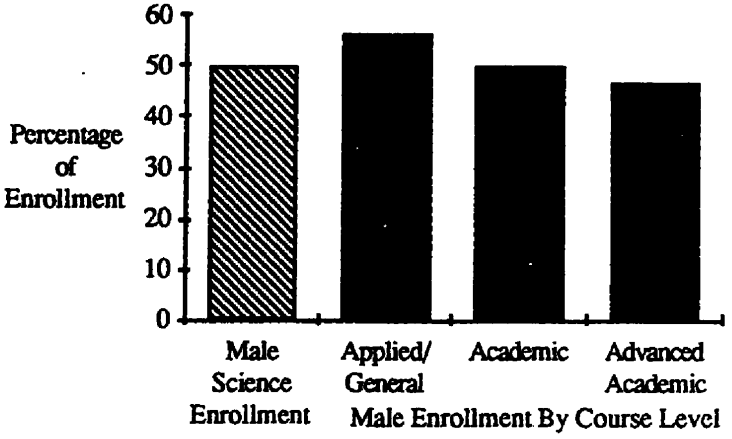

Figure 11: Comparison of Percentage of Male Student Enrollment in Science Courses By Course Level to Percentage of Male Students Enrolled in all Science Courses.

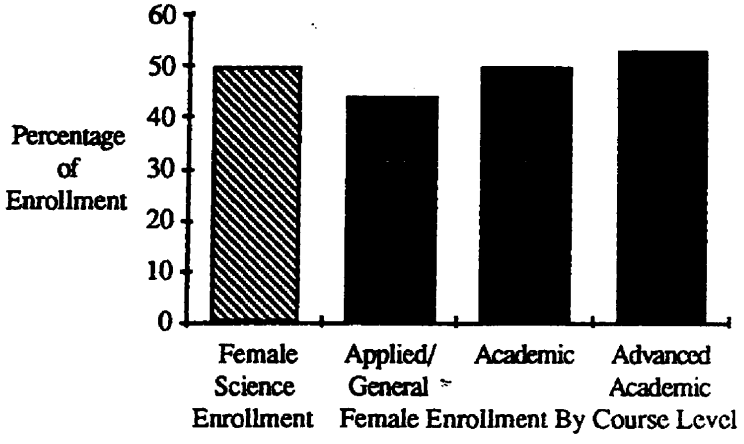

Figure 12: Comparison of Percentage of Female Student Enrollment in Science Courses by Course Level to Percentage of Female Students Enrolled in all Science Courses.

In the applied/general mathematics and science courses referred to in Figures 9-12, a greater percentage of males was enrolled than the representation of males in the total enrollment in science and mathematics courses. On the other hand, females were enrolled in applied/general mathematics and science courses at a lower percentage than the representation enrollment of females in these courses.

SUMMARY

Overall, the findings in this section of the study suggest that females are enrolled in academic and advanced academic mathematics and science at a level consistent with males. These findings are contrary to findings typically reported in the research literature.

FINDINGS: INFLUENCE OF TRACKING AND ABILITY GROUPING ON ACHIEVEMENT OF SELECTED GROUPS OF STUDENTS IN MATHEMATICS AND SCIENCE COURSES

Research has revealed that lower track courses in mathematics and science focus on memorization, simple skills and facts, while the higher track courses emphasize higher order skills (critical thinking, reasoning, and problem solving) which are transferable to further education and/or employment opportunities. Oakes (1990) reported that, "instructional grouping, which results in establishing a specific and rigid set of courses based on perceived student ability, often leaves students in lower ability groups unchallenged, unmotivated and stigmatized by the grouping."

This section of the study examined the results of the National Assessment of Educational Progress report (NAEP), ability grouping, and student achievement. The extent of ability grouping was represented by the distribution of students in the three levels of science and mathematics courses: applied/general, academic, and advanced academic. Student achievement in mathematics and science was based upon eleventh grade mean school division scores on the *Tests of Achievement and Proficiency (TAP)*.

NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

Entrance into advanced academic mathematics courses requires that students meet established prerequisites usually by completing a developmental sequence of courses. For students to enroll in Calculus, for example they must complete Algebra I, Geometry, Algebra II/Trigonometry, and an additional advanced academic course in Mathematical Analysis. To complete these prerequisite courses, students must begin the developmental sequence by taking Algebra I in eighth grade.

The 1990 National Assessment of Educational Progress: The Trial State Assessment at Eighth Grade provided an evaluation of eighth grade mathematics enrollment and proficiency scores by ethnicity and by course for the Commonwealth of Virginia (Table 2). For the state as a whole, 46 percent of eighth grade students were enrolled in eighth grade Mathematics, 35 percent in Pre-Algebra, and 16 percent in Algebra. The overall proficiency score for the Virginia sample was 264 on a scale of zero to 500. White students comprised 68 percent of the sample drawn for the National Assessment of Educational Progress. Forty-two percent of these students were enrolled in eighth grade Mathematics, 36 percent in Pre-Algebra, and 19 percent in Algebra. The proficiency score of white students enrolled in eighth grade Mathematics was 251, in Pre-Algebra 277, and in Algebra 307.

Table 2:

1990 National Assessment of Educational Progress
The Trial State Assessment at Eighth Grade

Students Reports on the
Mathematics Classes They Are Taking

Percentage of Students Enrolled and
Average Mathematics Proficiency (0 - 500 scale)

1990 NAEP Trial State Assessment	Eighth Grade Mathematics	PreAlgebra	Algebra
State Total			
% Enrollment	46	35	16
(264-Proficiency)	244	271	301
Race/Ethnicity			
68% Pop.			
White %Enr.	42	36	19
Prof	251	277	307
13% Pop.			
Black %Enr.	57	32	9
Prof	228	252	*Insuf

n=2661 representing 94% Pop.

*The Sample Size is Insufficient to Permit a Reliable Estimate (Fewer than 62 Students)

Black students comprised 23 percent of the sample drawn for the National Assessment of Educational Progress. Fifty-seven percent of these students were enrolled in eighth grade Mathematics, 32 percent in Pre-Algebra, and nine percent in Algebra. The proficiency score of black students enrolled in eighth grade Mathematics was 228, in Pre-Algebra 252, and in Algebra the data were insufficient to report.

Comparing the state mean enrollment by course and by ethnicity reveals that the mean enrollment of white students in Algebra (19%) was three percentage points higher than the state sample mean enrollment (16%), while the mean enrollment of black students (9%) was seven percentage points lower than the state mean enrollment. The mean enrollment of whites in Pre-Algebra (36%) was similar to the state mean enrollment (35%). Black student mean enrollment in Pre-Algebra was three percentage points lower than the state mean. In eighth grade Mathematics, the mean enrollment of white students (42%) was three percentage points higher than the state sample mean enrollment (46%), while the mean enrollment for black students was 57 percent, 11 percentage points above the state mean.

Comparing the state mean proficiency scores by course and by ethnicity reveals that the mean proficiency of white students in Algebra (307) was six points higher than the state sample mean proficiency (301), while the mean proficiency of black students could not be determined because of insufficient data. The mean proficiency of whites in Pre-Algebra was six points higher than the state mean proficiency (271). Black student mean proficiency in Pre-Algebra was 19 points lower than the state mean. In eighth grade Mathematics, the mean proficiency of white students (251) was seven points higher than the state sample mean proficiency (244), while the mean proficiency for black students (228) was 16 points below the state mean.

In summary, white students comprised a larger percentage of students taking Algebra in the eighth grade than the state mean percentage of students taking Algebra and a smaller percentage of students taking eighth grade Mathematics. On the other hand, black students comprised a smaller percentage of students taking Algebra in eighth grade than the state mean percentage of students taking Algebra and a higher percentage of students taking eighth grade Mathematics. Black students were a smaller percentage of the enrollment in Algebra in eighth grade which begins the developmental sequence leading to advanced academic mathematics study.

TESTS OF ACHIEVEMENT AND PROFICIENCY

During March-April 1991, approximately 57,000 students in grade 11 were given the *Tests of Achievement and Proficiency (TAP)*. These tests, which comprise the Riverside Basic Skills Assessment Program, were administered in the state testing program. The test scores from the six subtests, one of which was mathematics, provided information for the following purposes: (1) to aid teachers and other school personnel to identify the general academic needs of individual students and groups of students so that instruction could be tailored to those needs; (2) to provide a standard by which to measure the academic progress of students; and (3) to provide a means of comparing the academic achievement of individuals and groups of Virginia students with that of students in the same grade across the nation. Each school division received a percentile rank corresponding to the average scores for students taking the tests in each school division in Virginia on each subtest. The mean percentile rank for Virginia students on the 1990-91 test of mathematics achievement was 58; the national mean percentile rank for mathematics was 50.

MATHEMATICS COURSES

The percentage of students enrolled in mathematics courses by school division was compared to division mean test scores on the mathematics subtest of TAP (Figure 13). Divisions with more than 23 percent of the students enrolled in applied/general mathematics courses scored an average of eight points lower than the divisions with 0-23 percent of their students enrolled in these courses. These data suggest that the higher the percentage of students enrolled in applied/general mathematics courses, the lower the division mean mathematics scores. In Figure 13, the school divisions were separated into two groups based upon enrollment in applied/general mathematics courses above and below 23.0 percent. An enrollment of 23 percent was used to differentiate the two sets of school divisions because it was the point at which the mean school division TAP scores declined.

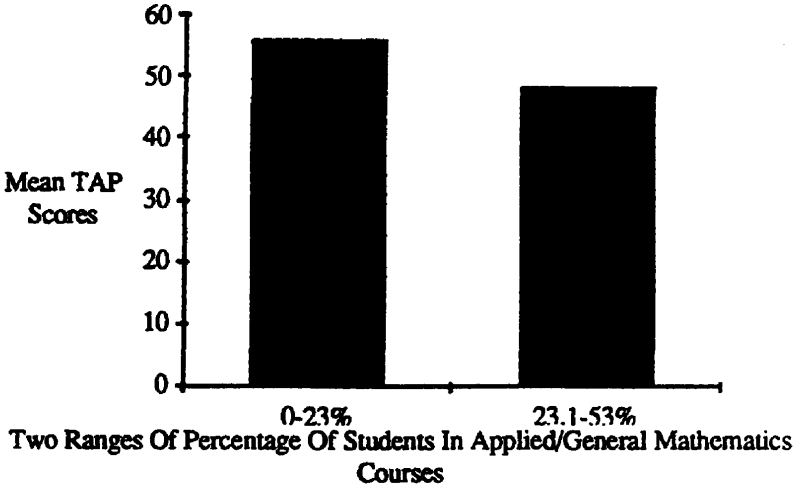

Figure 13: Comparison of School Division Mean TAP Scores With Percentage of Division Student Enrollment in Applied/General Mathematics Courses

Figure 14 illustrates the percent of enrollment in advanced academic mathematics courses in comparison to division mean achievement in mathematics. School divisions enrolling 0-7 percent of students in advanced academic mathematics courses scored an average of nine points below school divisions that enrolled approximately 8-18 percent of their students in advanced academic mathematics courses. These data suggest that the higher the enrollment in advanced academic mathematics courses, the higher the achievement in mathematics. In Figure 14, school divisions were separated into two groups based upon enrollment in advanced academic mathematics courses above and below seven percent. The enrollment comparison of seven percent was used because this score represented the point at which a difference in the mean school division TAP scores declined.

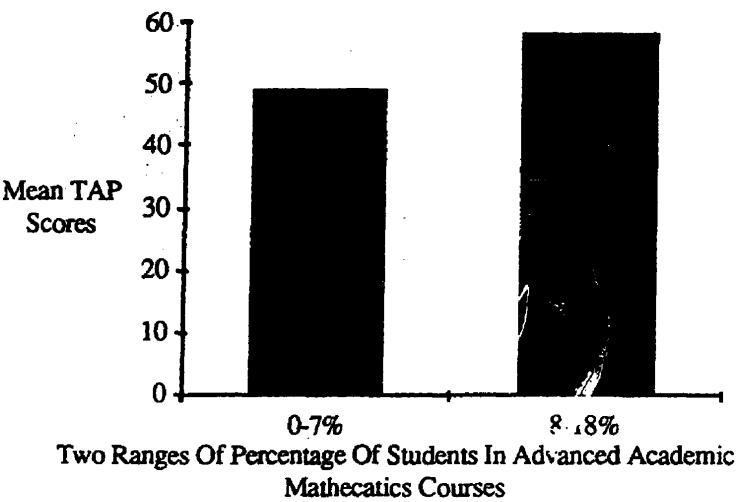

Figure 14: Comparison of School Division with Mean TAP Scores with Percentage of Division Student Enrollment in Advanced Academic Mathematics Courses

SCIENCE COURSES

The indicator of student achievement was the mean school division scores on TAP. The percentage of students enrolled in applied/general science courses by school division was compared to division scores on the science subtest of TAP (Figure 15). Thirty-three school divisions, one-fourth of all school divisions, had 16.1 to 66.0 percent of students enrolled in applied/general science courses. On the average, these school divisions scored seven points lower than the other ninety-eight school divisions that had 0.0-16 percent of students enrolled in applied/general science courses. This difference suggests that the higher the percentage of students enrolled in applied/general science courses by division, the lower the division mean test scores. In Figure 15, the school divisions were separated into two groups based upon enrollment in applied/general science courses above and below 16.0 percent. An enrollment of 16 percent was used to differentiate the two sets of school divisions because it was the point at which the mean school division TAP scores declined.

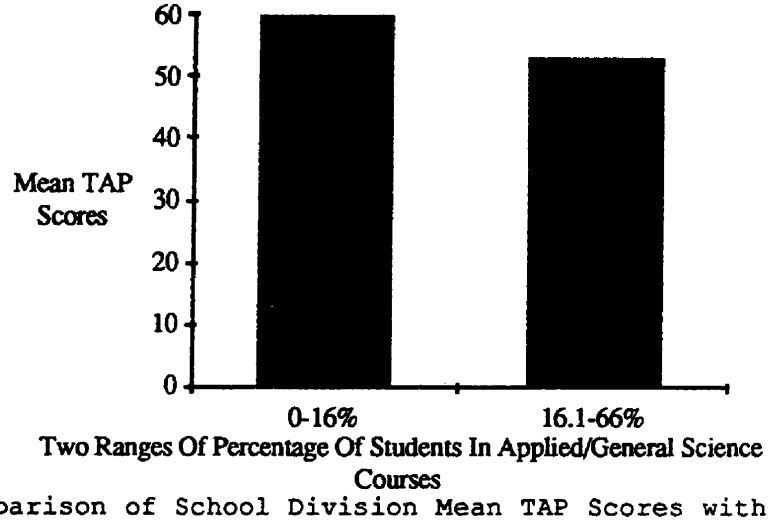

Figure 15: Comparison of School Division Mean TAP Scores with Percentage of Division Student Enrollment in Applied/General Science Courses

In Figure 16, the percentage of enrollment in advanced academic science courses by school division was compared to division achievement. A 12-point difference in the mean division scores was observed between those divisions with no enrollment in advanced academic science courses and those having between 0.3-25 percent of their students enrolled in advanced academic science courses. These data indicate that in science, school divisions that enrolled students in advanced academic science courses demonstrated higher science achievement than the school divisions that had no enrollment in these courses. In Figure 16, the school divisions were separated into two groups based upon enrollment in advanced academic science courses between zero percent (no enrollment) and greater than zero percent (some enrollment). The enrollment comparison of zero percent and greater than zero percent was used because this score represented the point at which a difference in the mean school division TAP scores declined.

