2

INTERIM REPORT
JULY 13, 1995

Attachment 2

THE HIGH SCHOOL ASSESSMENT PROJECT:

A SURVEY OF INSTRUMENTS, PRACTICES, AND SERVICES AVAILABLE FROM OTHER STATES, VENDORS, AND ASSESSMENT COALITIONS

Compiled by the
High School Assessment Coordinating Committee
Maryland State Department of Education

June 1995

INTERIM REPORT
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INTRODUCTION

In August 1994, the Maryland State Board of Education (SBE) reached consensus on a number of issues related to the design of the High School Assessment (HSA) system, including the following item:

> **Consensus item #6:** *Content teams should review with the idea of using if possible, national and international materials, national standards, existing criterion-referenced tests, and perhaps even recommended pilots of the assessment types with Maryland students with such instruments as The New York Regents Examinations, North Carolina End of Course Tests, Indiana high school tests, Oregon Certificate of Initial Mastery Assessments, California Assessments, New Standards Project Assessments, Advanced Placement, ACT and SAT Achievement Tests, etc., as part of their deliberations. Such reviews should include curriculum matches with the assessments against Maryland, national, and international goals, an analysis of pros and cons related to each of the assessment types, as well as a recommendation for what should be used in Maryland. Norm-referenced materials will not be reviewed since that direction is contrary to the philosophy of the Maryland School Performance Program. This decision is also consistent with the Governor's Commission on School Performance exhortations.*

The assumption in consensus item #6 is that useful tests in an HSA system design probably already exist, and subsequent discussions with the SBE only reinforced the sense that "off-the-shelf," content-specific tests are widely available

and will allow Maryland to avoid the expense and delay of test development. The SBE's consensus item #2 favored end-of-course tests for their proximity to instruction and short turnaround time for making results available to teachers and students. The High School Assessment Coordinating Committee (HSACC), a diverse group of MSDE professionals (see Appendix 1 for membership), was charged with surveying available sources to discover useful instruments and practices.

Following the lead outlined in consensus item #6, the HSACC identified five areas in which to conduct the search:

(1) Major national test publishers (e.g., Psychological Corporation).

(2) National test development and research organizations (e.g., ETS).

(3) Other states with reputations for exemplary assessment practices (e.g., Kentucky).

(4) Coalitions of states and national test design and development enterprises (e.g., New Standards).

(5) Assessment practices in other nations with reputations for exemplary educational practices (e.g., Germany).

Procedures for conducting the inquiry across these five areas varied. In some cases, HSACC invited vendors to present their wares and services (see sample letter in Appendix 2). In other cases, a comprehensive review of the published literature sufficed. Inquiries with ETS and the College Board led to on-site visits in Princeton, and HSACC met with representatives from New Standards on a number of occasions. A survey of assessment practices in other states was done by structured telephone interview. And, finally, information on international practices came from the American Federation of Teachers, from MSDE's own cross-national studies, and from the University of Maryland's Center for Learning and Competitiveness.

Obviously, HSACC found many interesting and potentially useful instruments and practices. Assessment is a major issue in national reform efforts. No educational reform can succeed without reforms in assessment, but errors in design, implementation, or communication with stakeholders are more likely to tilt education back into the past than forward into the future. Witness California, where the governor shutdown the entire state performance assessment program, or Littleton, Colorado, where the public terminated an outcomes-based program.

The HSACC found many instruments or practices that could be used in a comprehensive assessment system (that is, one involving both state and local responsibilities), but it did not find useful "off-the-shelf," end-of-course measures for Maryland's proposed learning goals. *Pacesetter* from ETS, for instance, provided assessments for a fourth-year course in mathematics, quite beyond the scope of Maryland's learning goals. AP tests from the College Board covered few of Maryland's required academic courses, and its performance standards were at the college level. Georgia's or Minnesota's measures, by contrast, fell beneath Maryland's expectations, providing assessments more in line with minimal competence than the SBE's expectations for Maryland's high school graduates. The reasons for the mismatch between Maryland's expectations and available tests will become apparent in the review of available instruments and practices summarized below in the five major areas of the inquiry.

The following sections contain a descriptive review of instruments, practices, and services available from other states, vendors, and assessment coalitions. Conclusions and recommendations will be included in the HSACC final report. Additional information on the Scholastic Aptitude Test and Scholastic Achievement Test, American Federation of Teachers studies, and the University of Maryland's Center for Learning and Competitiveness reports will also be included in the HSACC final report.

TEST PUBLISHING COMPANIES

In the spring of 1995, the HSACC invited the following test publishers (see letter in Appendix 2) to present their instruments and support services (e.g., scoring) to the HSACC:

(1) The Riverside Publishing Company (Houghton Mifflin).

(2) Psychological Corporation (Harcourt Brace).

(3) CTB/McGraw-Hill.

Each publisher received copies of Maryland's Core Learning Goals, the assessment models under consideration (Paradigms 1,2, and 3), and a list of expectations and constraints. The vendors were asked to match the learning goals with items in proposed tests, and to present the tests and support services to the HSACC at a scheduled review session. Each of the vendors responded, and the HSACC evaluated their proposals.

One vendor proposed the use of its norm-referenced achievement test battery as an appropriate instrument for measuring students' attainment of Maryland's Core Learning Goals. The other two vendors announced at the beginning of their presentations that no off-the-shelf test of Maryland's learning goals existed in the industry. Instead, they offered two services:

(1) Customized test development for Maryland, picking and choosing among items from various tests in their library and "filling in the blanks" as necessary; or

(2) A collaborative test development process between Maryland and their own considerable test development resources, resulting in tests designed and developed specifically to measure student competence in the learning goals.

Both proposals would assure content validity and reliability, necessities for an individual student accountability program. Different formats (e.g., multiple choice plus short answers as in the New York State Regents Exams) could be provided. Both publishers cited a trend among states toward collaborative test development (e.g., Arizona). These publishers are quite capable of supporting these kinds of collaborations.

TEST DEVELOPMENT AND RESEARCH ORGANIZATIONS

Educational Testing Service (ETS)

The HSACC staff searched the "ETS Test Collection Catalog Volume 1: Achievement Tests and Measurement Devices" (Oryx Press, 1993) for end-of-course tests in academic subjects. All tests in the subject index for the following categories and content areas were identified: high school students, achievement tests, biology, chemistry, physics, science (earth and physical), economics, literature, American government, history, social studies, algebra, pre-algebra, geometry, and general mathematics. Information from the test descriptions was used to produce matrices (see Appendix 3) in which the row headings are the test titles and dates of production and the column headings are test characteristics (e.g., source/test description/and number of forms available from that source, number of test items per form, type of item formats included, score interpretations possible—CRT, NRT, amount of engaged testing time for administration).

A cursory survey of these entries shows that most measures were developed prior to 1989, and contained 40 or fewer multiple-choice items with only norm-referenced score interpretations. The description for the CTB End-of-Course Tests suggested that the content might be relevant to Maryland's needs. Therefore, HSACC requested sample test forms of these measures from CTB. CTB supplied the forms, but revealed that these tests are no longer available because they were created

using items from ETS item banks leased to CTB for production. Inasmuch as the tests did not sell well, CTB chose to discontinue production of them. In producing the catalog, ETS did not evaluate the tests or determine their current availability. Thus, although the catalog was produced in 1993, it contains references to materials which may no longer exist. Every source would have to be contacted to verify the accuracy of the listed information and to request the actual test materials. In summary, the implied availability of end-of-course tests in the catalogues is not supported by HSACC's inquiry.

The College Board

Pacesetter. On learning that a *Pacesetter* program in mathematics was being pilot tested in Maryland, HSACC staff consulted with the site coordinator and then visited the project directors and subject coordinators at the ETS campus in Princeton (the College Board is a subsidiary of ETS).

Pacesetter is an "integrated program of standards, teaching, and assessment" under development by the College Board. *Pacesetter* is presented as a series of courses written to the highest standards. Fourth-year "capstone" courses in English and mathematics are being pilot tested. A fourth-year course in science and a world history course are under development.

HSACC staff were impressed with the quality and care taken in development of *Pacesetter* courses. The available courses, English and mathematics, however, are quite beyond the scope of Maryland's Core Learning Goals. The mathematics course, for example, assumes prior student success in algebra I, geometry, and algebra II. When (and if) *Pacesetter* produces courses at the ninth- and tenth-grade levels, *Pacesetter* may be a very attractive option for Maryland's high school assessment.

Advanced Placement (AP) Tests. "The AP Program is a cooperative educational endeavor between secondary schools and colleges and universities. For students who are willing and able to apply themselves to college-level studies, the Program" provides the means for colleges to grant credit, placement, or both to students who have applied themselves successfully (*A Guide to the Advanced Placement Program,* 1994).

"The AP Program is administered by the College Board, which contracts with ETS for technical and operational services." The AP Program does the following:

- "Provides conferences, consultants, and curricular materials to help interested schools establish college-level courses.
- Furnishes and grades examinations based on the learning goals described in the AP course descriptions.
- Sends examination grades to the students, their schools, and their designated colleges.
- Prepares publications to supplement and support the program's activities.
- Conducts appropriate research and strives to develop new services and products that enhance quality education.

"On average, 65 percent of those who take an AP Exam receive a grade that is accepted for college credit, advanced placement, or both. Almost 50 percent of U.S. secondary schools currently participate in the program, serving approximately 15 percent of their college-bound students." (*A Guide to the Advanced Placement Program, 1994.)*

New AP Exams are developed each year and available in art, history, biology, chemistry, computer science, economics, English, French, German, government and politics, European history, U.S. history, Latin, calculus, music theory, physics, psychology, and Spanish.

The preceding summary makes it clear that AP exams are intended to be college-equivalency tests for high-achieving students. Therefore, they target fourth-year high school courses like calculus rather than algebra and geometry in mathematics. Like *Pacesetter,* AP tests are quite beyond the State Board of Education's intentions in both the content and performance of Maryland's high school assessment project. The State Board of Education, however, might well consider giving students credits for successful performance on AP tests so that high-achieving students would not be double-tested, that is, State tests plus AP tests, in effect penalizing them for their competence.

American College Testing (ACT)

ACT Assessment. The ACT Assessment is designed to assist students in their transition from high school to post-secondary education. The primary purpose of ACT is to provide college admission and placement data. The test is usually taken by second semester juniors in high school. ACT assessments cover English, mathematics, reading, and science reasoning, using a multiple-choice format. The test takes three hours with 35 to 60 multiple-choice items per subject. ACT also offers a tenth grade writing assessment. There is no social studies component at present.

ACT assessments might well be used in conjunction with Maryland's own end-of-course-tests, but they clearly cannot serve the SBE's intentions for the HSA. At best, ACT assessment would be an end-of-discipline test, a general measure of achievement rather than a criterion-referenced testing program for Maryland's learning goals by subject.

PLAN. *PLAN* is an achievement test battery in academic subjects. It is designed for administration at the beginning of grade 10. In response to HSACC's invitation to vendors, the American College Testing Company presented *PLAN* as an appropriate measure for Maryland's learning goals. *PLAN* is not an end-of-course test, nor is it an end-of-course-of-study test. Instead, it is a single achievement test covering English, mathematics, reading and science reasoning, all in multiple-choice format with about 24 to 30 items per subject. The test takes about two hours to administer. The *PLAN* program also includes a study power assessment, a student needs assessment, and an Educational Planning Profile in which students indicate the course work they have already taken in high school, as well as their future educational and career plans. There is no social studies component at present. Currently, the State of Oklahoma and several Maryland counties (e.g., Howard, Montgomery, Baltimore City, St. Mary's, Wicomico) either use or are considering use of *PLAN*.

PLAN's administration at the beginning of grade 10 would only account for one year of instruction in HSA's learning goals. Moreover, only 30 items per subject could not provide the coverage of learning goals required for a criterion-referenced test interpretation. For example, Maryland's preliminary plans were to devote about two hours of testing time for each subject as end-of-course exams. Therefore, *PLAN* does not seem to provide useful data for Maryland's HSA system.

Work Keys. *Work Keys* is an assessment/instructional program produced by the American College Testing Company for the purpose of assessing the skills that employers are looking for in the areas of problem solving, communications, and personal skills. The assessment component of *Work Keys* enables learners to demonstrate their competence through performance-based and criterion-referenced assessments. Present forms of *Work Keys* cover reading for information, applied mathematics, listening, writing, locating information, teamwork, and applied

technology. There are also components dealing with job profiling, instruction, and reporting in the *Work Keys* program.

The *Work Keys* program most closely matches the learning goals in Maryland's Skills for Success. However, the expectations for student performance in *Work Keys* are much lower than those in Maryland's Skills for Success. In addition, *Work Keys* is limited to preparation for work, while Maryland's Skills for Success are targeted equally at preparation for post-secondary education and personal/social life. Therefore, *Work Keys* is not an appropriate assessment system for Maryland's Skills for Success.

SELECTED STATE PRACTICES

Introduction

As part of its search for appropriate assessment designs and instruments, the High School Assessment Coordinating Committee (HSACC) undertook a survey of selected states' practices in the area of mandated statewide high school assessment. The data generated in this survey are summarized here in order to provide participants in Maryland's high school assessment project with up-to-date information on high school assessment practices in other states.

States were selected for inclusion in the survey on several bases. A number of states, such as New York, North Carolina, and Oregon, were included due to expressed State Board interest in their high school assessment practices. Several other states were included due to information on state programs which was shared with the HSACC in the fall and winter of 1994. States which could be identified as having noteworthy high school assessment programs were included in the survey. Other states which were in the process of developing these programs were also included. Several additional states, such as California and Iowa, have invested substantial effort towards the development of a statewide high school assessment

program, only to have the project stopped prior to implementation. The experience of one of these states (Iowa) is included in this survey to illustrate this result.

Survey information on the high school assessment programs of these states was collected between October 1994 and June 1995 by members of the HSACC. The survey was completed through direct personal contact, in the form of one or more telephone interviews, with the official in each state in charge of that state's high school assessment program. Information from the survey instrument for each state is summarized on the one-page Response Matrix (see page 13), which is followed by a brief summary for each state, with additional information on that state's program, experiences, and plans as appropriate.

The high school assessment practices across many of the states represented here are in a state of flux. Today's information can be outdated a month from now. In preparing to conduct this survey, the MSDE team used resources such as the recent review by the Association for Supervision and Curriculum Development, and the more comprehensive work from the Chief State School Officers. However, personal contacts were inevitably necessary in getting up-to-date, reliable information on these evolving practices.

In summary, the high school assessment practices of these states reveal a substantial level of change and evolution at this time. There are several clear trends in these findings, however. States are generally moving away from multiple-choice test formats, toward multiple formats and/or performance assessments. There is also a trend away from a "minimum competency" approach to high school assessment toward assessment of "higher level" knowledge, thinking skills, and problem-solving abilities. At the same time, the trend is to use high school assessment results for a public information/school improvement purpose (such as Kentucky), or for student recognition (such as Maine or New York), rather than for individual accountability/graduation requirements. Those few states (such as Massachusetts)

which appear to be moving towards high-level testing as a graduation requirement are just beginning to do so, and do not yet have experience in resolving some of the anticipated challenges of that approach.

State	Mandated Statewide High School Assessment	Academic Subjects Tested by Grade	System Under Review or Evolving	Individual Consequences		School Consequences				Format		Scoring Practices	
				Graduation	Recognition	Privatization	Reconstitution	Recognition	Other (Specify)	Multiple Choice	Other (Specify)	Machine Scored	Other
Georgia	Yes	Gr. 11: Reading, Writing, Science, Math, Soc. Studies	Yes	Yes					?	Yes	Writing Test	Yes	Writing Test scored locally
Iowa	No	Varies across local districts	N/A						Public Information				
Kentucky	Yes	Gr. 11: Reading, Writing, Science, Math, Soc. Studies	No				Yes	$ Reward for teachers		No	Open-Ended (Portfolio in Gr. 12)		Contractor, Trained Teachers
Maine	Yes	Gr. 11: Reading, Writing, Math, Science, Soc. Studies, Humanities, Arts	No		Yes			Yes		No	Open-Ended		Contractor scoring: items scored 0-4 based on rubrics
Massachusetts	Yes	Gr. 10: Reading, Writing, Math, Science, Soc. Studies	Yes						Public Information	Yes	Open-Ended	Yes	Planning to develop local scoring capacity
Michigan	Yes	Gr. 11: Reading, Writing, Math, Science	Yes		Yes				Public Information	Yes	Constructed Response	Yes	Constructed Response scored by teachers
Minnesota	Yes	Basic Skills & Science, Gov't, Geography, & Profile of Learning	Yes	Yes, in 2002					Public Information	Yes	Real-life Simulation	Yes	Under Development
New York	Yes	High School: Reading, Writing, Math, Science, Soc. Studies	Yes		Yes			Yes		Yes	Writing	Yes	Writing test scored locally by teachers
North Carolina	Yes	End-of-course tests in 11 Academic Subjects	Yes	Yes (Math & Reading)			Soon		Public Information	Yes	Writing (Field-testing, Open-ended)	Yes	Writing: Contractor Open-ended: Trained Teachers
Oregon	Yes	Gr. 10: "CIM." Reading/Writing, Science, Math, Soc. Studies Gr. 11: "OSA"	Yes		Yes				?	Yes	Writing, Portfolio, Perf. Assess.	Yes	Hand-scored Locally (State Audit)
Texas	Yes	Starting in Gr. 10: "Essential Elements"	Yes	Yes					Public Information	Yes	Writing Performance	Yes	Contractor
Vermont	Yes	Gr. 10: Math	Yes	Yes					?	No	Portfolio		Hand-scored

Selected State Practices: Narrative Summaries

Georgia. Georgia has state-mandated tests for reading, writing, mathematics, science, and social studies. Tests are in multiple-choice format, plus writing tests. Students must pass all five tests to graduate. Tests are first given in grade 11. Students have four re-test opportunities thereafter, and may continue retesting when no longer attending school. Tests are intended to go beyond minimal competency, but high percentages pass them each year, due to low performance standards on the tests.

Indiana. Efforts to collect information on the high school assessment program in Indiana have not been successful to this point.

Iowa. Several years ago Iowa undertook a substantial effort to generate statewide educational outcomes in the major academic achievement areas, with the intention of developing a statewide assessment program which would include high school assessments. The state was recently forced to abandon any statewide assessment program based on these educational outcomes, due to the intense opposition of some members of the public and of some organized conservative groups.

Almost all LEAs employ the Iowa Tests of Basic Skills, as well as the Iowa Tests of Educational Development; many also use the ACT. Graduation requirements are locally determined. The Iowa State Department of Education summarizes information from locally-administered tests into an annual "Condition of Education" report.

Kentucky. The mandated statewide high school assessment test is given in grade 11. It is an open-response test which covers math, reading, writing, science, and social studies. In addition, students submit a portfolio of math and writing work in grade 12. Test results are reported, but do not affect graduation statewide. Some local systems may use test results as a graduation requirement, however.

The primary purpose of the tests is to assess the performance of the schools. Schools are rated on a scale from 1 to 5. Level 1 schools are considered to be exceeding expectations, and receive a financial reward for teachers. Level 2 schools are designated as successful, or achieving expected performance levels. Level 3 designates a school which is improving. At level 4 the school is considered to be in decline, with falling scores, and will have a "distinguished educator" assigned to help with the school improvement plan. The level 5 designation indicates a school in crisis, to receive additional assistance; this designation may not have been used yet. There are currently 60 Kentucky schools involved in the state plan for high school restructuring.

Maine. The Maine Educational Assessment Program mandates testing in grades 4, 8, and 11. The testing is all open-ended, with no multiple-choice items. The tests are not designed to assess minimal competencies, but are instead designed to assess problem-solving, evaluation, and synthesis of information. A passing score is not required for graduation, but students who score at the 99th percentile are awarded a four-year scholarship in the Maine State University system. School-wide test results are summarized and reported to the public, and are used as one of the criteria for identifying "Blue Ribbon Schools" in Maine each year. Results are also used to monitor student progress, and to monitor the effectiveness of the curriculum and of instruction at the school and district level.

Grade 11 tests employ a "matrix-sampling" approach for all subject areas, as well as having a set of common items for reading, writing, and math. Individual student scores are derived in the three areas having common items; school and district results are reported for all areas.

The testing program is contracted with a private company, Advanced Systems in Measurement and Evaluation, Incorporated.

Massachusetts. The current mandated statewide testing program, the Massachusetts Educational Assessment Program, is being phased out. Previously testing was conducted in reading, math, science, social studies and writing in grade 12. Now testing is conducted in these areas in grade 10. There are 15 multiple choice items and one open-ended item in each test category. There are no individual student consequences for the tests; results are only reported at the building and district level. Schools and districts may be compared using these results.

The new system, now scheduled to be implemented for the class of 1999, is currently designed to set graduation requirements for all students. Content standards are under development. Concerns are being raised about the estimated high proportion (30-40%) of low functioning/at-risk students who would likely be unable to pass all of the new tests. The new system may eliminate or greatly reduce multiple-choice items, and expand open-ended and portfolio-based assessments. Currently under examination are options for (and the capacities of) local school systems to conduct their own portfolio assessments.

Michigan. Michigan is currently making a transition from an all-multiple-choice format for its eleventh-grade tests, to a multiple-format model, which will be initiated in the fall of 1995 (for the class of 1997). These tests are designed to be "high level assessments" and to result in individual student recognition, through state "endorsement" of the standard diploma, which is issued by the local district. Students lacking the endorsement will still receive the local diploma, but certain colleges and universities will require the endorsement for admission, and certain employers will require it before employment. Test results are compiled and reported to the public by school and by district.

The new system (being phased in with the class of 1997) involves both multiple-choice and constructed-response formats. The writing test is all writing; reading, math, and science will use both formats. The multiple-choice items are

scored by a state-contracted company; constructed responses will be scored by Michigan teachers who go through a training program. The new program is currently being tested.

Minnesota. Minnesota is developing a new high school assessment system that will require students graduating in 2002 to demonstrate competence in Minnesota's "Basic Requirements" and a "Profile of Learning." The Basic Requirements cover seven academic subjects, including mathematics, reading, and science. The state builds specifications for tests in these subjects and will allow local systems to develop their own tests. Preliminary results in mathematics indicate performance standards at about the eighth-grade level.

Performance standards in the required Profile of Learning will be higher, but the content standards will be more expansive than traditional academic courses (e.g., making informed decisions or managing a household or business.) Content standards in the Profile of Learning emphasize the use of knowledge in complex, real-life situations, and assessment methods will, therefore, vary accordingly from traditional measures.

