Scientific Inquiry Planning Unit
Program Review
The Evergreen State College
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Scientific Inquiry Vision

The Scientific Inquiry (SI) planning unit aims to teach students to think like scientists engaged in the significant problems of their time; that is, identify significant problems, and to use appropriate instruments, theory, models and technology to arrive at sound conclusions. This approach is embodied in the study of different scientific domains including the physical sciences, mathematics, computing, and laboratory biology. **These subjects are studied in several ways: for their own sake, for their applications, in terms of the philosophical issues they raise, and for their place in society.** In our latest catalog, the faculty in Scientific Inquiry described itself as committed to the ideal of science education in the context of a liberal arts education. **Our goal is to help students – whatever their primary interests may be – understand nature and science as a force in our technological society.** Since science and technology are central to our world today, citizens must be scientifically informed so they can make informed decisions and participate intelligently in a democratic society. At the same time, **scientists must consider the social implications and consequences of their work; and they must know how science has impacted society in the past.** Thus, our studies of science itself are combined with studies of the history of science and with philosophical, social and political issues.

In the 1998 Self-Study the SI faculty identified ten abilities to be achieved by students and faculty; we continue to espouse these abilities as central to our work:

1. Students will have a working understanding of the field – to be able to apply concepts and ideas in situations which are different from the context in which they were learned.
2. Students will have developed a natural confidence in the workplace – to feel “at home” in the laboratory, at the computer, in the library and in a technical discussion.
3. Students should have a liberal perspective – to have a knowledge of the liberal arts as well as the relationship of one's field to society and other cultures.
4. Students should have the ability to clearly explain subject matter in one's field – to be able to present ideas and material clearly and coherently, both orally and in writing – and to do so in a manner that is accessible to a beginner.
5. At the advanced level, students should know a specialty within the field well enough to be able to formulate significant questions and be able to design experiments or procedures for answering those questions.
6. Students should demonstrate the ability to critically reason in science.

7. Faculty should be able to keep current in their fields.
8. Faculty should have a natural confidence with the new technology that the students will be using.
9. Faculty should have meaningful joint teaching experiences outside the subgroup and the planning unit.
10. Faculty should be able to carry out research in conjunction with students, in a specialty area and present the results to students and audiences outside of Evergreen.

SI Curriculum Description

The SI curriculum is composed of repeating programs (either every year or every other year) as well as some more specialized programs that are offered occasionally depending on faculty interests. The repeating programs provide several pathways that correspond to a typical science major, although individual entry level programs may also be taken as part of a less specialized education. The repeating programs consist of:

Biology	**Chemistry**	**Computer Science**	**Mathematics**	**Physics**
Health and Human Development (to be replaced by the pre-health option identified in the enrollment growth plan)	Introduction to Natural Science/Matter and Motion	Algebra to Algorithms	Matter and Motion/Data to Information	Physicist's World
Introduction to Natural Science	Molecule to Organism	Data to Information	Math Methods	Matter and Motion
Molecule to Organism	Environmental Analysis	Computability	Computability	Astronomy and Energy
Advanced Biology	Atoms Molecules Research	Student Originated Software	Math Systems	Physical Systems

SI faculty are also committed to providing opportunities to do research, as part of an ongoing faculty research program. To that end, many SI faculty support undergraduate research for advanced students.

Do we meet student needs?

The SI faculty agree that determining student needs is difficult. There are three classes of students we considered:

1. Science majors going on to graduate school in science or mathematics,
2. Non-science majors,
3. Science majors with no interest in graduate school.

Most of the faculty believe they are meeting the needs of students who intend to go on to graduate school in the sciences based on personal knowledge of students who have attended or are attending graduate school or are working in a field closely related to their education (testimonials of Schofield, Shulman, Cushing, Leisenring). However, we don't know the percentage of SI students who go on to graduate school or to meaningful work in a science related field. According to informal statistics gathered by Al Leisenring, 13% of the students enrolled in Computability and Cognition between 1988 and 2003 went on to graduate school. Of those who went on to graduate school, about 22% went into non-science graduate programs.

In the 2002 Alumni Survey of the Class of 2000-01, the SI alumni are moderately satisfied with their Evergreen education, although according to the numbers only about half of the respondents were working in SI related fields. Of the 38 SI alumni who responded to the survey, five were in graduate school. These five graduate students reported that Evergreen had prepared them adequately or very well for their graduate programs.

We have little data about non-science majors. Non-science majors may be students who take only one of the SI programs (an entry-level program) or may be students in core or inter-area programs. The data collected about Computability and Cognition students suggests that some students went on to non-science academic careers: these students may have been either science or non-science majors. (Computability and Cognition may be taken by students with broad interests.) Our representation in core and inter-area is low relative to our faculty numbers (so we have fewer opportunities to get to know non-science majors personally), and we have no institutional data from these non-majors telling us about the degree of their satisfaction.