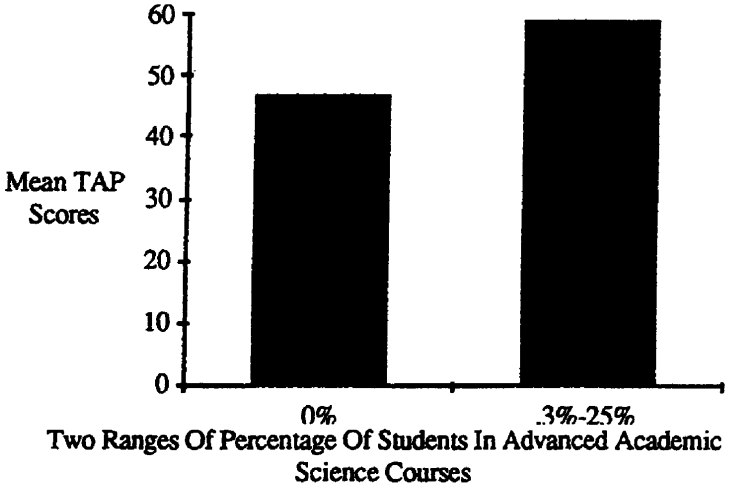

Figure 16: Comparison of School Division Mean TAP Scores with Percentage of Division Student Enrollment in Advanced Academic Science Courses

SUMMARY

Based upon the TAP test results in mathematics and science, school divisions with high percentages of students enrolled in applied/general mathematics and science courses generally had lower mean scores than divisions with low percentages of students enrolled in these courses. Divisions that had low percentages of students enrolled in advanced academic mathematics and science courses generally had low mean scores on the mathematics and science TAP subtests than divisions with high enrollment in these courses. From these findings, it can be inferred that division achievement in mathematics and science appears to be connected to the percentage of students distributed in the three levels of mathematics and science courses.

ETHNICITY

Table 3 indicates the number and percentage of types of diplomas received by white students and black students; other minorities are not shown. Within the population of graduates, 74 percent were white students and 21 percent were black students. Among students receiving the advanced studies diploma, 80 percent were white students and 13 percent were black students. White students received a higher percentage, and black students received a lower percentage, of advanced studies diplomas as compared respectively to the representative population of whites and blacks.

Of students receiving standard diplomas 70 percent were white students and 26 percent were black students. A lower percentage of white students, than represented in the population, received standard diplomas. Conversely, a higher percentage of black students, than represented in the population, received standard diplomas. These findings show that black students are not enrolled in courses that enable them to earn the advanced studies diploma in proportion to the population of black student graduates.

Table 3

Diploma Type Received by Ethnicity

Diploma Type	Diploma Type Received by Ethnicity				
	Total	White		Black	
Standard	36,505	70%	25,652	26%	9,489
Advanced	23,649	80%	18,941	13%	2,965

Note: Percentages will not total 100 percent because other ethnic categories are not shown.

GENDER

Table 4 describes the number and percentage of types of diplomas received by males and females. Within the population of graduates, 49 percent were males and 51 percent were females. Among students receiving the advanced studies diploma, 43 percent were males and 57 percent were females. Female students received a higher percentage, and male students received a lower percentage, of advanced studies diplomas as compared respectively to the representative population of females and males. These data show that more females are enrolling in high level (academic and advanced academic) courses than their male counterparts.

Table 4

Diploma Type Received by Gender

Diploma Type	**Diploma Type Received by Gender**				
	Total	Male		Female	
Standard	36,505	53%	19,374	47%	17,131
Advanced	23,649	43%	10,176	57%	13,465

Of standard diplomas awarded 53 percent were received by males and 47 percent by females. A lower percentage of female students, than represented in the population, received standard diplomas. Conversely, a higher percentage of male students, than represented in the population, received standard diplomas. These findings show that males are not enrolled in courses that enable them to receive the advanced studies diploma in proportion to the population of male student graduates.

FINDINGS: APPROACHES TO INCREASE ENROLLMENT OF BLACK AND LOW SOCIOECONOMIC STATUS STUDENTS IN MATHEMATICS AND SCIENCE

In the Standards for Accrediting Public Schools in Virginia, 1988, standard C-10 states that "each school shall have a program designed to improve the academic achievement and aspirations of culturally disadvantaged students". This section of the study focuses upon a discussion of incentives, strategies, and initiatives which could contribute to an improvement in the achievement and participation of blacks and low socioeconomic status students in academic and advanced academic mathematics and science courses. The incentives, strategies, and initiatives which follow should assist school divisions in meeting the spirit and letter of the standard. The sources of these data include:

- review of the literature and program descriptions of successful programs;
- recommendations of guidance directors which were included on the Student Enrollment Survey Form; and,
- recommendations from organizations and agencies which were invited to respond with opinions and positions statements.

The study team reviewed the data and summarized aspects that were pertinent to this section of the study.

INCENTIVES TO ENCOURAGE ENROLLMENT IN HIGHER LEVEL MATHEMATICS AND SCIENCE COURSES

A review of the research literature and the findings on the distribution of black and low socioeconomic status students from this study suggest that special incentives should be considered to increase the participation of black and low socioeconomic status students in mathematics and science courses. The following options exist and could be replicated as successful programs to provide incentives for increasing the enrollment of black students and low socioeconomic status students in higher level mathematics and science courses.

- Special summer programs at colleges and universities for secondary students serve as an incentive for improved achievement in mathematics and science in the public schools. The National Science Foundation, beginning in the late 1950's, provided funds for the support of these types of programs.

- Special programs, such as the Cooperating Hampton Roads Organizations for Minorities in Engineering (CHROME) have been effective in improving the achievement of minority students in mathematics and science. The program offers strategies to stimulate the motivation of students and to develop interest in mathematics and science. The program is sponsored by a consortium of school divisions, business concerns, colleges and universities, and private citizens in the Tidewater area of Virginia.

- Mentorship programs, job shadowing opportunities, and internship programs, with monetary compensation in some cases, have been found to increase interest in careers in mathematics and science (Virginia Department of Labor, 1991).

- Scholarship programs for special summer mathematics and science programs for pre-college students have been created. Two well-established programs have been held at Hampton University and Virginia State University. These two programs, which serve students in mathematics and science, have been most accessible to black and low socioeconomic status students in the geographic area of the sponsoring institutions.

- Scholarship programs supported jointly by business/industry and public agencies for black and low socioeconomic status students are effective. Guidance directors who responded to the question on the Student Enrollment Survey Form recommended scholarships for these students as a means of promoting interest in mathematics and science studies.

INITIATIVES AND STRATEGIES TO IMPROVE ACHIEVEMENT AND PARTICIPATION OF BLACK AND LOW SOCIOECONOMIC STATUS STUDENTS

The findings of this study determined that blacks and low socioeconomic status students appeared to be adversely affected by tracking and ability grouping practices in the secondary schools. The study team was able to identify several initiatives and strategies which could alleviate the negative effects of past tracking and ability grouping practices and promote an increase in the achievement and participation of black and low socioeconomic status students. The following initiatives and strategies are offered for the improvement of the achievement and participation of these groups.

- Steps need to be taken to improve the quality of mathematics and science education in the elementary and middle schools of the Commonwealth. The development of the Virginia Common Core of Learning will promote a substantial change in curriculum. The effort to design a Common Core of Learning should yield a relevant curriculum, which should prepare students to compete in a global economy. The Common Core of Learning will contribute to the improved delivery of instruction and assist students in developing critical thinking skills.

- The availability of summer programs and after school programs for black and low socioeconomic status students should be increased. These programs should emphasize innovative, and challenging instructional strategies and activities designed to improve the interest and achievement of students in mathematics and science. The National Science Foundation Program could serve as a model.

- Teacher training should be improved to provide high quality instructional services to black and low socioeconomic status students. Special training modules should be provided which address the educational needs of these students. Teacher recruitment should be examined so that appropriate role models are available for students.

- Programs should be developed for parents which prepare them to assist their youngsters in making course selection decisions and wise career choices. Information should be provided for parents so that they are competent to assist their youngsters.

- Alternative instructional approaches should be considered which promote cooperative group experiences for youngsters in the classroom setting. Teachers must be trained in the effective use of these strategies.

- Summer,after school, and enrichment programs for black and low socioeconomic status students should be developed and offered. The use of local resources and facilities for the support of these afterschool and enrichment programs should be maximized.

- The implementation of a holistic framework, such as the V-QUEST initiative should be supported. This National Science Foundation program will provide for the improvement of mathematics and science education in the elementary and secondary schools of Virginia. Funding of this initiative will support reform in student programs and teacher preparation.

FINDINGS: RESPONSES ON TRACKING AND ABILITY GROUPING FROM SELECTED ORGANIZATIONS AND AGENCIES IN VIRGINIA

Position statements regarding the issues on tracking and ability grouping stated in House Joint Resolution No. 358 were requested from thirty organizations (See Appendix) on May 1, 1991. Organizations were provided with a copy of the resolution, and responses were requested by June 1, 1991. Written responses were received from eight organizations/agencies. One organization, Virginia Vocational Association, indicated that it had no position on the issue.

Responses were received from the following agencies/organizations:

Department of Labor and Industry
Virginia Community College System
State Council of Higher Education
Governor's Employment and Training Department
Association for Women in Science
Virginia Middle School Association
Virginia School Boards Association
Virginia Education Association

Pertinent comments from the responding agencies/organizations were excerpted, and are presented as follows:

VIRGINIA SCHOOL BOARDS ASSOCIATION

"All students should have access to a program of quality education which meets their individual needs. Inherent in this commitment is our conviction that such a program must provide the basic skills, together with instruction in those areas which offer enrichment and enhance each individual's contribution as a member of society." *(VSBA Policies and Resolutions, Section 2)*

"The Virginia School Board Association believes that local school boards, together with local administrators and teachers, are best suited to evaluate student needs .., then design instructional programs which address the concerns raised by your study. Of course, this should be done within the legal parameters related to court prohibitions against tracking (Hobson v. Hansen, D.C.) and our moral obligation to eliminate discrimination in any form" Bradford A. King, VSBA (May 8, 1991).

VIRGINIA EDUCATION ASSOCIATION

"Differences exist between desired outcomes and the methods of achieving these outcomes. If there is a difference of principle between the advocates and the critics of tracking, it relates to the role and desirability of student diversity.... The strength of our education system is in its diversity--diversity of students, professionals, and learning environments."

"Neither tracking nor heterogenous groups are necessarily good or bad. The effectiveness of grouping depends on the specific situations and needs within a school. If ability grouping is to be effective, it must have the following characteristics: flexibility, correction of specific learning difficulties, high expectations for all students, accountability of the system, no negative stereotyping."

"Tracking does not begin after children arrive at school. Children come to school with a readiness for learning based on parental care, nutrition, health, etc. Effective intervention must take place early. We must stop problems before they exist. To do this would require concentrating our efforts and funding such early education services as prenatal care, day-care, latch-key programs, early intervention programs for children who are disabled or at risk, and permanent shelters for homeless children."

"Class size and diversity are related. From a classroom teacher's perspective, when incompatible learning styles are added to a classroom, the number of students in a classroom must be decreased, or the ability to optimize academic performance for all students will be sacrificed.... Newer research on the effects of class size indicates that numbers must be reduced to about fifteen students to achieve high outcomes for all students in a diverse classroom."

"There are preconditions to the elimination of tracking and ability grouping. Attempts to eliminate tracking outside the context of restructuring schools and without first addressing the issues of class size, diversity, and funding are likely to end in failure. The effective elimination of academic tracking requires adequate preparation and resources. Federal and state mandates without adequate resources for training and implementation have no chance for success."

"Any meaningful change must be made at the individual building level."

"Teachers must be prepared to work in restructured schools and with heterogenous populations. Teachers have found certain activities to be helpful when working with heterogenous groups in the same classroom. These include cooperative learning, peer teaching, whole-class teaching, individualization of instruction, team teaching, and the use of a theme approach or "integrated day" instruction. Another category of effective flexible grouping includes techniques that combine cooperative learning with within-class skill grouping."

(Report of the NEA Executive Committee Subcommittee on Academic Tracking, June, 1990, supported by VEA).

VIRGINIA MIDDLE SCHOOL ASSOCIATION

"Common tracking and rigid ability grouping do not accommodate the diverse nature and characteristics of early adolescents who attend middle schools. Research has clearly demonstrated that such practices have either negative (particularly in the case of minority and economically disadvantaged students), or at best (in the case of virtually all other students), no impact on enhancing student achievement and self-concept. We believe that middle schools should implement flexible grouping practices which place student needs above organizational and instructional convenience" (Virginia Middle School Association, May 30, 1991).

STATE COUNCIL OF HIGHER EDUCATION

"[W]e agree with President Bush, the nation's governors, the National Education Association, and noted researchers that tracking too often denies equal educational opportunities to those students who have historically been excluded from full participation in the educational system. The Council will support Department of Education efforts to eliminate tracking and other forms of ability grouping" (Council of Higher Education, June 1, 1991).

GOVERNOR'S EMPLOYMENT AND TRAINING DEPARTMENT

"Studies have shown that African American and Hispanic students are significantly overrepresented in the general and vocational education tracks, and significantly under represented in the academic program track [and] are over represented in the general or vocational tracks. High representation in the vocational track is a positive change only if the vocational track does indeed provide worthwhile programs that lead to the acquisition of worthwhile and marketable skills and entrance into meaningful employment.... The separation negatively changes the way students think about themselves, the teacher (authority figure), and the way they think about each other. The ability of students to function well in a more heterogenous environment is also impacted. This has a considerable relationship to the student's ability to later function successfully in the world of work.... Many young people have not acquired the discipline to appear on the job regularly, and have developed a distrust of supervisors in the guise of teachers, police and other authority figures, so that they are unable to accept supervision imposed by the labor market" (Governor's Employment and Training Department, May 31, 1991).

ASSOCIATION FOR WOMEN IN SCIENCE

"[Association for Women in Science] supports classroom environments which encourage young women of all races to be interested in science. We endorse the goal of scientific literacy for everyone, regardless of perceived abilities or propensities. Association for Women In Science emphasizes that no one--not the student, nor the test or teacher -- can predict which individual will find within herself the interest and persistence to become a scientist" (Association for Women in Science, 30 May, 1991).

"Factors which can help bring about an understanding of an enthusiasm for science include (but are not limited to) the following: small classes; teachers who thoroughly understand.... science....; teachers who are experienced....and can convey the process of science as a way of knowing and not just as a

collection of facts; opportunities for hands-on, investigative activities; textbooks which are accurate, well-written, and well-balanced" (Association for Women in Science, 30 May, 1991).

DEPARTMENT OF LABOR AND INDUSTRY APPRENTICESHIP DIVISION

"The Department of Labor and Industry Apprenticeship Division endorses a comprehensive school-to-work initiative as a strategy with the potential for increasing academic achievement; developing the ability to think and make informed decisions; and providing an effective means of developing technical skills proficiencies. While these benefits would accrue to all students, female, minority and low income students would especially benefit, because they frequently are least well informed about the world of work and work opportunities in technical fields..." [detailed discussion of this proposal followed] (Department of Labor and Industry, June 4, 1991).

"Successful school-to-work programs would require retraining of teachers, counselors, and school administrators to provide methods of teaching that will enable students to see the link between what is taught in school and what is needed for current and future success; enable administrators and counselors to redirect emphasis from college to all forms of post high school education and training; emphasize the merits and dignity of the various kinds of education and training: and make less prevalent elitist attitudes about attending college" (Department of Labor and Industry, June 4, 1991).

SUMMARY

The salient ideas taken of organizations which responded are summarized below:

- All students should have access to a program of quality education which meets their needs;
- Neither tracking nor heterogenous grouping is good or bad, the effectiveness of grouping depends on the specific situations and needs within a school;
- Tracking and ability grouping does not accommodate the diverse nature and characteristics of early adolescents who attend middle schools.
- Minority students are overrepresented in general and vocational education tracks and underrepresented in academic program tracks;
- Women of all races should be encouraged to develop an interest in science;
- The effective elimination of tracking requires adequate preparation and resources; and
- Local school boards, administrators, and teachers are best suited to evaluate student needs and design instructional programs.

SUMMARY

The purpose of this study was to collect, review and analyze information on the status of tracking and ability grouping with respect to mathematics and science course offerings. While House Joint Resolution 358 requested information on pedagogical styles of teaching instructional approaches and on the learning environment in mathematics and science classes, the study team focused on the main issue of tracking and ability grouping. The study team recommends that those issues be addressed in a separate study. In addition, the study team recommends that further study be conducted to examine the issue of low motivation of minority and low socioeconomic status students.