New York. The State Education Department of New York currently requires four examinations: the Regents Examinations, the Regents Competency Tests, the occupational education proficiency examinations, and the second language proficiency examinations. The Regents Examinations are a basis for evaluating the quality of instruction and learning that has taken place, and are not designed for all students. All students must demonstrate proficiency in specified academic subjects, through the Regents Examinations, the competency examinations, or alternate (non-test) methods.

New York is currently in the process of hiring a new director for the statewide assessment program. That person is expected to review the entire program.

North Carolina. North Carolina is moving away from its current minimal competency testing program, which was implemented in 1986. At present there are 11 end-of-course tests, which are frequently incorporated into the course grade, with local systems setting the standards. All are primarily multiple-choice, although the second year English test involves writing performance. Some open-ended items are being field tested in several subject areas. Minimum competency testing in math and reading is a graduation requirement.

Problems with the current system include students taking a particular course and test at different times, sequences, and grade levels. Timelines for content presentation vary across districts, as do the turn-around time for test scoring and reporting.

The accountability program for North Carolina schools includes report cards for the schools, with these test results being one of the factors reported and evaluated. At present the report cards are for public accountability, but the State will soon be moving to incorporate rewards and/or potential reconstitution as school performance consequences.

Oregon. Oregon's high school assessment program is in a state of flux until the state legislature acts (*ca.* mid-1995). As of now, there is no "diploma" in state law. Oregon has joined the New Standards Project and is working on operationalizing the Certificates of Initial and Advanced Mastery (CIM & CAM). Favored instruments include portfolio assessments. These may be recognition and school improvement rather than individual student accountability programs.

Oregon also administers an Oregon State Assessment (OSA) in reading, writing, math, science, and social studies in grades 3, 5, 8, and 11. These are graduation requirements. Oregon is working on assigning roles and responsibilities between the state and LEAs on measuring knowledge, skills, and applications.

Texas. High school students must pass the Texas Assessment System Exit Test, with the passing standard established by the Texas State Board of Education. Students are first tested in the spring of their sophomore year, and are given several additional opportunities to achieve success. Students are tested on content and process; Essential Elements specify the content required. Content areas are still under development; staff in the various curriculum areas are currently working to clarify the designated content by setting "targets" and "domains."

District-wide assessment results are reported to the public. Seriously poor performance could affect the accreditation of the district and the rating of the campus.

Vermont. Vermont has just completed a pilot of a grade 10 math test, done by the Vermont Science and Math Institute. The test will be administered to all tenth-grade students, beginning with the coming school year. A passing score will be required for graduation. The instrument is a math portfolio, and is part of Vermont's five-year plan. Assessments are also administered as non-mandated portfolios in lower grades, in math and writing.

COALITIONS

New Standards

The New Standards Project is a coalition among the University of Pittsburgh's Learning Research and Development Center, the National Center on Education and the Economy, and 17 states as of the spring of 1995. Maryland is considering joining the coalition. The coalition produces and evaluates content standards and assessments and related services (e.g., training on scoring). A current list of products and services follows this review.

HSACC staff met with representatives of New Standards on several occasions. These meetings covered a general overview of New Standards' products, services, and

specific assessments. One extended review session covered what New Standards called "reference tests" in English and mathematics. Content team specialists in English, mathematics, and science joined HSACC staff in the review of these measures.

The reference tests were in the format of six forms for each subject. In a matrix design, a student would take two to three forms, one during each period (45 minutes). Two forms per student would produce school improvement data. Individual student scores would require an additional form per student. While the forms were called "performance assessments," they would, in terms of Maryland's criteria, more accurately be labeled as independent, short-answer responses, ranging from a few sentences to a full page.

In terms of content, these tests are more like end-of-course-of-study than end-of-course assessments. They are designed for administration at the end of tenth grade or in the eleventh grade. Given the pool of items and forms they present, however, it might be possible to downsize them to end-of-course exams. Content specialists in English rejected these assessments for use in the HSA system on the grounds of failure to measure Maryland's Core Learning Goals and inappropriate format. Content specialists in mathematics felt the reference tests could be used as one source of items in a larger item pool from which Maryland could construct end-of-course tests.

HSACC staff also reviewed New Standards' portfolio assessments. They are largely "shells," including guidelines for selecting entries and managing them, scoring systems, parent pamphlets, and leadership training workshops. Portfolio assessments offer an assessment format appropriate for measuring Skills for Success. In the case of a partnership between state and local agencies, where state tests are in multiple-choice plus short-answer formats for breadth of coverage, portfolio assessments might

well serve local agencies as a consistent format to measure depth of knowledge and ability to use that knowledge as a complement to state tests.

INTERNATIONAL PRACTICES

American Federation of Teachers (AFT) Reports

The American Federation of Teachers (AFT) provided HSACC staff with a current summary of secondary school assessment practices in biology in the following countries: England and Wales, France, Germany, Japan, and, by comparison, the United States (*What College-Bound Students Abroad Are Expected to Know About Biology: Defining World Class Standards,* Vo.l. I, 1994). In this report, the AFT provides a brief "country profile" of educational assessment practices in biology in selected countries known for their exemplary educational systems. The current folume focuses on "examinations taken by college-bound students at the end of their secondary school careers." Sample test items and general descriptions of exams are included for each country. Comparable tests used in the United States are the Scholastic Achievement Test (SAT), the American College Tests (ACT), and the subject-specific Advanced Proficiency (AP) tests. The chart that follows summarizes selected information from the AFT report. Excerpts of Volume I will be found as Attachment 5.

Country	Curriculum	Exam	Testing Time*	Format	Scoring
England/ Wales	national/ regional	A-level exams	9 hours	fill-in-the-blank, short answer, extended responses	regional
France	national	baccalaureat	3 hours	written & oral sections; short-answer & extended responses	regional
Germany	local with national guidelines	arbitur	4 hours 30 minutes	short answer (reasons and explanations) and extended responses	local or regional
Japan	national	university entrance center exams	2 hours 30 minutes	fill-in-the-blank, short answer & selected responses	

*Testing time for the sample exam given in Vol. I.

What is striking in comparison between the exams in the United States and abroad is (1) format variations, and (2) results. Few if any items in the samples from abroad are in multiple-choice format. In sharp contrast, all or most of the items in the exams used in the United States are in multiple-choice format. The results in achievement are even more dramatic:

> *With the exception of the United States, every country brings a significant number of students-- at least 25 percent and as much as 36 percent of the age cohort-- up to the level of performance demanded in these exams. In contrast, only 4 percent of 18-year-olds in the United States take and pass one or more AP exams.*
>
> (Vol. I, p. 4)

HIGH SCHOOL ASSESSMENT COORDINATING COMMITTEE MEMBERSHIP LIST

Mr. Ted Schuder, Coordinator
Specialist in Research and Development
School Performance: Research and Development Office
410-767-0372

Dr. Gail Bailey
Chief, School Library Media Services & State Media Services Branch
Division of Library Development and Services
410-767-0451

Dr. Kay Birukoff
Chief, Arts and Sciences Branch
Division of Instruction and Staff Development
410-767-0349

Dr. Jerry Day
Chief, Program Enrichment Services Section
Division of Career Technology and Adult Learning
410-767-0186

Dr. Steven Ferrara
Coordinator, Assessment Team
Division of Planning, Results, and Information Management
410-767-0081

Dr. William Flook
Specialist, Psychological Services
Division of Compensatory Education and Support Services
410-767-0307

Dr. Robert E. Gabrys
Assistant State Superintendent
School Performance: Research and Development Office
410-767-0368

Dr. Gail Goldberg
Assessment Specialist
Division of Planning, Results, and Information Management
333-2367

Dr. John Haigh
Staff Specialist, Accountability/Outcomes
Division of Special Education
410-767-0236

Dr. Eileen Oickle
Specialist in Middle and High School Learning
Division of Instruction and Staff Development
410-767-0345

Dr. Jessie Pollack
Specialist in Research and Development
School Performance: Research and Development Office
333-2375

Dr. Kathy Rosenberger
Coordinator, School Performance Team
Division of Planning, Results, and Information Management
410-767-0373

SAMPLE LETTER OF INVITATION TO TEST PUBLISHERS

[Date]

[Recipient]

Dear [Name]:

Thanks for agreeing to present your assessment programs to us on [date]. Here is a brief outline of what we need to hear about.

Background

The State of Maryland is preparing new high school graduation requirements. Each of the academic subjects—English, mathematics, science, and social studies—has developed a new set of Core Learning Goals (enclosed) that represent state-mandated requirements for learning for all students. The intention is to raise standards and create some level of uniformity across the State of Maryland. These standards are intended to be nationally and internationally competitive.

These learning goals have been before stakeholder groups and the State Board of Education on several occasions. They will be submitted to the State Board for approval in July 1995. We do not expect major changes in the enclosed drafts.

Besides the new learning goals, the State Board also intends to mandate new assessments of individual student achievement of these goals. This is an individual student accountability program for high school graduation, so the measures must meet national standards for reliability and validity.

Assessment Systems Designs

The State Board and various stakeholder groups are currently discussing several different possibilities for a statewide assessment system (paradigms 1, 2, and 3, enclosed). In brief, two of the models (paradigms 1 and 2) feature state-mandated end-of-course exams of the mandated learning goals, where the learning goals would be merged into a variety of course configurations. All students would be required to take these examinations to gain credit for graduation. Paradigm 3 replaces end-of-course exams with end-of-course-of-study (or end-of-discipline)exams in each of the four academic subjects (e.g., the Certificate of Initial Mastery idea). These subject exams would be administered at the end of tenth or in the eleventh grade. All students would be required to take all subject exams to earn credit for graduation.

Time Frame and Process

In July 1995, a design for an assessment system will be presented to the State Board for approval. That proposal will include recommended measures available in the test development community. These proposals represent a prodigious increase in state-mandated testing in Maryland.

The State Board would rather purchase than develop tests, no matter what model they approve. In order to submit a proposal for funding to the State board, we need to go through several steps: (1) an original screening of available measures by major test developers, (2) a recommendation to the content (subject area) teams to review possible measures in their disciplines, (3) a review of possible measures by the subject matter experts who developed the learning goals, and (4) a recommendation to the State Board for instrumentation in July 1995.

What We Need

We have scheduled a meeting with you to screen (step 1 above) possible measures for use in an individual student graduation requirement system. We will meet at the Maryland State Education Building in Baltimore on [date] from [time]. I am sending you (enclosed) the following documents.

- Copies of the Core Learning Goals
- Diagrams of paradigms 1, 2, and 3
- Questions about scoring

We would like to have you present to us (approximately 10 staff) possible instruments to use in measuring student attainment of these learning goals. Documentation will be important. You should provide us with:

1. A content match of proposed tests with our learning goals down to the level of specific items which purport to measure specific indicators.

2. Evidence in writing that these instruments meet nationally accepted standards for reliability and validity.

3. Services available in writing (e.g., scoring).

4. Responses in writing to the enclosed questions on scoring.

5. Estimated costs per student for use of instruments or item pools and varying levels of services.

6. Future test development plans or projects under development that might produce useful instruments for Maryland.

I have said nothing about test format so far. Some members of the State Board favor multiple-choice testing, but that does not exclude multiple formats (e.g., some constructed responses) or multiple instruments comprising a "test" (e.g., one "test" in multiple-choice and one in constructed-response format—say, short answer items).

The State Board is not very receptive to performance assessments or portfolio assessments for this program, but such alternative assessments may well play a role in the design recommended to them in July. The more viable choices you offer us at this stage, the better. One caution: no one here is interested in "minimal competency" testing.

Who We Are

You will be presenting to an MSDE staff committee charged with surveying high school assessment practices nationally and internationally and screening potential instruments. We represent the following array of competencies: psychometrics, alternative assessment, assessment systems design, teaching-learning-testing relationships, diagnostic testing, curriculum design, instruction, the psychology of learning, special education, school-to-work programs, etc. A diverse group! If you focus on matches between instruments, learning goals, and possible systems designs (e.g., end-of-course vs. subject area exams and multiple formats), you can treat us as a single audience.

Please call if you have questions. I will send additional information on the meeting site. You will have an hour and a half to make your presentation and one-half hour to answer questions.

Sincerely,

Ted Schuder
Specialist in Research and Development

TS/bef
Enclosures

c: Bob Gabrys
Jessie Pollack

SURVEY OF SUBJECT-SPECIFIC TESTS
COLLECTED FROM ETS's TEST COLLECTION CATALOG

Content Mastery Tests-Biology

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/E
Nat. Profic. Survey Series Dale P. Scannell, 1989	Riverside Publishing Co.	?1	45	?	NRT,CRT	40	
	Measures knowledge of living world ranging from single-celled organisms to the human body						
ATP Achievement Test in Biology	The College Bd.	?1	100	?	?	60	
	Cont. includes cellular & molecular bio, reproduction, growth & nutrition & ecology; genetics & evolution; organismal bio; systematics; behavior						
NABT/NSTA High School Biology Exam, 1987	National Sci. Teachers Association	?1	80	M-C	NRT	110	
	Evaluates students' understanding of basic biological concepts: genetics, ecology, taxonomy, cell structures, evolution, animal morphology.						
High School Subject Tests Biology, 1988	Amer. Testronics	2	60	M-C	NRT,CRT	40	
	Measure students' knowledge of biology or as preassments to measure students knowledge prior to formal course of study of biology						
End-of-Course Tests:Biology 1986	CTB	1	48	M-C	NRT	45	
	Cont of the test covers cellular, molecular, & organismic bio, heredity, evolution, & ecology						

Content Mastery Tests-Chemistry

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/ST
ACS Chemistry in the Community (ChemCom) Curric., H.S. Chem., 1991	ACS DivCHED Examinations Institute Emphasize both the acquisition of knowledge of chemistry and the development high level decision-making skills.	1	60	Special?	?	80	
Nat'l Proficiency Survey Series, Chemistry, 1989	Riverside Pub. Measures understanding of atomic theory, the nature of matter, and its states	?1	42	?M-C	NRT,CRT	40	
End-of-Course Tests: Chemistry, 1986	CTB Measures structure of matter, chemical formulas and equations, states of matt property and character of matter and chemical reactions.		48	?M-C	NRT	45	
General Chemistry Test, 1989	Journal of Research in Science Teaching Measures knowledge of chemical formulas and writing chemical equations.	1	25	MC	?	?	
ACS-NSTA Cooperative Exam.: H.S. Chemistry, 1983	Examinations Inst.-ACS Measures laboratory techniques; descriptive chemistry; stoichiometric calculations; states of matter, including gas laws; thermochemistry; kinetics equilibrium; acids and bases; electrochemistry; bonding; introductory organic trends in the periodic system; atomic structure; environmental topics; and nuclear chemistry.	1	25	MC	?	?	

Content Mastery Tests-Chemistry (Continued)

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
Nat'l Achievement Tests: Gen. Chem. Test, 1958	Psychometric Affiliates Measures the student's basic knowledge of chemistry, and ability to apply th knowledge.	?1	120	?M-C	?	40	
H.S. Subject Tests: Chem., 1988	Amer. Testronics Measures students' knowledge of chemistry.	2	40	?M-C	NRT,CRT	40	
ATP Achievement Test in Chem.	The College Bd. Measures what subject matter student knows and how effectively he or she can this knowledge.	1	90	?M-C	?	60	
ACS-NSTA Cooperative Exam.: H.S. Chemistry	ACS Div/CHED Exams Inst. Measures structure and bonding; acid base chemistry, and periodic charts and similar concepts appearing in textbooks, including laboratory techniques, descriptive chemistry, stoichiometric calculations, states of matter, gas la thermochemistry, kinetics, equilibrium, electrochemistry, organic chemistry, environmental topics, and nuclear chemistry.						

Content Mastery Tests-Physics

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
Nat'l Proficiency Survey Series, Physics, 1989	Riverside Pub.	?1	45	?M-C	NRT,CRT	40	
	Examines the nature of energy and the relationship between energy and matte from mechanics through nuclear reactions.						
ATP Achievement Test in Physics	The College Bd.	?1	75	?M-C	?	60	
	Measures classical mechanics, electricity, and magnetism, heat and kenetic theory and modern physics. knowledge.						
AAPT/NSTA H.S. Physics Exam, 1988	Nat'l Science Teachers Assoc.		80			90	
	Measures students' understanding of basic physics concepts (e.g., mechanics heat and kenetic theory, electricity and magnetism).						
H.S. Subject Tests: Physics, 1988	Amer. Testronics	2	40	?M-C	NRT,CRT	40	
	Measures students' knowledge of physics or as a preassessment to measure students' knowledge prior to formal course o fstudy of physics.						
End-of-Course Tests: Physics, 1986	CTB	?1	48	?M-C	?	45	
	Measures knowledge and understanding of atomic structure and theory, kenetic theory and gases, heat, mechanics, waves, electricity and magnetism to appl what they have learned.						
Nat'l Achievement Tests: General Physics Test, 1958	Psychometric Affiliates	?1	130	?M-C	?	40	
	Tests the student's knowledge of physics, and ability to apply that knowled						

Content Mastery Tests-Science - Earth & Physical

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST
H.S. Subject Tests: Physical Science, 1988	Amer. Testronics Measures students' knowledge prior to formal course of study of physical science.	2	50	?M-C	?	40	
AGI/NSTA Earth Science Exam	Nat'l Science Teachers Assoc. Measures students' understanding of basic earth science concepts including geology, astronomy, oceanography, and meteorology.	2	120	?M-C	NRT	110	

Content Mastery Tests-Algebra

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
HS Subjects Tests Algebra, 1988	Am Testronics Knowledge of algebra	2	40	?MC	NRT,CRT	40	
HS Subjects Tests Pre-Algebra, 1988	Am Testronics Knowledge of pre-algebra	2	40	?MC	NRT,CRT	40	
Nat.Achmnt Tests First Yr Algebra 1959,1962	Psychometric Affiliates First year algebra	2	48	?MC	?	40	
National Profcncy Survey Srs, 1989 Algebra I	Riverside Undrstndng of real nmbrs & variables & their opertns in equations & inequali	?1	39	?MC	NRT,CRT	40	
National Profcncy Survey Srs, 1989 Algebra II	Riverside Undrstndng of real nmbrs & polynomals, solving of linear, quadratic, trigonometric equations; and the graphing of functions.	?1	39	?MC	NRT,CRT	40	
ERB Modrn Second Year Algebra Test	Eudctional Records Bureau Equations, wrd problems, logarithms, simplifying	?1	50	MC	?	80	

Content Mastery Tests-Geometry

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST
National Profic Survey Series, 1989	Riverside Measures understanding of nature & relationship of poins, lines, angles, p curckesm polygons, & solids	?1	39	M-C	NRT,CRT	40	
End-of-Course Tests, 1986	CTB Measures knowledge & understanding of such concepts as congruence, similar angle relationships, special properties of polygons, & determination of perimeters, areas, & volumes of most common polygons & solids	?1	42		NRT	45	
Nat. Achievement Tests; Plane Geo. Test, 1960	Psychometric Affiliates Measure students' knowledge of plane geo & their ability to apply that knowledge	?1	48	M-C	?	40	
High School Sub. Tests Geo, Form B 1988	American Testronics Measures students' knowledge of geometry or as preassessments to measure students' knowledge prior to formal course of study of geometry.	?	40	M-C	NRT,CRT	40	
Nat. Achievement Tests; Solid Geometry, 1960	Psychometric Affiliates Measure secondary school students' achievement level in solid geometry						

Content Mastery Tests-General Mathematics

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST
Nat. Profic. Survey Series, Gen. Math, 1989	Riverside	?1	42	?M-C	NRT,CRT	40	
	Measures computation skills with integers & the knowledge of basic geometric concepts						
High School Sub. Tests: Gen. Math Form B, 1988	American Testronics	2	40	?M-C	NRT,CRT	40	
	Measures students' knowledge of general math.						

Content Mastery Tests-English

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
Nat'l Proficiency Survey Series, English IV, 1989	Riverside Pub. Evaluates a student's ability to use language effectively to organize and support ideas.	?1	42	?M-C	NRT-CRT	40	

Content Mastery Tests-Language

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST
English Language Skills Profile, 1987	Macmillan Ed. England Total language approach in which the emphasis is on assessing and developi. receptive and expressive skills.	?	?	?	?	?	
H.S. Subj. Tests: Language, 1988	Amer. Testron- ics Measures students' knowledge prior to formal course of study of language.	?1	70	?M-C	NRT-CRT	40	

Content Mastery Tests-Literature

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
H.S. Subject Tests: Literature & Vocabulary, 1988	Amer. Testronics Allows pre- and posttest analyses of individuals, classes, or specific grou for grades 9 through 12.	2	50	?	NRT-CRT	40	
Nat'l Proficiency Survey Series, Literature, 1989	Riverside Pub. Draws from the works of a wide variety of authors and from different types literature	?1	39	?	NRT-CRT	40	
Amer. Literature Test Series: 1800-1899, 1986	Perfection Form Contains matching-type questions on identification of characters, multiple-choice questions on story content, and true-false questions on story content.	10	50/Form	TF M-C Matching		?	
Amer. Literature Test Series: 1961-Present, 1986	Perfection Form Contains matching-type questions on identification of character, multiple-c questions on story content, and true-false questions on story content.	10	50/Form	TF M-C Matching		?	

Content Mastery Tests-Writing

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/E
Nat'l Proficiency Survey Series, Writing Fundamentals, 1989	Riverside Publishing Co.	?1	66	?M-C	NRT-CRT	40	
	Measures the meaning of words and vocabulary devlopment in specific academic subject areas.						

Content Mastery Tests-History

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/t
Nat Proficiency Survey Series World History 1989	Riverside Publishing Co. Measures knowledge of world geography and historical info from early civilizations to the current age	?1	45	?M-C	NRT,CRT	40	
Nat Proficiency Survey Series 1989	Riverside Publishing Co. Measures U.S. History from early exploration to the present.	?1	42	M-C	NRT,CRT	40	
High School Sub Tests, American History, Form B	American Testronics Measures student's knowledge of American history.	2	50	M-C	NRT,CRT	40	
End-of-Course Tests; American History, 1986	CTB Focuses on cultural & economic forces that influenced the development of the U.S.	?1	50	M-C	NRT	45	
End-of-Course Tests: World History, 1986	CTB Measures the understanding & knowledge of the events, individuals, & politic & religious ideas that formed Western, Asian, and African civilizations	?1	50	M-C	NRT	45	

Content Mastery Tests-History (Continued)

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
Nat. Achievement Tests; American History, Govt Problems of Democracy, 1958	Psychometric Affiliates	?1	100	?M-C	?	40	
	Measure students' knowledge of American history, govt & politics						
Nat. Achievement Tests; World History, 1948	Psychometric Affiliates	?1	100	?M-C	?	40	
	Measures student's concept of world history and its application to present world affairs						
American History Tests, Rev., Sr. High	Perfection Form Co.	?	?	?	?	?	
	Measures America's heritage, background of the Revolution, U.S. Constitutio Washington's administration, the age of Jackson, expansion, war and reconstruction, emergence of modern America, U.S. becomes a world power, prosperity and depression, the U.S. and world leadership.						

