The Evergreen State College

Scientific Inquiry Planning Unit

Self-Study

1998

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Reaccreditation Self-Study

Revised June 14, 1998 —David W. Paulsen, SI Planning Unit Coordinator

OUTLINE

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I. Description of the Scientific Inquiry Planning Unit

The Scientific Inquiry (SI) planning unit offers programs that focus on topics in the lab sciences (lab biology, lab chemistry and physics), mathematics and computer science. It shares with Environmental Studies (ES) the responsibility of creating and delivering entry level and more advanced, interdisciplinary programs with substantial science content. Although there is significant coordination between these planning units, they cut across traditional subject matter organization in different ways. In particular, the Scientific Inquiry Planning Unit focuses on lab biology and chemistry, whereas Environmental Studies emphasizes field biology and chemistry in an environmental setting. They also differ in their relationship to traditional divisions. Environmental Studies links topics in science with issues in the social sciences, particularly public policy; whereas Scientific Inquiry is more closely linked with the humanities, in particularly, to the philosophy and history of science and mathematics as well as the cultural history of technology. The area aims at empowering students by giving them a firm foundation in science as well as a full appreciation of the philosophical, historical, cultural and ethical context of scientific inquiry.

(A) How is the teaching of science at Evergreen different?

Critiques of science education in American colleges and universities frequently points to a variety of factors that undermine success for many undergraduate students:

- An environment that is characterized as highly competitive, pitting students against one another
- Large lecture classes that stress rote and passive learning,
- Fragmentation of the curriculum
- Little relation between theory and practice.

Evergreen is structured in ways that allow us to deliver a science curriculum that avoids these pitfalls and promotes the best practices mentioned in these critiques of traditional science education. Science teaching in SI differs from that found in more traditional institutions in a number of ways that reflect the area's commitment to foci that characterize Evergreen as a whole:

1. (*Intensive Study*) SI aims at providing an intensive two-year program (typically 96 quarter hours) which provides a firm and coherent foundation in a scientific discipline or disciplines rather than spreading out the work over four or five years. This is possible in part because of the advantage that comes from having the same group of students studying the same topics for a whole year. Although students may enter the program with a variety of backgrounds, all students in the winter quarter, for example, have taken the same fall quarter "prerequisite". This is even more evident for spring quarter topics that can depend on two quarters of previous study in a particular subject matter or in relevant related subjects.

2. (*Interdisciplinary Work*) SI teaches subject matter in an integrated, interdisciplinary format that allows for synergy that arises when, for example, the teaching of physics can be directly tied to the teaching of calculus, the teaching of computer algorithms to issues in discrete mathematics, the teaching of metabolism to biochemistry. This format also promotes the study of interdisciplinary themes and content. We provide opportunity for students to study topics found in a more traditional departmental structure, but we do so in a manner which stresses integration of different disciplines as well as the importance of the social, political, cultural and ethical dimensions of science.

3. (*Active learning*): SI prides itself on getting the students to do hands-on work regularly throughout their time in the area. From freshman through seniors, our students are actively learning the material rather than passively taking in reading by rote memory only to be spit out on a test and forgotten. The majority of our programs have laboratories where students spend several hours a week and often have open-ended laboratory projects that the students design and carry out during the year. In addition to the laboratory, many of the faculty have their students giving guest lectures, presenting projects in the form of poster sessions, oral presentations, as well as the more typical written reports on topics of their choice. The fact is, most of our students' learning is active rather than passive. Study groups, laboratory partnering, and workshops contribute to this as well. This expectation of active engagement is found as well in seminar discussion and related small group activities.

4. (*Theory and Practice*) SI includes a number of programs (described later) that directly tie theory and practice such as the research opportunities though the *Undergraduate Research* option; the year-long, client-centered software engineering projects of *Student Originated Software*; and the extensive cognitive science research project in the *Science of Mind*. Other programs typically include more applications than found in their equivalents at other institutions.

(B) How is SI structured?

The SI curriculum is more established and recurring than in most of the other planning groups at the college, perhaps only matched by repeating programs in Expressive Arts. This may be in part because of the issue of skill-building, which both groups share, as well as the nature of laboratory-based, hands-on studies. Some of our colleagues at Evergreen decry this amount of structure and suggest that we are like any other science department, in spite of the differences noted above. This criticism is in part an artifact of our choice to retain the same name for a program, even when the themes and content change from year to year in important ways (unlike other areas of the college which might teach the same topics under new names). But the area regularly faces the tension between the demands of coverage and of flexibility, both across the SI curriculum and within programs. Part of the tension comes from the subject matter we teach. Students typically don't come to the college with a strong background in science and mathematics. This means that a year of "Entry Level" work is often necessary to tackle seriously more advanced themes. Nevertheless, we recognize the need to provide more expansive and risky programs, particularly those that might attract students from outside the area. But we recognize as strongly the importance of providing those students with a keen interest in science the opportunity to take programs which will empower them to work or study in science after graduation without additional undergraduate study elsewhere. This commitment to quality (as measured by external standards) and the limited number of faculty has made it difficult to provide many such thematic science programs with a wide, cross-divisional audience. This is a tension that projected enrollment growth at Evergreen might help resolve, assuming the number of faculty in the area increases significantly as well.

Scientific Inquiry has consistently delivered a slowly evolving series of interdisciplinary programs in science at the intermediate and more advanced levels. Titles remained constant but content and element of structure changed reflecting developments in various fields as well as differences in teaching teams. We have found that retention of program titles helps students find their way through the curriculum. SI offers a basic two year curriculum consisting of three "Entry Level" programs offered every year and a variety of more advanced programs, typically offered on a biennial basis. Relatively few graduating students who take advanced programs in the area have been at Evergreen for four years (less than 25% of the SI students receiving a BS degree in 1997). Students staying for the full four years typically take programs from other planning units. Like other areas of the college, many of our students are transfers who remain at Evergreen about two years. SI's offerings grew out of a series of programs in the early years of the college that provided background in physics, mathematics, chemistry and biology as well as related topics from other areas of the college. In the early 1980's computer science was added. Until the recent reorganization of the college from "specialty areas" to "planning units," it also had affiliated additional faculty in psychology and areas of health policy.