The following summary provides a description of the findings which serve as a basis for recommendations.

1. The report of distribution of course offerings revealed that some school divisions do not offer any advanced academic mathematics and science courses. In the area of academic mathematics and science courses, some divisions offered seven or more while others offered as few as three. This finding is indicative of a need for concern about the availability of course offerings in some school divisions. The Virginia Department of Education should continue to investigate alternatives for the support of additional course offerings in mathematics and science for school divisions with few offerings.

2. The findings of this study, teacher qualifications for instruction in mathematics and science were not identifiable as an area of concern. However, because some divisions did not offer advanced mathematics and science courses, the lack of availability of qualified teachers may be an issue. It is recommended that the Department of Education survey school divisions to determine if the lack of availability of qualified teachers is a problem for those divisions that did not offer advanced academic mathematics and science courses. A plan of action should be developed based upon the findings of the survey.

3. With respect to the issue of opportunity for enrollment of female students, low socioeconomic status students, and black students, the findings were as follows:

- The enrollment of females in academic and advanced academic mathematics and science courses revealed no discernible pattern to indicate lack of opportunity. Female students were enrolled in academic and advanced science courses slightly above their representative enrollment in the total survey population.

- There are indications that student enrollment in advanced academic mathematics courses varies with respect to the percentage of students on free and reduced lunch, an indication of low socioeconomic status. School divisions with a high percentage of low socioeconomic status students had low enrollments in advanced academic courses. This finding has implication for low and socioeconomic statusstudents enrollment in college. It is suggestedthat further investigation be undertaken to determine what influence tracking and ability grouping may have on low socioeconomic status students.

- Black students were enrolled in academic and advanced academic science and mathematics courses at percentages less than the representative enrollment of black students in grades 9-12. These findings reveal that black students were not enrolled at representative percentages of the population of blacks in courses that are college preparatory. It is recommended that the Department of Education conduct a study of tracking and ability grouping in the elementary and middle schools in the Commonwealth. This study should examine patterns of grouping which have a negative influence on the degree of preparedness of black students for entry into academic and advanced mathematics and science courses in high school.

4. Based upon the TAP test results in mathematics and science, it was found that divisions with high percentages of students enrolled in applied/general mathematics and science courses generally had lower mean scores than divisions with lower percentages of students enrolled in these courses. Divisions that had low percentages of students enrolled in advanced academic mathematics and science courses generally had low mean scores on the mathematics and science TAP subtests than divisions with high enrollment in these courses. From these findings, division achievement in mathematics and science appears to be connected to the percentage of students distributed in the three levels of mathematics or science courses. The analysis of data on student course enrollment by ethnic group and data on total representation of the ethnic group in the 9-12 population reveals several findings. The representation of white students in the academic or college preparatory programs in mathematics and science exceeds the percent of white students in the general population. However, the representation of black students in the academic or college preparatory programs in mathematics and science was less than the percent of black students in the general population. The marked difference in the representation of black students in comparison to the representation of white students provides evidence that black students may be adversely affected by tracking and ability grouping in Virginia public schools. This finding has implications for black student enrollment in college.

5. The examination of diplomas awarded by gender and ethnicity produced similar findings about the apparent negative influence of tracking and ability grouping. When the percentage of female students who received the advanced studies diploma was compared to the percentage of male students, it was found that the female students exceeded the percentage of advanced studies diplomas awarded to male students. In addition, female students were awarded advanced studies diplomas at a level which exceeded the representation of female students in the population. There was no evidence that female students were not engaged in programs leading to the advanced studies diploma or were negatively affected by tracking and ability grouping.

When the comparison was done for black and white students, the results were markedly different. Of the total number of advanced studies diplomas awarded during 1990 (23,649), 80 percent of the recipients were white students and only 13 percent were black students. White students composed 74 percent of the total student population and black students composed 21 percent of the total population. This finding supports other data which show that black students may be adversely affected by tracking and ability grouping practices which interfere with the attainment of a comparable level of achievement.

6. Special incentives and programs for black and low socioeconomic status student populations are important aspects of providing access to educational opportunity, if these students are to be brought into the mainstream of academic education. The incentives and strategies identified within this section could alleviate the negative effects of past tracking and ability grouping practices and promote an increase in the achievement and participation of the black and low socioeconomic status students.

7. The salient ideas taken from the position statements of the organizations which responded are stated as follows:

   - all students should have access to a program of quality education which meets their needs;
   - neither tracking nor heterogenous grouping is good or bad; the effectiveness of grouping depends on the specific situations and needs within a school;
   - tracking and ability grouping does not accommodate the diverse nature and characteristics of early adolescents who attend middle schools;
   - minority students are overrepresented in general and vocational education tracks and underrepresented in academic program tracks;
   - encourage women of all races to be interested in science;
   - the effective elimination of tracking requires adequate preparation and resources;
   - local school boards, administrators, and teachers are best suited to evaluate student needs and design instructional programs.

BIBLIOGRAPHY

Allan, S.D. (1991). "Ability-Grouping Research Reviews: What Do They Say About Grouping and the Gifted?" *Educational Leadership*, 48 (6): 60 - 65.

Balow, I. H., and A. K. Ruddell. "The Effects of Three Types of Grouping on Achievement." California *Journal of Educational Research* 14 (1963): 108-117.

Becker, H. J. "Addressing the Needs of Different Groups of Early Adolescents: Effects of Varying School and Classroom Organizational Practices on Students from Different Social Backgrounds and Abilities." *Technical Report No. 16* Baltimore: The Johns Hopkins University, Center for Research on Elementary and Middle Schools, 1987.

Bicak, L. J. "Achievement in Eighth Grade Science by Heterogeneous and Homogeneous Classes." Doctoral Dissertation, University of Minnesota, 1962.

Borg, W. R. "Ability Grouping in the Public Schools: A Field Study." *Journal of Experimental Education* 34 (1965): 1 - 97.

Borg, W. R., and T. Perpich. "Grouping of Slow Learning High School Pupils." *Journal of Secondary Education* Vol.41 (1966): 231-238.

Bremer, N. "First Grade Achievement Under Different Plans of Grouping." *Elementary English* 35 (1958): 324-326.

Carnegie Foundation Technical Report. (1988). The Condition of Teaching: A State-by-State Analysis. The Carnegie Foundation for the Advancement of Learning. Princeton, N.J.: The Carnegie Foundation.

Czukio, Roman, and David Berstein. "Who Takes Science," *American Institute of Physics*.

Davis, O. L., and N. H. Tracy. "Arithmetic Achievement and Instructional Grouping." *Arithmetic Teacher* 10 (1963):12-17.

Department of Education. (1989). Mathematics Counts in Virginia, Main Report. Richmond, VA: Commonwealth of Virginia Department of Education.

Department of Education. (1988). Standards for Accrediting Public Schools in Virginia. Richmond, VA.

Drews, A. M. "Student Abilities Grouping Patterns and Classroom Interaction." *Cooperative Research Project No 608*. Washington, D. C.: U. S. Department of Health, Education, and Welfare, 1963.

"Educating Scientists and Engineers from Grade School to Grad School." Office of Technology Assessment (1988) Washington, D.C.

Epstein, J. L., et al. "Special Report on the Middle Schools: A Description of Organizational Structures in Middle Schools and Their Effects on Student-Teacher Relations and Instruction." *CREMS Report*, June 1987. Center for Research on Elementary and Middle Schools, The Johns Hopkins University, Baltimore, MD.

Esposito, D. "Homogeneous and Heterogeneous Ability Grouping: Principal Findings and Implications for Evaluation and Designing More Effective Educational Environments."*Review of Educational Research* 43 (1973): 163-179.

Evertson, C. M. (1982). "Differences in Instructional Activities in Higher-and Lower-Achieving Junior High English and Math Classes." *Elementary School Journal*, 82: 329 - 350.

Executive Committee. National Education Association. *Report of Tracking*. Washington, D.C.: NEA, 1990.

Gamoran, A., and Berends, M. (1987). "The Effects of Stratification in Secondary Schools: Synthesis of Survey and Ethnographic Research." *Review of Educational Research,* 57: 415 - 435.

George, P. S. (1988). What's the Truth About Tracking and Ability Grouping Really??? An Explanation for Teachers and Parents. Gainesville, FL: Teacher Education Resources.

Good, T., and S. Marshall. "Do Students Learn More in Heterogeneous or Homogeneous Groups?" *Student Diversity and the Organization, Process, and Use of Instructional Groups in the Classroom*, ed. by P. Peterson and L. Cherry Wilkinson. New York: Academic Press, 1984.

Jones, L.V., Davenport, E.C., Bryson, A., Bekhuis, T., and Zwick, R. (1986). "Mathematics and Science Test Scores as Related to Courses Taken in High School and Other Factors." *Journal of Educational Measurement*, 23 (3): 197 - 208.

Kulik, C. L., and J. A. Kulik. (1982). "Effects of Ability Grouping on Secondary School Students: A Meta-Analysis of Evaluation Findings." *American Educational Research Journal*, 19 (3): 415 -428.

Kulik, J. A., and C. L. Kulik. "Effects of Accelerated Instruction on Students." *Review of Educational Research* 54 (1984): 409 - 425.

Kulik, C. L. (1985). "Effects of Inter-Class Ability Grouping on Achievement and Self-Esteem." Paper presented at the annual convention of the American Psychological Association. Toronto, Canada (ERIC No. ED 255 329)

Mathematical Sciences Education Board. "Making Mathematics Work for Minorities: Report of A Convocation, May 3-4,1990" Washington, D. C.

Miller, W. S., and H. J. Otto. "Analysis of Experimental Studies in Homogeneous Grouping." *Journal of Educational Research* 21 (1930): 95 - 102.

National Assessment of Educational Progress. (1991). The State of Mathematics Achievement in Virginia. Washington, D.C.: U.S. Department of Education, Educational Testing Service.

National Center for Educational Statistics. (1991). The 1990 National Assessment of Educational Progress: The State of Mathematics Achievement in Virginia - The Trial State Assessment at Grade Eight. Report No. 21-ST-02. Educational Testing Service, N.J.

National Education Association. *Ability Grouping Research Summary.* Washington, D. C.: NEA, 1968.

National Education Association. (1990). Report of Tracking. Washington, D. C.

Oakes, J. (1985). Keeping Track: How Schools Structure Inequality. New Haven, CT: Yale University Press.

Oakes, J. *Lost Talent: The Underparticipation of Women, Minorities and Disabled Persons in Science,* Santa Monica, CA. RAND Corporation, 1990.

Oakes, J. (1990). Multiplying Inequities: The Effects of Race, Social Class and Tracking on Opportunities to Learn Mathematics and Science. Santa Monica, CA: The RAND Corporation.

Office of Technology Assessment, (1988). Educating Scientists and Engineers from Grade School to Grad School. Washington, D. C.

Provus, M. M. "Ability Grouping in Arithmetic." *Elementary School Journal* 60 (1960): 391 - 398.

Slavin, R. E. (1987). "Ability Grouping and Student Achievement in Elementary Schools: A Best Evidence Synthesis." *Review of Educational Research,* 57: 213 - 236.

Slavin, R. E. (1990). "Achievement Effects of Ability Grouping in Secondary Schools: A Best-Evidence Synthesis." *Review of Educational Research,* 60 (3): 471-499.

Slavin, R. E. "Grouping for Instruction in the Elementary School." *Educational Psychologist* 22 (1987): 109 - 127.

Slavin, R. E. (1988). "Synthesis of Research on Grouping in Elementary and Secondary Schools."*Educational Leadership,* 46: 67 - 77.

Sleeter, C. and S. Grant, 1990, "An Analysis of Multicultural Education in the United States," in *Facing Racism in Education,* eds. Hidalto, McDowell, and Siddle, *Harvard Educational Review,* Reprint Series, No. 21, pp.138-161.

Thesaurus of ERIC Descriptors. (1990). 12th Edition. Pheonix, AR: Oryx Press.

Tulley, Sandra. (1988). "Schools for All Children: Recommendations for Including Kentucky's Poor and Minority Children in School Reform. Louisville, KY: Kentucky Youth Advocates, Inc.

West. J., and C. Sievers. "Experiments in Cross Grouping." *Journal of Educational Research* 54 (1960): 70 - 72.

APPENDICES

APPENDIX A

House Joint Resolution No. 358

GENERAL ASSEMBLY OF VIRGINIA--1991 SESSION

HOUSE JOINT RESOLUTION NO. 358

Requesting the Board of Education to study the use of tracking and perceived ability grouping of students, and its effect on student academic achievement and the learning environment.

Agreed to by the House of Delegates, February 4, 1991
Agreed to by the Senate, February 21, 1991

WHEREAS, the Commonwealth is committed to providing high standards and assisting every student in achieving academic excellence; and

WHEREAS, widely published studies document that females, minorities, and the poor are disproportionately represented among low achieving students, especially in the fields of science and mathematics; and

WHEREAS, studies also indicate that the nation's economic base has become increasingly dependent upon technology, and that fewer persons are entering the scientific and technological areas of study; and

WHEREAS, without substantial increase in student academic achievement and the number of youth electing such courses of study, the nation will experience great difficulty in meeting society's scientific and technological needs in the future; and

WHEREAS, considerable concern has been expressed regarding the use of tracking or perceived ability grouping in the public schools, noting that such procedures convey low expectations of certain students and stifle motivation, unjustly label students, provide learning environments without challenges, and limit access to quality learning opportunities for thousands of students who are poor, disadvantaged, female, belong to a minority group, average or under-achievers, or who have been identified as at-risk; and

WHEREAS, it is believed that tracking and perceived ability grouping of students may have a significantly negative effect on the educational achievement of students and on their participation in science and mathematics, particularly for a number of female, minority, and poor students in Virginia; and

WHEREAS, further analysis is necessary to determine the process and extent of tracking and perceived ability grouping of students in the public schools of the Commonwealth, and the effect of such procedures on such students' access to educational opportunities, and on student achievement; now, therefore, be it

RESOLVED by the House of Delegates, the Senate concurring, That the Board of Education is requested to study the use of tracking and perceived ability grouping of students, and its effect on student academic achievement and the learning environment. The Board shall (i) determine the types of science and mathematics courses offered by public schools and examine the distribution of such course offerings throughout the Commonwealth; (ii) determine the level of the science and mathematics classes offered, the local school divisions which offer such courses, the qualifications of the instructors, and the pedagogical style and instructional approach used in such courses; (iii) evaluate the effect of tracking and perceived ability grouping on student achievement and the learning environment (iv) consider the need for greater access to science and mathematics courses, particularly higher level science and mathematics courses, by female, minority, and poor students; (v) develop incentives to encourage such students to enroll in these classes; and (vi) develop strategies and initiatives to increase the academic achievement, critical thinking and decision-making skills, and technical skill proficiencies of such students to better prepare them for work and higher education.

The Board shall ensure the participation of the State Council of Higher Education, the Virginia Community College System, the Virginia Education Association, the Virginia School Boards Association, the State Chamber of Commerce, the Department of Labor and Industry, the Governor's Department of Employment and Training, the Virginia Chapter of the National Association for the Advancement of Colored People in the course of this study. The Board may confer with such other interested groups and organizations as it may deem appropriate.

The Board of Education shall complete its work in time to submit its findings and recommendations to the Governor and to the 1992 Session of the General Assembly in accordance with the procedures of the Division of Legislative Automated Systems for the processing of legislative documents.

APPENDIX B

List of Secondary Mathematics and Science Course Offerings

SECONDARY MATHEMATICS AND SCIENCE COURSE OFFERINGS

This appendix lists the mathematics and science courses offered in Virginia public secondary schools and categorizes them by type.

Applied/General Courses. Applied/general courses are traditionally designed with content and expectations differentiated for students perceived to be of low ability, or perceived to lack appropriate preparation for academic courses Students who pursue these courses are generally not expected to attend college, but to immediately enter the work force upon graduation. These courses give credit toward the standard diploma.

Academic Courses. Academic science courses prepare students for post-secondary education as well as job entry in some technical fields. These courses give credit for both the advanced studies and the standard diplomas.

