

# **Shaping the Future**

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**Volume II: Perspectives on Undergraduate Education  
in Science, Mathematics, Engineering, and Technology**

**Contributions to the  
Review of Undergraduate Education**

**by the**

**Advisory Committee**

**to the**

**National Science Foundation  
Directorate for Education and Human Resources**

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1. This publication is a companion volume to the report *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology* (NSF 96-139) and its stand-alone Executive Summary (NSF 96-141), published by the National Science Foundation in 1996. The views, opinions, and recommendations expressed in this report are those of participants in the Review of Undergraduate Education, the “National Year of Dialogue” and the Advisory Committee to NSF’s Directorate for Education and Human Resources; they do not necessarily represent the official views, opinions, or policy of the Foundation.
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## Table of Contents

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The Charge to Revitalize Undergraduate Education in Science, Mathematics, Engineering, and Technology	vi
Introduction to the Second Volume	1
<b>I. Activities in the Reform of Undergraduate Education Since Volume I of <i>Shaping the Future</i></b>	<b>3</b>
Introduction	5
Shaping the Future NextSteps	5
External Assignment of Dr. Robert Watson	6
Regional Workshops for “Shaping the Future”	7
Strengthening Participation by Corporations and Foundations	8
Working Through Scientific Societies and Professional Associations	9
Chronological List of Conferences Sponsoring Workshops & Presentations in Support of Shaping the Future NextSteps	10
Bibliography of New Publications in Support of <i>Shaping the Future of Undergraduate Education in Science, Mathematics, Engineering, and Technology</i>	16
<b>II. Program History of Undergraduate Activities at NSF Since the Neal Report (NSB 86-100)</b>	<b>21</b>
Leadership	23
Leveraged Program Support	25
<b>III. Written Remarks Contributed as Part of the EHR Advisory Committee Public Hearings on Undergraduate SME&amp;T Education</b>	<b>27</b>
<b>Remarks Contributed to the Hearing on Disciplinary Perspectives</b>	<b>29</b>
Invited Speakers	30
<b>MRC Greenwood</b> , <i>Dean, Graduate Studies &amp; Vice Provost, Academic Outreach University of California at Davis</i>	31
<b>Rita R. Colwell</b> , <i>President, American Association for the Advancement of Science (AAAS) &amp; President, University of Maryland Biotechnology Institute</i>	37
<b>Alan Tucker</b> , <i>Distinguished Teaching Professor, State University of New York-Stony Brook &amp; Chair, Education Coordinating Council of the Mathematical Association of America</i>	43
<b>Eleanor Baum</b> , <i>Dean of Engineering, Cooper Union for the Advancement of Science and Art (NY)</i>	
<b>Winfred Phillips</b> , <i>Dean of Engineering, University of Florida</i>	49