Table 1 displays the regularly recurring offerings in the area and marks the way in which "traditional" science subject matter areas are incorporated into them. But as indicated in Figure 1, these interdisciplinary programs provide an overlapping array of topics that cut across tradition departmental lines. As indicated in the table and figure, the area offers three entry level programs: *Introduction to Natural Science* (formerly *Foundations of Natural Science*) with substantial biology, chemistry and math content, *Matter and Motion*, with calculus-based physics, chemistry and math content, and *Data to Information* with computer science and math content. Each of these programs includes a seminar component that addresses larger interdisciplinary themes, such as issues in the history of technology included in the Data to Information program, or oscillations in Matter and Motion.

At a more advanced level, students interested in biology can take *Molecule to Organism*, which has focused on molecular biology and *Science of Mind* which includes neurobiology. In addition, selected advanced students have been able to do *Undergraduate Research* in one of the grant-funded research programs. Advanced students interested in physical chemistry can take *Atoms, Molecules and Research* (which grew out of an early program called *Chemical Systems), Environmental Analysis* for analytical chemistry and *Molecule to Organism* for topics in organic and biochemistry. Advanced students focusing on physics take *Physical Systems* and *Energy Systems (*replaced by *Energies: celestial and terrestrial).* Advanced students with special interest in math can take *Math Systems* as well as *Physical Systems* (which treats mathematical applications in more advanced physics) or *Computability and Cognition* (which covers mathematical logic, foundations of set theory and discrete math). Advanced students pursuing studies in computer science can take *Student Originated Software* (which provides background in software engineering) and *Computability and Cognition* (which is focused on more formal topics in computer science as well as artificial intelligence)

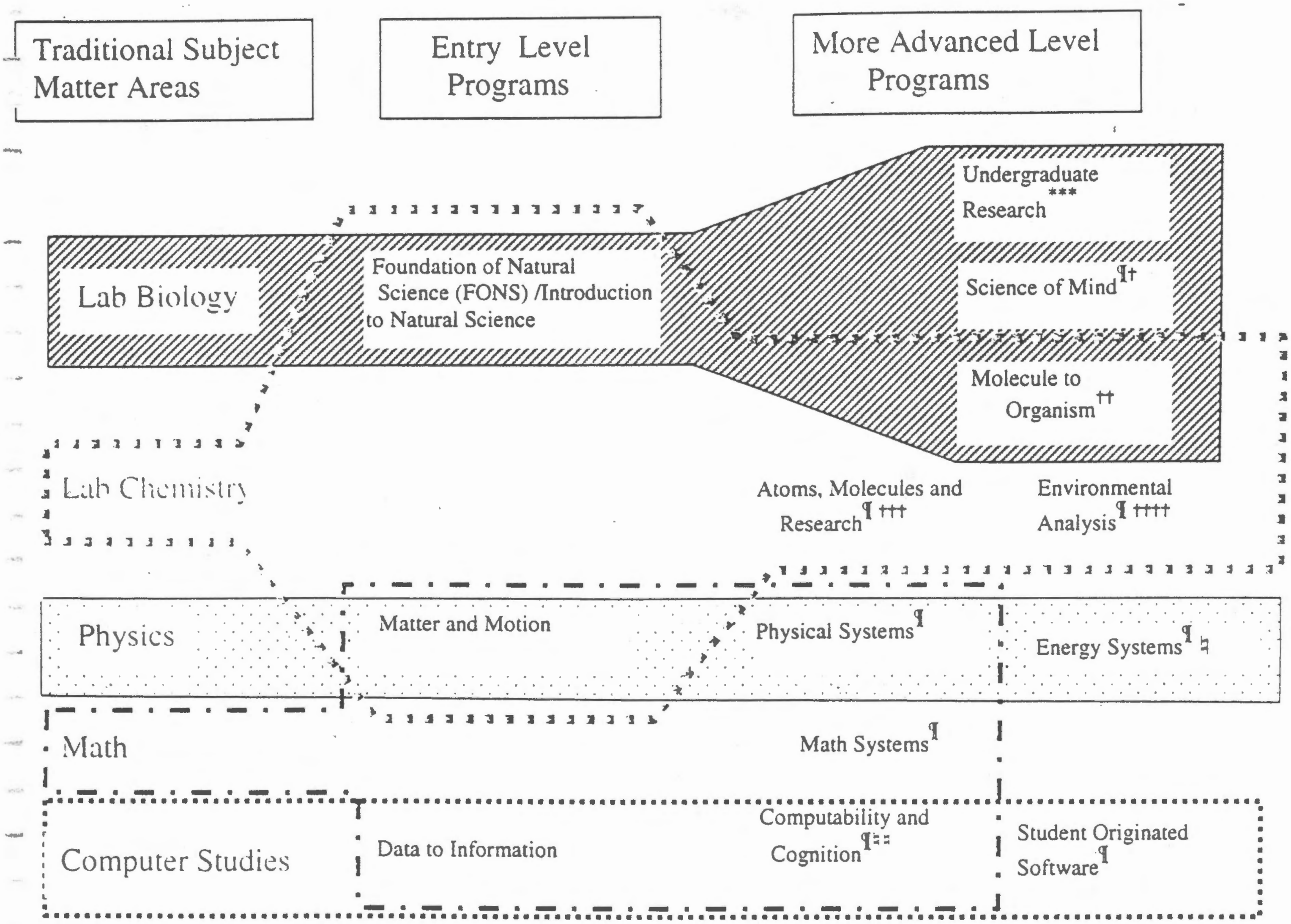
In addition to these regularly repeating programs, the area offers programs on occasion with an emphasis on Philosophy of Science as well as special topics such as Evolution and joint programs with Environmental Studies concerned with environmental chemistry. Faculty affiliated with the area have participated in Core programs with a significant science content, such as *Society and the Computer*, *Reflections on Nature* and *Water, Environment, Land and People.*

