The Liberal Art of Science: *Agenda for Action*

The Report of the Project on Liberal Education and the Sciences

American Association for the Advancement of Science

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PREFACE

Science influences every aspect of contemporary American life, yet the United States has been described as a nation of scientific illiterates. The appraisal of leaders in government, education, and the private sector is that the welfare of the nation and the individual will be improved when all citizens have sufficient understanding of science to make soundly based personal, civic, and professional decisions. This national goal can be achieved only through the radical reform of science education at all levels. Of critical concern is education in the natural sciences at the undergraduate level.[1] *The Liberal Art of Science: Agenda for Action* addresses this concern.

This report presents the conclusions and recommendations of the Study Group of the American Association for the Advancement of Science (AAAS) Project on Liberal Education and the Sciences. The members of the Study Group deliberated about the level of scientific understanding required for optimal participation in life in the 21st century and about the nature of undergraduate education in the natural sciences necessary to achieve a proper level of understanding. As a result of their inquiry, the members of the Study Group reaffirm the value of liberal education for all undergraduates, set goals for the natural sciences in liberal education, and recommend mechanisms for their attainment.

The AAAS Project on Liberal Education and the Sciences was initiated in response to recommendations contained in the report of the Carnegie Forum on Education and Economy, *A Nation Prepared: Teachers for the 21st Century* (1986), and in *Tomorrow's Teachers: A Report of The Holmes Group* (1986). Both reports recommended that the undergraduate education major be eliminated and replaced by a major in the liberal arts. However, they did not discuss the nature of the new major. Because implementation of this recommendation depends on defining the characteristics of the new major, the Carnegie Corporation of New York invited the AAAS to organize a study of the education of prospective teachers in the natural sciences.

The AAAS accepted the invitation, but expanded the study to include the role of the natural sciences in the liberal arts curriculum for all students. Understanding science as a liberal art will be equally important for all undergraduates when they become America's future leaders in the private sector, education, and government.

Plans for the scope and direction of the project were made with the help of members of the AAAS Coalition for Education in the Sciences, a consortium of scientific and educational associations. The members of the project's Advisory Board and Study Group were selected in consultation with the leaders of these associations (see Appendix E for a list of these groups). Six representatives of the scientific, engineering, and educational communities and of the private sector comprise the Advisory Board. The 15 members of the Study Group represent diverse disciplines and share a firm commitment to strengthening undergraduate education in the natural sciences.

[1] This report is limited to the role of the *natural* sciences in undergraduate education. Comments on the mathematical, engineering, and other sciences are made only insofar as they contribute to understanding the natural sciences.

The project's strategy—assembling a multidisciplinary team to discuss the issues—was based on the assumption that consensus reached by such a team on the place of the natural sciences in liberal studies would be a valuable resource for stimulating discussion of the issues at the national level. Joining this group of senior scholars were graduate students and young professionals, identified by Study Group members, who served as Study Group Associates and joined in the group's deliberations. One purpose of this experience was to develop in the group of young academicians an interest in and an understanding of issues in higher education.

The Liberal Art of Science: Agenda for Action contains the Study Group's recommendations of goals for liberal education in the sciences as well as the multidisciplinary curriculum and teaching strategies necessary to achieve them. It reaffirms the importance of the natural sciences in the liberal arts curriculum and recommends that the study of the natural sciences be multidisciplinary. Cross-disciplinary teaching that involves faculty from the humanities, the social sciences, and the practical and fine arts is encouraged. The Study Group also recommends teaching science as it is practiced. This means incorporating the philosophy, values, and methods of science into instruction in the natural sciences.

The Study Group recognizes that implementation of its recommendations is the prerogative of faculty members in the nation's colleges and universities and trusts that they will consider this report in light of the needs and circumstances of students in their particular institutions.

Furthermore, the Study Group recognizes that implementing these recommendations will require the commitment of many resources and cannot be accomplished by institutions of higher education without assistance from the state and federal governments, the private sector, and professional associations. The issues involved are of such national importance that resources from all these sectors should be committed to support the necessary activities.

The Statement

STATEMENT OF THE STUDY GROUP OF THE PROJECT ON LIBERAL EDUCATION AND THE SCIENCES

Science is one of the liberal arts and should be taught as such.

Human survival and the quality of life depend on liberally educated citizens who are able to make informed assessments of the opportunities and risks inherent in the scientific enterprise. Yet there is every indication that present levels of scientific understanding, even among those who are otherwise well educated, are inadequate for life in the 21st century. In spite of the importance of science and the ubiquity of its applications, science has not been integrated adequately into the totality of human experience. Therefore, it is the central premise of this report that science must be taught as one of the liberal arts, which it unquestionably is.

Without the study of science and its relationships to other domains of knowledge, neither the intrinsic value of liberal education nor the practical benefits deriving from it can be achieved. Science, like the other liberal arts, contributes to the satisfaction of the human desire to know and understand. Moreover, a liberal education is the most practical education because it develops habits of mind that are essential for the conduct of the examined life. Ideally, a liberal education produces persons who are open-minded and free from provincialism, dogma, preconception, and ideology; conscious of their opinions and judgments; reflective of their actions; and aware of their place in the social and natural worlds. The experience of learning science as a liberal art must be extended to all young people so that they can discover the sheer pleasure and intellectual satisfaction of understanding science. In this way, they will be empowered to participate more fully and fruitfully in their chosen professions and in civic affairs.

Understanding science and its influence on society and the natural world will require a vast reform in science education from preschool to university. This report focuses on the need for curricular reform at the college level. It addresses goals for all students—science majors and nonscience majors alike—for science majors also must understand science as a liberal art in order to be responsible and reflective professionals.

Science should be taught as science is practiced at its best.

Education in science is more than the transmission of factual information: it must provide students with a knowledge base that enables them to educate themselves about the scientific and tech-