## Table of Contents

<b>Peter J. Denning</b> , <i>Associate Dean for Computing, George Mason University (VA)</i>	53
<b>Don K. Gentry</b> , <i>Dean of Engineering, School of Technology, Purdue University (IN)</i>	59
<b>Durward R. Huffman</b> , <i>President, Northern Maine Technical College &amp; Academic Officer, Maine Technical College System</i>	65
<b>Ernest L. Eliel</b> , <i>Professor of Chemistry, University of North Carolina at Chapel Hill</i>	69
<b>Angelica M. Stacy</b> , <i>Department of Chemistry University of California, Berkeley</i>	71
<b>Robert C. Hilborn</b> , <i>Professor of Physics, Amherst College &amp; President-Elect, American Association of Physics Teachers</i>	75
<b>Eric Mazur</b> , <i>Gordon McKay Professor of Applied Physics, Division of Applied Sciences &amp; Professor of Physics, Harvard University</i>	81
<b>Tanya Atwater</b> , <i>Professor of Geological Sciences, University of California, Santa Barbara</i>	83
<b>Remarks Contributed to the Hearing on Institutional Perspectives</b>	87
Invited Speakers	88
<b>Pamela A. Ferguson</b> , <i>President, Grinnell College (IA)</i>	89
<b>Thomas Morris</b> , <i>President, Emory and Henry College (VA)</i>	93
<b>Bruce Leslie</b> , <i>President, Onondaga Community College (NY)</i>	97
<b>Gwendolyn W. Stephenson</b> , <i>Chancellor, St. Louis Community College</i>	103
<b>David R. Pierce</b> , <i>President, American Association of Community Colleges (DC)</i>	107
<b>Frederick S. Humphries</b> , <i>President, Florida A&amp;M University</i>	109
<b>William E. Kirwan</b> , <i>President, University of Maryland, College Park</i>	115
<b>Paula P. Brownlee</b> , <i>President, American Association of Colleges and Universities (DC)</i>	119
<b>Saul K. Fenster</b> , <i>President, New Jersey Institute of Technology</i>	123
<b>Judith A. Ramaley</b> , <i>President, Portland State University (OR)</i>	131
<b>David Ward</b> , <i>Chancellor, University of Wisconsin - Madison</i>	141
<b>Homer A. Neal</b> , <i>Vice President for Research, University of Michigan, Ann Arbor</i>	145
<b>Remarks Contributed to the Hearing on Employers' Views</b>	151
Invited Speakers	152
<b>Walter G. Amprey</b> , <i>Superintendent of Public Instruction, Baltimore City Public Schools (MD)</i>	153

<b>Eugene Galanter</b> , <i>Professor of Psychology, Columbia University</i>	157
<b>Peggy Ruth Cole</b> , <i>Director of Program Planning and Development, New York Hall of Science</i>	163
<b>Israel J. Galvan</b> , <i>President, GHG Corporation</i>	167
<b>Albert L. Moyé</b> , <i>University Relationships Manager, Hewlett Packard Company</i>	
<b>Robert W. Ritchie</b> , <i>Director, University Affairs, Hewlett Packard Company</i>	171
<b>John H. McMasters</b> , <i>Senior Principal Engineer, Aerodynamics Engineering, The Boeing Company</i>	
<b>James D. Lang</b> , <i>Director of the Technology Division, New Aircraft and Missile Products, McDonnell Douglas Aerospace</i>	177
<b>Roberts Jones</b> , <i>Executive Vice President, National Alliance of Business</i>	187
<b>John L. Sisler</b> , <i>Manager of Exploration and Production Training, Shell Exploration and Production Company</i>	189
<b>Patrick White</b> , <i>Vice President, Strategy, Bell Atlantic Corporation</i>	195
<b>Remarks Contributed to the Social Sciences Workshop</b>	197
Participants in the Social Sciences Workshop	198
Overview	199
<b>Andrew Abbott</b> , <i>Professor in Sociology and Master, Social Sciences Collegiate Division, University of Chicago</i>	205
<b>John F. Dovidio</b> , <i>Department of Psychology, Colgate University</i>	209
<b>Ronald G. Ehrenberg</b> , <i>Vice President for Academic Programs, Planning, and Budgeting, Cornell University</i>	213
<b>Kenneth E. Foote</b> , <i>Associate Vice President for Research, The University of Texas at Austin</i>	217
<b>Rochel Gelman</b> , <i>Professor of Psychology, University of California, Los Angeles</i>	221
<b>Maureen Hallinan</b> , <i>White Professor of Sociology, University of Notre Dame</i>	223
<b>Jill H. Larkin</b> , <i>Department of Psychology and Center for Innovation in Learning, Carnegie Mellon University</i>	225
<b>Frederick Reif</b> , <i>Department of Physics, Carnegie-Mellon University</i>	231
<b>Nora S. Newcombe</b> , <i>Department of Psychology, Temple University</i>	235
<b>Neil Stillings</b> , <i>Cognitive Science Program, Hampshire College</i>	239
<b>IV. Findings from the Focus Groups Conducted During the Review of Undergraduate Education</b>	243
Introduction	245
Summary of Employer Focus Groups	249
Summary of Teacher Preparation Focus Groups	255