Table 1: "Pathways" for students with a Special Interest in Specific Subject Matter

Traditional Subject Matter Areas	"Typical" ENTRY LEVEL PROGRAM	More ADVANCED PROGRAMS
Lab Biology	Introduction to Natural Science(INS)/ Foundations of Natural Science (FONS)	Molecule to Organism (M2O) *or thematic equivalent* Science of Mind* *{Undergraduate Research}*
Lab Chemistry	Matter and Motion	Atoms, Molecules, Research* Environmental Analysis*
Physics	Matter and Motion	Physical Systems* Energies: Celestial and Terrestial* *(Energy Systems)*
Mathematics	Matter and Motion *(Calculus)* Data to Information *(Discrete Math)*	Math Systems* *{Physical Systems*, Computability and Cognition*}*
Computer Science	Data to Information	Computability and Cognition* Student Originated Software*
Cognitive Science	Introduction to Natural Science(INS))/ Foundations of Natural Science (FONS) Data to Information	Science of Mind* Computability and Cognition*

* Offered every other year

Figure 1: Interdisciplinary content of Recurrent Offerings in the Scientific Inquiry* Planning Group by Level and Coverage ** of "Traditional " Subject Matter Areas



¶ Offered every two years
*Includes programs from the Science. Technology and Health (/STH) Specialty Area that continue in SI
**These programs cover topics from other "traditional" areas of science as well as from other divisions as well but featured in the figure represent areas of central focus
***The Undergraduate research option was traditional associated with molecular biology, but has recently been expanded to include faculty and options from throughout the area
† Science of Mind is an InterArea program with a significant cognitive psychology and research methods components.
†† *Molecule to Organism* has been replace (1997-98) by two programs: a thematically oriented option (*Vital Stuff* and a customary molecular biology option, (*The Structure of Life*) linked by a common organic chemistry component
††† *Atoms, molecules and Research* replaced *Chemical Systems* offered in earlier years
†††† scheduled to be offered for 3 quarters 1998-99 and again in 2000-01
♮ Replaced (1997-98) by *Energies: Celestial and Terrestrial*
:: *Computability and Cognition* together with *Science of Mind* provide a Cognitive Science option in the area

(C) What is our teaching "Vision "?

The area takes seriously its commitment to empower students by providing high quality teaching of subject matter found in science courses at traditional liberal arts colleges, but it seeks to do so in a way which reflects the five foci of the college, particularly in linking theory to practice through interdisciplinary programs which encourage active learning in a collaborative, group setting. Unlike traditional colleges, however, it seeks to present science in a way that emphasizes the connection of science to larger social, political, intellectual issues. According to a recent Evergreen catalog

> *The Scientific Inquiry planning group aims to teach students to think like scientists; that is, to collect and evaluate data, to employ theory, to do quantitative modeling and to use appropriate instruments and technology. 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.*
>
> *The programs offered by faculty from this area will be useful to students interested in careers or future work in science, those interested in applying science in selected technical areas as well as those interested in understanding more about science by doing science as part of their more general liberal arts education. Students from this area work in careers requiring a scientific, mathematical or computing background, enroll in medical school, or go on to graduate study in a variety of scientific or related areas. High quality introductory and advanced study provide them with a foundation in both theory and practice that can enable them to be part of the conversation in these fields, as informed listeners able to effectively communicate the process and results of scientific inquiry in speech and writing. Science and technology play an important role in modern America. It is essential that citizens be scientifically informed in order to make responsible decisions, and that scientists be broadly trained in the liberal arts to contribute responsibly to social issues. [from the 1997 - 1998 catalog]*

This approach is articulated more fully in the "vision statement" adopted by the area. It defines the area primarily in terms of the abilities we want our students to have. We seek that all of our 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
- 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
- will 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
- will 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
- at the advanced level, will 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 these questions.

This original list was modified in the fall of 1997 to include the general aim of promoting

- Critical reasoning in science

In order to achieve these aims for our students, the faculty in the area recognize the importance the following aspirations for the faculty:

- to keep current in our field
- to have a natural confidence with the new technology which our students will be using

- to have meaningful joint teaching experiences with other faculty outside the subgroup and outside the planning unit
- to carry out research, in conjunction with students, in our specialty and present the results to students and audiences outside of Evergreen.

D. Description of Subareas and Pathways

The Scientific Inquiy planning unit can be divided into several subareas: computer science, physical science (physics and chemistry), laboratory biology and mathematics.

1. Computer Science Education at Evergreen.

Evergreen's mode of education is particularly well suited to this emerging, quickly changing and inherently multidisciplinary area of study. Our computer science curriculum is currently organized into three coordinated studies programs, each of which is full-time, year-long, interdisciplinary and team taught. Each program has a significant seminar component, writing assignments, in-class presentations, hands-on (laboratory-oriented) workshops and team-oriented activities. Seven faculty trained in a relatively wide spread of disciplines (mathematics, philosophy, psychology and computer science) regularly teach in the area; three of those faculty have some practical experience in software development. Several factors assure a flow of new ideas into the computing curriculum, for example: (1) faculty from outside "the area" sometimes team-teach with one of the seven in these programs, (2) most of the seven faculty also teach outside the area or conduct interdisciplinary research (e.g., mathematics, cognitive science, social impact of technology and environmental studies), (3) a perpetual fund (from royalties on software developed at the college) sponsors a yearly speaker series on some broadly based topic related to computing (See Appendix for list), (4) Evergreen has received outside funds to develop a model interdisciplinary computer science curriculum, (5) there is strong interest in the use of computing across the curriculum, including graphics imaging, electronic music and scientific computing.