Another estimate of how well we meet student needs may be based on student interest: Can students who are interested in science get the education they want? The institutional data from the 2003/2004 entering class indicated that about 11% of first-time-first-years expressed an interested in SI. About 13% of the transfer students identified SI as their area of interest. The entering class of 03/04 consisted of 460 first-time-first-years and 726 transfers, for a total of 148 entering students with an expressed interest in SI. According to institutional data on enrollment (03/04) SI faculty accounted for 1192% of the overall undergraduate FTE. Unfortunately, it's hard to draw conclusions from this; we don't know if students with an SI interest take core programs, inter-area programs, entry level SI programs, or advanced programs (for transfer students). We do have some ad hoc data that shows some students cannot get the SI programs they want or need (based on wait lists, personal experience with certain groups of students who can't get the programs they need, such as sophomores or upside-down students).

Do we meet our own goals?

Our goals are expressed in our vision (emphasized in bold in our vision) and can be summarized as:

1. Provide a science education for non-science majors,
2. Provide an understanding of societal issues in the practice of science and the relationship of the sciences to a broader liberal arts education (for both science and non-science majors),
3. Provide curriculum supporting students who want a traditional science major,
4. Provide a comprehensive environment for the practice of science as expressed in the 10 abilities.

One measure of how well we provide a science education for non-science majors is the number of SI faculty in core and in inter-area. In the 03/04 academic year SI provided an average 39.4 FTE per quarter in core out of 294.4 (in *Algebra to Algorithms, Nature, Nurture, or Nonsense? and Perception*), or 13.4% of the student FTE in core. In inter-area programs, SI provided an average 86.7 FTE per quarter out of 663.9 (*Ecological Design, Forensics, Health & Human Development, Science, Cognition, and Consciousness*), or about 13.1%. For the purposes of determining the number of students who have science education, the full number of seats should be counted: in that case 33.3% of the core and 26.5% of the inter-area FTE seats were in programs that offered science education. However, we have not articulated our goals for providing science and math education to non-majors nor identified what percentage of students should leave Evergreen having some meaningful science and math education.

If we turn to science majors, our own goals are captured by our curriculum and the ten abilities. SI faculty are generally satisfied with the SI curriculum for students who enter Evergreen as freshmen and are able to follow the SI pathways. In the faculty's estimate, the ten abilities that we hope to achieve in our curriculum are all moderately or very important:

	Not Important	***Moderately Important***	***Very important***
Working understanding of the field			13
Natural Confidence in workplace		6	7
Liberal Perspective		7	6
Ability to explain clearly		1	12
At an advanced level: know a specialty in field/form significant questions		3	10
Ability to critically reason in science		1	12
Faculty keep current in field		4	9
Faculty have confidence with new technology		5	8
Faculty have meaningful joint teaching outside subgroup and planning unit	1	6	6

	Not Important	***Moderately Important***	***Very important***
Faculty to carry out research in conjunction with students in specialty	1	5	7

The faculty estimate of how well we meet those abilities for students is positive (note that the faculty is more positive about the first six items which relate to student abilities and less so about the last four which relate to faculty abilities).

	Poorly	***Modestly***	***Fairly Well***	***Very Well***
Working understanding of the field			2	10
Natural Confidence in workplace		1	5	6
Liberal Perspective		3	10	
Ability to explain clearly		1	6	6
At an advanced level: know a specialty in field/form significant questions	1	1	4	5
Ability to critically reason in science		2	4	6
Faculty keep current in field	1	5	4	3
Faculty have confidence with new technology	1	2	5	5
Faculty have meaningful joint teaching outside subgroup and planning unit		6	3	3
Faculty to carry out research in conjunction with students in specialty	2	5	1	**4**

From faculty comments our greatest strengths are:

1. (Kelly): dedicated faculty, excited students

2. (Schofield): Meeting students needs/demands, preparing students for professional careers, providing research opportunities for students, i.e. integrating research into teaching, and fulfilling five foci and six expectations.
3. (Sunderman): The group is enthusiastic and passionate about teaching. The group is capable of discussions with differing points of view. We have very solid program offerings for non-transfer students seeking science careers.
4. (Nelson): Consistent curriculum, hands-on work and skill building in mathematics and science and computing,
5. (Knapp): hard-working, knowledgeable faculty; strong commitment to student welfare; considerable resourcefulness and inventiveness about details; smart and effective support from Science Instructional Technicians (SITs).
6. (Brabban): Hands on science exposure, real world science, research opportunities.
7. (Cushing): Excellent learning opportunities for outstanding students; personal attention to weaker students.

One of the goals and abilities articulated in our vision is our intent to help students understand the social implications and consequences of science. This is covered in our statement that "students should have a liberal perspective – to have a knowledge of the liberal arts as well as the relationship of one's field to society and other cultures." In the faculty responses, this was the only ability that no one thought we met very well in our programs.

Review of the issues identified in the 1998 Self-Study

The major issues in the 1998 study were:

1. Concerns about the increase in class size,
2. Expectations about faculty participation in core and inter-area,
3. Opportunities for students to do advanced work,
4. Opportunities for research,
5. Concerns as to how well the pathways work.

Are these issues still with us?

