

COMMITTEE ON THE SCIENCE REQUIREMENT

Report on the Science Distribution Component of the Science Requirement

In the spring of 1989 the Faculty passed a motion endorsing the addition of biology to the Science Requirement. It also endorsed retaining eight subjects in the Requirement by reducing the number of Science Distribution subjects from three to two.

The Committee on the Science Requirement was formed to examine how the new biology requirement might be implemented and how the Science Requirement should be modified to accommodate it. At the same time an experiment was tried with about two hundred freshmen to cover introductory biology, chemistry, and materials science in a single two-term subject. When the experiment was discontinued, the Biology Department proposed offering a single subject in modern molecular biology, 7.01, which would be part of the Science Core. After careful study, we fully endorsed this plan. In the past two years we also studied a wide variety of options for the Science Distribution. Eventually we concluded that the original suggestion of the Faculty was best: the Distribution should consist of two subjects.

We made these recommendations to the CUP which included them in a motion which was approved by the Faculty at its meeting of April 17, 1991. The relevant parts of the approved motion are as follows:

That one semester of modern biology be added to the Science Core of the General Institute Requirements, effective with the freshman class entering in the Fall 1993.

That the name "Science Distribution" be changed to "Restricted Electives in Science and Technology". That the number of subjects required in Restricted Electives in Science and Technology be reduced from three to two; both of these may be specified by departmental programs, but no more than one may lie inside the department.

In this report we will present our understanding of the purposes of the Core and Distribution components of the Science Requirement, discuss our reasons for modifying the Distribution, and suggest revised and sharpened criteria for subjects on the Restricted Electives in Science and Technology list.

The special kind of education offered by MIT, almost unique in this country, involves an immersion in the concepts of science and technology. But the single feature which best exemplifies the character of a university, and safeguards its values, is the required part of the curriculum. Thus the Committee strongly endorses the concept of a Science Requirement for all of our undergraduates. Traditionally, the Science Requirement has been divided into two parts. The Science Core was intended to provide a basic background in science while the Science Distribution was intended to provide more depth, breadth, and some flexibility.

The Committee spent a good fraction of its time during the past two years discussing the nature of the Science Requirement. We believe that the magnitude of the requirement, eight subjects, is still appropriate. Moreover, the division into Core and Distribution components has served well the educational needs of our students and should be continued, albeit with some changes.

We believe that the Science Core has the following purposes:

- 1) to provide an analytic ability and some common background in science as one of the defining features of an MIT education;
- 2) to provide a common body of knowledge and methods on which subsequent education is based;
- 3) to provide an introduction to several basic disciplinary areas.

These purposes have been satisfied well by the five subjects currently in the Core—two subjects in physics, one in chemistry, and two in mathematics—and will be strengthened by the addition of one subject in modern biology. Biology will contribute to 1) both by familiarizing students with a technical area of growing importance to modern society and by introducing them to an analytic approach to scientific problems which is different from that used in physics or chemistry. With respect to 2), it is likely that, in the short run, biology will not be used as a prerequisite for subsequent subjects as often as physics and chemistry, but we expect that will change as the revolution in modern biology proceeds. Certainly purpose 3) is satisfied as more of our students pursue careers in biology oriented fields.

The goals of the Science Distribution have been less clear than those of the Core. Operationally, the Distribution list is a limited set of electives in science, technology, and mathematics. These subjects cover broad and important areas, and they have in their number some of the Institute's most popular offerings. The student must take three subjects from the list: no more than two may be required by the student's departmental program, and no more than one may be in the student's department.

The Committee did not sense a desire on the part of the Faculty to make major changes in the Science Distribution. We did find, however, some level of dissatisfaction, both with respect to the Science Distribution living up to its title, and with respect to the current list of allowed subjects. Some faculty pointed out that not all of the subjects on the list were in science. Others were concerned that students could satisfy the requirement by taking professional subjects in their field, giving them little exposure to disciplines other than their own. A number of our colleagues thought that the distribution list had grown too large. They worried that with so many subjects the quality of individual offerings could not be closely monitored, nor could adherence to a stated goal for the program be enforced.