The three programs:

Data to Information (DtoI). This introductory program, team-taught by two faculty (a computer scientist and a mathematician), is primarily aimed at second-year students interested in computer science. Transfer students and some third or fourth year students from other disciplines seeking to develop background in computer science also take this program. The program includes introductory programming (the language varies from year to year -- C, C++, Java, ML, Haskell); data structures and algorithms; discrete mathematics and some other mathematics such as statistics, calculus, or linear algebra; digital logic, computer architecture and operating systems; and an integrative seminar. DtoI is intended to provide a solid foundation in computer science; because the material is taught in a one-year intensive and integrative manner, more can be covered in one elapsed year than at other institutions.

Student Originated Software (SOS). This year-long upper division program provides students with in-depth practical experience prepatory for working in a team on major software projects. It further integrates concepts, abilities, and skills that provide a sound basis in the theory and practice of advanced computer science into the study of software engineering. SOS was conceived and has been most often taught by faculty with experience in the software industry, who have an understanding of modern software development methodology and who maintain contact with significant software engineering efforts in the Seattle-Portland area, state government and "high-tech" start-ups. Student projects are team-based, with each team responsible for organizing itself; finding its project and "real-world" clients; preparing a feasibility study; and completing systems analysis, specification, software design, development, user's and training guides, maintenance and installation plans. SOS is aimed particularly for students who plan on careers in software development or entrepreneurship, but the program is also excellent graduate school preparation. SOS alums currently work for companies such as Microsoft, Hewlett Packard, GemStone, and small high-tech startups, state government, and the national laboratories.

Computability and Cognition (C&C). This program is an integrated course of study in computer science, mathematics, and cognitive science, team-taught by faculty with expertise in mathematical logic, philosophy and computer science. C&C emphasizes the nature of formal systems -- their power and limitations, including challenges to symbolic approaches in artificial intelligence, currently those growing out of connectionist computational models. Students follow a rigorous study of discrete mathematics, formal logic, logic programming, automata theory, computability theory, connectionist computational models (artificial neural networks), as well as integrative seminars in the philosophy of mathematics, language and cognitive science. This program attracts students from philosophy and mathematics as well as computer science and is strongly recommended for any student with aspirations towards graduate school. Along with the *Science of Mind* program, C&C provides significant background in Cognitive Science. Graduates of this program have continued their studies in graduate schools such as Edinburgh, Brown, CalTech, Stanford, UCSD, and the Oregon Graduate Institute.

Tracking students through the curriculum. Students who want to concentrate in computer science and who follow a traditional undergraduate course of study (four-years, at Evergreen), would take the *Data to Information* program in their second year of college (or, if they are well prepared, as freshmen). Depending on individual educational goals, students then typically choose one of two advanced programs -- "Computability and Cognition" or *Student Originated Software* for their junior or senior years. Students are encouraged to spend at least one year studying other areas, such as mathematics, the physical or cognitive sciences, language and culture, or the expressive arts; *Matter and Motion*, *Science of Mind* and *Media Works* are particularly synergistic and make particularly good companions to the computing curriculum. In addition to their study in year-long programs, many computer science students complete individual study or project work and internships (e.g. research projects at Evergreen, at nearby software firms, or with one of Washington state's governmental agencies).

Many Evergreen students do not follow the traditional four-year course of study. Transfer students, returning students, and students who discover computer science through other disciplines often take these programs in an order different from the "standard". Thus, for example, some transfer students with background in computer science from community colleges will take SOS in their junior year, and then go on to take C&C or some of DtoI to fill in gaps in their education. Other students may "discover" computing through their interest in cognitive science in C&C, and go on to take SOS. We have found that these paths also work, if faculty are willing to make concessions for students who may not have all the prerequisites, or to make substitutions for students who have had some of the material a program offers.

Outside support for computing at Evergreen. Evergreen has a number of NSF awards to support involving undergraduates in research. During the last three years, this part of the curriculum has received over $300,000 from the Computer and Information Sciences and Engineering Division of the National Science Foundation to integrate recent computer science research results into the curriculum. To that end, five faculty have spent time at a nearby research institution, the Oregon Graduate Institute in Portland, Oregon, to study research programs and design curricular materials. We offered two summer workshops to export our ideas in the region and nationally (See NSF/CISE web pages accessible from the Evergreen home page, www.evergreen.edu/nsfcise)

2. Physical Science Education at Evergreen: Physics and Chemistry

Programs with substantial physical science content provide a strong background for further work or study in chemistry, physics or some field of engineering, as well as a strong foundation for students going into medicine or quantitative environmental studies. The entry-level program for the physical sciences, *Matter and Motion* is offered every year. The central content has remained the same: calculus, physics, and chemistry. Three faculty (a mathematician, a physicist, and a chemist) taught the program in 1989 when the student to faculty ratio was 20, but now it is staffed by only two faculty. In 1989, the program made extensive use of the outstanding Computer Applications Lab (described below) for a full 3 days each week. The CAL is still used extensively in the program, but only for portions of two days each week. It is currently under review and will be intensively studied during the summer if 1998.

For more advanced students interested in physics, the *Physical Systems* and *Energy* programs alternate. The major change in content over the past few years has been an increasing technical component to the program. Enrollment in a portion of *Energies: Celestial and Terrestrial*, for example, requires calculus as a prerequisite for the first time in many years. The *Math Systems* program is offered in alternate years in such a way that a student could take *Physical Systems* one year and *Math Systems* in the alternate year.