Advanced Academic Courses. Advanced academic courses are offered in Virginia secondary schools for students with exceptional interest and/or aptitude for mathematics and science topics. These courses are offered either as Advanced Placement programs, or locally selected second level courses. These courses are offered to students who have completed prerequisite academic courses and have met other prerequisites.

Secondary schools in Virginia are required by The Standards for Accrediting Schools to offer four academic science and mathematics and science courses in their programs of study. Courses may be selected from the lists of applied/general and advanced academic categories for inclusion as well. The number and type of applied/general and advanced academic courses selected for inclusion in a secondary school's program of studies is a local school division decision.

MATHEMATICS COURSES

Applied/General

21	General Mathematics I
26	Applied Mathematics
28	Consumer Mathematics
33	Basic Algebra
42	Informal Geometry

Academic

30	Algebra I
31	Algebra I, Part I
32	Algebra I, Part II
35	Algebra II
37	Intermediate Algebra/Trigonometry
43	Geometry
50	Trigonometry
60	Advanced Algebra/Trigonometry
61	Advanced Mathematics
84	Computer Mathematics

Advanced Academic

62	Mathematics Analysis
63	Elementary Mathematics Functions
70	Calculus
76	Analytical Geometry
77	Advanced Placement Calculus
78	Multivariant Calculus
85	Advanced Placement Computer Science
90	Probability and Statistics

SCIENCE COURSES

Course Reference No.*	Applied/General
25	Applied Earth Science
35	Applied Biology
43	Applied Physical Science
45	Consumer Chemistry
55	Applied Physics

Academic

210	Earth Science
310	Biology I
410	Chemistry I
510	Physics I

Advanced Academic

240	Geology
250	Oceanography
260	Astronomy
320	Biology II
340	Advanced Placement Biology

420	Chemistry II
440	Advanced Placement Chemistry
520	Physics II
540	Advanced Placement Physics

*These course reference numbers were assigned for the convenience of this study and as such should not be confused with Course Codes assigned by the Virginia Department of Education.

APPENDIX C

Student Enrollment Survey Form

COMMONWEALTH of VIRGINIA

DEPARTMENT OF EDUCATION
P.O. BOX 6-Q
RICHMOND 23216-2060

June 4, 1991

TO: Directors of Guidance
Middle/Junior/Intermediate and Secondary Schools

FROM: Edward W. Carr
Assistant Superintendent for Public Affairs and Human Resources

SUBJECT: Study of the Use of Tracking and Perceived Ability Grouping

The Department of Education is conducting a survey, **"Study of the Use of Tracking and Perceived Ability Grouping of Students in Virginia Public Schools,"** as required by House Joint Resolution 358 of the 1991 Virginia General Assembly. This project involves investigating the nature and use of tracking and perceived ability grouping in Virginia's public schools, and establishing correlations between these practices and student academic performance and participation in advanced level mathematics and science courses. The resolution specifically requires emphasis on the achievement of minority, female, and low socio-economic status students.

We are soliciting your cooperation in collecting the data necessary to complete this research. Please complete the accompanying survey, including all the information applicable to your school situation. The surveys may be copied and disseminated to teachers for input if appropriate. Please complete and return the surveys by June 25, 1991.

While we realize this comes at a very difficult time of the year, we find it necessary to solicit this information in order to comply with the legislative mandate. If there are questions regarding this effort, please contact Timothy W. Corman, Associate Specialist, Science at 804/225-2070. Thank you very much for your cooperation.

STUDENT ENROLLMENT SURVEY

DIRECTIONS: Please provide 1990-91 enrollment information appropriate to your school's organization. *Specifications for racial/ethnic categories are listed below. Thank you.

1. Indicate the total number of students enrolled, by grade.

_____ grade 7	_____ grade 10
_____ grade 8	_____ grade 11
_____ grade 9	_____ grade 12

2. Indicate by racial/ethnic category, gender, and grade, the total number of students enrolled.

	American Indian	Asian American	Black	Hispanic	White
	M/F	M/F	M/F	M/F	M/F
Grade 7	___/___	___/___	___/___	___/___	___/___
Grade 8	___/___	___/___	___/___	___/___	___/___
Grade 9	___/___	___/___	___/__	___/___	___/___
Grade 10	___/___	___/___	___/___	___/___	___/___
Grade 11	___/___	___/___	___/___	___/___	___/___
Grade 12	___/___	___/___	___/___	___/___	___/___

* Specifications for racial/ethnic categories:

-American Indians (Includes Alaskans)
-Asian & Asian American (includes Pakistanis, Indians & Pacific Islanders)
-Black (includes Jamaicans, Bahamians and other Carribbeans of African but not Hispanic or Arabian descent)
-Hispanic (includes persons of Mexican, Puerto Rican, Central or South American or other Spanish origin or culture)
-White (includes Arabian)

3. Indicate the number of students in the Class of 1991 who received the Advanced Studies Diploma.

American Indian	Asian American	Black	Hispanic	White
M/F	M/F	M/F	M/F	M/F
___/___	___/___	___/___	___/___	___/___

4. Indicate, by racial/ethnic category and gender, the total number of seventh grade students enrolled in pre-algebra (or equivalent course specifically designed to prepare students for Algebra I in the eighth grade).

American Indian	Asian American	Black	Hispanic	White
M/F	M/F	M/F	M/F	M/F
___/___	___/___	___/___	___/___	___/___

5. Indicate, by racial/ethnic category and gender, the total number of eighth graders enrolled in Algebra I during the 1990-91 school year.

American Indian	Asian American	Black	White	Hispanic
M/F	M/F	M/F	M/F	M/F
___/___	___/___	___/___	___/___	___/___

6. Indicate, by racial/ethnic category and gender, the total number of students who scored 1100 or above on the Scholastic Aptitude test (SAT).

American Indian	Asian American	Black	Hispanic	White
M/F	M/F	M/F	M/F	M/F
___/___	___/___	___/___	___/___	___/___

7. Are students ability-grouped for the following courses? If so, how many levels are available?

	Yes	No	# of Levels
Earth Science	___	___	___
Biology	___	___	___
Chemistry	___	___	___
Physics	___	___	___
Algebra I	___	___	___
Algebra II	___	___	___
Geometry	___	___	___

8. List incentives which would encourage female, ethnic minority and low family income students to enroll in science and math courses.

_____

_____

_____

_____

9. List strategies and initiatives which would increase the academic achievement and critical thinking skills of female, ethnic minority and low income students such that they are better prepared for work and higher education?

_____

_____

_____

_____

_____ _____ _____

Survey Completed By School Division Date

_____

School

APPENDIX D

Sample Letter to Organizations

COMMONWEALTH of VIRGINIA

DEPARTMENT OF EDUCATION
P.O. BOX 6-Q
RICHMOND 23216-2060

May 8, 1991

Ms. Madeline I. Wade, President
Virginia Education Association
116 S. Third Street
Richmond, Virginia 23219^R

Dear Ms. Wade:

The Board of Education is in the process of completing the **Study of the Use of Tracking and Perceived Ability Grouping of Students** in response to House Joint Resolution 358, passed by the 1991 General Assembly. The project will investigate both the use of tracking and perceived ability grouping and its effect on student academic achievement and the learning environment.

We wish to ensure that we have included the opinions of educational professionals, parents and members of the business community in the completion of this study. As such, we are soliciting the comments from a number of organizations and agencies. We specifically would like to invite the Virginia Education Association to provide us with a position statement addressing the issues identified in the Resolution:

- the impact of tracking or perceived ability grouping on student expectations, student motivation, student labeling, learning environments and learning opportunities;

- the impact of tracking or perceived ability grouping on students who are poor, disadvantaged, female, belong to a minority group, average or under-achievers, or who have been identified as at risk;

- the impact of tracking or perceived ability grouping on access to science and mathematics courses by female, minority and poor students;

- potential strategies and initiatives to increase the academic achievement, critical thinking and decision-making skills and technical skill proficiencies of female, minority and poor students.

(over)

In order to meet the obligations for reporting our findings to the Governor and the 1992 General Assembly, we will need to receive your position statement by June 1, 1991.

Thank you for your willingness to provide us with the knowledge and experiences of the Virginia Education Association. Please do not hesitate to contact us if you have any questions or comments regarding this study (Dr. Power-Cluver 804/225-2818; Mr. Carmichael, 804/225-2836).

Sincerely,

Lissa Power-Cluver, Ph.D.
Principal, Policy and Planning

Harvey Carmichael
Lead, Pre-Adolescent Services

/lpc
Enclosure: HJR 358

APPENDIX E

List of Organizations and Agencies from Which Positions Were Solicited

List of Organizations and Agencies from Which Positions Were Solicited

Virginia Organizations

Virginia Association of School Superintendents
Virginia Association of Independent Schools
Virginia Association of School Personnel Administrators
Virginia Association of Elementary School Principals
Virginia Association of Secondary School Principals
Virginia Association for Supervision and Curriculum Development
Virginia Committee, Southern Association of Colleges and Schools
Virginia Congress of Parents and Teachers
Virginia Consortium of Administrators for Education of the Gifted
Virginia Council for Private Education
Virginia Council for Mathematics Supervision
Virginia Council of Administrators of Special Education
Virginia Council of Teachers of Mathematics
Virginia Council on Vocational Education
Virginia Education Association
Virginia Middle School Association
Virginia School Boards Association
Virginia Vocational Association

Virginia Agencies

State Council of Higher Education for Virginia
Virginia Community College System
State Chamber of Commerce
Virginia State Conference of the NAACP
Governor's Employment and Training Department
Department of Labor and Industry

National Organizations

American Association for the Advancement of Science
Association for Women in Science
Blacks and Mathematics
Comprehensive Mathematics and Science Program
Minority Women in Science

APPENDIX F

Responses from Organizations and Agencies

INTRODUCTION TO APPENDIX F

Responses were received from the following eight (of 29) professional organizations and agencies contacted by the study team:

Governor's Employment and Training Department
Department of Labor and Industry
State Council of Higher Education for Virginia
Association for Women in Science
Virginia Middle School Association
Virginia School Boards Association
Virginia Education Association
Virginia Community College System

JUN 3 1991

COMMONWEALTH of VIRGINIA

Area Code 804
367-9800

Governor's Employment & Training Department

James E. Price
Executive Director

The Commonwealth Building
4615 W. Broad Street, 3rd Flr.
Richmond, VA 23230

May 31, 1991

M E M O R A N D U M

TO: Dr. Lissa Power-Cluver, Principal, Policy and Planning Department of Education

FROM: James E. Price

SUBJECT: Response to House Joint Resolution 358

Attached is the Governor's Employment and Training Department's response to your request related to the study called for by House Joint Resolution 358. This response is provided in the context of the population served by the Job Training Partnership Act.

If you have any questions, please call Gail Nottingham at 367-9827. Thank you for the opportunity to comment.

Attachment

JEP/gn

c: Charles K. Price
Gail Nottingham
Reading File

THE IMPACT OF TRACKING OR PERCEIVED ABILITY GROUPING FROM AN EMPLOYMENT AND TRAINING PERSPECTIVE AS IT RELATES TO THE ECONOMICALLY DISADVANTAGED

LABOR MARKET BACKGROUND

The process by which many people prepare for obtaining their first occupational experience is defined as the "Natural System." Entry usually takes place after the individuals have gained literacy, and possibly additional skills, sufficient to gain admission into the labor market. Thereafter, the individuals go through a process by which they define their occupation, achieve additional learning on-the-job, or through further education, and eventually advance on the job.

The key elements of the natural system are that skills are acquired in an occupation for which there is a demand in the labor market. Once hired, a period of performance occurs during which time the employee's attendance, promptness, ability to adjust to fellow workers, supervisors, and general performance in a work situation is observed. Once entry credibility is established, the opportunity for advancement is expected to eventually follow. If no advancement is available, the employee can find another job with better pay, or better working conditions, or offering greater opportunity for advancement. The experience obtained in the first job is transferable to a second job.

The examination of the natural system has indicated that there are many circumstances in which the natural system fails particular target groups. These groups include minorities and women, particularly older women, and single heads of households. In addition, most youth and most poor people have a disproportionate share of problems in gaining access to the labor market.

One of the major conditions that limits access to the labor market for these groups is the inadequacy of their education and training to meet employer demands. Additionally, many young people have not acquired the discipline to appear on the job regularly, and have developed a distrust of supervisors in the guise of teachers, police, and other authority figures, so that they are unable to accept supervision imposed by the labor market. Many know so little of the world beyond their immediate neighborhood, and have so few models or mentors that they are unable to obtain access to or understand enough to work within the system.

TRACKING AND PERCEIVED ABILITY GROUPING

Studies of tracking and ability grouping have called attention to their potential harmful effects on low income and racial and ethnic student subgroups, who are often overrepresented among the low tracks and classes. At a recent Congressional hearing, a representative of the General Accounting Office testified that " a disproportionate number of minority students in our nation's public elementary and secondary schools are in the lower-ability classes and special education. This has led to Congressional concern about student resegregation resulting from within-school discrimination."

Curriculum tracking in American high schools acts as an allocation mechanism that sorts students into vocational, academic, and general education programs. Vocational programs are designed to develop specific occupational skills that lead to direct entry into the labor market; academic programs are designed to develop the more advanced academic skills and knowledge which are prerequisites for postsecondary schooling, prior to labor force entry; general education programs lack the specialized focus of either the vocational or college prep curriculum, serving mainly as a holding pen prior to graduation or dropping out.

Tracking may operate as a key mediating mechanism in the link between education and adult career success. Recently, corporate leaders and educators have focused increased attention on the relationship between the type and level of skill brought by American high school graduates to the U.S. workforce, and the content and quality of their courses and programs of study. Students' "opportunities to learn" are directly related to their course and track placements. Thus there is a growing concern about the impact of tracking and educational stratification generally on the well being of our national economy.

Studies over a recent ten year period (1972-1982) have shown that African American and Hispanic students are significantly overrepresented in the general and vocational education tracks, and significantly underrepresented in the academic program track. This creates a situation where the majority of African American and Hispanic students are in the general or vocational tracks. High representation in the vocational track is a positive change only if the vocational track does indeed provide worthwhile programs that lead to the acquisition of worthwhile and marketable skills and entrance into meaningful employment.

The best evidence from randomized and matched equivalent studies strongly supports the positive achievement effects of the use of within-class ability grouping in math and certain approaches to reading. In contrast, there is no support for the practice of assigning students to self-contained classes according to general ability or performance level, and there are enough good quality studies of this practice that if there were any effect, it would surely have been detected. In particular, there is good reason to avoid ability grouped class assignments, which seem to have the greatest potential for negative social effects since they entirely separate students into different streams.

Critics of ability grouping have often noted the detrimental psychological effect of being placed in a low achieving class or track. The separation negatively changes the way students think about themselves, the teacher (authority figure), and the way they think about each other. The ability of students to function well in a more heterogeneous environment is also impacted. This has a considerable relationship to the student's ability to later function successfully in the world of work.

Widely published statistics document patterns of disproportionately low achievement and participation in science and mathematics by women, minorities, and the poor. These patterns are generating increased concern as the nation's economic base shifts toward technology and the traditional pool from which scientific workers have been drawn (i.e., young white males) continues to shrink. Evidence bends considerable support to the argument that the ability group or track method provides fewer opportunities for low-income, minority, and inner-city students to learn science and mathematics. They have considerably less access to science and mathematics knowledge at school, fewer material resources, less-engaging learning activities in their classrooms, and less-qualified teachers.

THE ARTIFICIAL SYSTEM

In addition to the 3 million people who enter the labor force via the "Natural System" each year, another .5 million persons attempt to enter. Due to some critical problem, usually on the "supply" side (inadequate education), these persons find that entry impossible to achieve. Because of these problems, the individual may remain, even in ten or twenty years later, still subject to intermittent employment in the secondary labor market. For these people, an alternative procedure for obtaining access to the labor market has been developed. This alternative system is called the "artificial" or "second chance" system.