Summary of Student Focus Groups	261
Summary of Recent Graduate Focus Groups	267
Summary of Parent Focus Groups	273
<b>V. Background Data and Information Influencing the Conclusions and Recommendations of <i>Shaping the Future</i> by Staff of the Division of Undergraduate Education</b>	<b>275</b>
Overview	277
Education Concerns: precollege	277
Education Concerns: undergraduate	277
Post-Secondary Education Issues	
Public subsidies and faculty priorities	287
Rising costs	291
Pressures on public revenues	294
Where are the undergraduate students?	
By type of institution	295
By discipline and type of institution	297
Distribution of Federal Funds for Science and Engineering, by type of institution	299
Faculty Teaching Methods and Class Size, by type of institution and discipline	302
Employers' Perspectives on Features of a Well-Educated Undergraduate	307
Electronic Technology and Systemic Reform	310
<b>VI. Contributors to the EHR Advisory Committee Review of U.S. Undergraduate Education in SME&amp;T</b>	<b>313</b>
Acknowledgment of Participants by Melvin D. George	315
The Request for Comment from Luther Williams, NSF Assistant Director for Education and Human Resources	316
Respondents to the Letter from Luther Williams, NSF Assistant Director for Education and Human Resources	319
Undergraduate Convocation Program Steering Committee for <i>From Analysis to Action</i>	327
Participants in <i>From Analysis to Action</i> , April 9-11, 1995	329
The EHR Advisory Committee	346
EHR Committee for the Report <i>Shaping the Future: New Expectations for Undergraduate Education Science, Mathematics, Engineering, and Technology</i>	347
NRC Center for Science, Mathematics, and Engineering Education Committee on Undergraduate Education	348
NRC "Year of Dialogue" Steering Committee	349
Participants in the EHR Advisory Committee Public Hearings on Undergraduate Education in SME&T	350
Participants in the <i>Shaping the Future</i> Conference, July 11-13, 1996	351
<b>VII. Bibliography for the Review of Undergraduate Education in Science, Mathematics, Engineering, and Technology</b>	<b>381</b>

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REVIEW OF UNDERGRADUATE EDUCATION

by the

Advisory Committee

to the

National Science Foundation  
Directorate for Education and Human Resources

NATIONAL SCIENCE FOUNDATION  
OFFICE OF THE ASSISTANT DIRECTOR FOR EDUCATION AND HUMAN RESOURCES

Review of Undergraduate Education in Science, Mathematics, Engineering and Technology  
June 1995

CHARGE TO THE SUBCOMMITTEE

I appoint a Subcommittee of the Advisory Committee to the Directorate for Education and Human Resources (ACEHR) to conduct a Review of the state of undergraduate education in science, mathematics, engineering, and technology (SME&T); to identify its recent successes and to point out both its needs and opportunities for its improvement. Members of the Subcommittee will be: Drs. Melvin George (chair), Sadie Bragg, Frederick Brooks, James Rosser, David Sanchez, and Carolyn Meyers (consultant). [Drs. Alfredo de los Santos, Jr., Denice Denton, Mary Lindquist, and Mr. Peter Gerber were later added to the membership of the Subcommittee.]

The Subcommittee should consider the needs of *all* undergraduates attending *all* types of U.S. two- and four-year colleges and universities that provide undergraduate education in science, mathematics, engineering, and technology. In particular, the review should address issues of preparation of K-12 teachers in these fields, the needs of persons going into the technical work force, the preparation of majors in these areas, and the issue of science literacy for all. The review should cover the full range of general issues in undergraduate education—curriculum, educational technology, pedagogy (including the degree to which student learning is infused with research), institutional practices and the need for comprehensive reform, and key student transitions between levels of education (*from* high school, *between* undergraduate institutions, and *to* graduate school) and from undergraduate studies to employment. The review should draw upon a full range of constituent groups having a stake in undergraduate education—students, parents, faculty, administrators, scientific societies, accrediting groups, employers, and state and local education officials. The Subcommittee is requested to develop a schedule of draft reports and activities leading to a Final Report.