Content Mastery Tests-Economics

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
End-of-Course Tests: Consumer Economics, 1986	CTB	71	45	7M-C	NRT	45	
	Measures the ability to conceptualize basic economic principals and to make decisions based on this knowledge.						

Content Mastery Tests-American Government

NAME/DATE	SOURCE/ DESCRIPTION	# FORMS	# ITEMS	FORMATS	SCORES	TESTTIME	COST/
Nat'l Proficiency Survey Series, Amer. Govern., 1989	Riverside Pub.	?1	45	?M-C	NRT,CRT	40	
	Measures information about state and federal governments, elections and the Constitution.						
Amer. Government Tests, 1970	Perfection Form	?	75	T-F M-C Matching	?	?	
	Covers state and local government, the judiciary system and civil liberties legislative branch, the executive branch including political parties and elections, fundamentals of government.						

LEARNING RESEARCH AND DEVELOPMENT CENTER, UNIVERSITY OF PITTSBURGH
NATIONAL CENTER ON EDUCATION AND THE ECONOMY

New Standards

New Standards Products

The following products will be available from New Standards beginning in Summer 1995

Performance standards. We are producing a set of performance standards for math, English, science and applied learning for elementary, middle and high school. The standards will be linked to the standards and outcome statements of all New Standards partners (including Pennsylvania), but will add considerable detail – including descriptions of the kinds of tasks students would have to do to demonstrate mastery, descriptions of scoring criteria, and benchmark examples of graded student work to illustrate each score level.

Local standards review processes. We will develop and test procedures for local consideration of the performance standards, to analyze how they match local goals and outcomes and to recruit public support for teaching to standards. We will offer a workshop that trains local people to conduct these processes in their districts.

School exams. New Standards will have ready for next year a set of exams that are keyed to the performance standards. In mathematics, the exam will require 3-4 class periods to administer. They will contain several extended problems to solve as well as some shorter tasks covering concepts and skills specified in the standards. The official administration of the exams will occur in late spring, 1996. A "practice version," based on this year's exams, will be available for use in Fall 1995. The practice exam could be used to acquaint everyone (students, teachers, parents) with the nature of the coming exams.

Exam scoring workshop. Scoring the open-ended tasks on the New Standards exams is a powerful professional development experience for teachers. If your Partnership schools use the Fall "practice" version of the math exam, a professional development program could be launched at that time. This would provide scores quickly and educate teachers at the same time.

Portfolio handbooks. The second revision of the New Standards portfolio handbooks will be ready for use in Fall 1995. The handbooks, written for students (with a teacher and parent version also available), explain what kinds of work portfolios should contain and how they will be judged. The handbooks are explicitly keyed to the New Standards performance standards, thus making the exams and portfolios into a unified assessment system.

Portfolio launch workshop. This is a workshop used at startup of the portfolio process. It works best as a follow on to the exam scoring workshop. It focuses on the practical procedures associated with portfolios as well as on how to develop tasks and projects for inclusion in the portfolio.

Portfolio grading workshops. These are under development now by New Standards staff. They will extend the professional experience of teachers to include evaluation of the kinds of extended, problem-solving oriented work that will be characteristic of portfolio entries. Participation in one or more of these during the next school year would prepare a school staff for eventual official grading of portfolios leading – for those districts desiring it – to New Standards certified portfolio grades.

Defining World Class Standards

A PUBLICATION SERIES OF THE AMERICAN FEDERATION OF TEACHERS

Excerpts from

What College-Bound Students Abroad Are Expected To Know About Biology

Exams from England and Wales, France, Germany and Japan

Plus a comparative look at the United States

THIS VOLUME CO-SPONSORED BY

AMERICAN FEDERATION OF TEACHERS

NATIONAL CENTER FOR IMPROVING SCIENCE EDUCATION

THERE IS a growing awareness in this country both that academic performance in our schools is not high enough and that we need to set "world class" standards for our students. The American Federation of Teachers has been a strong advocate for school reform based on rigorous academic standards for many years, and we are thrilled that the national conversation has taken off at such a fast pace. Yet, as we have observed and become involved in some of the standards-setting activities under way at the national, state and local levels, we have noticed an alarming inconsistency. Many people are using the term "world class standards," but there is a surprising dearth of resources available to show educators, policymakers, and others exactly what "world class" means.

This spring, the AFT launched a new publication series designed to fill that void. The *Defining World Class Standards* series will publish translated assessments, curriculum materials, and other foreign documents that may help illuminate what a world class standard is and bring substance to the current standards-setting discussions and activities. Over time, we hope to cover a variety of subject areas and grade levels, and we intend to focus on standards for both work-bound and college-bound students. The inaugural volume of the series focuses on standards for college-bound students in science, specifically biology.

What College-Bound Students Abroad Are Expected To Know About Biology, a joint publication of the AFT and the National Center for Improving Science Education (NCISE), contains examinations taken by college-bound students at the end of their secondary school careers in England and Wales, France, Germany, and Japan. These exams—the A-levels in England and Wales, the *baccalauréat* in France, the *Abitur* in Germany, and the university entrance exams in Japan—are among the most challenging tests given to students in these countries; and the tests (though not necessarily in biology) are required of all college-bound students. As an additional resource, the Advanced Placement (AP) biology exam is also included in the book along with a discussion of standards—or the lack thereof—for college-bound students in the United States. Unlike the foreign exams, the AP is not required of college-bound youngsters and is taken by only a small percentage of American students.

The materials and information in this book and the series that will follow should serve as a valuable resource to anyone involved in setting or evaluating academic standards for students, whether at the national, state, local, or school level. All of us will be wiser, more informed participants in discussions about standards if we are aware of what is demanded elsewhere. But it is our hope that the *Defining World Class Standards* series will serve an even wider audience. We expect that educators will want to use the materials to compare their expectations for their students with those of their counterparts overseas. Parents might also be interested in making similar comparisons. Business leaders will want to know what other countries expect of high school graduates and how well prepared they are to enter the work force. Higher education faculty will be interested in the standards for college-bound students.

In the end, we hope this book and the series that will follow will be not only a resource but also a clarion call. Our goal is to generate broad awareness among educators and the general public that we are expecting too little of our students and that we need to work together to enact the kinds of reforms that will enable our schools to help all youngsters reach their maximum potential.

The following report is an abridged version of *What College-Bound Students Abroad Are Expected To Know About Biology*. This report is organized into five sections: an introduction, which discusses the rationale for both the *Defining World Class Standards* series and this volume; a section on each of the featured countries; and, finally, a comparative discussion of all five countries and their examination systems. We are only able to include here portions of the exams and surrounding information on three of the five countries featured in the book: England and Wales, France, and Germany. Please note, however, that the other two countries included in the full book—Japan and the United States—are mentioned in the comparative discussion in the last section of this report. For each of the three countries, we have included portions of the exams as well as sample answers, or in the case of England and Wales, excerpts from the official scoring guides used to grade the exams. Prior to each exam is a brief country profile, which provides important background information and describes the role the exam plays in that country's education system.

* * *

IN 1989, a historic meeting took place in Charlottesville, Virginia. The nation's governors and the president came together collectively to address the need for fundamental changes and improvements in our schools. The result was a commitment to a set of six national education goals that would propel our education system into the 21st century. Two of those goals indirectly called for the setting of rigorous, "world class" academic standards for our students, standards that would drive everything else we do in our schools.

Why the emphasis on making our education standards "world class"? The president and governors fully

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What College-Bound Students Abroad Are Expected To Know About Biology *was co-sponsored by the American Federation of Teachers and the National Center for Improving Science Education, and is the inaugural volume of the AFT's* Defining World Class Standards *series. The principal author was Matthew Gandal, who is a research associate in the AFT Educational Issues Department. The research assistant on the project was Charles Hokanson. Ted Britton coordinated the project for NCISE.*

Copies of the book are available for $10. Shipping and handling costs are included. Send prepaid orders to Biology Book, AFT Order Dept., 555 New Jersey Ave., N.W., Washington, DC 20001. Checks should be made payable to the AFT.

recognized the link between students' performance and success in school and the contributions students will ultimately make to their communities and the nation as a whole. In order for the United States to remain internationally competitive—and for American families to raise their standard of living—businesses must be able to hire youngsters with the knowledge and skills necessary to compete in today's global economy. And, increasingly, youth without these skills will find it difficult to get and keep jobs that pay decent wages. It is imperative, therefore, that our schools help students learn and achieve at levels comparable to those reached by students in our competitor nations. Unfortunately, international comparisons over the years have clearly shown that we are not bringing our students up to those levels.

There is another reason, as well, to look at and be informed by internationally competitive standards. If we don't, there is a danger that those of us who have been involved so long in the struggle to raise student achievement will become prisoners of the status quo, unable to imagine youngsters achieving at higher levels than we are accustomed to. In this sense, our own experience can be limiting. The current emphasis on world class standards is designed to free us from these limitations and biases, and encourage us to learn from the experiences of other countries. By looking at what students in other nations are capable of accomplishing, we may aim higher when judging the potential of our own youngsters.

Since the Charlottesville Summit, much attention has been paid to the challenge of setting world class standards. With the support of the Clinton administration (and the Bush administration before that), the U.S. Congress, the nation's governors, professional associations and the business community, some of the nation's most highly respected educators and scholars have begun to develop national standards for what students should be expected to learn in the core academic subjects. In addition, educators at the state, district, and school levels are simultaneously organizing their own efforts to set world class standards for students.

But what is a world class standard? Despite the frequent use of the term and the references to high achievement in other lands, there is, unfortunately, not much available to apprise us of what is actually expected of foreign students in particular subjects.

Focusing on Science

The poor academic performance of our students has been well documented over the years in subjects across the board, including science. According to the most recent report on science achievement from the National Assessment of Educational Progress—*The 1990 Science Report Card* (published in 1992)—most U.S. eighth and 12th graders know some basic scientific principles, but a low percentage possess in-depth scientific knowledge and reasoning skills. Fewer than half of 12th graders demonstrated the ability to interpret graphs and tables, evaluate and design experiments, or make use of detailed scientific information. The message was similar when the 1991 International Assessment of Educational Progress measured science achievement among 13-year-olds: the United States ranked 13th out of 15 nations.

At a time when the global economy is becoming more and more dependent on scientific research and technology, we simply cannot afford such low levels of science achievement in our schools.

What are students in other countries expected to know and be able to do in science? How do these expectations compare with our own? These are the sorts of questions that many educators, parents and policymakers are asking as they become involved in the national conversation about standards. And it was questions like these that motivated the AFT and NCISE to produce a book on science expectations overseas.

Why focus on biology? Because it is the most commonly studied science subject in American high schools. Whereas only limited numbers of high school students in this country are exposed to physics and chemistry (20 percent and 45 percent respectively), 95 percent of students take at least one biology course.

As is discussed in significant detail in the final section of this report, one of our most striking findings has to do not with whose exams are most difficult, but rather with how many students in these countries are taking and passing the exams each year. With the exception of the United States, every country brings a significant number of students—at least 25 percent and as much as 36 percent of the age cohort—up to the level of performance demanded in these exams. In contrast, only 4 percent of 18-year-olds in the United States take and pass one or more AP exams.

Another important finding is that these foreign exams must be passed by students who want to go on to study in colleges and universities. And since the exams are well-aligned with the school curriculum, students understand that working hard in school will pay off. This alignment of curricula, exams, and incentives does not exist in the United States. Indeed, the test most widely taken in the U.S. for college admissions purposes—the SAT—makes a point of not being linked to any curriculum. In fact, the SAT does not even have specific sections or questions in subjects such as science, history, geography, or literature.

We believe that the information in this book will become a valuable resource for standards-setters at the national, state, and local levels; for professional and lay people who will be reviewing these standards; and for teachers involved in course and curriculum development. We hope it will stir discussion not only among educators and policymakers, but also among parents, students, and business and community leaders about what we *do* and *should* expect from our students. In England and Wales, France, Germany, and Japan, where students, teachers and parents all know what is expected of the college-bound and what is at stake, a significant number of youngsters rise to the challenge and achieve high standards. We think that upon reading through this material you will agree with us that we are asking too little of too many of our students, and we are giving them very few incentives to work hard.

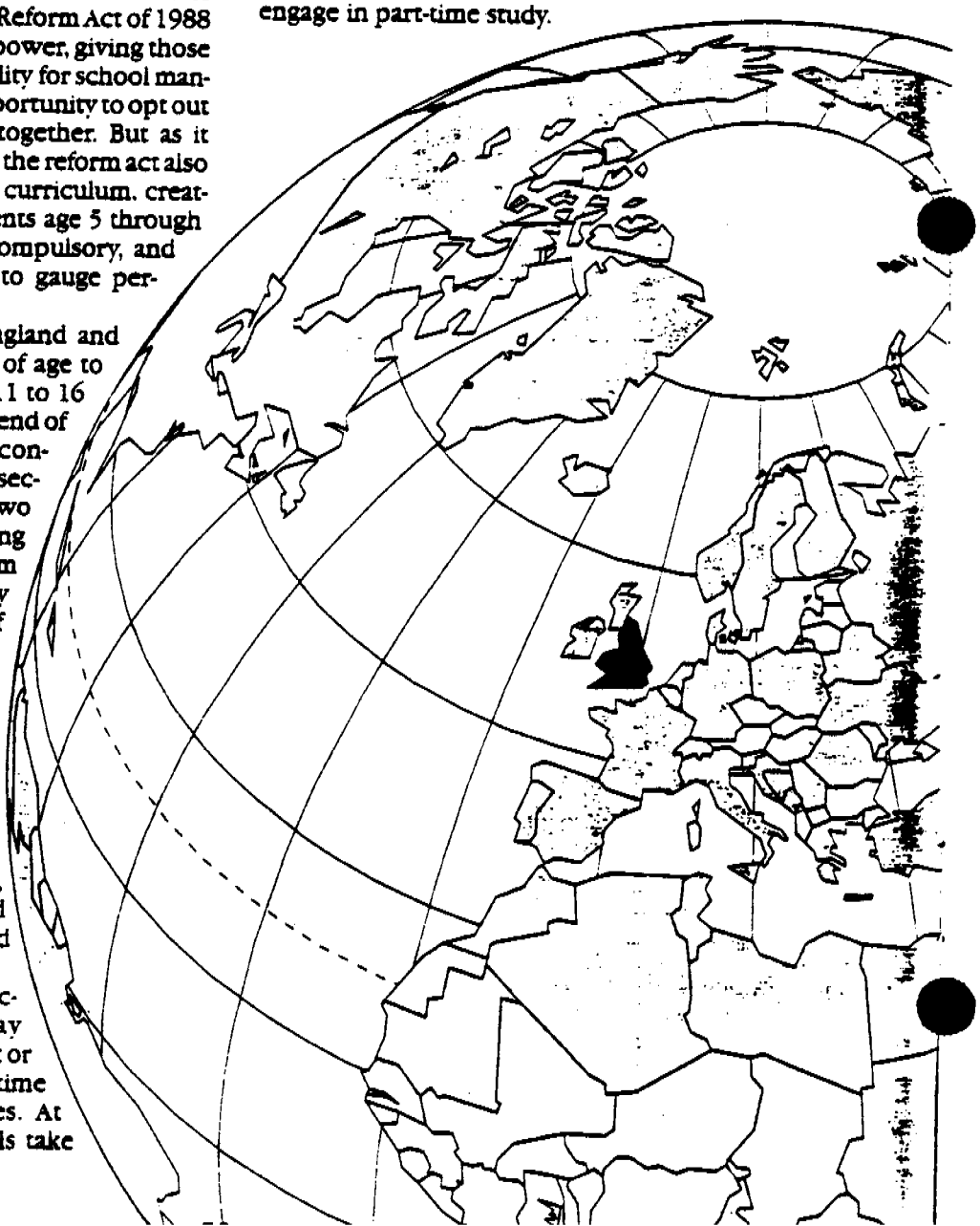
A Profile of the Education System in England and Wales

Until recently, most of the administrative control of schools in England and Wales rested with elected local governments that set up school boards called Local Education Authorities (LEAs). As in the United States, this strong tradition of local autonomy meant that the national government played only a distant policy role. Sentiment about Britain's tradition of local control began to change in the mid- to late-1980s, however, due largely to the efforts of Prime Minister Margaret Thatcher. The Education Reform Act of 1988 stripped the LEAs of much of their power, giving those at the school level more responsibility for school management and giving schools the opportunity to opt out of the jurisdiction of the LEAs altogether. But as it decentralized school management, the reform act also brought more centralization to the curriculum, creating a national curriculum for students age 5 through 16, the years when schooling is compulsory, and introducing national assessments to gauge performance.

The predominant pattern in England and Wales is for children 5 to 11 years of age to attend primary schools and those 11 to 16 to attend secondary schools. At the end of compulsory education, students continuing their studies may remain in secondary school for an additional two years or enroll in vocational training schools. The national curriculum applies to all primary and secondary school children through the age of 16. The subjects covered include English (and Welsh in almost all schools in Wales), mathematics, science, history, geography, technology, music, art, physical education, and—for secondary school students—foreign languages. Up to 70 percent of teaching time is supposed to be spent on these subjects, and national assessments are applied at four key stages (ages 7, 11, 14, and 16).

At age 16, after five years of secondary education, students may choose either to enter the job market or to pursue further full-time or part-time academic and/or vocational studies. At this time, the vast majority of pupils take examinations for the General Certificate of Secondary Education (GCSE) in various subjects. Typically, students take GCSE exams in eight subjects, and those intending to go on to further academic studies are expected to earn grades of A, B, or C on an A-G scale in five or more subjects.

In 1991, 62 percent of 16-year-olds chose to continue in full-time academic or vocational education. Another 20 percent chose to engage in part-time study.



THE A-LEVEL EXAMINATIONS

After taking GCSE examinations, students continuing their academic schooling spend two years preparing for the advanced, or A-level, exams. While in the first five years of secondary schooling students receive a fairly well-rounded curriculum, including at least those subjects mandated in the national curriculum, those working toward their A-levels usually concentrate on just three subjects, spending approximately equal time on each. Students are free to choose which subjects they will study. While students have traditionally chosen all three subjects in the same area, such as math/science or the humanities, thereby providing a focus for further specialization at a university, there has been an increasing trend toward studying for A-level exams in more than one curriculum area. Even if students do choose to take all three A-level exams in the same area, schools generally require some additional study in an area outside students' selected specialization (for instance, a humanities course for math/science students or a general science course for humanities specialists).

At the end of the second year, typically at age 18, students take the A-level examinations in each subject they studied. Some colleges and universities require candidates to have taken and passed two, others three. And the better the grade on each exam, the better the candidate's chances of being accepted to the school and discipline of his or her choice. In 1992, 31 percent of the age cohort took A-level exams in at least one subject. Nearly 80 percent of those earned passing grades: Fifteen percent of the age cohort earned three or more A-level passes, 6 percent earned two passes, and 4 percent earned one passing grade. Sixteen percent of all A-level candidates chose biology as one of their subjects, and 78 percent of those who took the exam passed it.

In an effort to allow A-level students to study a wider range of subjects, advanced supplementary (AS) courses were introduced in 1987, and AS exams in 1989. AS-level courses require half the teaching time and cover half the subject matter of the A-level, though the standard of work is supposed to be comparable. The addition of the AS-level was designed to allow for a wider combination of courses across discipline areas; however, the new option has yet to be widely used by students. In 1992, students took only 53,000 AS subject examinations in contrast to more than 700,000 A-level exams.

HOW ARE THE A-LEVEL EXAMS DEVELOPED AND GRADED?

A-level exams are developed by seven different examination boards, one for Wales and six for England (there is also one for Northern Ireland). Each board is responsible for developing exams and the corresponding curricula in all A-level subjects. While there is no published set of standards or guidelines for the examining boards to follow, the boards do agree on a common core of content in certain subjects, and a recently established national body, the School Curriculum and Assessment Authority (SCAA), monitors the boards' work to ensure consistent and high standards. Appointed by the Secretary of State for Education, the SCAA has the power to approve or withhold recognition of a particular exam and curriculum. It also must approve all new exams and curricula or any significant changes to existing ones.

The examination boards were originally set up by universities or groups of universities to help in the admissions process. Although some still have strong ties to universities, they are now independent, nonprofit organizations whose main source of revenue comes from the fees they charge schools for using their exams and curricula. Over the years, some boards have come to serve certain regions more consistently, but they have no territorial claims to any particular locality or region. In order to attract students and schools, the boards must rely on the quality of their materials and their reputations. As recently as 1990, a board that could not attract enough candidates was forced to shut down.

The competitive nature of the examination business makes the role of the SCAA very important. Its seal of approval is essential, and this ultimately is what keeps the boards accountable to the public. Universities also have a considerable amount of influence on the boards, particularly in terms of their reputations, since they, more than anyone else, rely on the boards to give them accurate information about the performance of students.

Each year, the examination boards hire secondary school and university level educators on a part-time basis to develop the exams and the scoring guides used by the teachers who grade them. Separate panels are created for each subject area, and business representatives are included on the panels when appropriate. The exam questions must cover the content laid out in the syllabi previously approved by the SCAA. Any significant changes in the syllabi or the make-up of the exams must be resubmitted for approval.

REPRINTED IN THIS REPORT

What College-Bound Students Abroad Are Expected To Know About Biology contains the complete 1992 A-level Biology Exam from the University of London Examinations and Assessment Council. The exam is nine hours long and consists of five different papers or sections, some of which have up to three subsections. The exam is by far the longest in the book, twice as long as the German exam, the second longest. Reprinted here are two of the five exam papers, totaling two and one-half hours of the nine-hour exam period, and selected excerpts from the Scoring Guide used to grade the exams. (The symbol Ⓐ next to a question indicates that the Scoring Guide for that question is provided at the end of the questions section.) NOTE: Paper four gives students a choice among three options: Microorganisms and Biotechnology, Applied Plant Biology, and Applied Animal Biology. We have chosen to show the third option, though the others are comparable in length and format.