The function of the "artificial system" is to make the system work for those people and employers for whom the "natural system" does not work some or all of the time. The poorer the individual is, the younger, the less educated, the less likely the natural system is to work.

The Job Training Partnership Act (JTPA) is an example of an "artificial system". Each year, however, JTPA only serves approximately four to five percent of the eligible population, due to resource limitations. Economically disadvantaged individuals age sixteen and above are eligible for JTPA. JTPA also allows for special exemplary youth programs for 14-15 year olds. JTPA offers a wide variety of employment and training programs to improve wage gain and job retention for the economically disadvantaged.

The "artificial system" is not designed to replace the major system (natural system) in America, which is charged with the responsibility of educating our youth. During Fiscal Year (FY) 1990, the JTPA year-round program in Virginia terminated 4,702 youth (age 14-21). Following are some select demographic data on these youth:

- Age 14-17 - 46%
- High School Dropout - 32%*
- Teen Age Parent - 13%*
- White - 50%
- Black - 49%
- Offenders - 7%*
- Reading Below 7th Grade Level - 37%*
- Disabled - 27%

Those categories marked with an asterik are justifiable risk factors because of their proven correlation with poor work history and their strength as predictors of future labor market difficulties. The natural system did not work for these youth. When you consider that JTPA can only serve four to five percent of the eligible population, these statistics are alarming. It is imperative that JTPA work with the public school system to effectively serve secondary school age students. It is clear, however, that if the schools are to meet the requirements of our

economy for a more highly skilled workforce (especially in light of changing demographics), public schools must provide more equitable access to "learning opportunities" which cultivate reasoning, inference, and critical thinking.

RECOMMENDED STRATEGIES

- Call Attention to the Problem - policymakers would do well to expand their efforts to fuel public concern about educational opportunities as well as outcomes. Strong advocacy from Washington and the state capitals would go a long way toward establishing a receptive climate for policies and practices aimed at both improving opportunities and distributing them more fairly.

- Generate Additional Resources - policymakers must seek new public funding , creative uses of existing funding, and new alliances with the private sector. These resources should be accompanied by policies that change priorities for their allocation.

- Distribute Resources and Opportunity More Equitably - financial incentives may need to be altered to prevent good teachers from abandoning schools that serve low-income and minority students. The federal government, states, local education agencies, and universities can initiate programs aimed at developing new knowledge, and building staff capacity to work effectively with diverse groups of students. Perhaps most important, improved curriculum and instruction should bolster the skills of currently disadvantaged children early on, so that they can more easily claim access to rigorous mathematics and science courses in junior and senior high school.

- Acknowledge the Need for a Substantial Investment in Teacher Training - Educators and researchers agree that substantial investments by school systems in staff training may be required to substantially alter current patterns of ability grouping and tracking; thus, if educators are to

insure equal educational opportunities and to provide every student with opportunities to learn to their fullest potential, it is necessary to know more about how to deal with student diversity and how to train teachers to do so.

- Hold States, Districts, and Schools Accountable for Equalizing Opportunity - given the difficulty and the potential political disincentives to equalizing educational opportunities, federal, state, and local efforts to reach this goal should be carefully monitored. Such monitoring efforts should be supported by a hierarchy of financial incentives to develop programs for equalizing opportunity, beginning at the federal level and extending to states, communities, and schools.

JUN 06 1991

COMMONWEALTH of VIRGINIA

Department of Labor and Industry
205 North Fourth Street

Carol Amato
Commissioner

P.O. Box 12064
Richmond, Virginia 23241

June 4, 1991

Lissa Power-Cluver, Ph.D.
Principal, Policy and Planning
Department of Education
P. O. Box 6-Q
Richmond, Virginia 23216-2060

Dear Dr. Power-Cluver:

Thank you for asking the Department of Labor and Industry to comment on House Joint Resolution 358. Attached is the department's position statement regarding the fourth issue identified by you: "potential strategies and initiatives to increase the academic achievement, critical thinking and decision-making skills and technical skill proficiencies of female, minority and poor students." We are not commenting on the other three issues, which are not as closely related to the department's mission to provide skill training through apprenticeship.

Please call if you have questions.

Sincerely,

Carol Amato
Commissioner

Attachment

DEPARTMENT OF LABOR AND INDUSTRY

COMMENTS

STUDY OF THE USE OF TRACKING AND PERCEIVED ABILITY GROUPING OF STUDENTS - HOUSE JOINT RESOLUTION 358

"Potential strategies and initiatives to increase the academic achievement, critical thinking and decision-making skills and technical skill proficiencies of female, minority and poor students."

The Department of Labor and Industry Apprenticeship Division endorses a comprehensive school-to-work initiative as a strategy with the potential for increasing academic achievement; developing the ability to think and make informed decisions; and providing an effective means of developing technical skill proficiencies. While these benefits would accrue to all students, female, minority and low income students would especially benefit, because they frequently are least well informed about the world of work and work opportunities in technical fields.

A school-to-work program includes activities that can easily be identified as pertaining to employment, with or without monetary compensation. Such activities would commence in kindergarten and develop according to the age and maturity of the students as they progress through the system. We believe job shadowing, mentoring, and student apprenticeship activities are especially effective for older students. This is because such activities directly allow students to see the relationships between what they learn in school, and being able to support themselves and make productive contributions to society.

In a typical scenario, students aged 12 and 14 would be encouraged to experience informal relationships with various business people through mentorships. The mentors would serve as role models, and the students would experience life in the workplace first-hand. This would be by observation and would not entail a wage or stipend.

Students aged 15 and 16, having experienced the mentor program, would move into structured work experiences called internships which would last for a specified period of time, could include a stipend, and would be designed to let students go beyond observation to hands-on experience.

Students having reached the age of 17 would have experienced several kinds of careers that interested them, both by observation and through actual hands-on. These students would be in a position to move into an apprenticeship, which is a formal method of qualifying an individual in a craft or trade by

combining on-the-job training with related classroom instruction. A student apprentice would be employed by the sponsor and paid based on a progressive wage scale. Other forms of school-to-work training would be available to those interested in non-apprenticeable occupations.

Mentorships, Internships, and Apprenticeships serve to strengthen decision making skills, provide good role models, and develop technical skill proficiencies. Academic achievement at an acceptable level based on the student's demonstrated abilities should be a requirement for participation in the school-to-work transition program.

Successful school-to-work programs would require retraining of teachers, counselors and school administrators would in order to:

1. Provide instructors with methods of teaching that will enable students to see the link between what is taught in school and what is needed for current and future success.

2. Enable administrators and counselors to redirect emphasis from college to all forms of post high school education and training.

3. Emphasize the merits and dignity of the various kinds of education and training, and make less prevalent elitist attitudes about attending college.

JUN 05 1991

COMMONWEALTH of VIRGINIA

Gordon K. Davies
Director

COUNCIL OF HIGHER EDUCATION
James Monroe Building, 101 North Fourteenth Street, Richmond, Va. 23219

(804) 225-2137

June 1, 1991

Dr. Lissa Power-Cluver
Principal, Policy and Planning
Commonwealth of Virginia
Department of Education
P.O. Box 6-Q
Richmond, Virginia 23216-2060

Dear Dr. Power-Cluver:

The Council of Higher Education is concerned about the effects of tracking on female, minority, and other students and is grateful for an opportunity to address this issue.

Although the Council has no authority over the public schools, we agree with President Bush, the nation's governors, the National Education Association, and noted researchers that tracking too often denies equal educational opportunities to those students who have historically been excluded from full participation in the educational system. The higher education community should be concerned about the disproportionate number of minority and low-income students who are automatically placed in low-level tracks in the elementary and secondary grades. These students have little opportunity to develop the skills and acquire the knowledge needed for college.

The Council of Higher Education encourages minority students to enroll in academic courses that will prepare them for college and provides information about educational activities, financial aid, and admissions to these students and their parents. It also provides on-campus experiences for pre-college students to strengthen their academic skills. But we realize that these activities cannot ameliorate the negative effects of tracking and ability grouping. Consequently, the Council will support Department of Education efforts to eliminate tracking and other forms of ability grouping.

Sincerely,

Gordon K. Davies

Association for Women in Science

AWIS •1522 K Street, NW • Suite 820 • Washington, DC 20005 • (202) 408-0742 • FAX (202) 408-8321

JUN 3 1991

30 May 1991

Dr Lissa Power-Cluver
Mr. Harvey Carmichael
Commonwealth of Virginia
Department of Education
P.O Box 60
Richmond, Virginia 23216-2060

Dear Dr. Power-Cluver and Mr Carmichael:

The Executive Director of the Association for Women in Science, Ms. Catherine Didion, has forwarded your request for an opinion on House Joint Resolution 356 to me for response. I do not have in hand results of education research which would enable me to respond with sound data on the first three issues which you raise. However, I have attached a statement pertinent to the fourth issue, "potential strategies and initiatives to increase the academic achievement...", which reflects my experience as a working scientist, professor of biological sciences, chair of the Education Committee of my national professional organization, and secretary of the California Textbook League. I am confident that the strategies I suggest would be endorsed by the Association for Women in Science, and I offer them to you on behalf of our organization.

Sincerely yours,

Ellen C. Weaver

Ellen C. Weaver, Ph.D.
President-elect

Statement for Commonwealth of Virginia
by Association for Women in Science (AWIS)

30 May 1991

AWIS supports classroom environments which encourage young women of all races to be interested in science. We endorse the goal of scientific literacy for everyone, regardless of perceived abilities or propensities. When young people understand the **process** of science, as well as the understanding it brings to natural phenomena, they will be better equipped to be citizens of this century and the next. Moreover, some of them will be sufficiently interested and enthusiastic to want to make science their life's work.

AWIS emphasizes that no one - not the student, nor any test or teacher - can predict which individual will find within herself the interest and persistence to become a scientist. The best and most supportive school environment can help reveal these people, first to themselves and then to others.

Factors which can help bring about an understanding of and enthusiasm for science include (but are not limited to) the following:

* Small classes

* Teachers who thoroughly understand the science they are teaching

* Teachers who are experienced in doing science, and thus can convey the process of science as a <u>way of knowing</u> and not just as a collection of facts.

* Opportunities for hands-on, investigative activities, both in a classroom and out of it.

* Textbooks which are accurate, well-written, and well-balanced

Support by the Commonwealth of Virginia towards achievement of these aims will benefit both the girls and young women of the Commonwealth, and also the society in which they live.

Virginia Middle School Association

The Crucial Link

Dr. Tom Gatewood, *Executive Secretary*
Virginia Tech
2990 Telestar Court
Falls Church, Virginia 22042

May 30, 1991

Dr. Lissa Power-Cluver
Principal, Policy and Planning
Virginia Department of Education
P.O. Box 6-Q
Richmond, VA 23216-2060

Dear Dr. Power-Cluver:

In response to your request to the Virginia Middle School Association for a position statement relative to House Joint Resolution 358 on tracking and perceived ability grouping of students, I have been directed to provide the following statement.

The Virginia Middle School Association believes, along with the National Middle School Association with which VMSA is affiliated, that common tracking and rigid ability grouping do not accommodate the diverse nature and characteristics of early adolescents who attend middle schools. Research has clearly demonstrated that such practices have either negative (particularly in the case of minority and economically disadvantaged students), or at best (in the case of virtually all other students), no impact on enhancing student achievement and self-concept. We believe that middle schools should implement flexible grouping practices which place student needs above organizational and instructional convenience.

We support a practice reported by over 40 per cent of the middle schools in the United States. These schools use an interdisciplinary team organization in which two to five teachers teach 50 to 125 students in most of the core academic subjects for most of the school day. Over half of those schools use heterogenous grouping for assigning students to those teams, without segregating students by ability, race, sex, or economic background. This practice allows all students much greater access to one another and to all courses, particularly in mathematics and science. Within heterogeneous team groups, some very limited and flexible ability grouping may be used in skill areas like reading and mathematics. This practice is supported by the

research on grouping as not being injurious to students socially and psychologically, and it can enhance their learning achievement. Many teams also use cooperative learning strategies to help students of diverse characteristics learn to accept one another and to learn together.

We also believe that special education and gifted and talented students should be integrated as much as possible into interdiscipinary team groups. Their special needs should be specifically differentiated and addressed within those groups, but not at the expense of segregating them from their peers at a time when they are vulnerable and self-conscious young adolescents.

The Virginia Middle School Association strongly supports your study of tracking and perceived ability grouping. Many of our VMSA member middle schools have exemplary programs similar to those described above. We will be glad to share the names of some of them upon your request, or to assist your study in any other way that we can.

Sincerely,

Thomas E. Gatewood
Executive Secretary

cc Mrs. Arnetta Washington

Executive Director
Frank E. Barnarn

FAX (804) 295-8785

VIRGINIA SCHOOL BOARDS ASSOCIATION
2250 OLD IVY ROAD, SUITE 1
CHARLOTTESVILLE, VIRGINIA 22901
(804) 295-8722

May 8, 1991

Mrs. Lissa Power-Cluver
Principal, Policy and Planning
Virginia Department of Education
P.O. Box 6-Q
Richmond, Virginia 23216-2060

Dear Mrs. Power-Cluver:

The Virginia School Boards Association is pleased to respond to the Department's request for input during its Study of the Use of Tracking and Perceived Ability Grouping of Students (as initiated by HJR 358). Please feel free to continue communicating with our Office of Governmental Relations as the study moves forward.

Although the Virginia School Boards Association has no official position specified for "tracking" or "ability grouping," several statements in the VSBA Policies and Resolutions reflect school board concerns related to instruction. In Section 2, the following prologue sets the tone for all subsequent policies related to program:

"All students should have equal access to a program of quality education which meets their individual needs. Inherent in this commitment is our conviction that such a program must provide the basic skills, together with instruction in those areas which offer enrichment and enhance each individual's contribution as a member of society. The Constitution of Virginia provides for local board control and initiative in determining educational programs and policies within the framework of state guidelines and statutory mandates."

The VSBA believes that local school boards, together with local administrators and teachers, are best suited to evaluate student needs, available resources, and best practices. They may then design instructional programs which address the concerns raised by your study. Of course all this should be done within the legal parameters related to court prohibitions against tracking (Hobson v. Hansen, D.C.) and our moral obligation to eliminate discrimination in any form.

Because the social conditions which affect student performance vary from division to division, local control is essential for determining what forms of grouping will guarantee that more students have better opportunities for success in the classroom. That ultimately should be our goal.

Thank you for consideration of these remarks and, again, for inviting the VSBA to participate in the study. As you begin reviewing statistics and opinions related to the tracking issue, please contact us again for further reaction.

Sincerely,

Bradford A. King

Bradford A. King
Governmental Relaitons Officer

BAK/hsn

VIRGINIA EDUCATION ASSOCIATION

Virginia Journal of Education

Gamble's Hill, 116 South Third Street, Richmond, Virginia 23219-3799

May 8, 1991

Dr. Lissa Power-Cluver
Mr. Harvey Carmichael
Commonwealth of Virginia
Department of Education
P. O. Box 6-Q
Richmond, VA 23216-2060

Dear Lissa and Harvey:

Thank you for the opportunity to comment on and add to your study of ability grouping and tracking of students. I am enclosing copies of a variety of materials from the Virginia Education Association and the National Education Association that may be helpful to you.

Here is a brief notation about each enclosure.

1. **VEA RESOLUTIONS D-18, CLASS SIZE, AND D-52, EDUCATION FOR CHILDREN WITH SPECIAL NEEDS**

These resolutions give Association policy related to class size and education for handicapped children. Relevant sections are quoted here:

> [The VEA calls for] A weighted formula reducing class size when handicapped and exceptional children are placed with non-handicapped children. (D-18, h.)
>
> The VEA recognizes the need for both special education and regular education to have successful mainstream experiences; therefore, the VEA should seek changes to the state school board regulations that would limit the number of special education students who can be mainstreamed into a regular classroom... (D-52, k.)

2. **NEA RESOLUTION C-32, DISCRIMINATORY ACADEMIC TRACKING**

This NEA position statement speaks for itself.