Students with a special interest in chemistry study advanced topics in chemical bonding and thermodynamics as well as chemical dynamics, molecular structure, biochemistry, and environmental chemistry. At the advanced level, *Chemical Systems* or its current equivalent, *Atoms, Molecules and Research* (described more fully in a "model program" portfolio on exhibition) have been offered every other year. Beginning in 1998-99, the Environmental Analysis program, which is a joint offering with the Environmental Studies Planning Group, will alternate with *Chemical Systems* on an every other year basis. In addition, a change in the scheduling is being arranged to begin in 1999-2000 so that *Chemical Systems* and *Physical Systems* will be offered in alternative years, rather than in competition with each other as is currently the case.

3. Laboratory Biology Education at Evergreen

Students with an interest in lab biology, often begin with an entry level program, called *Introduction to Natural Science* (INS) or *Foundations of Natural Science* (FONS). This program provides background in various topics in biology as well as chemistry and mathematics. It has been offered as a full, three quarter program, but in recent years has been reduced to two quarters followed by optional work spring quarter. Faculty come from the SI area as well as Environmental Studies. More advanced work is offered in the *Molecule to Organism* (M2O)program (or its equivalent) that is the preferred more advanced program for students with a strong interest in Laboratory Biology. In addition, the *Science of Mind* program, which provides InterArea work in cognitive science, includes a two quarter neurobiology component and serves as a feeder program for M2O.

These programs have various types of biology labs. Microbiology, physiology, neurobiology, genetics, and development are offered to varying degrees from year-to-year depending on which of the biologists are teaching in which program for a given year. However, the labs that are offered are high-quality and use state-of-the-art equipment that give students a chance to do the kind of work that they'll see in graduate schools. Furthermore, faculty believe faculty developed, highly structured labs are fine for the fall quarter, but by spring they open up the types of labs offered so that students are doing more self-directed, active work than at many colleges where class size limits the possibilities. For example, the current more advanced program began with several "canned" labs about microbiology around the microorganisms that affect food and water. Even these had student input when they were asked to bring in water to be tested. The same student-driven work happened in the study of water content in food – students brought in a food sample of their choice, then began studying such issues as fermentation by making sauerkraut and other fermented vegetables. As the year goes on, students expand their input by helping to choose the laboratory direction, and finally designing and implementing a project. Similarly, as indicated in the "model program" portfolio (available as an exhibit) , *Science of Mind* has a variety of project opportunities leading to a substantial spring quarter project.

There is also the chance for students to work in laboratories with ongoing projects. Under the auspices of the *Undergraduate Research* program, which encompasses several biology and chemistry labs, students have the chance to work in funded labs using state-of-the-art equipment. These labs are carrying out on-going projects and allow students (often in teams) to carry out research projects. It is especially aimed at providing a capstone research experience for advanced students.

5. Mathematics Education at Evergreen

Mathematics at Evergreen is largely taught through applications. Students with an interest in math often take *Matter and Motion* which teaches calculus as applied to physics and chemistry. There is a more advanced mathematics program, *Math Systems*, that teaches a variety of mathematical topics in an historical context, on an alternate year schedule. In addition, students can study mathematical logic, discrete math and the philosophy of mathematics in the *Computability and Cognition* program and multivariate and vector calculus in the *Physical Systems* program. Students with an interest in graduate study in mathematics need to carry out individual study with one of the mathematicians on campus to cover a fuller range of topics. The teaching of calculus has been influenced by an NSF grant to promote new methods of teaching calculus.

5. Cognitive Science at Evergreen

Students with an interest in cognitive science can take more advanced programs at Evergreen: *Science of Mind* and *Computability and Cognition* The *Science of Mind* program covers topics in neurobiology, cognitive psychology, psychological research methods, statistics and philosophy of science. It is designed to permit an extensive research project, typically in experimental psychology, during the spring quarter. The Computability and Cognition program focuses on issues in computer science and artificial intelligence, including artificial neural networks, as wêll as mathematics and philosophy of mind.

E. . Enrollment Patterns and Change of Curriculum Over Time

The overall structure of the curriculum content hasn't changed much over the past 10 years, but it has been (and is being) rearranged. Even the names of the programs have remained relatively constant since 1989 although some changes are evident in the 1997-1998 catalog due to the many discussions during the reorganization to planning units. Of course, specific content and pedagogy have changed depending on developments within fields and the areas of interest of the teaching faculty. Table 2 below indicates the years when the following programs were offered and their typical "content".

TABLE 2: Scientific Inquiry Curiculum: Repeating programs and their content

abbreviation	title of program	brief description of topics usually covered
FONS	= Foundations of Natural Science = INS	algebra, chemistry, biology, sometimes physics, philosophy
INS	= Introduction to Natural Science = FONS	similar to FONS but also aimed at serving Environmental Studies
M&M	= Matter and Motion	calculus, chemistry, physics, philosophy or sociology
M20	= Molecule to Organism	organic chemistry, cell & molecular biology, biochemistry, physiology
DtoI	= Data to Information	programming, data structures., computer. architecture, operating systems., discrete math
SoM	= Science of Mind	neurobiology, cognitive psychology, research design , statistics, philosophy of science
SOS	= Student Originated Software	computer science, software engineering, advanced programming
C&C	= Computability and Cognition	logic, philosophy of mind, programming, discrete mathematics, cognitive science.
M. Sys	= Mathematical Systems	advanced calculus, abstract algebra, geometry, topology, history
E.Sys	= Energy Systems	thermodynamics, multivariable calculus, fluids, energy policy,electronics
P. Sys	= Physical Systems	junior/senior level physics: mechanics, quantum mechanics, electromagnetism .
C. Sys	= Chemical Systems = AMR	junior/senior level chemistry: thermodynamics, inorganic, spectroscopy, lab
AMR	= Atoms, Molecules, Research	junior/senior level chemistry (see Chemical Systems above)