We believe that the Science Distribution has the following purposes:

- 1) to provide breadth in the knowledge of science or engineering, at a level suitable for freshmen and sophomores;
- 2) to provide an understanding of the scientific method by exposure to modern paradigms;
- 3) to provide reinforcement and refinement of the ideas in the Science Core.

It was clear to us that the word Science in the Science Distribution was meant to refer to a broad range of endeavors requiring a quantitative description, analytic approach, and solution by means of the scientific method. For example, exposure to the "scientific method" can include the application of synthesis and design within engineering disciplines. From this point of view we felt that the broad spectrum of subjects found on the current list was indeed appropriate.

We then discussed the degree to which this part of the Science Requirement could or should be used to enforce a measure of breadth in the student's academic program. We considered a wide variety of alternative options to the current form of the Science Distribution. They ranged from allowing any subject in the School of Science or the School of Engineering to satisfy the requirement, to narrowing the list to a few subjects specifically designed for the purpose. In considering the options we had to balance the pedagogical advantages of some of the more innovative suggestions with the fact that all of the engineering departments have incorporated two subjects from the current list into their departmental requirements. Major reform can only be accomplished at the expense of professional subjects, if the total number of subjects required for graduation is not increased.

The addition of biology to the Science Core automatically increases the breadth in the science that we require of our undergraduates. The Committee feels that breadth, or

distribution, should still be one of the goals of the second part of the requirement, as indicated in 1) above. However, it should not be a defining requirement of every subject on the list, nor of each student's program.

For these reasons the Committee suggested that the name of the second part of the Science Requirement be changed to Restricted Electives in Science and Technology, and the Faculty has concurred. The set of electives satisfying the requirement carries a special endorsement by MIT. A student outside of the Schools of Engineering and Science can be assured that a listed subject will be a worthwhile introduction to an area of analytic endeavor. Students in the School of Science will look to the list for guidance in broadening their outlook. The offerings on the list should be carefully reviewed on an ongoing basis.

We feel that a number of subjects on the current Distribution list may not fulfill the purposes outlined above. Therefore we recommend that all subjects on the current list be reviewed over the next three years as part of a sunset condition and that each REST subject be reviewed every five years thereafter. We propose that these reviews be undertaken by the Committee on Curricula with assistance and advice of the Committee on the Science Requirement, much as HASS-D subjects are reviewed. We expect that some of the subjects that fail to meet the requirements will simply be dropped from the list; others will be modified by the departments and kept on the list.

As a test exercise, the Committee carried out an informal review of the offerings from several departments on the current list. We estimated that the list could be shortened by about 30%. We found that the purposes stated above could be strengthened by the addition of the following criteria:

Subjects on the REST list should not be too specialized, too advanced, or devoted chiefly to instruction in a particular skill.

For example in the current list we felt that 8.243, Modern Optics, was too specialized and that 8.286, The Early Universe, was too advanced. We felt that 1.00, Introduction to Computers and Engineering Problem Solving, was too skill oriented if, as we were led to believe, it is primarily devoted to learning to program in C. On the other hand, we felt that a concept oriented subject in computation, for example 6.001, would be welcome on the list.

In addition to a review of subjects currently on the REST list, the Committee recommends the development of new subjects to meet the needs of MIT students majoring in schools other than Engineering and Science. We heard proposals for such subjects in physics and mathematics and feel that such efforts should be encouraged both by the departments and by the Institute administration.

There is one ambiguity with the current REST list that can be resolved easily. The Committee recommends that joint subjects on the list, those designated J, be allowed to satisfy the out of department requirement even if the student's own department is one of the sponsoring departments.

During our discussions of ways to limit the REST list, an administrative solution was proposed. Each department would be permitted to have no more than a fixed number, perhaps three, subjects on the list. These subjects would still have to satisfy the published criteria, but the list would be guaranteed to stay at a manageable size. The Committee is skeptical of administrative solutions to complex situations and feels that the review procedure it has proposed is the best way to implement the Institute's academic goals. However, if the periodic review of the REST list becomes too cumbersome, or too politically charged, this option should be reconsidered.

One of the members of the Committee, Prof. Peter Diamond, views the REST requirement quite differently. He feels that the REST requirement will affect the programs of such a small fraction of the student body that it is not worth the administrative effort both to maintain a regularly overseen list of subjects and to check student programs for compliance.

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