3. **PAPERS BY JOMILLS BRADDOCK AND ROBERT SLAVIN**

The NEA contracted with the Center for Research on Effective Schooling for Disadvantaged Students at the Johns Hopkins University to do a series of papers on tracking. I have sent you a copy of my file copies. Also included is the report, Academic Tracking, Report of the NEA Executive Committee Subcommittee on Academic Tracking.

4. **TEACHING COMBINED GRADE CLASSES: REAL PROBLEMS AND PROMISING PRACTICES**

This report is the result of a joint study between VEA and the Appalachia Educational Laboratory on the effect of teaching combination classes. One of the findings indicated that 38% of the respondents identified fragmentation, scheduling and grouping of students as a difficulty of teaching combined classes. Placement of students into these combined classes was also problematic: some felt isolated from others in their grade, and their self-esteem suffered (p. 14.)

5. **PAPERS FROM THE MILPNET CONFERENCE NETWORK**

This series of short papers came from the NEA Mastery in Learning Project School Network. They represent the thoughts of teachers and researchers on the real life implications of grouping and tracking students. These observations may be some of the most useful to you.

I hope these materials will be helpful to you both. If I can be of further assistance, please let me know.

Sincerely yours,

Helen G. Rolfe, Ph.D., Director
Instruction and Professional
Development

c: Madeline Wade

5-31-91

VIRGINIA COMMUNITY COLLEGE SYSTEM
James Monroe Building • 101 North Fourteenth Street • Richmond, Virginia 23219

Dr. Lissa Power-Cluver
Principal, Policy and Planning
State Department of Education
James Monroe Building
101 North 14th Street
Richmond, Virginia 23219

Dear Dr. Power-Cluver:

Attached please find data on the six courses in the science and math areas for the years 1988, 1989, 1990. The six courses selected are:

Fundamentals of Biology (Bio 101)
Fundamentals of Chemistry (Chm 111)
Fundamentals of Computer Information Systems (CIS 110)
Introduction to Computer Science (CSC 110)
Pre-Calculus (Mth 171)
Calculus and Analytic Geometry (Mth 173)

As we agreed over the phone, data for each year is displayed by course, sex, and race.

A quick analysis of the data reveal that white females are the largest group enrolled for all courses each year, and that black males have the smallest representation each year.

If you have any further questions, please call me.

Sincerely,

Roy Robbins

Roy Robbins 5-2127
Evaluation Coordinator

804-225-2117, FAX 804-786-3785, TDD 804-371-8504

TABLE: STUDENT PROFILE
VCCS ROUTINE PLANNING ELEMENTS

LLEGE: VCCS

DATA ELEMENTS	YEAR 1979-80	YEAR 1980-81	YEAR 1981-82	YEAR 1982-83	YEAR 1983-84	YEAR 1984-85	YEAR 1985-86	YEAR 1986-87	YEAR 1987-88	YEAR 1988-89	YEAR 1989-90	YEAR 1990-91
FALL QUARTER ENROLLMENTS												
Headcount	103839	110129	114082	107014	112336	105733	108495	116854	123086	115192	128195	129881
N change previous yr		6290	3953	-7068	5322	-6603	2762	8359	6232	-7894	13003	1686
% change previous yr		6.1%	3.6%	-6.2%	5.0%	-5.9%	2.6%	7.7%	5.3%	-6.4%	11.3%	1.3%
TUDENT PROFILE DATA												
ROGRAM TYPE												
Bachelor credit	14007	14706	16564	16853	18372	19817	21599	23639	26318	26476	31437	33753
N change previous yr		699	1858	289	2019	945	1782	2040	2679	158	4961	2316
% change previous yr		5.0%	12.6%	1.7%	12.0%	5.0%	9.0%	9.4%	11.3%	0.6%	18.7%	7.4%
Occ/Tech	31827	33720	36923	38058	39454	39067	40261	39559	41264	37471	40416	39264
N change previous yr		1893	3203	1135	1396	-387	1194	-702	1705	-3793	2945	-1152
% change previous yr		5.9%	9.5%	3.1%	3.7%	-1.0%	3.1%	-1.7%	4.3%	-9.2%	7.9%	-2.9%
Developmental	4237	4387	4792	3946	3804	3011	3163	3071	2721	2490	3627	4737
N change previous yr		180	405	-846	-142	-793	152	-92	-350	-231	1137	1110
% change previous yr		4.3%	9.2%	-17.7%	-3.6%	-20.8%	5.0%	-2.9%	-11.4%	-8.5%	45.7%	30.6%
Unclassified	53798	57316	55803	48157	50206	43838	43472	50585	52783	48755	52715	52127
N change previous yr		3518	-1513	-7646	2049	-6368	-366	7113	2198	-4028	3960	-588
% change previous yr		6.5%	-2.6%	-13.7%	4.3%	-12.7%	-0.8%	16.4%	4.3%	-7.6%	8.1%	-1.1%
TUS												
First time	38266	34662	33267	31031	29864	27890	29408	33244	34195	30096	28268	27509
N change previous yr		-3604	-1395	-2236	-1167	-1974	1518	3836	951	-4099	-1828	-759
% change previous yr		-9.4%	-4.0%	-6.7%	-3.8%	-6.6%	5.4%	13.0%	2.9%	-12.0%	-6.1%	-2.7%
Returning	60980	67211	71448	69184	73312	70358	70192	74310	78778	76238	84892	88252
N change previous yr		6231	4237	-2264	4128	-2954	-166	4118	4468	-2540	8654	3360
% change previous yr		10.2%	6.3%	-3.2%	6.0%	-4.0%	-0.2%	5.9%	6.0%	-3.2%	11.4%	4.0%
Transfer	4593	8256	9367	6799	9160	7485	8895	9300	10113	8858	15035	14090
N change previous yr		3663	1111	-2568	2361	-1675	1410	405	813	-1255	6177	-945
% change previous yr		79.8%	13.5%	-27.4%	34.7%	-18.3%	18.8%	4.6%	8.7%	-12.4%	69.7%	-6.3%
DENCE												
In state	99222	105059	108852	103198	107748	100816	103220	111061	116605	109295	121013	123274
N change previous yr		5837	3793	-5654	4550	-6932	2404	7731	5544	-7310	11718	2261
% change previous yr		5.9%	3.6%	-5.2%	4.4%	-6.4%	2.4%	7.5%	5.0%	-6.3%	10.7%	1.9%
Out of state	4617	5070	5230	3816	4588	4917	5215	5793	6481	5897	7182	6607
N change previous yr		453	160	-1414	772	329	298	578	688	-584	1285	-575
% change previous yr		9.8%	3.2%	-27.0%	20.2%	7.2%	6.1%	11.1%	11.9%	-9.0%	21.8%	-8.0%
NDANCE												
Day	62907	67790	72037	68965	71056	66299	67447	74018	79701	75218	86753	89462
N change previous yr		4883	4247	-3072	2091	-4757	1148	6571	5683	-4483	11535	2709
% change previous yr		7.8%	6.3%	-4.3%	3.0%	-6.7%	1.7%	9.7%	7.7%	-5.6%	15.3%	3.1%
Evening	40932	42339	42045	38049	41280	39434	41048	42836	43385	39973	41442	40419
N change previous yr		1407	-294	-3996	3231	-1846	1614	1788	549	-3411	1468	-1023
% change previous yr		3.4%	-0.7%	-9.5%	8.5%	-4.5%	4.1%	4.4%	1.3%	-7.9%	3.7%	-2.5%

...HENTS: VCCS

STUDENT PROFILE DATA	Year 1979-80	Year 1980-81	Year 1981-82	Year 1982-83	Year 1983-84	Year 1984-85	Year 1985-86	Year 1986-87	Year 1987-88	Year 1988-89	YEAR 1989-90	YEAR 1990-91
SEX												
Male	45713	47794	50754	46047	47673	44801	45975	49116	51472	47664	54638	54887
N change previous yr		2081	2960	-4707	1626	-2872	1174	3141	2356	-3808	7174	39
% change previous yr		4.6%	6.2%	-9.3%	3.5%	-6.0%	2.6%	6.8%	4.8%	-7.4%	15.1%	0.1%
Female	58126	62335	63328	60967	64663	60932	62520	67738	71614	67528	73357	75004
N change previous yr		4209	993	-2361	3696	-3731	1588	5218	3876	-4086	5829	1647
% change previous yr		7.2%	1.6%	-3.7%	6.1%	-5.8%	2.6%	8.3%	5.7%	-5.7%	8.6%	2.2%
RACE												
White	85421	90349	94259	88225	92237	87217	89621	96344	100525	94570	104514	104926
N change previous yr		4928	3910	-6034	4012	-5020	2404	6723	4181	-6015	10004	412
% change previous yr		5.8%	4.3%	-6.4%	4.5%	-5.4%	2.8%	7.5%	4.3%	-6.0%	10.6%	0.4%
Black	14654	15166	14626	13670	14434	12760	12807	13899	14783	13505	15363	16221
N change previous yr		512	-540	-956	764	-1674	47	1092	884	-1278	1858	858
% change previous yr		3.5%	-3.6%	-6.5%	5.6%	-11.6%	0.4%	8.5%	6.4%	-8.6%	13.8%	5.6%
American Indian	225	275	257	253	245	253	251	318	373	322	325	346
N change previous yr		50	-18	-4	-8	8	-2	67	55	-51	3	21
% change previous yr		22.2%	-6.5%	-1.6%	-3.2%	3.3%	-0.8%	26.7%	17.3%	-13.7%	0.9%	6.5%
Asian	1753	2330	2366	2977	3303	3422	3551	3837	4289	4056	4643	4779
N change previous yr		547	536	111	326	119	129	286	452	-233	592	131
% change previous yr		30.7%	23.0%	3.9%	11.0%	3.6%	3.8%	8.1%	11.8%	-5.4%	14.6%	2.8%
Hispanic	828	1117	1256	1204	1381	1439	1571	1684	1934	1848	2180	2339
change previous yr		289	139	-52	177	58	132	113	250	-86	332	159
change previous yr		34.9%	12.4%	-4.1%	14.7%	4.2%	9.2%	7.2%	14.8%	-4.4%	18.0%	7.3%
Other	928	892	818	685	736	642	694	772	1182	954	1465	1264
N change previous yr		-36	-74	-133	51	-94	52	78	410	-231	214	99
% change previous yr		-3.9%	-8.3%	-16.3%	7.4%	-12.8%	8.1%	11.2%	53.1%	-19.5%	22.5%	8.8%

VCCS SYSTEM SUMMARY AKI700

COURSE ENROLLMENT BY YEAR, SEX, AND RACE

FALL MID-TERM

COURSE	1988 MALES WHITE	1988 MALES BLACK	1988 MALES OTHER	1988 FEMALES WHITE	1988 FEMALES BLACK	1988 FEMALES OTHER	1989 MALES WHITE	1989 MALES BLACK	1989 MALES OTHER	1989 FEMALES WHITE	1989 FEMALES BLACK	1989 FEMALES OTHER	1990 MALES WHITE	1990 MALES BLACK	1990 MALES OTHER	1990 FEMALES WHITE	1990 FEMALES BLACK	1990 FEMALES OTHER	TOTAL
BIO 101	4694	378	300	6754	696	404	5070	372	350	7048	752	428	5254	436	396	7172	750	480	41742
CHM 111	1933	130	220	1196	114	90	1992	110	272	1188	148	138	1978	142	296	1360	126	150	11591
CIS 110	788	103	38	1390	305	59	924	104	52	1496	306	48	917	134	47	1366	284	38	8399
CSC 110	172	22	21	133	26	17	167	17	25	150	22	19	196	19	20	269	27	30	1360
MTH 171	1093	68	45	1061	104	47	1103	70	53	1010	99	40	1273	93	54	1074	99	61	7447
MTH 173	922	55	173	327	38	77	877	50	175	290	37	72	862	56	169	306	36	89	4611
TOTAL	9602	756	797	10861	1283	702	10133	723	935	11182	1364	745	10480	880	990	11547	1322	848	75150

APPENDIX G

List of Virginia School Divisions by Division Number

LIST OF VIRGINIA SCHOOL DIVISIONS BY DIVISION NUMBER

COUNTIES

Accomack	001
Albemarle	002
Alleghany	003
Alleghany/Highlands	099
Amelia	004
Amherst	005
Appomattox	006
Arlington	007
Augusta	008
Bath	009
Bedford	010
Bland	011
Botetourt	012
Brunswick	013
Buchanan	014
Buckingham	015
Campbell	016
Caroline	017
Carroll	018
Charles City	019
Charlotte	020
Chesterfield	021
Clarke	022
Craig	023
Culpeper	024
Cumberland	025
Dickenson	026
Dinwiddie	027
Essex	028
Fairfax	029
Fauquier	030
Floyd	031
Fluvanna	032
Franklin	033
Frederick	034
Giles	035
Gloucester	036
Goochland	037
Grayson	038
Greene	039
Greensville	040
Halifax	041
Hanover	042
Henrico	043
Henry	044
Highland	045
Isle of Wight	046
James City	047
King George	048
King & Queen	049
King William	050
Lancaster	051
Lee	052
Loudoun	053
Louisa	054
Lunenburg	055
Madison	056
Mathews	057
Mecklenburg	058
Middlesex	059
Montgomery	060
Nelson	062
New Kent	063
Northampton	065
Northumberland	066
Nottoway	067
Orange	068
Page	069
Patrick	070
Pittsylvania	071
Powhatan	072
Prince Edward	073
Prince George	074
Prince William	075
Pulaski	077
Rappahannock	078
Richmond	079
Roanoke	080
Rockbridge	081
Rockingham	082
Russell	083
Scott	084
Shenandoah	085
Smyth	086
Southampton	087
Spotsylvania	088
Stafford	089
Surry	090
Sussex	091
Tazewell	092
Warren	093
Washington	094
Westmoreland	095
Wise	096
Wythe	097
York	098

TOWNS

Cape Charles	201
Colonial Beach	202
Files	203
West Point	207

CITIES

Alexandria	101
Bedford	140
Bristol	102
Buena Vista	103
Charlottesville	104
Chesapeake	136
Clifton Forge	105
Colonial Heights	106
Covington	107
Danville	108
Emporia	138
Fairfax	134
Falls Church	109
Franklin	135
Fredericksburg	110
Galax	111
Hampton	112
Harrisonburg	113
Hopewell	114
Lexington	137
Lynchburg	115
Manassas	143
Manassas Park	144
Martinsville	116
Newport News	117
Norfolk	118
Norton	119
Petersburg	120
Poquoson	142
Portsmouth	121
Radford	122
Richmond	123
Roanoke	124
Salem	139
South Boston	133
Staunton	126
Suffolk	127
Virginia Beach	128
Waynesboro	130
Williamsburg	131
Winchester	132

APPENDIX H

Enrollment in Mathematics and Science Courses by Divisions

MATHEMATICS COURSES OFFERED
(Enrollment)