	89-90	90-91	91-92	92-93	93-94	94-95	95-96	96-97	97-98	name changes in 97-98
introductory offerings										
FONS/INS	o	√	√	√	√	√	√	√	√	
M&M	√	√	√	√	√	√	√	√	√	
DtoI	√	√	√	√	√	√	√	√	√	
advanced offerings										
M20	√	√	√	√	√	√	√	√	√	Vital Stuff + OrganicChem + Structure of Life
Atoms,Mol.Res /ChemSys	√	√	√	√	o	√	o	√	√	Environmental Analysis
Math Sys	√	o	√	o	√	o	√	o	√	
Phys Sys	√	√	o	√	o	√	o	√	o	
Energy Sys	√	√	√	o	√	o	√	o	√	Energies: celestial & terrestial
Sci of Mind	√	o	√	o	√	o	√	o	√	
SOS	√	o	o	o	√	o	√	o	√	
C&C	o	√	o	√	o	√	o	√	o	

As Table 3 indicates, FTE enrollment in Scientific Inquiry repeating programs has varied from year to year, but ultimately increased by about 30% over the period from fall 1991 to fall 1997, roughly paralleling the growth of the college as a whole. About half of the enrollment is in the three entry level programs (Data to Information, Matter and Motion, and Foundations of Natural Science (or its equivalent Introduction to Natural Science.)

TABLE 3: Fall FTE enrollment for Regularly Repeating SI Programs Fall 1991 through Fall 1997*

Year	Entry Level	Advanced **	Total	% Change from '91
1997	166.8	223.4	390.2	32.3
1996	195.3	153.9	349.2	18.4
1995	145.6	211.0	356.6	21.0
1994	183.2	143.7	326.9	10.9
1993	144.0	185.1	329.1	11.6
1992	184.8	159.0	343.8	16.6
1991	138.7	156.1	294.8	
Mean 91-97	165.5	176.0	341.5	

*This table does not include FTE generated by SI faculty in Core, in Intergroup programs other than Science of Mind, in courses and modules, and in other non-recurring programs

**Includes 2/3 of Science of Mind enrollment to reflect SI faculty contribution

The detailed enrollment patterns for each repeating program is listed in Table 4. It includes Fall, Winter, Spring, and average enrollment by both head count (number of students enrolled) and FTE equivalent students (where 15 quarter hours = 1 FTE equivalent student). It includes as well various programs offered by SI faculty on a one-time basis. The table also includes fall quarter to spring quarter attrition, which is computed by taking spring quarter head count as a portion of fall quarter head count. It indicates considerable variable in enrollment level and attrition between programs and for a recurring program from year to year Variability in attrition from year-to-year for a particular program are likely to reflect differences in the interaction of particular faculty teams and student cohorts. Attrition in advanced programs may reflect in part, students who finish up their studies mid-year as well as those who pursue an internship. In other cases, such as the Science of Mind program, it reflects as well the level of quantitative preparation of psychology students, who have difficulty keeping up in the statistics and neurobiology portions of the program..

In addition to these full time programs, FTE is generated by individual contracts taken by faculty as well as various courses offered as free-standing modules or as elements of a full time program open to students from outside the program. The following courses were offered during the 1995/96 and 19996/97 academic years: *Pre Calculus Math, Calculus I, II, III, Multivariable Calculus I, II, Introduction to Statistics, Intermediate Statistics General Chemistry, Inorganic Chemistry I, II, Organic Chemistry, Thermodynamics, Human Biology I, II, III, Astronomy I, Cosmology Seminar, Quantum Mechanics, Lecture series: Science Stories, Introduction to Relational Databases, Scientific Data Acquisition.* The Evergreen Summer school also regularly offers introductory courses in biology, chemistry, physics, mathematics and computer science to supplement the academic year offerings and provide requisite background for more advanced study in the sciences.

Table 4: ENROLLMENT PATTERNS IN SI PROGRAMS Fall 1991 through Fall 1997

	HEADCOUNT				FULL TIME EQUIVALENCY				STUDENT FACULTY RATIO			ATTRITION
Program	Fall	Winter	Spring	Ave HC*	F-FTE	W-FTE	S-FTE	Ave. FTE	Ave.Fac FTE	Ave. Student FTE/Fac	Ave. HC/Fac	HC F-S Attrition
Data to Information f97	52			**52.0**	55.5				2.0	27.7	26.0	
Data to Information 96/97	66	59	44	**56.3**	64.0	52.0	39.5	**51.8**	2.0	25.9	28.2	0.33
Data to Information (10 Freshmen) 95/96	51	42	38	**43.7**	51.7	41.9	31.6	**41.7**	2.0	20.9	21.8	0.25
Data to Information 94/95	46	43	44	**44.3**	47.6	38.1	34.9	**40.2**	2.0	20.1	22.2	0.04
Data to Information 93/94	31	25	18	**24.7**	32.3	25.9	17.3	**25.2**	2.0	12.6	12.3	0.42
Data to Information 92/93	35	32	31	**32.7**	34.7	29.3	26.1	**30.0**	2.0	15.0	16.3	0.11
Data to Information 91/92	32	34	27	**31.0**	29.9	29.6	23.7	**27.7**	2.0	13.9	15.5	0.16
Introduction to Natural Science f97	72			**72.0**	71.3				3.0	23.8	24.0	
Foundations of Natural Science 96/97	82	72	0	**51.3**	83.0	68.8	0.0	**75.9**	3.0	25.3	17.1	0.12
Found. of Nat Science (10 Freshmen)	45	54	33	**44.0**	46.8	47.6	26.4	**40.3**	3.0	13.4	14.7	0.27
Foundations of Natural Science 94/95	72	62	50	**61.3**	73.9	58.0	34.9	**55.6**	3.0	18.5	20.4	0.31
Foundations of Natural Science 93/94	68	69	50	**62.3**	70.6	65.2	35.8	**57.2**	3.0	19.1	20.8	0.26
Foundations of Natural Science 92/93	92	73	57	**74.0**	97.1	75.1	55.5	**75.9**	3.0	25.3	24.7	0.38
Foundations of Natural Science 91/92	63	58	57	**59.3**	65.9	56.1	53.8	**58.6**	3.0	19.5	19.8	0.10
Matter and Motion f97	41			**41**	40.0				2.0	20.0	20.5	
Matter and Motion 96/97	49	37	18	**34.7**	48.3	33.2	7.3	**29.6**	2.0	14.8	17.3	0.63
Matter and Motion (10 Freshmen)	50	41	33	**41.3**	47.1	35.2	23.7	**35.3**	2.0	17.7	20.7	0.34
Matter and Motion 94/95	66	53	45	**54.7**	61.7	50.5	36.4	**49.6**	3.0	16.5	18.2	0.32
Matter and Motion 93/94	46	42	36	**41.3**	41.1	36.8	28.6	**35.5**	3.0	11.8	13.8	0.22
Matter and Motion 92/93	56	47	40	**47.7**	53.0	43.8	39.3	**45.4**	3.0	15.1	15.9	0.29
Matter and Motion 91/92	42	37	32	**37.0**	42.9	36.0	30.7	**36.5**	3.0	12.2	12.3	0.24