Concerns about the increase in class size have not gone away: this has been partially addressed by the use of science instructional technicians in the labs. However, the expectations of faculty load continues to be an issue, particularly in advanced classes and undergraduate research and in low-enrollment programs (where the problem is too few students) and in lab-based programs (where large classes are difficult to manage in the lab).

Our representation in core and inter-area does not meet the 40% guidelines. This is largely due to our commitment to our curriculum. The desirability of our presence in core and inter-area programs really has three components: how well do we do at providing science education to first-year students in core programs? How well do we do at providing science education to non-majors? How well do we do at providing science intensive programs to first-year students who are interested specifically in science? These are still issues today.

Student opportunities for advanced work seem to no longer be a concern. Most of the SI faculty believe that our programs do well or moderately well at helping our students achieve an advanced understanding of a specialty area. In addition, the biologists and chemists have committed to offering a one quarter advanced bio/chem program every year to meet the bio/chem student demand. A number of faculty also offer undergraduate research to advanced students (Schofield, Kelly, Barlow, Cushing, Brabban, Shulman, Nelson, Kutter).

Faculty views on how well we are able to pursue research in conjunction with students is less positive: about 40% believe that we do well or moderately well (somewhat more than reported in the 1998 self study). This continues to be a concern since research is viewed by the faculty as an integral part of a science education.

Summary of our current needs and issues

Our current issues span:

- core and inter-area programs and their relationship to science and science faculty (how to provide science to freshman and to non-majors) (Knapp, Shulman, Bopegedera),
- problems providing for transfer students in our current pathways (Kelly, Sunderman: "The rigidness of INS being the first course makes getting requirements for transfer students difficult. We seem to have very little opportunity for calculus or physics with calculus. For being a "free-thinking" college, we have only one way to do the science gauntlet.")
- the relationship of entry level programs to core or first-year seats,
- how to provide prerequisites (for instance math) to transfer students or students who didn't get into the right track initially (Sunderman/Francis/Nelson),
- how to deliver curriculum in low enrollment areas.

Many of the faculty in SI are concerned with current core and inter-area needs. There are three aspects to this:

1. constraints placed on students requiring them to attend core programs with little or no science content,
2. constraints placed on science faculty to teach in core or inter-area when we have limited faculty to teach in our SI programs,
3. a sincere desire of many faculty to provide science education to non-science majors.

A related concern is program fit for transfer students. More of our transfer students identify themselves as interested in science (13% compared to 11% for first time first years). However, our programs are designed for students attending Evergreen as first years. Our entry-level programs provide many of the prerequisites, but transfer students may not be a good fit for these programs OR the advanced programs. (Sunderman, Shulman, Nelson, Cushing)

The emphasis on core programs for first-year students (as distinct from entry-level science programs) is viewed as

forcing a “holding pattern” for students who want to make science their primary focus. In order to address both this and the problem of first year seats, a number of entry-level programs in SI have been made all-level or have allowed for a certain number of freshman seats (such as INS). At the other end of the spectrum, there is some concern as to how we can continue to provide a broad liberal arts experience in the increasingly rigorous and specialized upper-level programs (Kevin Francis).

A related problem is how we (as an area) can provide science education to non-majors. Several faculty had concerns that we do not have enough faculty to staff the science curriculum, and participate in core, or inter-area (in order to provide science education to non-majors) (Kelly, Sunderman, Shulman, Cushing).

We need better tracking. We know from student testimonials that a number of our students go on to graduate school, but our belief in the percentage of students in graduate school was not reflected in the institutional data.

Two recommendations

We need better data on who our students are, their goals and needs, and what happens to them after Evergreen. We have some soft data: individual faculty often know where their students end up, particularly if they are in graduate school. We also know what conferences they attend while at Evergreen. This kind of data may be a better indicator of how well we are meeting the needs of a certain category of the student population. We should try and identify the kind of information that would be most helpful in determining if we have reasonable goals, and if we are meeting them.

We need to look more closely at our curriculum. Most of the faculty agree that we do a good job in satisfying our student abilities (from the list of ten abilities) in our programs, but these abilities relate primarily to our science major students and possibly to non-transfer students (we don't have the data to identify if the respondents to alumni surveys were transfers or not). The structure of our repeating science programs means that it is difficult for us to teach science in programs for the non-major, whether they are core programs or inter-area. Along with our emphasis on science majors, we have several SI sub-areas that are chronically under-enrolled (Physics and lately Computer Science). Although we have a commitment to support these academic areas, given the faculty ratio requirements, we should explore if these particular repeating programs are the best way to deliver all content.

Many of our concerns about the curriculum are connected: issues of transfer students, non-science majors, inter-area programs. Our emphasis on a repeating curriculum has its strengths but it also constrains us in ways that impact on the rest of the curriculum. The introduction of more advanced programs (for instance in biology/chemistry) also fragments the faculty more and prevents meaningful representation in inter-area programs.

Possibly our most important goal should be a substantive review of the curriculum with an emphasis on how we

balance our science-major curriculum with the needs of providing science education in a meaningful way to non-majors and to first-year students.