SCHOOL DIVISION NUMBER	Percent of Students In each track			APPLIED/GENERAL					ACADEMIC											ADVANCED ACADEMIC							
	ap/ge	acad	adv	21	26	28	33	42	84	30	31	32	35	37	43	50	60	61	62	63	70	76	77	78	85	90
1	43	52	5	324	96	110			4	150	116	62	95		154	36	11	14				27	21		11	
2	16	74	10	134	93	30		94		377	217	156	406		348	55		53	95			23	66		15	12
4	26	71	2	23		29	38		22	90			44		70		17				8					
5	27	68	5	123		66	100	33		154	130	117	107	63	199			34	41		11					
6	19	37	8	44		43		27		89	83	39	42	40	110			25	33		10					
7	14	68	18	403		116		13		691	352	196	141	241	686			310		396			169		38	86
8	21	72	6	159	169	181			43	481	284	126		254	481			85	111				47			
9	33	65	2	15	19	18			2	19	6	11	14	8	27		2	12					3			
10	22	71	7	216		70	81	82	60	368	188	66	130	179	371			55	102		11		26			
11	26	37	1	33	6	16				65			32		28			27			2					
12	29	68	3	288		57	33	10	17	147	187	83	155	17	244			57	37		8					
13	58	40	2	171	116	49	24			82		33	46		62			30			12		1			
14	37	61	2	246	53	93	178		13	397			210		218	21	66	11			30		5			
15	44	55	2	114		32	87		56	103				59	44			25					1			
16	20	77	3	158		301		11	67	362	263	221	282	48	425		24	144			23		48			
17	43	56	1	81	8	26	251		37	173		42	73		105			40			8					
18	25	73	2	141		31	75		52	247			169		178		73		18				3			
19	38	62	0	24			49			49			25		38		6									
20	44	56	<1	84		75	55		7	130			60		67		17						2			
21	9	79	11	389		295	313	107	202	2140	1148	846	1357	351	2528		146	622	653	103	126		242		162	70
22	20	77	3	22		10	29		4	85			48		82		16						11			
23	39	61	0	39		13	9			49			19		19			9								
24	33	63	3	115	61	40	133			146	114	90	124		140			51					7		14	14
25	42	57	1	70		17	37			78			37		42		9						3			
26	35	61	3	184		114			110	171			77		128			33			12		3		14	
27	23	72	3	102		81	37			139	100	85	94	21	133			44		22						
28	29	67	4	36		53	21		25	74			62		66			28					8		6	
29	8	86	7	513		976	1527		1553	10455		13	7221	351	7893	3612	1990	981			1189		987	84	314	51
30	15	79	8	176			102	25		395	154	192	235		410	97		48	77		55		9		10	

MATHEMATICS COURSES OFFERED
(Enrollment)

SCHOOL DIVISION NUMBER	Percent of Students In each track			APPLIED/GENERAL					ACADEMIC										ADVANCED ACADEMIC							
	ap/ge	acad	adv	21	26	28	33	42	84	30	31	32	35	37	43	50	60	61	62	63	70	76	77	78	85	90
31	28	71	1	50	42	47			39	108			74		96			28			4				314	51
32	24	74	2	65	33		32			70	74	63	69		88	34					13					
33	29	64	7	148		70	275		57	431			91	117	352		20		93		1		18			
34	34	61	5	219		71	260	34	46	436			193		288			95	29		34		21			
35	29	68	3	73		55	81		20	188			121		114			41	7				12			
36	27	64	9	93	26	27	203		17	294	89	76	129		166			65	77				24		12	
37	19	79	2	36		26				75	49	20	42		63		12						7			
38	37	63	0	96	41	71				82	49	38	98		67		27									
39	32	62	6	71		7	42		3	62	34	26	34	25	50						14				7	
40	40	59	1	176		57	48	16		115	113	37	38	20	109	3							4			
41	53	46	1	310	155	55	232	54		334			190		121	54						21				
42	20	74	6	228		183	118	30		752		64	478		514	137		171					88		15	78
43	24	70	6	659	387	430	53	453	50	1258	931	803	1321	117	1107		20	285	328				179	6	13	
44	29	65	6	267		161	202		8	303	215	141	301		342	87				48			65			10
45	15	72	14	14						28			14		14	13			13							
46	29	69	1	99		84	41			218			118		154		35						11			
48	18	80	2	52		35	44		14	124	83	62	77		138		11	61			14					
49	3	97	0	6						64	48		23		26			8								
50	30	64	6	69		19	25			58	9	28	45		82			18					8		15	
51	38	55	7	73		28	64			67	47	35	24	24	46				10				7		14	
52	30	68	2	147	125	23		15	18	194	55	32	213		136		7	43			16					
53	26	72	3	274	45	189	434		54	950			618		604		249	100					86		11	14
54	29	70	2	77	20	77	61			63	127	79	98	17	148		44						3		10	
55	45	49	5	72		46	101	17		145			52		61				20				8			
56	32	58	10	60		46	45		35	125			60		55				23		10				4	
57	20	79	1	45		31				45	68	15	50	16	44		45	20					5			
58	38	61	2	233			184			112	132	76	155		199						4		13			
59	15	81	5	15	13	23				30	58	29		43	78		39						16			
60	28	69	3	266		161	169	30		564			341		416			207			20		56			

MATHEMATICS COURSES OFFERED
(Enrollment)

SCHOOL DIVISION NUMBER	Percent of Students In each track			APPLIED/GENERAL					ACADEMIC										ADVANCED ACADEMIC							
	ap/ge	acad	adv	21	26	28	33	42	84	30	31	32	35	37	43	50	60	61	62	63	70	76	77	78	85	90
62	20	77	2	34		28	22			69	48	63			79			62					10			
63	24	73	3	53	34	17				47	39	58	53		95			28	14							
65	25	70	5	81	57	25		9		123	134	39	80		84			13	20		11		1			
66	40	58	2	48	43	37				48	38	29	24		48				7				1			
67	38	57	5	110		59				65	41	28	40		76				18		5					
68	22	77	1	88	10	66	25		26	145	78	78	110		134		42	36					10			
69	39	60	2	116	121	40			50	75	92	55	46		76			35			11		2			
70	28	63	8	90		46		54		144	60		28		114			77	36				18			
71	34	63	3	357	287	215			81	384	257	119	353		299			78	22		16					
72	26	73	1	65		59	23			38	111	79	85		73			32			6					
73	36	63	0	14	58	30	68		18	79	10	8	43		93	30	10									
74	32	62	6	197	54	74	39	11		312			152		219			41	40		5		18		8	
75	15	76	9	596		846		183	115	2202	1276	776	1351	441	1949			331	239	240	16	140	162	34	106	123
77	24	71	5	77	70	33	104	57		299	173	64	247		192			61		22	25		12		14	
78	27	68	5	19	36	17				46			33		34			20			13		1			
79	15	85	0	8			25			37	46	26	30		31			16								
80	23	73	4	312		309	247			948			591		779	37	25	342	20		25		63		47	
81	32	55	12	43	122	16	99		11	125	31	49	113		151				61		34		12			
82	24	69	7	247	203	99		42	19	384	201	112	208		322				105	33	8		33			
83	39	58	3	199		123	42		17	250			130		75	30		32	14		5		6			
84	18	79	3	45	20	42	65		6	262	76	42	142		166		7	49	17		9		4			
85	27	70	3	123		83	77			287			160		188		99				33					
86	29	67	4	173	131	84			25	257	132	75	37	136	251				110		15		28			
87	37	63	<1	111		58				113			59		81		7	24					1			
88	17	75	7	213	115	238			111	415	503	352	476		560				137		36		35		20	
89	15	79	6	168		178	137	9	61	647	337	261	498		630	179		51		34		68	72			23
90	12	82	6	16		12	5		5	17	57	52	20	15	55			4	12				4			
91	36	64	<1	49	23		48			77			55		51		32						3			
92	30	67	2	297		299	134		111	402	176	115	324		359		80	53			23		28		5	

MATHEMATICS COURSES OFFERED
(Enrollment)

SCHOOL DIVISION NUMBER	Percent of Students In each track			APPLIED/GENERAL					ACADEMIC										ADVANCED ACADEMIC							
	ap/ge	acad	adv	21	26	28	33	42	84	30	31	32	35	37	43	50	60	61	62	63	70	76	77	78	85	90
93	21	71	8	73		60	16	12		188	53	74	62	59	114				49				11			
94	23	65	12	107	101	123		146	60	423	126	58	289		370		31	17	168		58		26			
95	34	66	0	21		23	77			102			32		75			30								
96	35	56	8	279	57	72	264	76	25	388	144	74	309		247				123		21		30			
97	30	68	2	168	79	62			17	218	89	62	153		158			15			12		13			
98	24	66	10	114	79	115	286	73	49	688			600		319	147			149		63	34			20	
99	27	70	3	132	81	49			64	119	104	85	105	52	139						15				12	
101	18	74	8	191	61	119				473	164		259	63	433	105	37			78	18	13	23		12	19
102	36	63	1	83		84	55			148			77		126		23	15			9					
103	19	81	0	11		23	17			87			57		139		17	26								
104	20	71	9	88		30	54	31	22	185	81	60	147	74	39				42		32				14	
106	9	79	12	40		22	23		34	87	112	77	98		127			57	51				8		19	13
107	17	81	2	23	13	4			13	24	22	24	44		55		11						4			
108	37	59	4	306	277	118			33	527			157		285	50		82	65				12			
109	16	68	5	30	19			8		61			43	17	87			35		25	15			9	6	
110	25	70	5	91		54				104	35	46	93	30	74			18	10				12		6	
111	27	67	5	37	20	24			17	41	32	51			51			31	8				9			
112	26	69	5	236		361	567	55	93	1407			550	28	853	245		98	122		46		21		34	
113	11	73	16	15		19	50			200			169	15	122			42			21	55	30		15	
114	42	56	1	76	59	44	235		51	217			95		100	41	16	30					14			
115	14	79	6	101	51	164				571	96		347		498	108	28	117	77	15	17		31			
116	32	57	12	101	51	53		33		179	48		14		84		14	82	68		18					
117	41	54	5	728		326	1230	341	46	1276			611	291	1006	205			246		50		56			
118	40	55	5	1511	66	481	896	108	14	800	1045	621	470		672				164				46			101
119	44	49	7	42		37	26			46			29		38				13				3			
120	40	59	2	245	36	126	122	15	41	260			125		142			50			11		9			
121	29	69	2	774		316			11	631	562	330	357		542			136	27				55	8		
122	12	84	4	26		22				83	54	21	68		76		17	27			18					
123	30	66	4	324	115	124	756	141		1306	74		581	91	988	17	34	79	43	74	26		28			

MATHEMATICS COURSES OFFERED
(Enrollment)

SCHOOL DIVISION NUMBER	Percent of Students In each track			APPLIED/GENERAL					ACADEMIC										ADVANCED ACADEMIC							
	ap/ge	acad	adv	21	26	28	33	42	84	30	31	32	35	37	43	50	60	61	62	63	70	76	77	78	85	90
124	22	74	4	342	35	126		140		564	489	304	234	29	364	67		65	49				21		40	
126	22	68	10	55	43	54	19			150	70	38		87	133			54	69		12					
127	28	71	1	218		197	145			468	147	157	337		212		90				30					
128	29	62	8	2588	587	600	53	536	24	4143	87	89	1189	1473	3057	227			876				250	12	60	198
130	19	80	1	46	34	35				83	94	42	99		91			71			7					
131	28	62	11	54	63	99	173	42		471			149	63	200					46	67		40			
132	26	71	3	67	89	26				78	90	51	103		115			54	7				14			
135	10	78	12		37	14				94	47	32	127		84				42				17			
136	32	64	4	1040	17	466	622	101	84	1603			1060	78	1136			392	188		16		61		24	
139	18	80	2	114		34			14	294			141		133		7	71	2				16			
142	24	66	10	19		36	92	11		160			91	36	121	32			33				12			20
143	23	65	12	51	35	55		114		236	100	67	146		125	36		22	71			18	19		2	20
144	15	82	3	20		13				10	109		28		39					7						
202	39	57	3	31	19					40			9		20		4						4			
207	23	65	12			10	32			46			30		42						22					

SCIENCE COURSES OFFERED
(Enrollment)

SCHOOL DIVISION	Percent of Students			APPLIED/GENERAL					ACADEMIC				ADVANCED ACADEMIC								
NUMBER	ap/ge	acad	adv	25	35	43	45	55	210	310	410	510	240	250	260	320	340	420	440	520	540
1	5.7	88.2	6.1			61			395	407	105	34				34	20	3	8	0	0
2	0	90.1	9.1						581	634	336	272				86	17	0	0	54	26
4	0	100	0						91	129	43	13				0	0	0	0	0	0
5	0	96	4						355	353	184	35				39	0	0	0	0	0
6	10.4	83.2	6.4		52				165	150	81	20				32	0	0	0	0	0
7	7	72.4.	20.6			31	159		641	660	344	326			102	170	40	23	108	107	12
8	21.9	75.8	2.5	109	184			146	537	544	306	129				7	0	0	34	0	5
9	0	93.4	6.6						47	46	21	13				9	0	0	0	0	0
10	12.7	75	12.2		140		73		373	486	311	84				184	0	20	0	0	0
11	7.4	81.7	10.9			13			69	57	9	8				19	0	0	0	0	0
12	9.8	79.8	10.4	39	87			90	137	303	147	22				48	22	26	0	0	0
13	4.8	95.2	0			23			218	163	58	18				0	0	0	0	0	0
14	15.5	74	10.5	.	191	22			428	345	176	66				129	0	15	0	0	0
15	7.6	91	1.4				32		165	165	48	5				6	0	0	0	0	0
16	19	74.1	7	178	136				349	544	260	75				81	0	33	0	0	0
17	27.8	63.4	8.7	37	68		77		206	136	62	11				57	0	0	0	0	0
18	7.8	85.7	6.6	52			20		285	327	172	12				61	0	0	0	0	0
19	0	100	0						70	69	16	10				0	0	0	0	0	0
20	0	91	9						129	149	77	0				0	37	0	0	0	0
21	8.7	86.1	5.1			155	697		3049	3166	1395	799				175	91	62	33	49	90
22	23.3	76.7	0		31	34			71	79	42	22				0	0	0	0	0	0
23	0	76.7	23.3						47	16	12	14				27	0	0	0	0	0
24	1	95.1	3.8			10			305	386	150	37				0	21	14	0	0	0
25	12.6	82	2.5		37				111	43	0	42				0.	6	0	0	0	0
26	29.7	68.7	1.5	57	93	32	30		198	158	97	38				11	0	0	0	0	0
27	5.2	94.7	0			35			258	259	101	16				0	0	0	0	0	0
28	0	81.4	18.6						123	104	30	19				63	0	0	0	0	0
29	4.7	85.5	9.8	395	695		446		7131	8629	7070	5352	422	168	129	327	740	628	530	126	176
30	3.2	94.1	2.7			48			530	520	292	89				13	16	0	12	0	0

SCIENCE COURSES OFFERED
(Enrollment)

SCHOOL DIVISION	Percent of Students			APPLIED/GENERAL					ACADEMIC				ADVANCED ACADEMIC								
NUMBER	ap/ge	acad	adv	25	35	43	45	55	210	310	410	510	240	250	260	320	340	420	440	520	540
31	4.5	90.6	5		7		12		120	143	95	26				13	0	1	3	4	0
32	0	100	0						155	145	65	24				0	0	0	0	0	0
33	0	95.4	4.6						509	506	252	48				49	0	0	0	0	14
34	0	93.6	6.4						155	500	201	55				40	0	0	7	0	15
35	20.2	73.3	6.5	41	29	44	11		179	198	58	18				24	16	0	0	0	0
36	0	85.6	14.4						292	381	163	23		62		46	0	37	0	0	0
37	15.1	73.1	11.8		24		22		86	69	54	13				24	12	0	0	0	0
38	25.3	60.4	14.2		60	70			137	124	37	12				73	0	0	0	0	0
39	0	99.3	0.7						109	114	40	35				2	0	0	0	0	0
40	65.9	34	0	198	61		75		41	62	54	16				0	0	0	0	0	0
41	17.5	78.8	3.7		93	89	48		471	400	130	35				25	6	0	0	0	18
42	10	69.7	21	68	61	134			652	771	402	74				423	56	0	32	0	53
43	4.7	89.9	5.4			249	7		2245	2339	1248	597			8	173	13	0	67	0	17
44	38.2	55.6	6.1	12	350		292		118	365	309	159				92	0	13	0	0	0
45	0	93	7						35	23	8	0				5	0	0	0	0	0
46	0	89.5	10.5						291	274	90	13				66	12	0	0	0	0
48	0	100	0						197	172	149	30				0	0	0	0	0	0
49	36	48	16	14	58				27	46	19	4				32	0	0	0	0	0
50	0	100	0						126	59	45	12				0	0	0	0	0	0
51	0	84	16						111	105	28	28				52	0	0	0	0	0
52	20	74	6	26	107	44			193	234	185	42				8	34	0	11	0	0
53	0	98.5	1.5						1084	1037	656	158				0	130	0	31	0	0
54	23	70.4	6.6	49	67	18	22		217	145	55	61				22	10	0	13	0	0
55	40.4	56.5	3.1	85	84				102	59	64	11				13	0	0	0	0	0
56	12.5	83.3	4.2				39		126	95	46	8				0	0	13	0	0	0
57	6.1	86.8	7.1				18		115	93	40	8				21	0	0	0	0	0
58	0	100	0						368	368	160	65				0	0	0	0	0	0
59	17.1	76.6	6.3		44				102	46	27	21				16	0	0	0	0	0
60	13.8	81.3	4.9	98	41	26	88		553	573	300	75				39	12	9	17	0	12