* HC stands for "Head Count"

Program	Fall	Winter	Spring	Ave HC	F-FTE	W-FTE	S-FTE	Ave. FTE	Ave.Fac FTE	Ave.Student FTE/Fac	Ave. HC/Fac	HC FS Attrition
Structure of Life f97	24			**24.0**	18.1				1.0	18.1	24.0	
Vital Stuff f97	55			**55.0**	36.1				1.5	24.1	36.7	
Organic Chemistry f97	80			**80.0**	30.9				1.5	20.6	53.3	
Molecules & Organisms 96/97	80	80	64	**74.7**	79.1	72.5	47.3	**66.3**	3.0	22.1	24.9	0.20
Molecule to Organism 95/96	80	77	59	**72.0**	80.8	70.5	38.1	**63.1**	3.0	21.0	24.0	0.26
Molecule to Organism 94/95	83	78	57	**72.7**	73.9	47.5	36.6	**52.7**	3.0	17.6	24.2	0.31
Molecule to Organism 93/94	67	59	50	**58.7**	62.0	55.1	48.7	**55.3**	3.0	18.4	19.6	0.25
Molecules to Organism 92/93	70	59	46	**58.3**	61.6	54.5	42.1	**52.7**	3.0	17.6	19.4	0.34
Molecules to Organism 91/92	52	47	33	**44.0**	51.1	43.4	30.7	**41.7**	3.0	13.9	14.7	0.37
Atoms, Molecules & Research 96/97	12	10	12	**11.3**	12.8	10.4	9.1	**10.8**	**1.0**	10.8	11.3	0.00
Atoms, Molecules & Research 94/95	16	10	10	**12.0**	13.5	8.9	7.3	**9.9**	1.0	9.9	12.0	0.38
Atoms, Molecules & Research 92/93	24	21	16	**20.3**	24.7	21.0	13.7	**19.8**	1.0	19.8	20.3	0.33
Mathematical Systems f97	16			**16.0**	13.1				1.0	13.1	16.0	
Mathematical Systems 95/96	17	15	14	**15.3**	14.0	13.5	11.5	**13.0**	1.0	13.0	15.3	0.18
Mathematical Systems 93/94	31	27	30	**29.3**	26.3	24.3	25.3	**25.3**	1.0	25.3	29.3	0.03
Mathematical Systems 91/92	13	14	11	**12.7**	12.3	11.2	7.5	**10.3**	1.0	10.3	12.7	0.15
Computability and Cognition 96/97	42	40	30	**37.3**	38.3	32.8	25.6	**20.0**	2.0	10.0	18.7	0.29
Computability and Cognition 94/95	29	28	19	**25.3**	29.9	24.7	17.6	**24.0**	1.2	20.6	21.7	0.34
Computability and Cognition 92/93	42	41	34	**39.0**	42.4	35.1	30.1	**35.9**	2.0	17.9	19.5	0.19
Student Originated Software f97	44			**44.0**	46.5				2.0	23.3	22.0	
Student Originated Software	52	56	45	**51.0**	54.3	54.9	42.9	**50.7**	2.0	25.4	25.5	0.13
Student Originated Software 93/94	29	31	31	**30.3**	30.1	30.9	29.6	**30.2**	1.0	30.2	30.3	-0.07
Student Originated Software 91/92	23	22	22	**22.3**	23.2	21.9	21.6	**22.2**	1.0	22.2	22.3	0.04