1992 Advanced Level Examination in Biology

from the University of London Examinations and Assessment Council

PAPER 2

Time allotted: One hour and 30 minutes
Answer ALL FIVE questions.

1. Describe the technique you would use to compare the biochemical oxygen demand (BOD) of two water samples using methylene blue. (*7 points*) Ⓐ

2. Describe, with practical details, how you would compare the reducing sugar and non-reducing sugar content of a sample of beans. (*10 points*) Ⓐ

3. You are provided with an extract of chlorophyll pigments in an organic solvent. Describe, with practical details, how you would separate the pigments in the extract using chromatography. (*5 points*) Ⓐ

4. You are asked to investigate the difference in plant species diversity between two areas of grassland, one of which has been grazed by sheep and the other which has been left ungrazed.

   a. (i) State the method you would use to investigate the two areas of grassland. (*1 point*)

   (ii) Describe how you would carry out the method. (*5 points*)

   b. Suggest differences that you would expect to find between the two areas. (*2 points*)

5. Red blood cells (erythrocytes) transport oxygen from the alveolar surface to the respiring tissues. A group of students expressed the view that people living at high altitude should have higher red blood cell counts than people living at sea level.

   The students selected two independent samples of people. Sample A contained nine people who lived at sea level, and sample B contained nine people who lived up a mountain at an altitude of 2,000 m above sea level.

   Samples of blood were taken from each person and the cell counts were determined using counting chambers.

   a. The table below shows the red blood cell counts of the nine people in each of the two samples.

Sample	Number of red blood cells/ $dm^{-3} \times 10^{12}$								
A (sea level)	5.0	5.1	4.9	5.3	5.4	5.0	4.8	5.1	5.5
B (high altitude)	4.9	5.3	5.7	5.5	5.6	5.4	5.3	5.6	5.4

   The data were analysed using a Mann-Whitney *U* test to test the null hypothesis that there is no difference in the red blood cell counts of the two populations at a 5% significance level.

   (i) The median value at high altitude (sample B) is 5.4. Find the median value for the sea level population (sample A), and comment on the difference between the two median values. (*2 points*)

   (ii) Arrange the data from the table in order and in a form suitable for analysis using a Mann-Whitney *U* test. (*2 points*)

   b. (i) For this investigation the critical value of *U* at the 5% significance level is 17. The values calculated for *U* are 16 and 65. Which value of *U* would you take to determine the significance of these results? (*1 point*)

   (ii) Do the results enable you to accept or reject the null hypothesis? Explain your answer. (*2 points*)

   c. If the study was extended to use larger samples (100 people), explain how you would select the people for each sample. (*3 points*)

PAPER 4
OPTION C: Applied Animal Biology

Time allotted: One hour
Answer ALL SEVEN questions.

1. A comparison was made of the size of trout of different ages in two lakes in North Wales. The average length of trout from a mountain lake, Llyn Mynydd, was compared with trout from Llyn Alaw, a reservoir in a lowland agricultural area. The results are shown in the table below.

Age in years	Average length of trout/cm	
	Mountain lake	Reservoir
1	5	12
2	10	25
3	20	38
4	21	42

a. (i) How could the age of the fish be determined? (*1 point*) A

(ii) Give *one* reason why length was used as a measure of growth rather than any other parameter. (*1 point*) A

b. (i) Comment on the similarities in the growth patterns shown by the two populations of trout. (*2 points*) A

(ii) What is the percentage difference in growth rates as shown by average length of the two populations during their third year? Show your work. (*2 points*) A

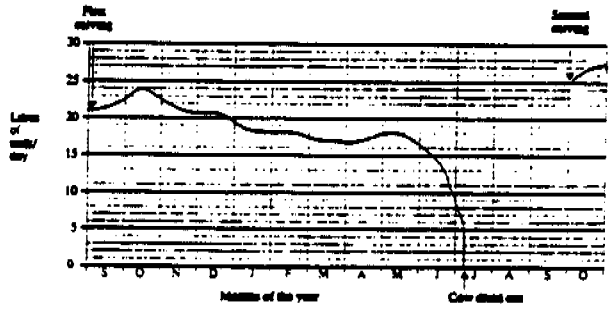
c. The difference in the growth rates of the two populations of trout has been attributed to the difference in nutrient availability in the mountain lake and in the reservoir.

Suggest how this difference could have arisen and why it would have had an effect on the average length of the trout. (*3 points*) A

d. Suggest *one* other factor which could differ in the two lakes and explain how this might affect the growth rates of the trout. (*2 points*) A

2. A cow does not produce milk without having a calf, and the aim of the farmer is to calve the cow once a year, at a time to suit the system of farming.

The graph below shows a cow's lactation over a year.



a. (i) How much milk was the cow giving per day at peak yield? (*1 point*)

(ii) Calculate the percentage increase in milk yield at the beginning of the second calving, compared with milk yield at the beginning of the first calving. (*1 point*)

(iii) In which month would the cow have been inseminated in order to produce the second calf in September? (*1 point*)

(iv) State one method by which drying-off is achieved. (*1 point*)

(v) Explain how drying-off benefits the cow. (*2 points*)

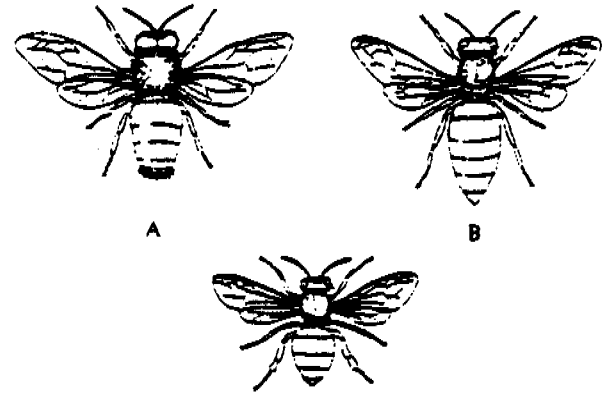
b. Colostrum (beastings) is produced by the cow for 3 to 4 days after calving.

(i) State *two* ways in which colostrum differs from ordinary milk. (*2 points*)

(ii) State *two* benefits to the calf of being given colostrum in the first few days of life. (*2 points*)

c. State *two* characteristics which a farmer would consider important in a good dairy cow. For each characteristic, give a reason to support your answer. (*4 points*)

3. The diagram below shows the three types of honey bee, labeled A, B and C.



a. Identify A, B and C. (*3 points*) A

b. State three ways in which bees are of economic importance. (*3 points*) A

4. Describe how you would carry out an investigation to identify the food constituents of a chicken's egg. (*6 points*)

5. Describe the differences between the processes of pasteurisation and sterilisation of milk, indicating the effectiveness of each method. (*6 points*) A

6. a. Make a labeled diagram to illustrate the life cycle of an aphid. (*5 points*)

b. State two ways in which aphids are of economic significance. (*2 points*)

7. Discuss the advantages and disadvantages of the use of hormones to improve the growth of cattle for meat production. (*10 points*) A

1992 Advanced Level Examination in Biology

from the University of London Examinations and Assessment Council

PAPER 2

Time allotted: One hour and 30 minutes
Answer ALL FIVE questions.

1. Describe the technique you would use to compare the biochemical oxygen demand (BOD) of two water samples using methylene blue. (*7 points*) Ⓐ

2. Describe, with practical details, how you would compare the reducing sugar and non-reducing sugar content of a sample of beans. (*10 points*) Ⓐ

3. You are provided with an extract of chlorophyll pigments in an organic solvent. Describe, with practical details, how you would separate the pigments in the extract using chromatography. (*5 points*) Ⓐ

4. You are asked to investigate the difference in plant species diversity between two areas of grassland, one of which has been grazed by sheep and the other which has been left ungrazed.

   a. (i) State the method you would use to investigate the two areas of grassland. (*1 point*)

   (ii) Describe how you would carry out the method. (*5 points*)

   b. Suggest differences that you would expect to find between the two areas. (*2 points*)

5. Red blood cells (erythrocytes) transport oxygen from the alveolar surface to the respiring tissues. A group of students expressed the view that people living at high altitude should have higher red blood cell counts than people living at sea level.

   The students selected two independent samples of people. Sample A contained nine people who lived at sea level, and sample B contained nine people who lived up a mountain at an altitude of 2,000 m above sea level.

   Samples of blood were taken from each person and the cell counts were determined using counting chambers.

   a. The table below shows the red blood cell counts of the nine people in each of the two samples.

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   The data were analysed using a Mann-Whitney *U* test to test the null hypothesis that there is no difference in the red blood cell counts of the two populations at a 5% significance level.

   (i) The median value at high altitude (sample B) is 5.4. Find the median value for the sea level population (sample A), and comment on the difference between the two median values. (*2 points*)

   (ii) Arrange the data from the table in order and in a form suitable for analysis using a Mann-Whitney *U* test. (*2 points*)

   b. (i) For this investigation the critical value of *U* at the 5% significance level is 17. The values calculated for *U* are 16 and 65. Which value of *U* would you take to determine the significance of these results? (*1 point*)

   (ii) Do the results enable you to accept or reject the null hypothesis? Explain your answer. (*2 points*)

   c. If the study was extended to use larger samples (100 people), explain how you would select the people for each sample. (*3 points*)

PAPER 4
OPTION C: Applied Animal Biology

Time allotted: One hour
Answer ALL SEVEN questions.

1. A comparison was made of the size of trout of different ages in two lakes in North Wales. The average length of trout from a mountain lake, Llyn Mynydd, was compared with trout from Llyn Alaw, a reservoir in a lowland agricultural area. The results are shown in the table below.

Age in years	Average length of trout/cm	
	Mountain lake	Reservoir
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2	10	25
3	20	38
4	21	42

Excerpts from the Scoring Guide for the 1992 A-level Biology Exam

Key : indicates separate marking points
/ indicates alternative marking points
eq means allow any correct equivalent point
(acceptable alternatives are discussed at the Examiners' coordination meeting)

Paper 2

1. 250 cm^3 samples: bottles filled completely / all air excluded ; add 1 cm^3 or reasonable stated volume methylene blue / stated exact number of drops ; pipette well below surface ; replace stoppers immediately ; without introducing air ; incubate at 20 - 25°C ; in dark ; note time when colour disappears ; use of white background ; replication / split sample ; etc. ;
or
water sample ; + 10 cm^3 Fehling's B ; stated number drops methylene blue ; titrate with ferrous sulphate ; end point burette tip under water ;
7 points

2. known / weighed mass of sample ; stated volume of distilled water added to bean sample ; breaking / macerate / homogenise in blender / mortar and pestle ; filter / centrifuge ; add measured volume of filtrate ; to equal / stated volume of Benedict's (Fehling's) solution / clinitest tablet ; state how test is carried out / heat / boil (for up to 2 minutes) ; measure volume/weight of precipitate / compare with chart (clinitest) ; same volume of filtrate for non-reducing sugar / filter off precipitate ; details of acid hydrolysis ; neutralise ; repeat Benedict's test using same reagent volumes / repeat clinitest ; compare volume / weight / colour of precipitate with previous ; replication of whole experiment ;
10 points

3. mark the origin ; spot on the extract using a capillary tube pipette / glass rod / etc ; use of hair dryer to stop spreading / allow concentration of the spot ; repeat spotting ; solvent ; correct example e.g. petrol-ether + propanone (acetone) ; how paper is supported in solvent ; origin above solvent ; atmosphere saturated with solvent ; run until solvent front just below support ; mark solvent front ; place in dim light ;
5 points

Paper 4, Option C — Applied Animal Biology

1 a. (i) rings on scales / tagging and recapture
1 point

(ii) easy to do / fish kept out of water for minimum time / isometric growth so good correlation / not affected by recent meal / eq ;
1 point

b. (i) both show exponential phase / growth doubles each year ; both show reduced growth / least growth during fourth year ; *2 points*

(ii) mountain lake 10 cm for the year, reservoir 13 cm / 10^{-13} / difference in growth rate is 3 cm per year ; 3/10 x 100 = 30% / 3/13 x 100 = 23% ;
2 points

(c) reservoir has rich nutrient run off ; mountain lake surrounded by infertile land ; nutrients needed for growth of plant life ; trout part of food chain / eq ;
3 points

(d) pH ; could affect the availability of nutrients / growth of organism ;
or
temperature ; affects growth rates of food organisms / trout more active feeder at higher temperature ;
or
named pollutant ; toxic effect in relation to trout growth ;
or
light ; depth / volume light / could affect plant growth hence trout ;
or
oxygen ; related to metabolism of the trout ;
2 points

3. a. A = drone ; B = queen ; C = worker ; *3 points*

b. honey formation / production ; wax formation / production ; royal jelly ; queen / new colonies sold ; pollination ; *3 points*

5. *pasteurisation*: high temperature / 72° ±3 / 62° ±3 stated ; for short time / time stated / related to temperature (15 sec / 30 min) ; improves keeping qualities of milk ; kills some microorganisms ;

sterilisation: high temperature / 130 - 140°C / 100 - 120°C ; time stated / related to temperature (UHT 2 sec / 15 - 40 mins) ; microorganisms killed ; more effective than pasteurisation / milk will keep longer ; vitamin content of both affected ; comment about taste ;
6 points

7. hormones concerned are anabolic / steroid hormones ; naturally occurring ones are progesterone / testosterone / androgen / eq ; some artificial ones / named e.g. ; implanted / tagging ears ; used with steers / bullocks ; castration of bulls removes the source of testosterone ; so growth would be slower ; treated cattle convert their food to meat more efficiently / ref weight gains / less food for same amount of muscle / large size "sooner" (time ref) ; leaner animal / carcass is produced ; danger / uncertainty of hormones getting into humans ; farmers have more control over meat production ; leaner meat / preferred by humans / better for them / less chance of coronary heart disease ; may interact with other chemicals in the animal / cattle body / side effects / abnormalities / eq ; cost implications elaborated / cost of chemicals ; cost of development / pretesting / trialling ; better profit related to meat sale ; ethics / moral objections ;
10 points

A Profile of the French Education System

EDUCATION IN France is a highly centralized institution. The Ministry of National Education has authority over the content of the curriculum and assessments in primary and secondary schools, leaving the local administrative responsibilities to 28 regional academies (26 in France, two overseas). Consequently, students in all regions of France follow a common core curriculum and are tested on the same knowledge and skills. The common core does, however, allow for some regional variation.

Schooling is compulsory in France between the ages of 6 and 16. Pre-elementary schooling is available to children 2 to 6 years old, and though not required, 35 percent of 2-year-olds, over 97 percent of 3-year-olds, and nearly 100 percent of 4-, 5-, and 6-year-olds attend. Students spend their first five years of compulsory education in primary school (*école primaire*) and the next four in secondary school (*collège*). From *école primaire* through *collège*, all students follow a national core curriculum that prescribes the number of hours per week to be spent on each subject. At the end of their last year of *collège*, students may earn a diploma, the *brevet de collège*, based on their *collège* grades and test scores in three subjects: French, mathematics, and history/geography.

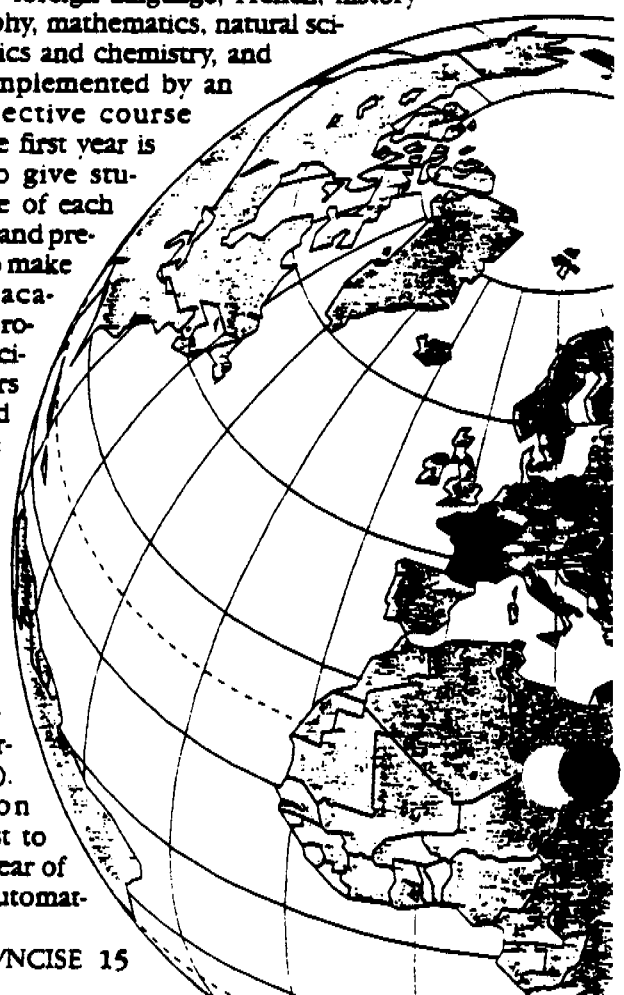
At the completion of the *collège*, students continue in the second cycle of secondary school, the *lycée*. Those who do must decide whether they will enter a three-year stream leading to the *baccalauréat* diploma and higher education, or a two-year vocational/technical stream leading to the *Certificat d'Aptitude Professionelle* (CAP). Although compulsory education ends at age 16, over 85 percent of 17-year-olds and over 55 percent of 18-year-olds study full-time in *lycées*.

The Road to the French Baccalauréat

Students in general or specialized academic *lycées* work toward a special diploma called the *baccalauréat*, which is awarded based on their performance on a set of exams taken during the final or *terminale* year. Since its introduction in the Napoleonic era, the *baccalauréat* has been targeted at the highest-achieving French students, serving as their ticket to higher education and the most prestigious careers. It has earned a strong reputation in France and around the world and has even inspired others to pattern their programs after it, most notably the International Baccalaureate program.

Over the years, some have criticized the *baccalauréat* process for being elitist. The French government has tried to respond to these concerns by expanding the *baccalauréat* curriculum and opening it up to a greater number of students. Before 1950, there were only four different subject areas in which students could specialize during their final years in the *lycée* and only one kind of *baccalauréat* diploma. Only 5 percent of the age cohort typically earned the *baccalauréat* each year. In 1992, 51 percent of the age cohort passed the *baccalauréat*. And it is now offered in 38 subject areas and comes in three different types of diplomas: the general *baccalauréat*, offering a purely academic curriculum for college-bound students; and two vocational diplomas, the technical *baccalauréat*, for students planning to attend two-year vocational programs preparing them for the job market, and the professional *baccalauréat*, for students who will be directly entering the job market. In every case, however, students receive a well-rounded curriculum in terms of the core disciplines, and they are expected to demonstrate mastery—the degree of which may vary—in most of these subject areas.

During the first year of *lycée*, students follow a common curriculum with a strong emphasis on the core disciplines—foreign language, French, history and geography, mathematics, natural sciences, physics and chemistry, and sports—complemented by an array of elective course options. The first year is designed to give students a taste of each subject area and prepare them to make important academic and professional decisions in years two and three. The course load is quite heavy during the first year, and a significant number of students repeat the grade (15 percent in 1992).



Promotion from the first to the second year of *lycée* is not automar-

ic but depends on student achievement and elective course difficulty during the first year. Some students leave school at the end of the first year to enter the work force or begin apprenticeships; and, as mentioned earlier, others repeat the grade. In 1992, 80 percent of *lycée* students moved from the first to the second year.

At the end of the first year, students must choose the focus of their studies during their final two years of *lycée* and, consequently, decide which of the three types of *baccalauréat* diploma they will seek.

To earn their "general" or academic *baccalauréat*, there are eight subject area tracks (usually referred to by their corresponding letter assignments) in which students can focus: (A1) literature and mathematics; (A2) literature and languages; (A3) literature and art; (B) economics and social sciences; (C) mathematics, physics and chemistry; (D) biology, mathematics, physics and chemistry; (D') agriculture; and (E) mathematics and technology. The "C" track is regarded as the most demanding.

Beginning in 1995, the organization of the three types of *baccalauréat* exams will change due to 1993 *lycée* reforms. The general (academic) *baccalauréat* will be reduced to 3 main tracks, referred to by their initials: L (literary, consolidating the former "A" tracks); S (scientific, including the former "C," "D," and "E" tracks); and ES (economic and social sciences, the former "B" track).

The Baccalauréat Exam

At the end of the third and final (*terminale*) year of *lycée*, students take the *baccalauréat* exams in the subject areas required by their particular tracks. (The exception is French, which all students take at the end of year two.) The exams consist of both written and oral sections, with the written tests lasting up to four days and the total testing time averaging up to 25 hours. Students are tested in certain core subjects even if not directly related to their area of focus. While students in all tracks take the same exam in French literature, in almost all other subjects students take exams that differ by track. The scores from these exams are also weighted differently when the overall *baccalauréat* grade is determined. For example, the French exam will count more for those who have chosen literature as an area of concentration than for those who have chosen science.

A student's final *baccalauréat* score is determined by taking the average of the scores for all of the exams after applying the appropriate weights. The grading scale runs from 0-20, with a 20 being a near perfect score. A total score of 10 or above is considered passing, and only students who pass may receive a *baccalauréat* diploma.

The *baccalauréat* process has evolved considerably as a result of the government's desire to make it accessible to a larger, more diverse population. Although passing the *baccalauréat* still earns students the right to enter higher education and remains a requirement for university entrance, the most prestigious and selective universities (*grandes écoles*) and the more popular divisions in other universities (medicine, dentistry, and some science departments) require passage of another exam, the *concours*. This normally requires one or two additional years of intense preparation after the *baccalauréat*. Admission to *grandes écoles* is competitive, and even a strong performance on the *concours* may not ensure admittance. Over 30 percent of 19- to 21-year-olds attend universities, *grandes écoles*, or classes preparing them to enter *grandes écoles*.