SCIENCE COURSES OFFERED
(Enrollment)

SCHOOL DIVISION	Percent of Students			APPLIED/GENERAL					ACADEMIC				ADVANCED ACADEMIC								
NUMBER	ap/ge	acad	adv	25	35	43	45	55	210	310	410	510	240	250	260	320	340	420	440	520	540
62	16	84	0		55				111	84	60	35				0	0	0	0	0	0
63	0	100	0						161	130	41	32				0	0	0	0	0	0
65	27.5	66.3	6.4	119					47	122	72	15				21	0	0	6	0	0
66	6.1	87	6.9			16			86	89	43	10				18	0	0	0	0	0
67	4.3	95.7	0				15		164	116	53	11				0	0	0	0	0	0
68	24.7	65.2	11.1	85	98				157	138	128	29				50	16	0	12	0	0
69	22	71.6	6.4	20	109	11			233	158	50	15				31	0	10	0	0	0
70	3.1	96.9	0				15		176	218	59	23				0	0	0	0	0	0
71	13.7	78.1	8.2	48	147		86		633	614	265	88				120	0	47	0	0	0
72	0	82.5	17.5						183	128	56	30				41	0	42	0	0	0
73	25.8	74.2	0		73		40		180	68	61	16				0	0	0	0	0	0
74	13.4	82.3	4.3	81		59			296	376	156	31				29	0	0	0	0	16
75	8	84.7	7.3		465		284		2421	2626	1919	922				472	0	40	61	104	0
77	9.3	79.8	10.9	48			55		269	304	144	60			33	74	13	0	0	0	0
78	0	95	5						71	60	31	27				10	0	0	0	0	0
79	35.4	64.6	0	27	42				55	41	30	0				0	0	0	0	0	0
80	14.1	62.1	23.9			513			1085	630	381	171				465	0	266	0	140	0
81	2.5	93.8	4.6		11				257	223	108	42				24	0	7	0	0	0
82	24.2	69.9	5.9	223	163	48			493	473	239	49				95	0	12	0	0	0
83	0	92.5	7.5						408	373	109	51				68	0	8	0	0	0
84	11.9	64.2	23.7	72			25		110	295	104	20				161	34	0	0	0	0
85	8.9	74.7	16.4		83				260	230	157	47	57			95	0	10	0	0	0
86	2.1	87	10.9	14	12				421	389	189	63				106	0	27	0	0	0
87	2.5	97.5	0				11		199	139	66	23				0	0	0	0	0	0
88	0	94.2	5.8						870	930	432	70				120	0	3	9	11	0
89	26.1	65.5	8.4	217	325	49	132		574	691	420	129				214	0	0	20	0	0
90	0	100	0						68	79	31	5				0	0	0	0	0	0
91	18	82	0		52				114	40	70	13				0	0	0	0	0	0
92	0.5	91.5	8			11			715	694	246	70				141	9	0	0	0	0

SCIENCE COURSES OFFERED
(Enrollment)

SCHOOL DIVISION	Percent of Students			APPLIED/GENERAL					ACADEMIC				ADVANCED ACADEMIC								
NUMBER	ap/ge	acad	adv	25	32	43	45	55	210	310	410	510	240	250	260	320	340	420	440	520	540
93	1.8	94.6	3.6				14		316	249	139	38			28	0	0	0	0	0	0
94	3.7	87.1	9.2	65					577	576	293	103				89	75	0	0	0	0
95	18.7	62	19.3	71					112	52	47	24				67	6	0	0	0	0
96	12.7	84.4	1.9	7	171				468	428	271	33				27	0	0	0	0	0
97	1.3	98.7	0		11				327	330	132	33				0	0	0	0	0	0
98	8.6	78.9	12.3		71	110			604	574	367	109				182	40	0	35	0	0
99	0	86.1	13.9						236	264	82	20				97	0	0	0	0	0
101	16.1	75.4	8.5	71	172		45		253	562	284	254			27	0	54	7	36	0	29
102	43.2	52.3	4.2	117	111				97	104	55	18				0	8	14	0	0	0
103	6	94	0			13			92	77	19	10				0	0	0	0	0	0
104	13	80.5	6.5	56	37				187	189	144	61				29	18	0	0	0	0
106	9.2	84.6	6.2		62				261	6	106	36				0	29	0	13	0	0
107	0	82.2	17.8						67	63	11	2				9	0	22	0	0	0
108	23.3	74.3	2.4		189	40	155		461	415	258	77				28	0	0	11	0	0
109	2	76.1	22.1	5					67	99	51	0				0	16	0	5	14	28
110	18.8	78.6	3.4	35	59				187	91	93	23				0	17	0	0	0	0
111	12.5	63	24.6		13	16			67	49	12	18				31	17	9	0	0	0
112	0.5	79.9	19.5	24					1366	1316	421	127		109		368	7	268	4	34	0
113	13.3	81.1	5.6	16			57		221	151	82	97				0	20	11	0	0	0
114	6.9	93.1	0	30	27				337	311	72	44				0	0	0	0	0	0
115	6.3	93.4	0.3	122					622	698	334	147				0	0	0	6	0	0
116	0	96.6	3.4						285	154	89	44				0	20	0	0	0	0
117	0	87.7	12.3						1688	2003	688	180				526	76	31	0	6	0
118	2.4	90.3	7.3				139		2043	2120	836	315				383	49	0	0	0	0
119	3.4	96.6	0		25				65	22	29	5				0	0	0	0	0	0
120	0	100	0						406	289	131	33				0	0	0	0	0	0
121	0	92.1	7.9						1160	1013	223	110	27	67	24	0	62	0	7	0	0
122	15.8	78.1	6.2		46				87	57	54	30				18	0	0	0	0	0
123	4	78.9	17.1	40	95		21		1582	850	501	135				406	26	186	17	23	51

SCIENCE COURSES OFFERED
(Enrollment)

SCHOOL DIVISION	Percent of Students			APPLIED/GENERAL					ACADEMIC				ADVANCED ACADEMIC								
NUMBER	ap/ge	acad	adv	25	35	43	45	55	210	310	410	510	240	250	260	320	340	420	440	520	540
124	16.1	80	3.9	77	70	230			786	721	264	96				62	29	0	0	0	0
126	8.7	87.9	3.4		41		13		223	146	154	20				21	0	0	0	0	0
127	11.2	83.5	5.3		189				721	429	202	63				68	0	0	22	0	0
128	3	92.5	4.5			382			4628	4780	1726	691		128		0	289	0	148	0	13
130	0	94.2	5.8						194	149	100	42				30	0	0	0	0	0
131	0	77.6	22.4						295	328	224	97				70	203	0	0	0	0
132	0	96.3	3.7						194	206	110	40				21	0	0	0	19	0
135	0	94.3	5.7						141	145	104	22				0	6	0	19	0	0
136	8.8	84.1	7.1		488				2078	1469	973	168				292	58	48	0	0	0
139	5.5	88	6.5			48			272	319	122	57				36	0	21	0	0	0
142	8	90.8	1.3	14			24		125	144	125	39				0	0	6	0	0	0
143	16.5	77.8	5.7		103	30			199	201	168	59		12		0	25	0	0	0	9
144	3.7	96.3	0				7		76	88	18	0				0	0	0	0	0	0
202	0	78.3	21.7						45	42	9	5				28	0	0	0	0	0
207	18.1	79.7	2.1		21		4		29	46	27	8				0	3	0	0	0	0

APPENDIX I

Report of Distribution of Course Offerings in Mathematics and Science in Virginia High Schools

Advanced Academic Math Courses

State Average for Number of Courses Offered is 2

25 divisions offer 4 or more classes
53 divisions offer 3 or more classes
33 divisions offer 1 class
9 divisions offer 0 classes

Advanced Academic Science Courses

State Average for Number of Courses Offered is 2

33 divisions offer 3 or more classes
71 divisions offer 2 or more classes
35 divisions offer 1 class
25 divisions offer 0 classes

Academic Math Courses

State Average for Number of Courses Offered is 6

49 divisions offer 7 or more classes
47 divisions offer 5 or less classes
20 divisions offer 4 or less classes

Academic Science Courses

125 divisions offer 4 classes
6 divisions offer 3 classes

Types	Applied-General		Academic		Advanced Academic	
Number of Possible Course Offerings	Math 5	Science 5	Math 10	Science 4	Math 8	Science 9
Average	6		4	2	2	
School Divisions						
Accomack (1)	3	1	9	4	3	4
Albemarle (2)	4	0	7	4	5	4
Amelia (4)	3	0	5	4	1	0
Amherst (5)	4	0	7	4	2	1
Appomattox (6)	3	1	6	4	2	1
Arlington (7)	3	2	7	4	4	7
Augusta (8)	3	3	7	4	2	3
Bath (9)	3	0	9	4	1	1
Bedford (10)	4	2	8	4	3	2
Bland (11)	3	1	4	4	1	1
Botetourt (12)	4	3	8	4	2	3
Brunswick (13)	4	1	5	4	2	0
Buchanan (14)	4	2	7	4	2	2
Buckingham (15)	3	1	5	4	1	1
Campbell (16)	3	2	9	4	2	2
Caroline (17)	4	3	5	4	1	1
Carroll (18)	3		5	4	2	1
Charles City (19)	2	0	4	4	0	0
Charlotte (20)	3	0	5	3	1	1
Chesterfield (21)	4	2	9	4	6	6
Clarke (22)	3	2	5	4	1	0
Craig (23)	3	0	4	4	0	1
Culpeper (24)	4	1	6	4	3	2
Cumberland (25)	3	1	4	3	1	1
Dickenson (26)	2	4	5	4	3	1
Dinwiddie (27)	3	1	7	4	1	0
Essex (28)	3	0	5	4	2	1
Fairfax (29)	3	3	9	4	5	9
Fauquier (30)	3	1	7	4	4	3
Floyd (31)	3	2	5	4	3	4
Fluvanna (32)	3	0	6	4	2	0
Franklin (33)	3	0	6	4	3	2
Frederick (34)	4	0	5	4	3	3
Giles (35)	3	4	5	4	2	2
Gloucester (36)	4	0	7	3	3	3
Goochland (37)	2	2	6	4	2	2

Types	Applied-General		Academic			Advanced Academic	
Number of Possible Course Offerings	Math 5	Science 5	Math 10	Science 4		Math 8	Science 9
Average			6	4	2	2	
School Divisions							
Grayson (38)	3	2	5	4		0	1
Greene (39)	2	0	7	4		2	1
Greensville (40)	4	3	7	4		1	0
Halifax (41)	5	3	4	4		1	3
Hanover (42)	4	3	6	4		3	4
Henrico (43)	5	2	9	4		4	5
Henry (44)	3	3	7	4		3	2
Highland (45)	0	0	4	3		1	1
Isle of Wight (46)	3	0	4	4		1	2
King George (48)	3	0	8	4		1	0
King & Queen (49)	1	2	5	4		0	1
King William (50)	3	0	6	4		2	0
Lancaster (51)	3	0	6	4		3	1
Lee (52)	4	3	8	4		1	3
Loudoun (53)	4	0	6	4		3	2
Louisa (54)	4	4	7	4		2	3
Lunenburg (55)	4	2	3	4		2	1
Madison (56)	3	1	4	4		3	0
Mathews (57)	2	1	8	4		1	1
Mecklenburg (58)	2	0	5	4		2	0
Middlesex (59)	3	1	6	4		1	1
Montgomery (60)	4	4	4	4		2	5
Nelson (62)	3	1	5	4		1	0
New Kent (63)	3	0	6	4		1	0
Northampton (65)	4	1	6	4		2	3
Northumberl.(66)	3	1	5	4		2	1
Nottoway (67)	2	1	5	4		3	2
Orange (68)	4	2	8	4		0	1
Page (69)	3	3	7	4		2	2
Patrick (70)	3	1	5	4		2	0
Pittsylvania (71)	3	3	7	4		3	2
Powhatan (72)	3	0	6	4		1	2
Prince Edward (73)	4	2	8	4		0	0
Prince George (74)	5	2	4	4		4	2
Prince William(75)	3	2	8	4		8	4
Pulaski (77)	5	2	6	4		4	3

Types	Applied-General		Academic		Advanced Academic	
Number of Possible Course Offerings	Math 5	Science 5	Math 10	Science 4	Math 8	Science 9
Average			6	4	2	2
School Divisions						
Rappahannock (78)	3	0	4	4	2	1
Pulaski (77)	5	2	6	4	4	3
Rappahannock (78)	3	0	4	4	2	1
Richmond (79)	2	2	6	3	0	0
Roanoke (80)	3	1	6	4	4	3
Rockbridge (81)	4	1	6	4	3	2
Rockingham (82)	4	3	6	4	4	2
Russell (83)	3	0	6	4	3	2
Scott (84)	5	2	8	4	3	2
Shenandoah (85)	3	1	4	4	1	2
Smyth (86)	3	2	7	4	3	2
Southampton (87)	2	1	5	4	1	0
Spotsylvania (88)	3	0	6	4	4	4
Stafford (89)	4	4	8	4	4	2
Surry (90)	3	0	8	4	2	0
Sussex (91)	3	1	4	4	1	0
Tazewell (92)	2	1	8	4	3	2
Warren (93)	4	1	6	4	2	1
Washington (94)	4	1	8	4	3	2
Westmoreland (95)	3	1	4	4	0	2
Wise (96)	5	2	6	4	3	1
Wythe (97)	3	1	7	4	2	0
York (98)	3	2	7	4	2	3
Allg-Highlands (99)	3	0	7	4	2	1
Alexandria (101)	3	3	6	4	6	5
Bristol (102)	3	2	5	4	1	2
Buena Vista (103)	3	1	5	4	0	0
Charlottesville (104)	4	2	7	4	3	2
Colonial Heights (106)	3	1	7	4	4	2
Covington (107)	3	0	7	4	1	2
Danville (108)	3	3	6	4	2	2
Falls Church (109)	3	1	5	3	4	4
Fredericksburg (110)	2	2	7	4	3	1
Galax (111)	3	2	6	4	2	3
Hampton (112)	4	1	7	4	4	6
Harrisonburg (113)	3	2	5	4	4	2

Types	Applied-General		Academic			Advanced Academic	
Number of Possible Course Offerings	Math 5	Science 5	Math 10	Science 4		Math 8	Science 9
Average			6	4	2	2	2
School Divisions							
Hopewell (114)	4	2	7	4		1	0
Lynchburg (115)	3	1	7	4		1	1
Martinsville (116)	4	0	6	4		2	1
Newport News (117)	4	0	6	4		3	4
Norfolk (118)	5	1	6	4		3	2
Norton (119)	3	1	3	4		2	0
Petersburg (120)	5	0	5	4		2	0
Portsmouth (121)	2	0	6	4		3	5
Radford (122)	2	1	7	4		1	1
Richmond (123)	5	3	8	4		4	6
Roanoke City (124)	4	3	8	4		3	2
Staunton (126)	4	2	6	4		2	1
Suffolk (127)	3	1	6	4		1	2
Va. Beach (128)	5	1	8	4		5	3
Waynesboro (130)	3	0	6	4		1	1
Williamsburg (131)	5	0	4	4		3	2
Winchester (132)	3	0	6	4		2	2
Franklin City (135)	2	0	5	4		2	2
Chesapeake (136)	5	1	6	4		4	3
Salem (139)	2	1	6	4		2	2
Poquoson (142)	4	2	5	4		3	1
Manassas (143)	4	2	7	4		5	3
Manassas Park (144)	2	1	4	3		1	0
Colonial Beach(202)	2	0	4	4		1	1
West Point (207)	2	2	3	4		1	1