The Final Report should be action oriented, recommending ways to improve undergraduate education in science, mathematics, engineering, and technology for all students in all types of colleges and universities. Recommendations should be directed not just to NSF but, as appropriate, to mission-oriented Federal agencies, business and industry, academic institutions and their faculties and administrations, professional societies, private sector organizations, state and local government, and to other stakeholders in undergraduate education. The recommendations should reflect an assessment of accomplishments during the recent past [i.e., those following completion of the National Science Board study *Undergraduate Science, Mathematics and Engineering Education* (NSB 86-100, 1986)] and be based on the comments and ideas submitted by individuals and groups during the course of the Review and on findings and analysis by the Subcommittee. The Report should consider carefully future roles for sponsors of educational improvements and the nature of their efforts to improve undergraduate education. In particular, guidance is sought for the National Science Foundation regarding its support of innovation in educational practice through a portfolio of programs ranging from sponsorship of individual investigator-led efforts to catalysis of institutional programs of comprehensive change and covering the full range of educational settings.

I ask that the Subcommittee complete and transmit its Report to me by March 1996. Thereafter, the Report will be submitted to the full ACEHR for its comment and approval and, when that is obtained, will be submitted to the NSF Director and to the Director's Policy Group for approval as a NSF Report.

Luther S. Williams  
Assistant Director

## Introduction to the Second Volume

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This is a companion volume to *Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering, and Technology* (NSF 96-139), the 1996 report of the Advisory Committee on Undergraduate Education to the National Science Foundation's Directorate for Education and Human Resources. For this supplement, we have selected the materials that helped to initiate the discussion and debate of the review, and provided the framework for the Recommendations presented in the first volume of *Shaping the Future*.

No single document could purport to fully represent the breadth and depth of the expansive and complicated endeavor of higher education and its reform. While the EHR Advisory Committee did a formidable job of soliciting broad-based community opinion, synthesizing the issues facing contemporary undergraduate education, and summarizing this process in its report to NSF, the material presented in this second volume provides an essential resource for anyone wishing to explore these issues more completely, without the benefit of interpretation or distillation. To this end, we have made every effort to allow these authors to express their views in their own words and present references and data without undue editorial revision or comment.

The review of undergraduate education and the *Shaping the Future* report have already generated much discussion and activity in the U.S. education community. In recognition of this, the National Science Foundation has initiated its "NextSteps in Shaping the Future" campaign to capitalize upon this enthusiasm, coordinate regional efforts, and help guide discussion towards a national movement to achieve even greater excellence in higher education. We begin this volume with a summary of these ongoing, follow-up activities.

Section II of this volume presents a detailed account of NSF programs in undergraduate education since NSB 86-100, *Undergraduate Science, Mathematics and Engineering Education: Role for the National Science Foundation and Recommendations for Action by Other Sectors to Strengthen Collegiate Education and Pursue Excellence in the Next Generation of U.S. Leadership in Science and Technology* the last substantive review of undergraduate education in this nation. Section III presents the written remarks contributed as part of the public hearings on undergraduate education held in October and November, 1995, as well as an overview of the Social Sciences workshop held in February, 1996. Section IV summarizes the series of national focus groups conducted by NSF in 1995 and 1996, while Section V presents data from a variety of sources that contributed many—but certainly not all—essential facets to the overall analysis.

Finally, no accounting of this remarkable, cooperative achievement would be complete without proper acknowledgment of the participants and contributors to this process (Section VI) and the benchmark publications upon which the current appraisal was founded (the References of Section VII).

*The National Science Foundation  
Division of Undergraduate Education  
Arlington, VA  
August, 1998*

