

# For the Technological Humanist:

## The WPI Plan

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**W**ORCESTER POLYTECHNIC INSTITUTE, in Worcester, Mass., is currently involved in an innovative campus-wide program for undergraduate education. It is individually structured, student-centered, project-oriented, with strong components in the social sciences and the humanities. The WPI plan seeks to graduate a new breed of professional: an individual who works creatively with specialists from other disciplines and has a wide awareness of the larger world of humanity. These are the characteristics an effective scientist or engineer in the last quarter of the twentieth century should have.

In the life sciences, in addition, WPI graduates must have a strong quantitative background in physics and chemistry and a sound working familiarity with modern instrumentation. James F. Danielli, head of the team which three years ago successfully reassembled a living, reproducing cell from dissociated components of differing amoeba species, came to WPI this fall to take over its new department of life sciences because, he says, "The WPI plan offers me the natural environment to pursue the new undergraduate life science education I have long wanted to get into."

WPI has managed to move into this new kind of life science education swiftly, for two reasons. As an engineering institution, it is by nature instrumentation oriented and equipped. Our undergraduate life science students have access, for example, to such advanced equipment as a scanning electron microscope, a transmission electron microscope, and two major computers.

But the principal reason is the WPI plan itself. Under the plan, students bear the central responsibility for learning. With close faculty guidance, they design their curricula to match their own goals and interests. There are no required courses; each student puts together the right mix of courses to work toward an individual goal of his own choice.

### *Four Degree Requirements*

The best way to sum up the plan is to briefly describe each of its four degree requirements: the "competency," the "sufficiency," and the two "qualifying projects."

Bruce Croft, a senior, is doing his interactive

qualifying project on the values involved in deciding what patients should get priority in access to rare therapy equipment. By a questionnaire mailed to 500 individuals he hopes to test his hypothesis, which is that respondents from lower-income brackets will prefer a decision process based on random processes such as a lottery, while those of higher brackets will opt for one that evaluates the patients' "social worth."

Because it has proved both a powerful motivator and an excellent mechanism for learning, we regard qualifying project work as the heart of the WPI plan. Students often select their courses in the later terms because they have clearly recognized them as indispensable to their projects.

"Taking a course because you have discovered a need for that knowledge is a precious experience," says Betty Hoskins, a faculty member of our life sciences department. "The students approach such work with an entirely different outlook and interest." A colleague in the same department, T. C. Crusberg, has found that "the quality of work done by our undergraduates frequently matches and sometimes exceeds that of conventional graduate work." We believe that projects have demonstrated the truth of the saying that the best learning often takes place outside the classroom.

Projects are carried out either on campus or at one of the more than 100 off-campus industrial firms, government agencies, or community organizations cooperating with the program. Where volume is high, WPI has established permanent off-campus project centers. These include the Worcester Foundation for Experimental Biology, St. Vincent's Hospital in Worcester, the U.S. Army Research Labs in Natick, and the Liberty Mutual Research Labs at Hopkinton, all in Massachusetts.

On September 1, 1974, we opened the WPI Washington Project Center, the first problem-solving satellite campus in the nation's capital run by a science-engineering institution. There each year, 80 undergraduates and 8 resident faculty members will complete their qualifying projects by assisting governmental and nongovernmental agencies in solving a wide variety of real-life problems.

The author is president of Worcester Polytechnic Institute, Worcester, Mass. 01609. He received B.S. and M.S. degrees in physics from St. Lawrence University and a Ph.D. in experimental physics from Cornell University, in 1947. He taught mathematics and physics at St. Lawrence University from 1936 to 1954, when he left teaching to carry out research for General Electric. He came to Worcester from the position of vice chancellor of professional schools and research at Washington University, in 1965. Hazzard is a board member of several organizations, including the Association of Independent Engineering Colleges, the American Society for Engineering Education, and the Commission on Liberal Learning of the Association of American Colleges.



The competency is an examination that requires students to demonstrate their understanding of their major fields. After an overview examination of the concepts of biology, it consists of a few problems that call for application of basic principles and for integrating knowledge in unfamiliar situations. Typically, the exam is a two-day open-book written portion, followed by an oral session. All of it is administered by faculty selected from those who teach the subjects that make up the candidate's major field.