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1992 Baccalauréat Exam in Biology (Track C)

from Paris, Amiens, Creteil, Lille, Rouen, Versailles

Time allotted: 3 hours
Students choose either Section I or II

SECTION I

PART A: Organized Recall of Knowledge (10 points total)

Measurements taken from a cell culture during the interphase preceding mitosis have revealed the following:

—a doubling of the quantity of DNA in the nucleus; and

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Document 1

Experiment A

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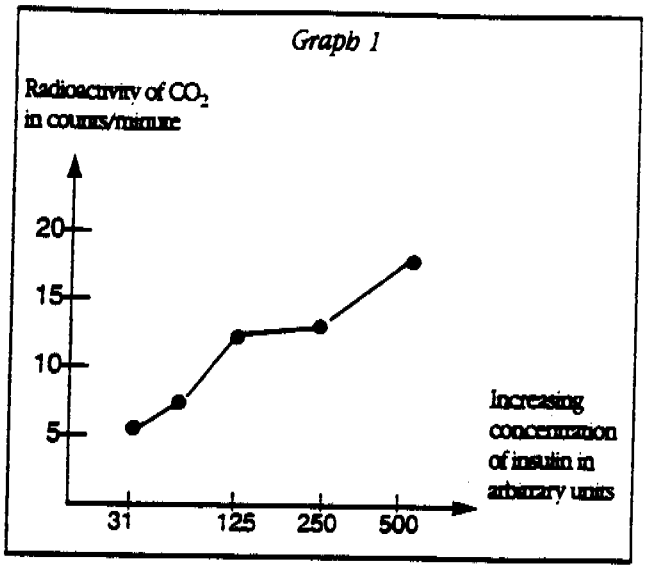
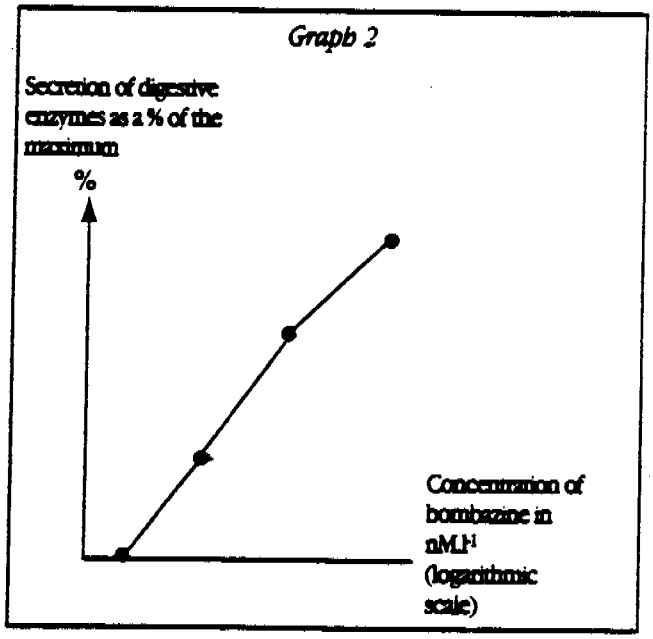


Experiment B

Insulin marked with a radioactive amino acid is injected intravenously in a mouse; we observe that the plasma membranes of the fat cells are radioactive.



Document 2

Experiment C

Pancreatic acinar cells are placed in a culture medium. The rate of secretion of digestive enzymes released by the cells in the medium is measured as a function of the concentration of bombazine added to the culture medium.

Graph 2 illustrates the results obtained.

Experiment D

In the presence of bombazine in a culture medium, an increase in the concentration of Ca^{2+} is observed in

ic but depends on student achievement and elective course difficulty during the first year. Some students leave school at the end of the first year to enter the work force or begin apprenticeships; and, as mentioned earlier, others repeat the grade. In 1992, 80 percent of *lycée* students moved from the first to the second year.

At the end of the first year, students must choose the focus of their studies during their final two years of *lycée* and, consequently, decide which of the three types of *baccalauréat* diploma they will seek.

To earn their "general" or academic *baccalauréat*, there are eight subject area tracks (usually referred to by their corresponding letter assignments) in which students can focus: (A1) literature and mathematics; (A2) literature and languages; (A3) literature and art; (B) economics and social sciences; (C) mathematics, physics and chemistry; (D) biology, mathematics, physics and chemistry; (D') agriculture; and (E) mathematics and technology. The "C" track is regarded as the most demanding.

Beginning in 1995, the organization of the three types of *baccalauréat* exams will change due to 1993 *lycée* reforms. The general (academic) *baccalauréat* will be reduced to 3 main tracks, referred to by their initials: L (literary, consolidating the former "A" tracks); S (scientific, including the former "C," "D," and "E" tracks); and ES (economic and social sciences, the former "B" track).

The Baccalauréat Exam

At the end of the third and final (*terminale*) year of *lycée*, students take the *baccalauréat* exams in the subject areas required by their particular tracks. (The exception is French, which all students take at the end of year two.) The exams consist of both written and oral sections, with the written tests lasting up to four days and the total testing time averaging up to 25 hours. Students are tested in certain core subjects even if not directly related to their area of focus. While students in all tracks take the same exam in French literature, in almost all other subjects students take exams that differ by track. The scores from these exams are also weighted differently when the overall *baccalauréat* grade is determined. For example, the French exam will count more for those who have chosen literature as an area of concentration than for those who have chosen science.

A student's final *baccalauréat* score is determined by taking the average of the scores for all of the exams after applying the appropriate weights. The grading scale runs from 0-20, with a 20 being a near perfect score. A total score of 10 or above is considered passing, and only students who pass may receive a *baccalauréat* diploma.

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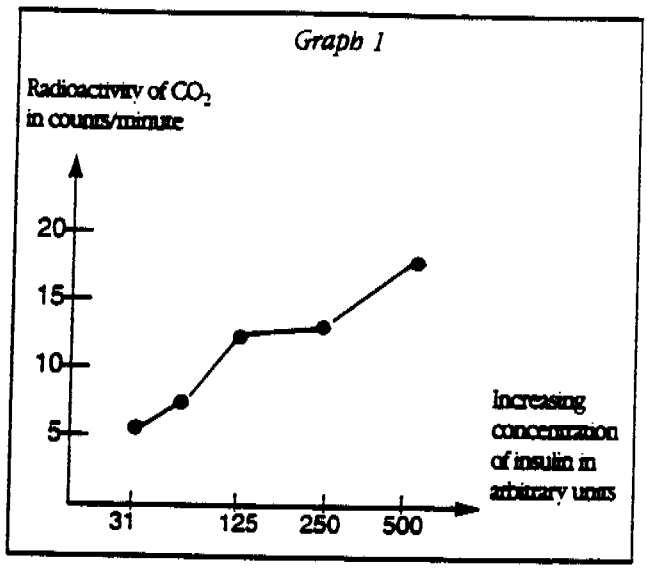

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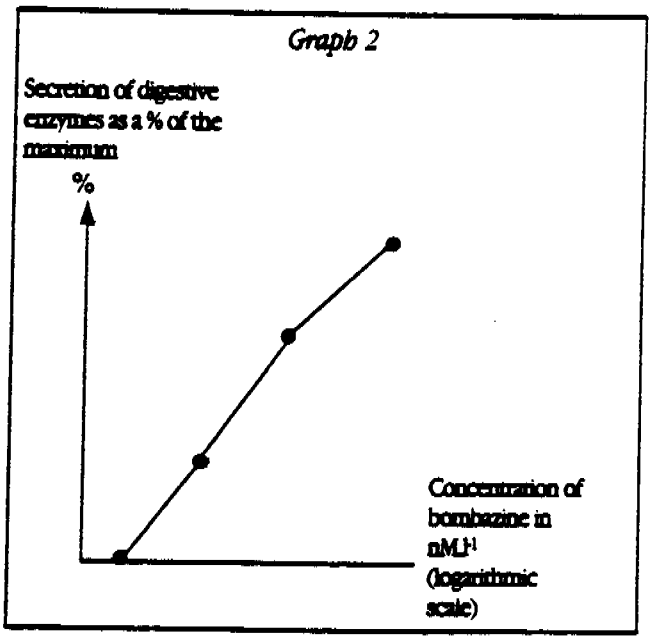


Document 2

Experiment C

Pancreatic acinar cells are placed in a culture medium. The rate of secretion of digestive enzymes released by the cells in the medium is measured as a function of the concentration of bombazine added to the culture medium.

Graph 2 illustrates the results obtained.

Experiment D

In the presence of bombazine in a culture medium, an increase in the concentration of Ca^{2+} is observed in

the cytoplasm of the cells in the culture.

Experiment E

In the absence of bombazine in this culture medium, a release of digestive enzymes by exocytosis is observed when Ca^{2+} is injected into the cytoplasm of an acinar cell. (See Illustration 1)

Illustration 1

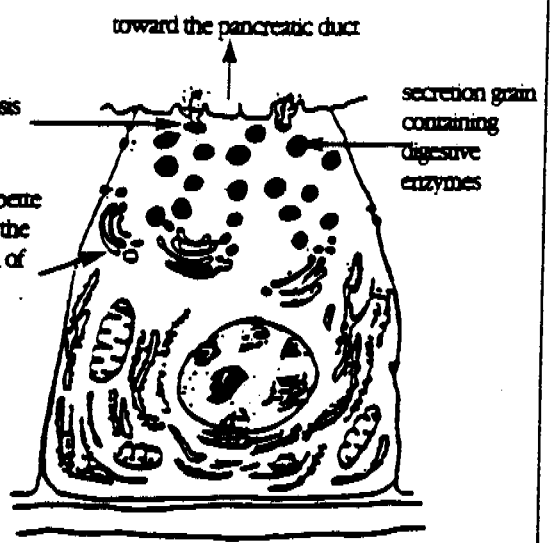


Diagram of an acinar cell in the pancreas observed under an electronic microscope

Question

1. Based on arguments drawn from Documents 1 and 2 show: *(2 points each)*
   a. the effects of insulin on fat cells and the effects of bombazine on acinar cells; and
   b. that these cells are target cells responding to a hormone message that you will define. (Your answer should include an explanation of what a hormone message is.)

Triggering the secretion of insulin.

Insulin is synthesized by the pancreas. Under normal physiological conditions, insulin secretion increases when the concentration of glucose in the blood rises.

Document 3

Experiment F

An islet of Langerhans isolated by microdissection is preserved under conditions ensuring that it will retain its physiological integrity. The penetration of calcium into the ß cells of an islet of Langerhans is measured at 5-minute intervals (Graph 3a), and the secretion of insulin by the same cells is measured every minute (Graph 3b), as a function of the concentration of extracellular glucose.

Experiment G

The injection of Ca^{2+} in the cytoplasm of the ß cells of the islets of Langerhans stimulates exocytosis of insulin, even in the absence of glucose.

Question

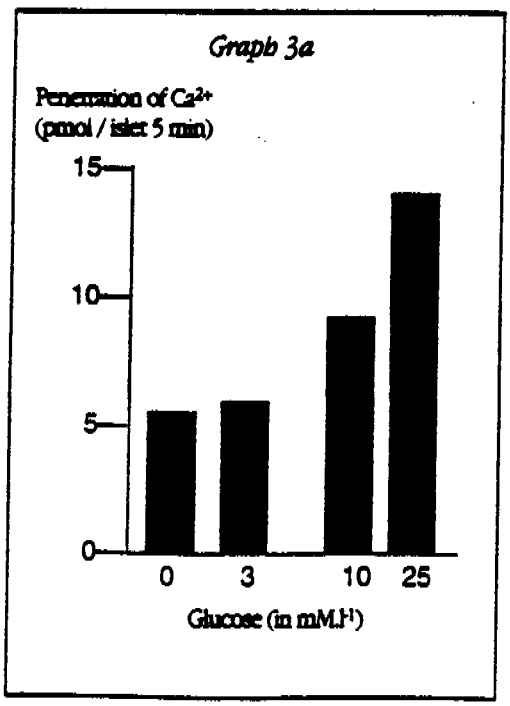
2. What information can you derive from a side-by-side comparison of all the data provided in Document 3 on triggering the secretion of insulin? *(1 point)*

Document 4

It has been shown that the membrane of the ß cells contains calcium ducts that are dependent on the transmembrane voltage; when these open, calcium penetrates the cell.

The difference in the transmembrane potential of ß cells is measured as a function of the concentration of extracellular glucose. (See Table 1)

Graph 3a



Graph 3b

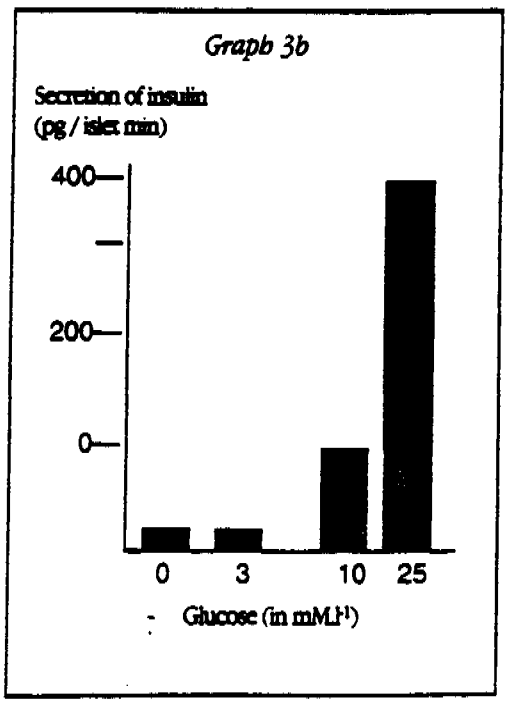


Table 1

Concentration of extracellular glucose in $mM.l^{-1}$	0	3	7	10	25
Difference of transmembrane potential of the ß cell of the islets of Langerhans	-70mV	-70mV	-55mV	Series of slow depolarizations at a rate of up to - 18 mV	Series of fast depolarizations at a rate of up to - 18 mV

Threshold point at which the calcium ducts that are dependent on transmembrane voltage open.

Questions

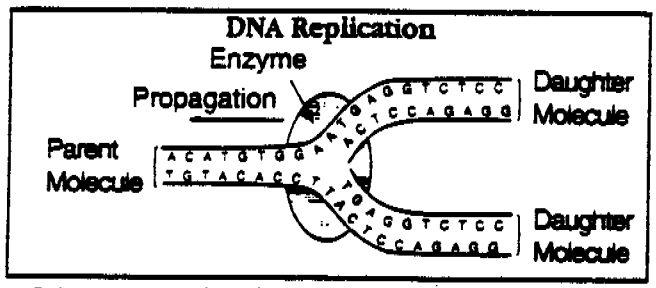
3. What new information does Document 4 provide? *(2 points)*

4. Use all your answers from Part B to draw a functional diagram showing the chronology of events leading to exocytosis of insulin. *(3 points)*

Answer for Section I, Part A

Doubling the Quantity of DNA

Deoxyribonucleic acid is a double-helix molecule: each of its two strands is a chain of nucleotides, units consisting of a phosphoric acid and a C5 sugar, to which an organic base is linked. The two strands are linked by the bases. There are four pairs of complementary species of bases. The pairs formed are A-T (adenine-thymine) and G-C (guanine-cytosine). This molecule is capable of reproducing itself, as shown in the diagram below, in which the DNA is represented only by its base sequences.



It is apparent that the two separated strands serve as a pattern and that the new bases are positioned across from a complementary base (semi-conservative replication). One molecule produces two. Several enzymes act as catalysts in this DNA synthesis.

The base sequence of the initial molecule is preserved in the two daughter molecules, which are replicas of the initial molecule. This continuity is assured because the bases are complementary. Because the sequence of the bases determines the genetic code, the daughter molecules inherit the information contained in the parent molecule.

Increase in Protein Mass

1. Location in the cell

The linking of amino acids to build a protein occurs in the cytoplasm. The sequence of the amino acids is determined by a gene, that is, a segment of a DNA molecule. However, the DNA does not leave the nucleus. All protein synthesis starts with copying the DNA code in the nucleus, or transcription.

2. Transcription: DNA ➡ mRNA

RNA is a single-stranded nucleic acid with the same bases as DNA except for U, uracil, which replaces T.

After a DNA molecule opens, one of its two strands serves as a pattern for building an RNA molecule.

The location of each new base is determined by the complementarity of A-U G-C; therefore the code is preserved. Enzymes are involved in the transcription process.

This RNA is called messenger RNA, because it is exported into the cytoplasm, where it will represent the genetic code and guide the synthesis of a protein.

Preparation for Mitosis

1. Information

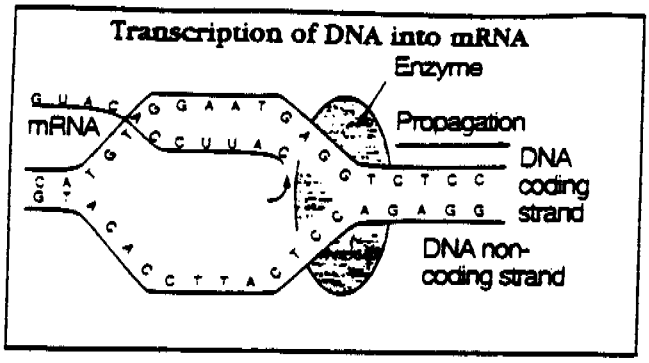
DNA is the main component of chromosomes. Its replication corresponds to the formation of double chromosomes formed by two chromatids. At the very beginning of mitosis, chromosomes have two chromatids, since replication occurs during interphase. The two chromatids of a chromosome contain the same genetic information. At the end of mitosis, they are distributed into the two daughter cells.

2. Protein mass

Protein synthesis enables the cell that is going to divide to have enough material for two cells. Each daughter cell quickly increases its protein mass, starting with the transcription of DNA into messenger RNA in its nucleus.

Conclusion

The interphase nucleus is active and prepares a cell for its next mitosis. The DNA is replicated in it. The transcription of DNA into messenger RNA triggers protein synthesis, which occurs in the cytoplasm. This ensures stability in structure and function from one



generation of cells to the next.

Answers for Section I, Part B

1. a.

■ **Action of insulin on fat cells**

Experiment A: By analyzing the graph, it is apparent that the insulin causes the fat cells to use the marked glucose for respiration (production of CO_2) and for synthesizing lipids (lipogenesis).

Conclusion: Therefore, a hormone changes the function of a target cell.

■ **Action of bombazine on pancreatic acinar cells**

Experiment C: By analyzing the document, it is apparent that, like in A, the bombazine stimulates the pancreatic cell and causes it to secrete its enzymes.

Same conclusion as in A: The hormone alters the function of a cell.

Experiment D: The presence of bombazine allows Ca^{2+} to penetrate the target cell.

Experiment E: This experiment shows that the penetration of Ca^{2+} causes enzymes to be released by exocytosis.

Conclusion: Hormone → penetration of Ca^{2+} → release of enzymes by exocytosis.

b.

Experiment B: The marked insulin has attached to the plasma membranes of the fat cells. Therefore, it has a special affinity for the membrane of the target cells, which denotes the presence of membrane receptors.

Conclusion: The target cells are characterized by their membrane receptors, which are capable of fixing the specific hormone corresponding to them.

■ Definition of the hormone message: this information is provided by the hormone molecule to the target cell: the message is carried throughout the body in the bloodstream and will be used only by competent cells having receptors to which the hormone will attach.

It is the association of hormone and receptor that will trigger changes in the membrane or cytoplasm needed for the target cell response.

2.

Experiment F:

■ The presence of glucose stimulates the penetration of Ca^{2+} into the β cells (Graph 3a).

■ The secretion of insulin increases with the concentration of glucose (Graph 3b).

Experiment G: The release of insulin is stimulated by the penetration of Ca^{2+} alone.

Conclusion: The increase in glycemia triggers the release of insulin by causing the calcium ions to penetrate the β cell.

This diagram is therefore similar to that of question 1.

hyperglycemia → penetration of Ca^{2+} → secretion of insulin (by exocytosis)

3. *Interpretation of Document 4:* By measuring the potential difference as a function of the concentration of extracellular glucose, the following is apparent:

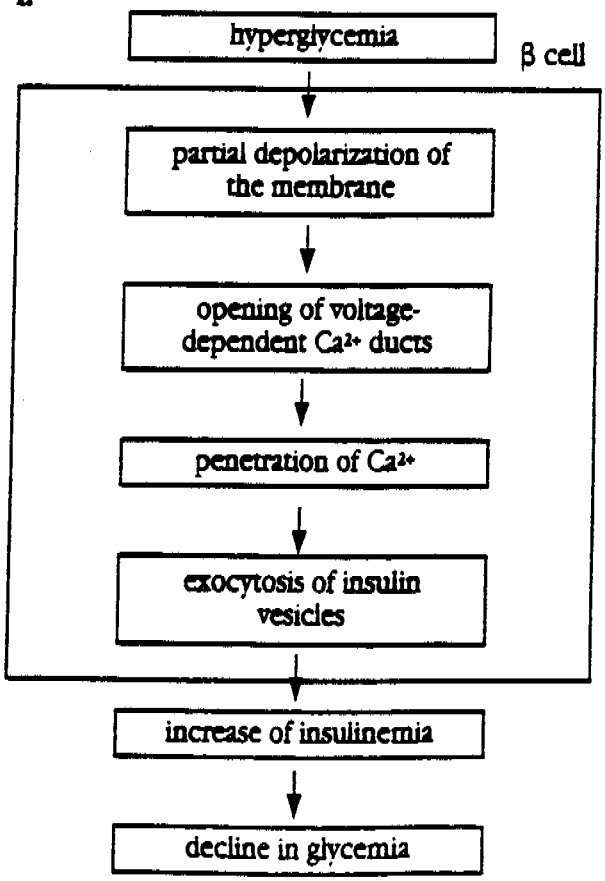
■ an increase in the glucose concentration causes depolarization, which is initially constant until it reaches a certain threshold;

■ from the concentration threshold, or from 7 to 10 mMl^{-1} inclusive, depolarization becomes rhythmic; and

■ beyond that threshold, the voltage-dependent calcium ducts begin to open.

Conclusion: The Ca^{2+} ducts open after partial depolarization of the membrane, which is related to hyperglycemia.

4.



A Profile of the German Education System

In Germany, as in the United States, local control of education is an important tradition. Schooling is primarily the responsibility of each of the 16 German states, or *Länder*, with the national government playing a coordinating role. There is, however, a certain degree of uniformity across the *Länder*, with common policies achieved by consensus in the Standing Committee of the Ministers of Education (*Kultusministerkonferenz*), a body composed of the education ministers from each of the *Länder*.

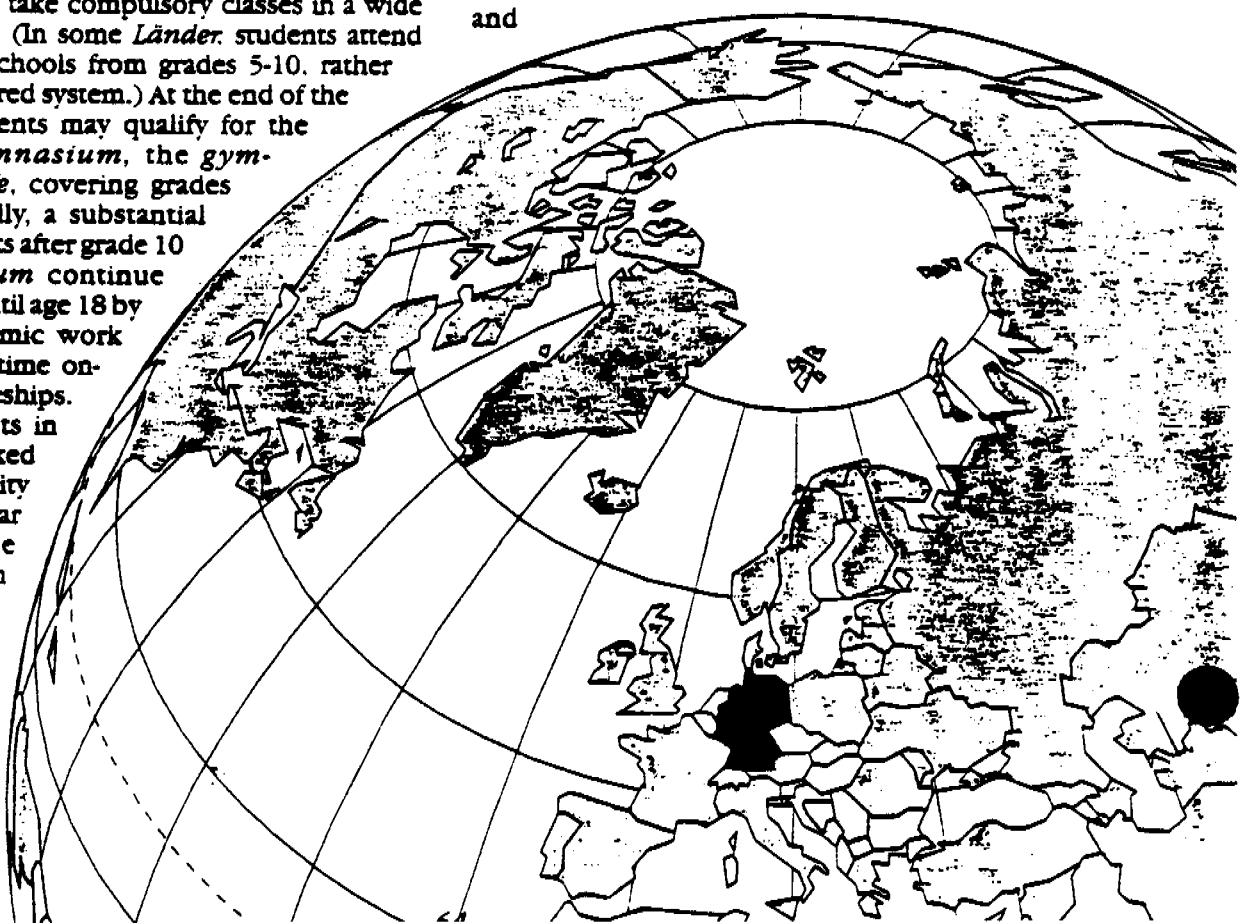
Compulsory schooling usually lasts nine or 10 years in Germany, beginning at age six. Children attend *grundschule*, or primary school, for four years (six years in two *Länder*), after which they move into one of three secondary tracks: (1) the *hauptschule*, the most basic level, lasting through the ninth year of schooling and preparing students to enter employment and receive additional training; (2) the *realschule*, a more advanced level that extends through the 10th year of schooling and prepares students primarily for middle-level, nonprofessional careers (while also allowing access to upper secondary education and university entrance); and (3) the *gymnasium*, the most academically rigorous secondary school path aimed at those students interested in attending a university. In grades 5-10 of the *gymnasium*, students take compulsory classes in a wide range of subjects. (In some *Länder*, students attend comprehensive schools from grades 5-10, rather than this three-tiered system.) At the end of the 10th grade, students may qualify for the upper-level *gymnasium*, the *gymnasiale oberstufe*, covering grades 11-13. Additionally, a substantial number of students after grade 10 of the *gymnasium* continue their education until age 18 by combining academic work with full- or part-time on-the-job apprenticeships.

Usually, students in Germany are tracked or grouped by ability after the fourth year of schooling (age 10). Exactly which secondary school path students take is determined by their performance in the *grundschule*. Recommendations are made by teachers (and other school personnel), and final decisions are made in consultation with parents, who ultimately decide. In 1990-91, approximately 33 percent of German students were in *hauptschule*, 28 percent in *realschule*, 31 percent in *gymnasium*, and 8 percent in comprehensive schools.

Grade-level retention does occur in secondary schools, but students in the *realschule* and *gymnasium* are not allowed to be held back more than twice. If such a situation arises, the student is transferred to a track below (i.e., from *gymnasium* to *realschule* or from *realschule* to *hauptschule*). Access to an upper-track school from one below is possible, but not very common. The most common upward move is when students who have completed the *realschule* move into the upper level *gymnasium* to prepare for university study. The transfer figures vary between *Länder* from 2 percent to 16 percent of students.

Standards for University Entrance: The Abitur

While there is no single set of national standards in Germany, there is a process for college qualification and an earned certificate called the *Abitur*, whose structure and



characteristics are quite consistent across the *Länder*.

During the 11th through 13th years of *gymnasium* (the upper level), students receive compulsory instruction in core subject areas with elective course options available as well. Each subject is taught at both a basic and an advanced level, the latter involving more rigorous content and more time for instruction. Students begin the process of working toward the *Abitur* at the beginning of the 12th year. Over those next two years, students must take a total of 28 courses, 22 at the basic level and six at the advanced level. Students must also choose four subjects in which they will eventually take the *Abitur* exam. At least one subject must be chosen from each of the following three fields of knowledge: (1) language, literature, and the arts; (2) social sciences; and (3) mathematics, sciences, and technology. At least two of the subjects chosen must be taken at the advanced course level.

Students usually take the *Abitur* exam at the end of their final *gymnasium* year. Three exams are written, and the fourth is oral. Exams in some subjects, such as art and music, may involve performance demonstrations. When a discrepancy exists between a student's course grades and exam scores, additional oral exams can be given.

The *Abitur* certificate is awarded based on a combination of students' grades over their final two years of coursework and their scores on the exams. Out of 840 total possible points, 540 are reflective of coursework (330 from the 22 basic courses, 210 from the six advanced), 300 of the exams. A total score of 280 is considered passing.

In 1991, 37 percent of the age cohort took the *Abitur*. More than 95 percent of these candidates passed. Typically, 85 percent of those who pass enroll in a university within two years (the remaining 15 percent are expected to enroll within a few more years).

At one time, passing the *Abitur* was enough to guarantee everyone a place in a university studying the subjects of his or her choice. Due in part to an increasing number of *gymnasia*, however, the number of students gaining an *Abitur* in Germany has increased beyond the capacity of the university system (from 1960 to 1986 the figure grew from 57,000 to 300,000). A passing mark on the Abitur still is required for university entrance, but it no longer guarantees students a choice of disciplines. Scores on the *Abitur* are now very important, and entrance into the more popular disciplines, such as medicine, is restricted by quota and often requires additional testing and interviews. In many cases, lengthy waiting lists exist.

How Is the Abitur Exam Developed and Graded?

The specific content of the *Abitur* exams and the syllabi for the courses leading up to the exams are determined by each individual *Land*. The education ministries in each of the *Länder* are responsible for defining the course content for each subject. But they must remain within a set of guidelines developed at the national level by the *Kultusministerkonferenz*, which determines issues such as eligibility to receive the *Abitur* and the number and distribution of subjects in which students must be examined. Though curricular differences exist across *Länder*, the national guidelines effectively maintain a high degree of uniformity.

In a great majority of *Länder*, teachers are responsible for developing the *Abitur* exams that will be given to their students. It is an accepted, indeed welcomed, responsibility of the job. At the beginning of each school year, teachers create a list of possible exam questions relating to their particular subjects and send them together as a school to the state education ministry (or to a regional "school inspectorate" in the larger *Länder*). Each question is evaluated based on a variety of criteria and either approved or returned to the teacher for improvement.

Teachers give the exams to their students, and they are also responsible for grading them in most *Länder*. In fact, part of their preservice training deals with creating and grading *Abitur* exams. Most *Länder* have a system in place for cross-checking teacher grading, but the system clearly requires a significant amount of trust to be vested in teachers.

In at least six *Länder*, the *Abitur* exams are created and graded at the state ministry level. Students in each of these *Länder* take the exact same exam in each subject. The exam reproduced in this volume is from Baden-Württemberg, one of these six *Länder*.

Reprinted in This Report

What College-Bound Students Abroad Are Expected To Know About Biology contains the entire 1992 Advanced level *Abitur* in Biology from Baden-Württemberg. Fifteen percent of *Abitur* candidates in Baden-Württemburg took this biology exam in 1992, and aproximately 96 percent passed. The exam is four and one-half hours long and consists of six sections. We have reprinted two of those sections here, along with sample answers for most questions in those sections. (The symbol Ⓐ next to a question indicates that a sample answer for that question is provided at the end of the questions section. As is the case with the *baccalauréat*, these are answers prepared by a publishing company that reprinted the exam materials and sold them to students as a study guide.)

Remember, *Abitur* candidates take four exams, and at least two of the four must be at the advanced level. In addition, to ensure that all students reach proficiency in a broad range of subjects, one of the four exams must be taken in each of the following three fields of knowledge: (1) language, literature, and the arts; (2) social sciences; (3) mathematics, sciences, and technology.

1992 Abitur Exam in Biology

from Baden-Württemberg

PART II: Immunobiology

Lyme disease (*Borreliosis*) is caused by a bacterial infection. The pathogenic organism (*Borrelia burgdorferi*) is transmitted by blood-sucking ticks. The following illustration shows the antibody concentration in the blood of a person after a first infection by *Borrelia burgdorferi*.

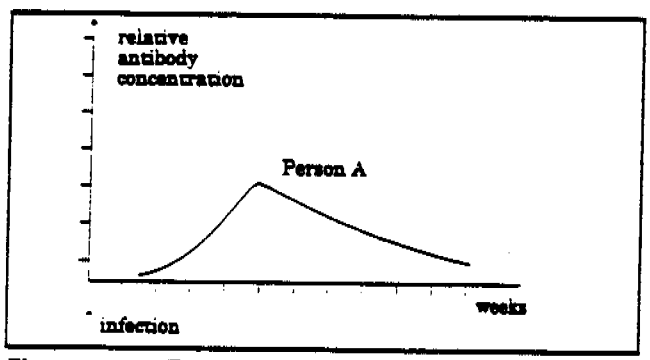


Illustration 1: Time progression of the antibody concentration after a first infection

1. Describe, with respect to the curve in Illustration 1, the development of antibodies after an infection. (A)

2. a. Describe the course of an immune reaction of another person (Person B) after a second infection and compare to that of Person A. (A)
   b. Redraw Illustration 1 on your answer sheet, and draw the curve for the antibody concentration to be expected for Person B. (A)

3. How could the antibody concentration in a patient's blood be determined? Describe a possible method. (A)

4. Make a schematic drawing of the structure of an antibody. Label the various parts. (A)

5. Another disease transmitted by ticks is early-summer meningoencephalitis (ESME). The cause is a virus. Active and passive immunization is possible against this disease.

   Explain the difference between active and passive immunization. In which case is the former used? In which case is the latter used? (A)

6. A severe case of *Borreliosis* can lead to nerve cell damage because of loss of myelin (demyelinization).
   a. Draw and label a motor nerve cell. (Size approximately one-half page)
   b. Explain which possible neurophysiological consequences may result from the demyelinization of a motor nerve cell. State your reasons.

PART III: GENETICS

Hereditary deafness can be caused either by anomalies in the inner ear (Family A) or by the degeneration of the auditory nerve (Family B). Deaf people have intimate social contacts among themselves and frequently marry. Illustration 1 shows the family trees of two families in which types of deafness appear.

1. a. Decide whether this handicap in Family A and Family B is dominant or recessive, and whether it will be inherited autosomally or gonosomally. Explain with the aid of Illustration 1. Give the genotypes of persons 1 through 6.

   b. Explain why person 7 and 8 are phenotypically healthy. Give their genotypes.

Questions 2-3

For about 20 years it has been possible, through amniocentesis (aspiration of amniotic fluid), to determine certain inherited ailments in the embryo. To do this, it is necessary to construct a karyogram.

2. a. What does a karyogram represent and what information can it give? (A)

   b. Why can't the deafness be diagnosed even with a karyogram? (A)

3. What inherited human ailments can be recognized with the help of a karyogram? Give three examples and state the corresponding changes in the karyogram. (A)

Questions 4-5

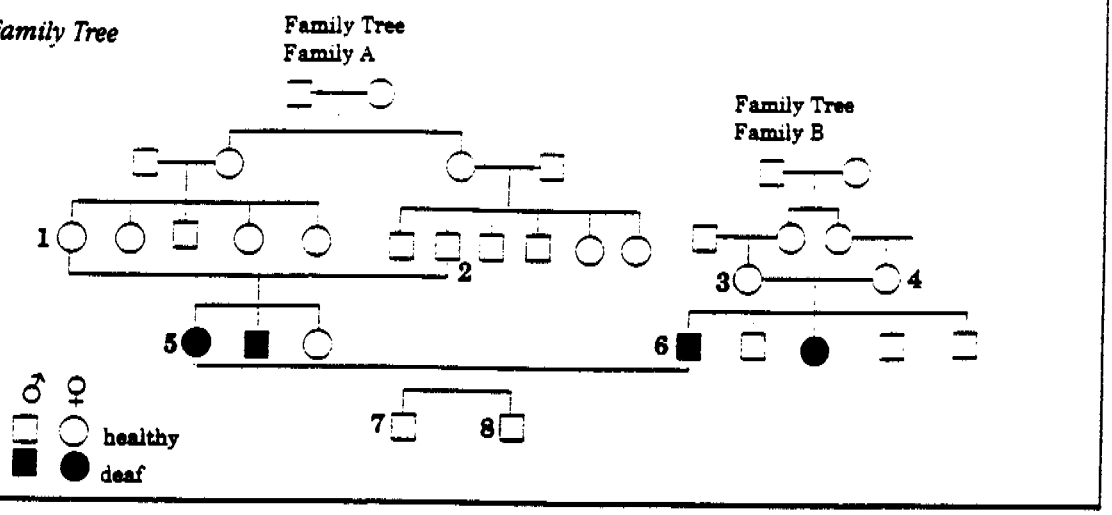
In 1908 HARDY and WEINBERG, independently of one another, formulated an important law of population genetics.

4. a. Explain what is meant by "population" in population genetics. (A)

b. Formulate the HARDY-WEINBERG law and explain what it states. Under what conditions is the HARDY-WEINBERG law valid? Ⓐ

5. A certain recessive hereditary trait appears in 16% of a population. How high is the percentage share of the carriers of the recessive allele? Ⓐ

Illustration 1: Family Tree



Sample Answers for the 1992 Abitur Examination in Biology

PART II: Immunobiology

1. In a bacterial infection, it is possible for either exotoxins produced by non-invasive bacteria or the bacteria themselves to enter the body. In either case, the immune response is activated by antibodies. In the first case, the immune system neutralizes the toxins produced by the bacteria with the help of antibodies. In the second case, the antibodies are aimed against the bacteria's surface molecules. The anti-phagocytic properties of the bacterial membrane are neutralized by the antibodies.

The increase of the relative antibody concentration and the consequent drop in the curve may be explained as follows:

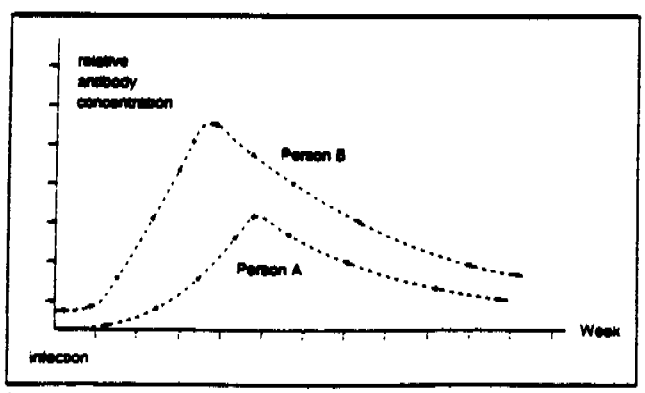
Week 1: After the infection, the number of antibodies is still normal. During this time the bacteria multiply (incubation phase). The recognition phase is in progress. The antigens encounter several T-lymphocytes, which are thereby activated and stimulated to divide. In this phase more T-helper cells are produced. These, in turn, cause the division of aforementioned B-lymphocytes which can form antibodies for the same antigen.

Week 2-5: During this time the differentiation phase takes place. The B-lymphocytes multiply extensively and are differentiated largely into plasma cells. Some of these become memory cells. The number of antibodies has now reached a maximum. Now begins the antigen-antibody reaction: the effector phase takes place.

From Week 5: The switch-off phase has begun. If no more antigen is present, no more antibodies are produced. The cessation of antibody production is effected by the T-suppressor cells. The reaction between antigens and antibodies causes the numbers of both to diminish.

2. a. After a second infection, the course of the immune reaction will be considerably faster in Person B than in Person A. The reason for this is that in Person B memory cells are still present from a similar, but earlier, infection. These are present for years (perhaps even for a lifetime) against a specific infection. If, during the course of a second infection, antibodies meet similar antigens, they are thereby activated and multiply quickly.

b.



Antibody concentration in the blood of A and B

3. To a defined volume of a patient's blood serum, an increasing amount of antigen is added. The result is an antigen-antibody reaction and, thus, a precipitation reaction. At very low levels of antibody mass, the test tubes remain in a refrigerator for a few days in order to obtain maximal precipitation. The precipi-

tates are then centrifuged off. Next, a method of quantitative determination is used. Since antibodies are proteins they could, for example, be hydrolytically split. The products of hydrolysis (amino acids) can be made to react with ninhydrin. The tinted liquid is examined photometrically. Similarly, this is done with a known amount of antigen as a reference substance.

4. The sketch should show the following structures: the constant and variable regions, the heavy and light chains, the point of contact of the antigens, and possibly the disulfide bridges.

5. Active immunization: Active immunization is based on the realization that human beings (as is the case among the higher vertebrates) who have recovered from certain illnesses are immune to them. Active immunization ensues through appropriate immunizing substances which are characterized by the fact that the infectious agent, while retaining fully its antigen structure, has been so modified that it is no longer capable of causing the corresponding disease. This may be done by using minimal doses of a preparation of the infectious agent or by modifying such a preparation chemically, by killing the pathogens, or by using living but weakened pathogens. Then the body has an immune reaction, forming antibodies. Since memory cells are formed at the same time, an active immunization acts preventively for a long time (often for years). This method is used when a certain illness has not yet been contracted (preventive immunization).

Passive immunization: Specific antibodies which are targeted at antigens which cause certain infectious diseases are administered. In contrast to active immunization, passive immunization is used only when contact with the antigen in question has already occurred (i.e., there is a high probability of its presence). By means of the administered antibodies, the organism is aided in its defense until enough of its own antibodies have been created. The antibodies themselves were obtained through actively immunizing a mammal (i.e., horse, cattle, sheep). Passive immunizations are effective for a few weeks only.

Part III: Genetics

2. a. In a karyogram the chromosomes of the metaphase stage are arranged according to their size and the position of the centromere. From a karyogram one obtains indications as to sex, as well as to those inherited ailments that have their cause in chromosome or genome mutations.

   b. In the case of deafness it is a matter of a gene mutation (point mutation). These types of mutation cannot be determined with the aid of a karyogram.

3. The following hereditary diseases could be recognized by means of a karyogram:

DOWNS syndrome:	2n + (Trisomy 21)
TURNER syndrome:	X0
KLINEFELTER syndrome:	XXY

4. a. A population means the totality of the individuals of a type of organism within a certain space and which, over several generations, is genetically connected. Therefore it encompasses same-species individuals of a region who may pair without restrictions.

   b. The HARDY-WEINBERG law states that in a so-called ideal population the relative frequency with which certain alleles are present in the gene pool remains unchanged over the generations. The allele frequencies can be calculated over as many generations as one likes. The prerequisite for these observations is an ideal population. In such a population, individuals pair at random. The individual genotypes are suited equally well to a constant environment and neither mutations nor selections appear. A genetic balance between the individual genotypes comes about, uninfluenced by how many individual alleles there were originally. If in such an ideal population a dominant allele A with a frequency p and corresponding recessive allele a with a frequency q appears, then, according to the law of population genetic balance, the individual genotypes AA, Aa and aa appear in the following relative frequency:

$$(p + q)^2 = p^2 + 2pq + q^2$$

or expressed differently since $p + q = 1$:

$$[p + (1-p)]^2 = p^2 + 2p(1-p) + (1-p)^2$$

5. There is the recessive allele: a and thus

$$a \cdot a = q^2$$

Let the dominant allele be A and thus $A \cdot A = p^2$

From the given pieces one obtains:

$$q^2 = 0.16 \text{ and } q = 0.4$$

Since $p + q = 1$, one obtains $p = 0.6$

Heterozygous carriers of a:

$$2pq = 2 \cdot 0.4 \cdot 0.6 = 0.48$$

For the carriers of the recessive gene one then obtains:

0.16 homozygote + 0.48 heterozygote= 0.64

Result: 64% of this population carry the recessive gene.

How Do These Countries Compare?

PERHAPS THE most striking finding from our research has nothing to do with which country's exams are hardest, but rather with how many youngsters take them.

Every country but the United States manages to bring a significant number of students up to the level of performance demanded by the exams in this volume. As illustrated in the accompanying graph, approximately one-third to one-half of the age cohort in England and Wales, France, Germany, and Japan take advanced subject-specific exams like the ones shown in this volume (though not necessarily in biology). In sharp contrast, only 7 percent of U.S. 18-year-olds take one or more AP exams.

Some like to downplay the high standards reached by students in other countries by labeling those systems as elitist. But this claim is difficult to justify in light of the numbers. As the graph shows, from one-quarter to over one-third of the age cohort in every country but the United States is able to meet the high standards reflected in these exams. Only the AP is reached by an elite number. (It is important to note, however, that the AP exams are offered in fewer than half of the high schools in the United States and—unlike the other examinations in this book—they are not required for university entrance.)

How do these countries prepare so many students to take these exams? Is there anything we in the United States can learn from these countries? Indeed, there are some basic ingredients in their education systems that differ from practices in the United States and that warrant further discussion.