The sufficiency is designed to confirm that students have a grasp of the humanities as an essential component of their lives. Characteristically, a student takes five thematically related humanities courses, then follows up with a sixth course-seminar, in which he shows a clear grasp of that thematic relationship. The sufficiency is meant to encourage the student, by deeply involving him in one area of the humanities, to acquire confidence and methodology for further learning in the humanities.

The two qualifying projects require students to integrate their learning through application of knowledge. The "major qualifying project" involves solving a problem in the student's chosen field. Such work, as a rule, begins near the end of the educational program, when students have developed the necessary background. To prepare themselves, they frequently participate as junior members in someone else's degree project.

One recent graduate, Kurt Lutgens, did a study of mammalian motion in his junior year. He dissected a dog skeleton and studied the muscle patterns and the directions of motion by applying the laws of mechanics. In making his report, he used video tape. Working at a local pharmaceutical firm he studied reflexes in relation to short-term anesthesia in dogs and sheep. He constructed an apparatus for obtaining electroencephalograms from sheep and dogs. The results of his major qualifying project were presented at a scientific meeting in Sweden this year and will soon be published in this country.

Margaret St. John, as a junior, developed a new technique for tissue-sample preparation and for observing prepared specimens by both transmission and scanning electron microscopy. Other recent major qualifying projects have dealt with ecosystem modeling, hypothermia, plethysmography, artificial kidney development, and circadian rhythms.

The "interactive qualifying project," the fourth degree requirement, relates the student's major field to the larger world, specifically to human and societal needs and values. Thus, in the life sciences, interactive qualifying projects often delve into such areas as bioethics and ecology. Students have also done interactive qualifying projects that involved teaching biology in high school and working with juvenile delinquents through special programs.

### *Implementation*

WPI learning methods include other self-paced programs, such as "individually prescribed instruction,"

which uses video tape along with such conventional sources as textbooks. A large number of our major courses are now available on video tape. Our graduation requirements are set into a new framework of student-faculty relations, grading, calendar organization, and admissions policy.

By the nature of the plan, we strongly rely on the faculty for advising students in charting their personal programs and in completing their projects. We use "acceptable," "acceptable with distinction," and "no record" as grades to encourage learning feedback and yet foster close student-teacher cooperation. Our regular academic year is divided into four seven-week terms, with a fifth term in summer. Intensive study in three courses per term is the norm; however, during those terms in which a student is engaged in project activity, the coursework load is reduced.

Because student responsibility in the learning process is pivotal, the admissions process draws students into deciding whether to enroll. We feel that on the basis of the unusual structure of the WPI plan, it is imperative that the student be a major participant in the enrollment decision. Extensive discussions with admissions people, faculty, and students actively encourage prospective students to consider most carefully whether WPI is the right educational environment for them. Students who come to us with four years of mathematics and three years of science will find that, to the WPI admissions office, their own assessment of their motivation is more important for our unusual educational experience than their SAT scores. That motivation, combined with a realistic assessment of academic strengths and weaknesses, will ultimately allow a student to negotiate his admission to the WPI community. And, because there are four regular terms, there are four regular admissions dates in the year.

In the four years since establishment of the plan, WPI has received growing and significant moral and financial support from the outside. Leading foundations, including Carnegie, Ford, Sloan, National Science, and the National Endowment for the Humanities, have given us major grants. (NSF gave us its largest College Science Improvement Program grant ever made.) Visitors from more than 150 other educational institutions have come here for a first-hand look. National news media have told our story to larger audiences. Enrollment has remained high.

When I am asked to explain this remarkable response, I cite two main factors. One is that the WPI plan meets personal and societal needs that are real and critical, which educators and students are beginning to recognize. Secondly, the WPI plan is not a pilot project but a new way of educational life that encompasses the entire campus, all departments, and all faculty. It measures and determines everything we do. It represents a total commitment of our resources—human and financial.

I believe the combination of promising innovation in undergraduate education and quality implementation has been responsible for its external support and for giving our students the education they need.