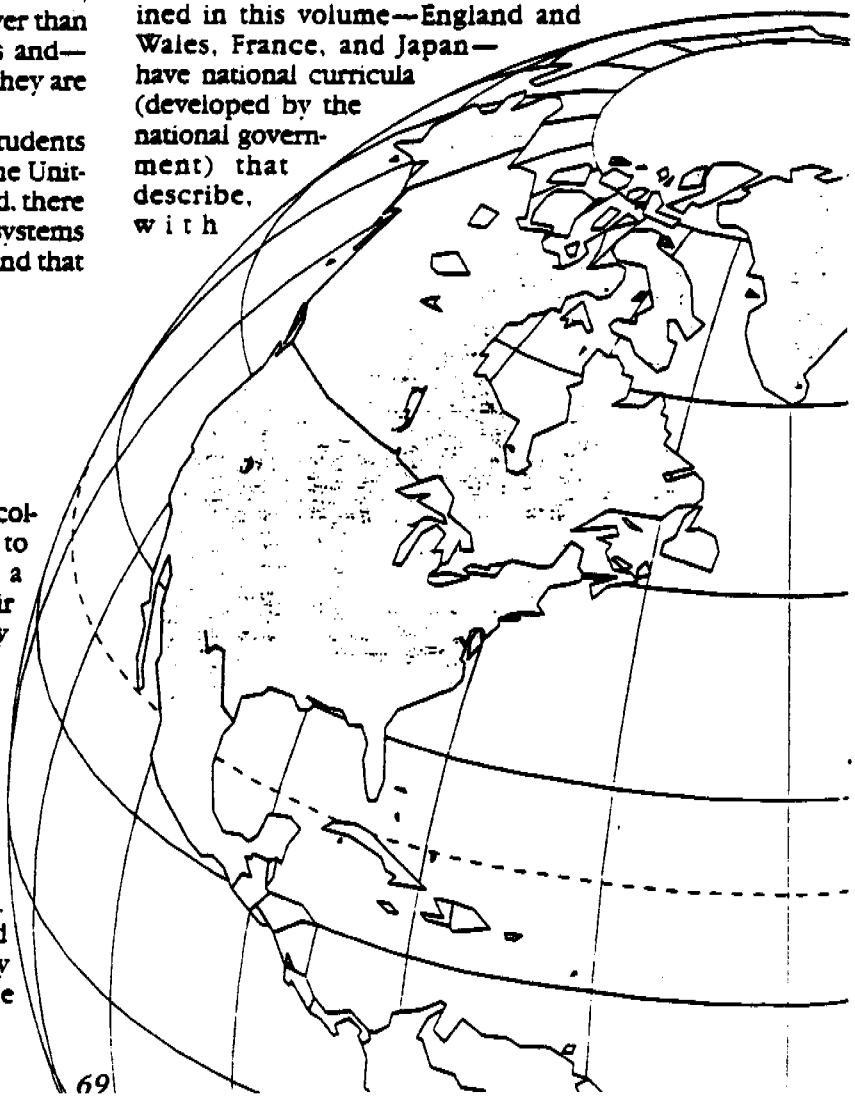
National Coordination of Curricula, Assessments, and Incentives

In each country except the United States, college-bound students know that if they want to study in a university they will have to pass a demanding set of exams. Furthermore, their course of study in secondary school is strongly tied to these exams. This reality serves as a powerful incentive for students to work hard and take school seriously. It also gives them, their parents, and their teachers something tangible to aim for.

In the United States, by contrast, a high school diploma is normally conferred based on taking a certain number of courses, not on reaching a particular standard of achievement. Although a few states, including New York and California, administer voluntary exams that may influence university admission and are tied to the curriculum covered in high school, there are no exams that all students nationwide must pass in order to be eligible for university study. Admission standards vary from institution to institution to the extent that some open-enrollment colleges and universities permit almost any student to attend. Unless students are among the few who plan on applying to highly selective institutions, there are no external incentives encouraging them to work hard and do well in difficult courses. This is markedly different from the incentives their European and Japanese counterparts face.

Central to each of these successful foreign systems is a clear relationship between the curricula and the exams. If schools are to prepare students to do well on a set of high-stakes exams, these exams must test what is covered in the curriculum. This is also essential to a meaningful incentive system for students. Students who see a link between what they are learning each day in school and the exams they will eventually need to take are likely to be motivated to concentrate on their schoolwork.

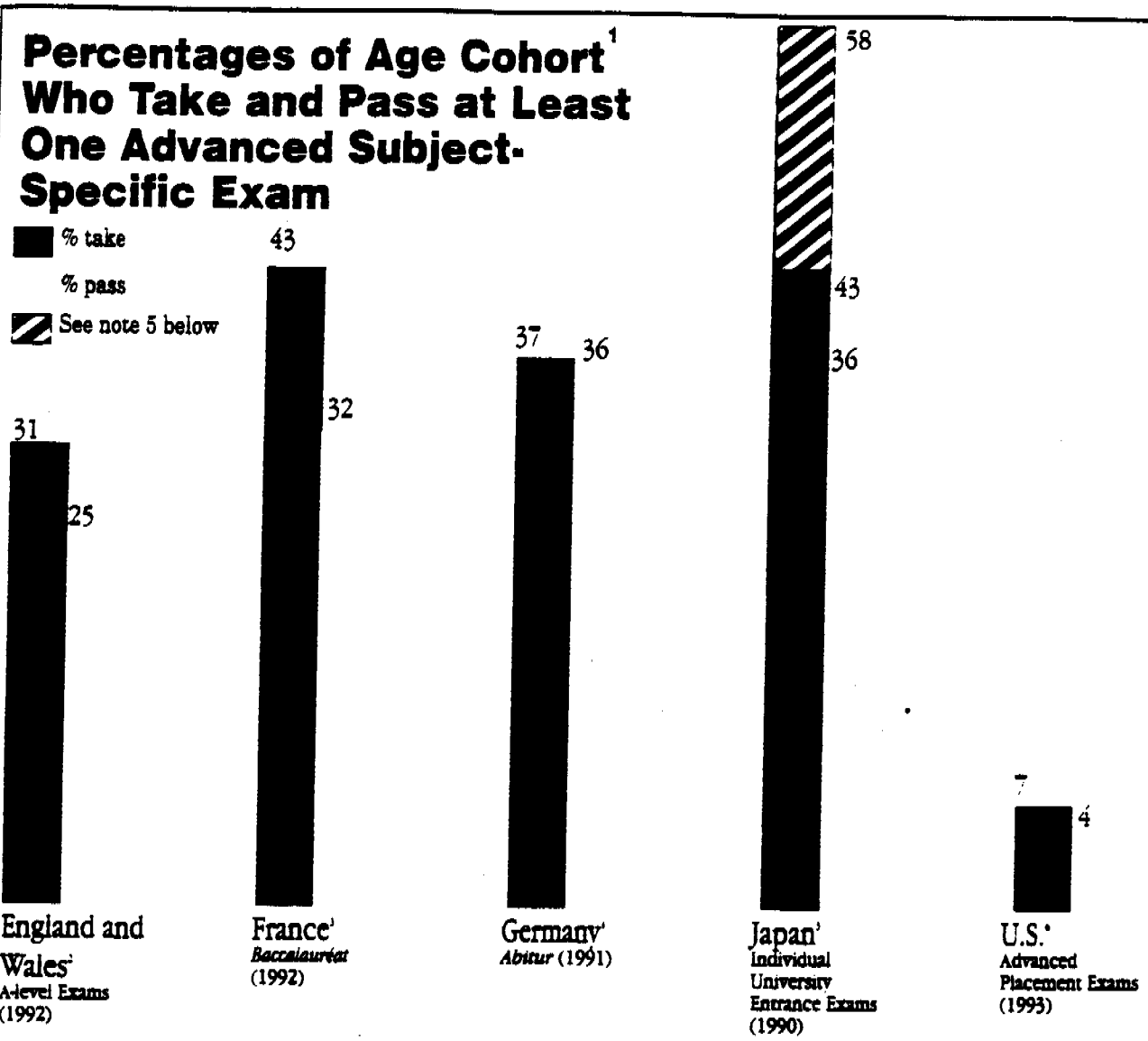
Three of the four foreign countries examined in this volume—England and Wales, France, and Japan—have national curricula (developed by the national government) that describe, with



varying degrees of specificity, the subject matter that students should be exposed to during their elementary and secondary years. In each of these countries, the key assessments taken by students throughout their educational careers—including the exams featured in this book—are tied to the curriculum.

Although there is no national curriculum in Germany, and each *Land* (or state) exercises authority over education within its boundaries, the link between what is taught and what is tested is strong. In the case of the *Abitur*, it is the teachers themselves who are responsible for coming up with the questions for the exams in most *Länder*. However, in doing so they are expected to follow guidelines set at the state

Percentages of Age Cohort[1] Who Take and Pass at Least One Advanced Subject-Specific Exam



[1] The age cohort for England and Wales, France, and the United States is approximately 18-years-olds, the age at which most students in these countries complete secondary school. For Japan, the age cohort is approximately 18- to 21-year-olds (see Note 5 below). For Germany, the age cohort is all 18- to 21-year-olds; the range is due to more frequent grade retention and the fact that the *Abitur* is taken at the end of what would be a 13th grade in the other countries.

[2] A-level candidates generally take three subject-specific exams. Approximately 15 percent of the age cohort earned three or more passes, 6 percent earned two passes, and 4 percent earned one pass. (Source: Associated Examining Board)

[3] *Baccalauréat* candidates generally take subject-specific exams in six or more subjects, depending on the track chosen. Percentages shown represent the proportion of the age cohort who tried for and received one of the general (academic) *baccalauréats*. Overall, 51 percent of the age cohort earned either an academic or vocational *baccalauréat*. (Source: Embassy of France)

[4] *Abitur* candidates take four subject-specific exams, at least two of which must be at an especially advanced level. (Source: Embassy of the Federal Republic of Germany)

[5] Since Japanese students must take subject-specific exams in order to apply to universities, and pass these exams in order to gain admission, the figures in this chart represent the number of Japanese applying to and enrolling in universities in 1990. It is common for university applicants who fail the entrance exams to retake them in subsequent years. It is also common for some university applicants to delay applying to universities for the first time for one or more years. For these reasons, the age cohort used for Japan includes individuals over the age of 18. The reason for the range shown here is that approximately one-quarter of applicants in 1990 had graduated from high school in earlier years, but it is not clear how many of them had previously applied to college, and thus had taken the exams already. The 43 percent figure assumes that *all* applicants who had graduated in years prior to 1990 had previously applied to universities. The 58 percent figure assumes that *no* applicants who had graduated in years prior to 1990 had previously applied. We estimate the actual percentage of first-time applicants in 1990 to be between 45 percent and 50 percent of the age cohort. (Source: "The University Exams in Japan" by Tae Ryu)

[6] (Sources: Advanced Placement Program and U.S. Department of Education publications)

and national levels by various governmental bodies. This arrangement serves both to maintain some comparability of curricula and exams across the country and to ensure that exams of such importance are firmly rooted in the curriculum taught by the teacher. It is also testimony to the significant trust and responsibility vested in German teachers.

In contrast, the two exams that most commonly serve as a gateway to college in the United States, the SAT and ACT, are not based on the curriculum students study in school. The AP exams are based on AP curricula, but those courses only last for a limited time, usually one year. Also, the courses are not required as a prerequisite for taking the AP exams.

National Leadership and Local Autonomy

There are concerns in these foreign countries, as in the United States, about the extent to which national leadership with respect to educational standards and exams impinges upon local autonomy. Each country addresses the issue in a different way. But in every one of these countries, the national government plays some role in establishing or coordinating the establishment of a publicly known, rigorous standard of achievement. In three countries highlighted in this book—England and Wales, France, and Germany—before students can be admitted to universities, they are required to pass certain exams that ministerial authorities ensure are pegged to a comparable standard. Yet none of these countries has a single national test that all college-bound students must take.

In England and Wales, France, and Germany, students in various parts of each country take exams that different governmental or government-monitored organizations develop according to a national specification. Hence, for these countries, the "national" exam is actually a set of comparable exams used by different regions.

In Japan, each university exercises its autonomy by developing its own set of entrance exams, though the content of these exams reflects the national curriculum. Japan does have a set of national exams—the UECE, produced by university faculty on behalf of the Ministry of Education, Science and Culture—that college-bound students may take, but only a portion of the universities require students to take these exams. Only the universities' individual entrance exams are required of all students aspiring to higher education.

Narrowly Defined Versus Broad-Based Curricula for College-Bound Students

The caliber of these foreign exams and the corresponding pass rates may lead one to wonder whether students in these countries are becoming proficient in some subjects at the expense of others. Are students who spend their time studying for these biology exams neglecting other important subject areas?

In England and Wales, France, and Japan, the national curricula ensure that all students are exposed to challenging courses in core subject areas such as language/literature, math, science, and history. In Japan, the national curriculum applies to students all the way through high school. In England and Wales and in France, college-bound students begin to specialize and narrow their focus upon entering the upper level of secondary schooling. French students choose among 38 different *baccalauréat* tracks, each with its own set of courses and exams, usually numbering between seven and 10. Students in all tracks, however, take courses and exams in some or all of the core subjects previously mentioned. In England and Wales, those studying for their A-levels normally limit their studies to three subject areas in which they have chosen to be examined. Universities and departments within universities have varied criteria on the number and subjects of exams that must be passed by applicants.

In Germany, all *gymnasium* students are required to take certain core courses all the way through secondary school, including their final two years as they study for the *Abitur* exams. Students eventually choose four subjects in which to take the exams, but they are required to take at least one in each of three major curricular areas: language, literature, and the arts; social sciences; and math, science, and technology. Course grades as well as the exams are factored into each student's final *Abitur* score.

College-bound students in the United States are not required to take any advanced subject-specific exams. The most common requirement of college-bound students is that they have obtained a minimal number of course credits—or Carnegie units—though this is not necessarily a reliable indicator of their academic performance. Those who take AP exams may do so in any subject in which the exams are offered, but there are no government or university requirements in terms of subject areas or numbers of exams to be taken.

Which Country's Exams Are the Most Rigorous?

Comparing exams at this level is not an easy task. As part of a separate project being undertaken by the National Center for Improving Science Education, an international team of experts has been assembled to make comparisons of these and other exams. (The full report from that effort will be released in late 1994.)

While we cannot draw any final conclusions about which exams are the most rigorous, we can provide readers with a framework for making their own comparisons. A variety of factors contribute to the rigor of an exam. Some have to do with characteristics of the exams themselves, others with elements of the examination systems that affect either the exams or the students taking them. Following is a discussion of some of the more significant factors one should consider when making judgments about rigor.

■ **Exam Length**—The exams in this book differ significantly in length. The Tokyo University entrance

exam in biology is two and one-half hours long, whereas students in England and Wales are expected to spend up to nine hours on the A-level. A longer exam does not necessarily translate into a more rigorous exam, though it does require students to demonstrate their command over a substantially wider or deeper range of material. The more important issue, however, is how much material students are expected to work through—and at what level of complexity—during a given amount of time. For example, are Japanese students expected to cover more material at a more complex level in the two and one-half hours than their counterparts in England and Wales during the same amount of time? If so, that is more meaningful than the difference in length alone.

There is a further implication of exam length that is also worth considering, though it is not as relevant to the discussion of rigor. Many readers will be impressed when they learn that students in England and Wales are expected to spend nine hours on an exam, and rightly so. It is rare that we ask the same of students in this country. The fact is, longer exams, such as the A-level, require students to display higher levels of discipline and fortitude.

■ **Question Type**—There are a variety of different types of questions used in the five exams in this volume, including multiple choice, short answer, essay and even an example of a performance-based exercise. The European exams only employ open-ended questions. These require responses varying from short answers (words, phrases, a sentence or a few sentences) to extended essays (a paragraph or multiple paragraphs). The U.S. and Japanese tests are the only ones to use multiple choice questions. In fact, 60 percent of the AP biology score is compiled from multiple choice questions.

To what extent does question type reflect on rigor? There is no rule that says multiple choice questions are any easier to answer than open-ended items. However, a few important differences are worth pointing out. First, multiple choice questions give students the opportunity to guess the correct answer, whereas other types of questions provide less of an opportunity to do so. Second, there are certain limitations to what multiple choice questions can assess. Whereas open-ended questions can ask students to make and defend judgments, demonstrate scientific method, explain complicated logic in clear prose, and otherwise show how they arrived at their answers, multiple choice questions cannot. Third, though multiple choice questions can be crafted to assess higher order thinking, oftentimes they simply ask students to recall facts, definitions, equations, etc. from memory. (It should be pointed out, however, that the process of scoring open-ended items is more complicated and labor-intensive than it is for multiple choice.)

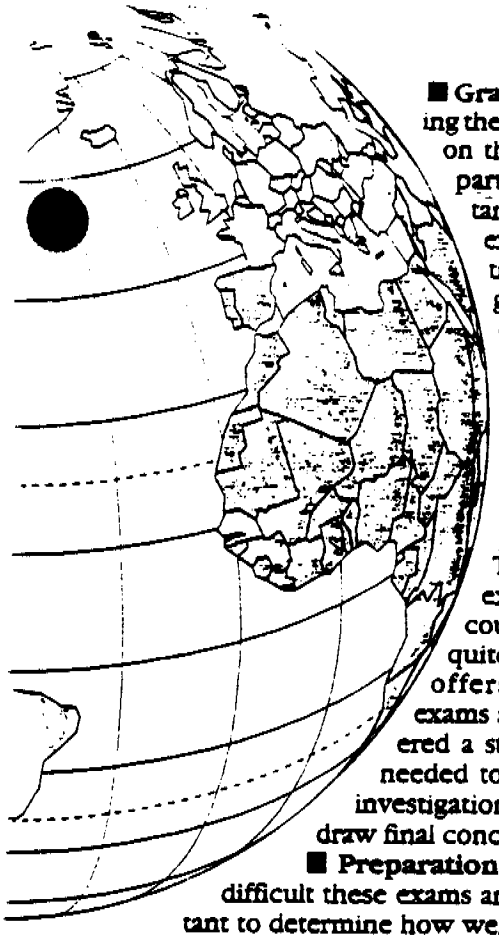
In contrast, the European exams make greater use of questions that require students to innovate, show their work, explain their answers, and back up their conclusions. For example, students taking these exams must be able to work through the often complicated steps necessary to solve the scientific problems posed, give explanations based on scientific principles, and plan or carry out scientific experiments. While the AP and Tokyo University entrance exams do require students to engage in these types of activities, they do so for a relatively small proportion of the exam. As mentioned earlier, both of these tests make use of multiple choice questions, the AP much more so than the Japanese exam. Of 24 questions on the Tokyo University exam, 10 are multiple choice questions. Of 124 questions on the AP exam, 120 are multiple choice, though the four open-ended questions represent 40 percent of the total grade.

■ **Breadth Versus Depth**—Educators are always debating this issue: Is it better to expose students to a large body of material or to limit the material and teach it in greater depth? The same is often asked of exams. There is no correct answer to this question, but it is instructive to think about how each country approaches the issue in these exams. While it is clearly true that an exam with greater depth and breadth is more rigorous than one with less of both, in most cases the issue is not so clear-cut. Of the exams in this book, for example, some emphasize depth more than breadth, others take the opposite approach, and some try to do both.

It is misleading to think about the depth and breadth of an exam, and impossible to accurately judge its rigor, without also looking at the curriculum students study in preparation. The exam is only part of a larger equation. Take France, for example. Even a quick read through these tests reveals a significant difference between the *baccalauréat* and the AP. While the French exam requires students to go into considerable detail on a small number of topics, the AP covers a substantially wider area in much less depth. Does this mean that the *baccalauréat* requires depth of knowledge but not breadth? Not necessarily. If the curriculum students study prior to taking the exam has breadth, then the students must know all of the subject matter in depth in order to do well on the exam, since they do not know which topics will be chosen. In this situation, neither depth nor breadth has been sacrificed, and it makes for a very rigorous test. On the other hand, if the French curriculum were narrowly defined but studied in depth, the *baccalauréat* would be considerably easier for students.

The England-Wales A-level in biology is an example of an exam that is able to emphasize both depth and breadth. Nine hours long, it covers quite a bit of ground, some of it in significant depth.

■ **Complexity of Knowledge**—One of the most important issues to confront when comparing exams, but also one of the most difficult, is how sophisticated or complex students' knowledge of a particular topic or concept must be. This is at the heart of what it means for one test to be more rigorous than another. One way to make such a comparison is to isolate questions of the same type and on the same topic, and determine which calls for more advanced knowledge. It is important to keep in mind the depth/breadth issue here, however, because some exams may cover more content but require a less thorough understanding of each issue. While we are unable to elaborate on the complexity of these exams in this book, NCISE's upcoming report will take up the issue in a more comprehensive manner.



■ **Grading Standards**—Comparing the complexity of the questions on these exams only deals with part of the issue. Just as important is how well students are expected to do on those questions. What is considered a good answer? How much is each question worth? Who grades the answers and using what scale? Are the scales for passing exams comparable? For example, is 60 percent considered a pass in one country but 70 percent a pass in another? The process of grading exams is different in each country, and in every case it is quite complicated. This book offers a glimpse at how the exams are graded, what is considered a strong answer, and what is needed to pass, but a more serious investigation is necessary in order to draw final conclusions.

■ **Preparation**—When considering how difficult these exams are for students, it is important to determine how well prepared students are to take them. As mentioned earlier, in order for an assessment to be a useful educational tool, it must be linked to the curriculum students study. It would then follow that the stronger the link between an exam and the curriculum, the better prepared the students will be to take it. (Of course this assumes, among other things, that educators do their part to effectively teach the curriculum.) If this is the case, it is important to ask certain questions: Do students in each country receive comparable instructional time in a tested subject area? To what extent is the secondary curriculum tailored to the subject areas of the exams? Do students in one country receive more instructional time in biology than students in another?

Other important questions to ask: To what degree can teachers and students in these countries anticipate exam topics, and thus study narrowly in preparation? To what extent can students learn how to do well on the exams through mastering certain methods, apart from the content knowledge?

A Broader Look at the Question of Rigor

What additional academic expectations do students face above and beyond the particular exams discussed in this book? After all, the ultimate question many readers will want to answer goes beyond comparing the particular exams and deals more broadly with the question of rigor. Put simply, how demanding are the expectations for college-bound students in these countries? Following are some of the issues worth considering:

■ **Scope of the Examination System**—Beyond the biology exams, how many other subjects are students tested on? How many of those subjects are outside the sciences? For example, do students who take these biology exams take other science exams such as physics or chemistry? Do they take exams in other subject areas, such as language/literature, mathematics, or history? Students in England and Wales who take the A-level in biology normally take exams in two other subjects of their choice, whereas French students taking the *baccalauréat* in biology must also take exams in French, history/geography, mathematics, philosophy, physics/chemistry, and a foreign language.

■ **How Much Does Each Exam Count?**—In every country but the United States, the exams in this book must be passed to gain admittance to a college or university. But there is a big difference between the value of a single exam in Germany and in England and Wales. A-level candidates take an average of three exams, and their scores on these exams are the main piece of information weighed by admissions offices in universities. In Germany, on the other hand, students' scores on their four *Abitur* exams make up only a fraction of their total *Abitur* grade. While this does not make one exam easier than another, it may put comparatively greater pressure on students to do well on the A-level.

■ **Expectations Beyond the Exams**—In the years leading up to the exams, do students have to study subject areas in which they will not be examined? Or is every course tied to a corresponding examination? In Germany, *Abitur* candidates must take 28 courses over a two-year period, but they are only tested in four of those areas. By contrast, in England and Wales, A-level candidates study almost exclusively the subjects they will be examined in.

* * *

These are just some of the factors readers should consider when comparing the exams discussed. It is by no means an exhaustive list. But it should serve as a helpful guide to anyone interested in contemplating what it means to have high standards for students. That is, after all, the purpose of the book from which this report is drawn and of the AFT's *Defining World Class Standards* series—to provide people in the United States with a firsthand look at what is expected of students in other countries so that we may become more informed judges of the standards we set for our own students. □

Comments:

- These expectations are not taught generally, but only in the probability/statistics class offered as an elective to those students who pass Algebra II.
- Goal is very difficult to achieve. There is no emphasis on understanding the information developed through the representations the student uses. Low-level students will not be able to analyze.

7. **To what extent do the instructional indicators for each expectation cover the scope of the expectation?**

Rating Scale:	a little.....a lot • • • • •
Number of Responses:	3 - 11 29 33

Comments:

- They are compatible.
- Many of the instructional indicators are written at a level which low-ability students cannot attain.

8. **To what extent are the goals, expectations, and indicators attainable by your high-achieving students?**

Rating Scale:	a little.....a lot • • • • •
Number of Responses:	32 20 9 6 6

Comments:

- Although high-achieving students could attain Goals 1 and 2, they would have trouble with Goal 3 unless they happen to take probability/statistics as an elective.
- Most of the goals, expectations, and indicators are written for and attainable only to advanced students.
- Depending on the level of assessment, these goals could or could not be easily attainable. Creating a test broad enough for all students to have a chance to pass will enable these high achievers to pass without any problem. These students should be challenged and responsible for more.

9. **To what extent are the goals, expectations, and indicators attainable by your average-achieving students?**

	a little.....a lot				
Rating Scale:	•	•	•	•	•
Number of Responses:	3	11	33	15	5

Comments:

- Although the average-achieving students receive Algebra and Geometry Concepts and Standards, they are not able to use these beyond skill steps. Time is not available to progress beyond basic skills teaching to investigative and problem-solving techniques.
- Attainable by average students.
- Students can reach some type of mastery with these goals. However, the level of assessment may be structured too high for their needs and/or level.

10. **To what extent are the goals, expectations, and indicators attainable by your low-achieving students?**

	a little.....a lot				
Rating Scale:	•	•	•	•	•
Number of Responses:	8	11	31	13	3

Comments:

- These students have a lot of trouble just identifying patterns of equation-solving steps and geometrical facts. Their calculation skills are dreadfully inadequate. These expectations are far beyond reach. They have no exposure to Goal #3. Reading is a preventative from even trying the problem.
- Students who are functioning at a low level but don't qualify for special education will not receive any support. There is quite a risk that they may fall through the cracks.
- There has been success at [school name] with the use of technology such as computers. Overall, this will pose a problem. Motivation will be the biggest problem for these students. At any level of assessment, these will be difficult goals to attain.

11. **To what extent are the goals, expectations, and indicators attainable by ESOL students?**

	a little.....a lot				
Rating Scale:	•	•	•	•	•
Number of Responses:	29	35	21	8	2

Comments:

- This is most likely dependent on many factors: intelligence, achievement, potential, and support.
- Accommodations need to be available as well as the modifications that are a regular part of their instructional day.

12. **To what extent are the goals, expectations, and indicators attainable by special needs students?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	29	35	26	8	2

Comments:

- These students struggle to meet minimum requirements. Going beyond would depend on the amount of support and modifications given.
- These students will have great difficulty trying to attain these goals.
- These goals could be difficult to attain. Some students may do fine. It's very difficult to set up assessments that are achievable by both special needs students and high-achieving students. A greater number of students are coming into high school with lower basic math skills. These students are having problems passing the Maryland Functional Math Test.
- I am not informed as to what level the students are.

What would you, as a high school teacher, need to implement the core learning goals in your classroom?

Comments:

- (1) Time to develop and add these goals to the basic curriculum. (2) Enough technology for each teacher and their classes, e.g., graphing calculators, computers, and software. (3) Training with technology and elements of these goals. (4) Money to cover all of the above.
- Staff development to teach content and methodology in statistics, analysis, and matrices. Modified curriculum, better and more technology, materials and textbooks, and graphic calculators.
- Plenty of time to restructure courses; this would take most of the 4 years to master for special needs students. More resources and materials such as computers, graphic calculators, textbooks, protractors, etc. Teacher training and the details of assessment to implement the Core Learning Goals in all classes. Levels of instruction and expectations for all types of students. More details on the exact type of questions on the test.
- When resources and class sizes are equitable across the city and counties of Maryland, maybe we can talk fairly about across-the-state standards.

SCIENCE

1. **To what extent does the introduction/rationale express your expectation of what the content of high school science should be in the 21st century?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	2	14	31	10	5

Comments:

- Greater flexibility.
- It seems to rationalize that students are going to be going to college or into an occupation where science is necessary. Needs to address all students.
- Periodic assessment as science and technology change.
- Stress the mastery of content. Expectation is for students to learn science by experiencing in the field and interacting with professionals in the workplace and classroom.
- Should Environmental Science be a separate discipline from Earth/Space Science? My rationale is that a student who had ninth grade Earth Science (or never had Earth Science at all) but did take Environmental Science may not do well on the assessment as organized.
- How will measurability with reliability be assured!
- Can't argue with it; wording is vague.
- Too limited, seems to "force" science to adapt to the student. Science is objective, you have to accept it and learn to use it.
- Well thought out.
- Yes.

2. **To what extent are the introduction/rationale, goals, expectations, and indicators clearly stated in the simplest language possible?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	2	-	9	22	13

Comments:

- Goals are well stated. Skills require units and development beyond basic understanding. Dumbing down an idea for temporary success is harmful for long term.

- Goals are clearly stated; extremely difficult to achieve. Needs staff development and training.
- Minimal equipment list detailing specific sizes and numbers of students per group. Updated yearly and as early as the beginning of the school year or end of prior school year.
- Be specific about what types of thinking.
- Stress content, process, and context.
- The goals are so inclusive, they don't convey a clear message.
- No need to simplify—especially first one.
- Good for teachers—some wording vague and others hard for laymen "formulate."
- Simplicity is important. Otherwise, it may not be read and properly interpreted by all (including parents and students).
- Example should read "suggested activity" and replace the words "student will" with "student might."
- I have a problem with the heading "Example" used throughout. It looks like an assessment example. Could it be labeled "Suggested Activity" and worded less formally, such as "Students might...."
- Terms such as "behaviorally," "indicators," and "cognitively" may not be understood by parents; may briefly define.

3. **To what extent do the five core learning goals cover the domain of high school science?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	5	1	11	17	14

Comments:

- Students require a continuing reinforcement of basic skills and application; not simply a use of a formula, but rather the why of its use and development.
- This is a major difficulty. Some of our students begin high school with biology. Many other students do not choose chemistry or physics.
- More interdisciplinary interaction of and between the four major science topics/subjects.
- Stress environmental and mathematical approach.
- There must be a distinction between theory (college prep) and applied and standard courses.
- But not many take physics!

- We presently do not teach environmental topics. Evolution should not teach "kinship" to species—I object on religious grounds.
- More Goals (specific to the class) have to be developed.
- Three credits—four content areas?
- If you make chemistry and physics ignore chemistry comm. and principles of technology, why bother with those classes?
- Covers all areas.
- Environmental seems to be in both ES/S and Biology. Will provision be made for a separate Environmental Science course?
- Should Environmental Science be a separate discipline form Earth/Space Science? My rationale is that a student who had ninth grade Earth Science (or never had Earth Science at all) but did take Environmental Science may not do well on the assessment as organized.
- 1 and 5 are ecologically based—too similar. #1 should emphasize broad diversity.
- Not possible in all classrooms at this time. It will take a sizeable investment of $ and expertise to equip classrooms to reach the goal.
- Students require a continuing reinforcement of basic skills and applications; not simlipfy a use of formula, but rather the why of its use and development.

4. **To what extent do the expectations under Core Learning Goal 1 cover the scope of the goal?**

Rating Scale:	a little.....a lot
	• • • • •
Number of Responses:	- 6 7 19 17

Comments:

- Student develops this recognition over time. Needs to be exposed to problem-solving and bias from the beginning. If the text is to be content-based rather than process-based, these expectations, then, would not fit.
- Goals are pretty good, except they fail to take into account other factors such as expectations #6 and 7. If a student has trouble with math, they will have trouble fulfilling this learning goal when using math in a science class, e.g., physics.
- Specific skills for students to attain must be written along with the equipment.
- Preparation begins in elementary and middle school.
- Make sure that instrumentation activities could be covered in the "lowest income" areas of Maryland.

- Skills.
- Seems to encompass all pertinent information. Things like algebra—ratio, statistics beyond low students.
- Expectation 7 doesn't fit as well as the first. Student develops this recognition over time. Needs to be exposed to problem-solving and basics from the beginning.
- If the test is to be content-based rather than process-based, these expectations, then would not fit.
- Well thought out.
- There is not enough time to read and analyze each goal with its expectations and indicators. I would like to read this in detail and give more input.

5. **To what extent do the expectations under Core Learning Goal 2 cover the scope of the goal?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	-	2	13	16	14

Comments:

- Include environmental focus and computers, software, etc. that are needed and not presently in the school.
- Expectation #6 is unrealistic. Keep politics out of science. Reword expectation, substitute *historical* for *political.*
- Greater emphasis on interconnectedness of earth phenomena (volcanos, earthquakes, etc.) and geography.
- Expectations do follow goal 2; however, expectations seem unrealistic for Earth Science courses as now taught.
- Gravity usually not covered in Earth Science.
- Change expectation #2 on gravity. Kids should be more concerned with other things besides gravity.
- Vocabulary/concepts of Earth Science are so varied and great that they cannot all be delved into in depth needed to meet all expectations.
- I don't like expectation #6.
- Number 6 doesn't seem to fit.
- Again, Earth Science should be instructional indicators. Number 3 should be part of an Environmental Science.
- Expectation #8 is covered in detail in our Environmental Science course!

- Spiral Information and scientific problem-solving to provide student confidence in exploring problems and possible investigative activities. Allow student to pursue his ideas and test his approaches. Students need a continuing situation of challenging their ideas and correlation of their relevance to science concepts.
- We need resources to do this.
- Quite thorough in extent.
- Extremely limited resources to achieve this goal.

6. **To what extent do the expectations under Core Learning Goal 3 cover the scope of the goal?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	-	1	12	14	9

Comments:

- The scope is covered. To implement these will take time and training for staff. Not all students possess the cognitive abilities to achieve these expectations.
- Students must have a working knowledge of prior sciences and math skills. Needs to be linked to chemistry and biochemistry.
- Include modeling of living organisms.

7. **To what extent do the expectations under Core Learning Goal 4 cover the scope of the goal?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	1	1	10	18	4

Comments:

- Concepts are sequential. Based on expectations, students must retain fundamental concepts to build later more complex ideas.
- They may cover the scope of the goal but most of our students elect not to take these classes.
- Where are solutions? Mixtures?

8. **To what extent do the expectations under Core Learning Goal 5 cover the scope of the goal?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	-	-	9	8	7

Comments:

- Rationale includes more problem solving, techniques to reinforce, and tools to illustrate modes of learning. Use model and diagram visuals to make ideas concrete to class members.
- Good.

9. **To what extent do the instructional indicators for each expectation cover the scope of the expectation?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	-	3	11	18	6

Comments:

- Basic concepts and language an absolute. Extension to broader and deeper understanding requires continued problem-solving situations.
- They were pretty good. Nice examples of what should have been achieved from each given situation. However, should students be able to achieve this by themselves or do they get it from the instructor?
- More allowance for change and also retaining specifics of the indicator.
- Instructional indicators allow the teacher to assess the goals.

10. **To what extent are the goals, expectations, and indicators attainable by your high-achieving students?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	8	7	9	7	9

Comments:

- Qualified students limited by compromises of previously learned material. Time is a problem always. It is difficult to cover the curriculum in 10 months. Planning time for integration with other areas is non-existent.
- Easily achievable.

- Math and English skills must be adequate. Prerequisites must be addressed for level.
- Very achievable.

11. To what extent are the goals, expectations, and indicators attainable by your average-achieving students?

Rating Scale: a little.....a lot

	•	•	•	•	•
Number of Responses:	1	9	16	13	4

Comments:

- Average is changing. Retention over the course of the school year would be a problem. Special needs students are becoming the norm. Students bring more baggage to the classroom, so we need to redefine average. Most students can learn, but their needs have to be addressed.
- Average student may have a little difficulty.
- Motivation is important. Hands-on activities with necessary equipment is a must with this level.
- Most of the average students will not be able to meet these goals without substantial changes in the educational environment.

12. To what extent are the goals, expectations, and indicators attainable by your low-achieving students?

Rating Scale: a little.....a lot

	•	•	•	•	•
Number of Responses:	10	7	5	1	-

Comments:

- Motivation and their need to succeed, coupled with self-esteem, will determine whether they are willing to expend the energy to be successful. Attention spans and their ability to focus may impact their direction.
- May not be successful at all of the goals, but may be successful at parts.
- More individual instruction, smaller classes, alternative programs for this level. Students lack adequate math and English skills.
- If we can tap into their interest, we can get them to achieve.

13. **To what extent are the goals, expectations, and indicators attainable by ESOL students?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	6	4	7	1	-

Comments:

- Depends on their personal motivation. Limited to the special needs and limitations.
- Goals must be drastically modified to be attainable.
- Inadequate training in ESOL will hamper these goals.
- More access to resource personnel. Command of English skills and language at average level of group.

14. **To what extent are the goals, expectations, and indicators attainable by special needs students?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	9	9	3	-	-

Comments:

- Extensive accommodations may be required.
- Very doubtful that special needs students will attain these goals.
- Alternative assessments or modified test? Students do not have adequate math and English skills to do this material. Small classrooms of no more than 10-15 students. Resource personnel to get better one-on-one instruction. Time factor, maybe 2 years to attain these levels. Dual certification of teachers—science and special education.
- Special needs students are not being addressed.

What would you, as a high school teacher, need to implement the core learning goals in your classroom?

Comments:

- Implementation requires time to plan, develop, and collect materials appropriate to the changes. Curriculum revisions and development of research improves mental attitude.
- Training for teachers, guidelines for special needs students, good equipment, small classes, and more parent accountability.
- Adequate funds, equipment, adequate laboratory areas, smaller classrooms, textbook funds (resource materials), computers, adequate number of teachers, trained and paid lab assistants.

- Classroom computers, laser disks, probes, CD-ROM, etc. are much needed. Funding, parental involvement and stability, school discipline.
- Inservice addressing the needs of the teachers as identified by the teachers, adequate funding, a recognition that the Core Learning Goals will not ever be reached by all students.

SOCIAL STUDIES

1. **To what extent does the introduction/rationale express your expectation of what the content of high school social studies should be in the 21st century?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	1	3	3	13	1

Comments:

- Teaching expectations are unclear. Content seems to be sacrificed as the consequence of pandering to process.
- Social studies curriculum needs improvement in elementary grades in order for students to have a foundation for additional information. The rationale needs to address the courses which the teachers must teach.
- A statement reflecting geography and economics content should be included.
- Idealism is definitely conveyed.

2. **To what extent are the introduction/rationale, goals, expectations, and indicators clearly stated in the simplest language possible?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	1	4	5	10	3

Comments:

- Time frame for U.S. content is K-12. Time frame for world history is 5-12.
- Simple and clear for educators but not so for most students.
- Are stated as clearly as possible.

3. **To what extent do the four core learning goals cover the domain of high school social studies?**

Rating Scale:	a little.....				.....a lot
	•	•	•	•	•
Number of Responses:	2	1	4	11	4

Comments:

- These Core Learning Goals appear to be the same as MSDE Outcomes and Indicators.

- It may be advisable to write core learning goals aimed at the required disciplines we have now (U.S. and World History, U.S. Government). Psychology and Sociology also need to be stressed.
- These are appropriate Core Learning Goals. It will be a hard task to help all students achieve these four as well as other areas (career education, drug education, and service learning).
- Is physical geography included in these goals?

4. To what extent do the expectations under Core Learning Goal 1 cover the scope of the goal?

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	1	3	5	9	4

Comments:

- Aligned with MSDE outcomes—addressed in ninth-grade curriculum. Major time problem. Too much emphasis on process rather than content. More resources: computers, modems, and statistics. Availability of local information.
- Needs indicators for more instruction in federal, state, and local government. Expectation 3 is vague—needs to concentrate on will of the people. #1A needs revision.
- Expectations 3 and 4 should be reversed and made more specific. Expectation 3 should analyze change and Expectation 4 should analyze results.
- Presumes a basis of skills and content knowledge in order to perform any of the task examples.

5. To what extent do the expectations under Core Learning Goal 2 cover the scope of the goal?

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	-	3	5	7	5

Comments:

- Data collections problem—if to be valid, need current statistics. Access to computers/modems for Internet-based research. Prime source material is not currently available.
- Expectations #1-3 are too vague and need revision. Expectations 2-4-5 are very specific and can be easily implemented into curriculum.

6. **To what extent do the expectations under Core Learning Goal 3 cover the scope of the goal?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	-	2	1	14	1

Comments:

- Students do not have geography after middle school. MSDE outcomes—some are addressed in ninth grade curriculum.
- Geography is not being taught in high school any more. Curriculums will have to be rewritten across the board.
- Indicator of Expectation 2 is vague. There is no mention of technology specifically in expectations or indicators.

7. **To what extent do the expectations under Core Learning Goal 4 cover the scope of the goal?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	-	1	3	10	4

Comments:

- Asking for students to apply U.S. and World History content when not all is taught prior to the eleventh grade is almost impossible, especially if middle [school] is focusing on process and not on content.
- Skill development is essential.
- Economics is not taught in many of Allegany County schools. However, economics would be a viable requirement or an elective for all students.

8. **To what extent do the instructional indicators for each expectation cover the scope of the expectation?**

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	-	3	6	7	2

Comments:

- The expectation is covered. However, the scope is too broad. The field of knowledge needs to be narrowed.

- The indicators for Goals 1 and 2 are on target for expectations. Curriculum adjustment is necessary if we are going to assess Goals 3 and 4. in addition to staff increasement.
- More indicators are needed to enhance the expectations and to demand accountability.
- Indicator 1 is great if proper resources are provided and made available to teachers.

9. **To what extent are the goals, expectations, and indicators attainable by your high-achieving students?**

Rating Scale: a little.....a lot

• • • • •

Number of Responses: - 4 7 6 2

Comments:

- These goals are overwhelming. Time and adequate instruction (content rather than process) is essential. These students will have increasingly difficult time in applying content when time frame is rushed in order to "get it all in!"
- The challenge is excellent and present. Student opportunity for evaluation may be important.
- Can be met with proper resources, training, and time to motivate and challenge them.
- Provides challenge to both teacher and student. A high-achieving student would able to do independent research.

10. **To what extent are the goals, expectations, and indicators attainable by your average-achieving students?**

Rating Scale: a little.....a lot

• • • • •

Number of Responses: - 4 10 6 -

Comments:

- This is the most difficult level to teach and most influenced by no-fail middle school philosophies. A large majority do not care. Students who focus on process do not do well on objective (multiple-choice) tests. These students need more opportunities to practice and stronger emphasis on content and objective tests.
- The students need the challenge that the expectations present. However, the students should be given the opportunity to assess the indicators before implementation of the program as it is written.
- Needs proper training, materials, and time.

- Some students will be able to work independently. Proper resources have to be provided. School needs updated social studies materials.

11. To what extent are the goals, expectations, and indicators attainable by your low-achieving students?

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	8	6	4	-	-

Comments:

- These classes must be extra small with individual access (or pair access) to the equipment and all resources. We will also need increased contact and support from parents. Parents of these students must understand and execute their role in the learning process. Additional print and non-print resources are critical.
- Students who are functioning at low levels but don't have IEPs may not pass because they can't receive any support.
- With proper training, materials, and time to stimulate them.
- Depends on the material provided and the creativity of the teacher.

12. To what extent are the goals, expectations, and indicators attainable by ESOL students?

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	7	3	4	-	1

Comments:

- Standards are too high for these students.
- Dependent practically on achievability of student.
- ESOL students tend to work harder.

13. To what extent are the goals, expectations, and indicators attainable by special needs students?

Rating Scale:	a little.....a lot				
	•	•	•	•	•
Number of Responses:	7	5	8	-	-

Comments:

- This will require doubling or tripling the number of special education assistants. These kids will give up easier. Additional resources (print and non-print) are essential.
- These students probably will not be able to master this, unless special provisions are made.
- Are attainable by special needs students. This will pose a problem for a number of these students who may have a problem with critical thinking and will require time.
- Small group settings. Individual attention. Constant encouragement and praise.

What would you, as a high school teacher, need to implement the core learning goals in your classroom?

Comments:

- (1) Equipment and technology: computers in every classroom, CD-ROM and networking (Internet, WorldWideNet, etc.), a TV/VCR in every classroom. (2) Better direction and time for implementation. (3) Support personnel to help with obtaining primary sources, communicating with government response people, etc.
- Additional staff, staff development, smaller class numbers, more audio-visual equipment and materials, expand the curriculum, cooperation on behavior problems.
- Adequate materials, resources/computers. Time, smaller class sizes, skill instruction, innovative teaching methods.
- A need for new and greater resources such as computers, texts, televisions with access to Maryland television stations, monitors for students to make multi-media presentations. Teacher training in implementation of goals, expectations, and indicators. Teachers will need to possess knowledge of assessment vehicles and local knowledge of outcomes.