Program	Fall	Winter	Spring	Ave HC	F-FTE	W-FTE	S-FTE	Ave. FTE	Ave.Fac FTE	Ave. Student FTE/Fac	Ave. HC/Fac	HC FS Attrition
Energies: Celestial and Terrestrial f97	28			**28.0**	19.5				1.0	28.0	28.0	
Energy Systems 95/96	26	22	20	**22.7**	23.5	19.2	17.9	**20.2**	1.0	20.2	22.7	0.23
Energy Systems 93/94	29	27	20	**25.3**	23.7	23.3	18.4	**21.8**	1.0	21.8	25.3	0.31
Energy Systems 91/92	27	26	22	**25.0**	28.0	26.9	20.8	**25.2**	1.0	25.2	25.0	0.19
Physical Systems 96/97	21	20	23	**21.3**	20.0	19.2	19.2	**13.2**	1.5	8.8	14.2	-0.10
Physical Systems 94/95	26	25	22	**24.3**	23.7	22.5	19.3	**21.9**	1.0	21.9	24.3	0.15
Physical Systems 92/93	20	18	21	**19.7**	20.5	18.1	18.9	**19.2**	1.0	19.2	19.7	-0.05
Science of Mind f 97	72			**72.0**	77				3.0	25.6	24.0	
Science of Mind 95/96	52	42	28	**40.7**	53.6	39.6	22.4	**38.5**	2.7	14.5	15.3	0.46
Science of Mind 93/94	60	40	33	**44.3**	62.8	39.5	30.4	**44.2**	2.7	16.6	16.7	0.45
Science of Mind 91/92	52	36	31	**39.7**	54.3	37.1	26.9	**39.4**	3.0	13.1	13.2	0.40
Undergraduate Research f 97	16			**16.0**	7.9							
Undergraduate Research 96/97	7	6	1	**4.7**	3.7	4.3	0.8	**1.7**				0.86
Undergrad Research in Molecular Bio	6	4	2	**4.0**	2.7	2.1	1.1	**2.0**				0.67
UG Research in Molecular Biology 94/95	5	4	6	**5.0**	2.7	1.6	2.8	**2.4**				-0.20
UG Research in Molecular Biology 93/94	3	2	2	**2.3**	1.9	1.5	1.5	**1.6**				0.33
UG Research in Molecular Biology 92/3	11	7	4	**7.3**	9.8	6.1	3.3	**6.4**				0.64
UG Research in Molecular Biology 91/92	6	8	7	**7.0**	5.3	5.3	5.3	**5.3**				-0.17
Evolutionary Biology 96/97	0	0	23				23.2	**7.7**				
Philosophy of Science 93/94	0	18	0		0.0	19.2	0.0	**6.4**				
Philosophy of Space Exploration 93/94	21	0	0		22.4	0.0	0.0	**7.5**				
Geology and Chemistry of Pollution 91/92	23	21	18		23.5	20.4	15.6	**19.8**				0,22
Elements of Chemistry	0	0	30		0.0	0.0	14.7	**4.9**				

F. SI Faculty and Areas of Expertise

The Scientific Inquiry planning unit is comprised of about 13% of the (non-library) teaching faculty on continuing appointment (20 out of 152 faculty listed in the 1997 catalog). Until 1995-96, these faculty were associated with *The* Science, Technology and Health (STH) specialty area. This self-study include relevant portions of the STH area, but will not include psychology and health policy since these faculty are no longer associated with the Scientific Inquiry planning unit due to the reorganization in 1995 based on the Long Range Curriculum Planning DTF recommendations and are discussed in the Social Science Self-study. Prior to this reorganization, the STH specialty area included 20% of the faculty (35 of 173 faculty in 1994). Before the reorganization, there were 13 "specialty areas" whereas now there are 5 "planning units". By percentage of the faculty, STH was the largest specialty area, but SI is now the smallest planning unit. This is due primarily to the consolidation of other specialty areas. Two other factors played a role in this switch from largest specialty area to smallest planning unit: (1) the four psychologists in STH became part of the new Social Science planning unit and (3) four of the faculty formerly associated with STH switched to other planning units. In addition, one member of the SI planning unit resigned from the college.

Although most of our faculty have expertise in (and teach) many disciplines, they are listed below according to their primary specialty. Only faculty on continuing appointments are listed here. The planning unit has a history of relying on repeating visiting positions especially in chemistry and computer science, which are currently being converted into continuing appointments.

Mathematics

1. George Dimitroff, Math and Computing) Algebra, Numerical Methods, Statistics
2. Al Leisenring,, Math and Computing) Mathematical Logic (probably retiring at end of 1999)
3. John Marvin, retiring at end of 1997 - 1998 year

Others mathematicians at Evergreen include: Masao Sugiyama (MIT), Josie Reed (CTL), and a new hire at the Tacoma campus

Computer Science

1. John Aikin Cushing, Digital Logic, Graphics, currently dean
2. Judy Bayard Cushing, Scientific Databases, Software Engineering, Object Technology
3. Neal Nelson Formal Computer Science, Networks (Visitor 1997-98, continuing hire beginning 1998-99)
4. Sheryl Shullman, Functional Languages hired 1997 First teaching year (on continuing contract) will be 98-99

Physics

1. Rob Knapp currently dean
2. Don Middendorf
3. E.J Zita, Astronomy

Other physicists at Evergreen include: Tom Grissom (CTL) and Rob Cole (Environmental Studies).

Chemistry

1. Clyde Barlow (generally ½ time teaching ½ research) general, organic, biochemistry
2. Dharshi Bopegedera, general, physical, inorganic chemistry
3. Jeff Kelly (generally ½ time teaching ½ research) general, organic, biochemistry
4. Jim Neitzel, general, organic, biochemistry
5. Paula Schofield, general, organic (new hire 1998)
6. Fred Tabbutt, inorganic, physical (retiring at end of 1997-98)

Other chemists who teach in programs in the area: Michael Beug, general chemistry, Sharon Anthony, physical and environmental chemistry (new hire 1998), both in Environmental Studies

Biology

1. Burt Guttman, Molecular Biology
2. Linda Kahan, Neurobiology
3. Betty Kutter, Molecular Biology
4. Janet Ott, Neurobiology
5. Julio Soto, Developmental Biology (new hire 1998)

Other biologist who teach programs in area Jude Van Buren Health Policy in Environmental Studies

Geology

1. Jim Stroh

Philosophy of Science /Philosophy of Mind

1. David Paulsen (Philosophy and Computing). Philosophy of Mind and Science, Artificial Intelligence currently Planning Unit Coordinator (release time in spring)

Library

1. Frank Motley, library teaching faculty and liaison with the Scientific Inquiry planning uit.

A number of faculty are associated with other planning units, but have taught programs offered by the Scientific Inquiry (or STH) area. These include Josie Reed who is affiliated with the Culture, Text and Language planning unit, but she often teaches mathematics in alternate years. Her plan is to continue this pattern. Rob Cole previously taught physics and calculus in the STH area, but he is now affiliated with the Environmental Science planning unit and plans to continue his involvement with the ES area for the foreseeable future to pursue his interest in mathematical modeling of environmental problems, but who is willing to teach SI programs on occasion. Tom Grissom plans to remain affiliated with the Culture, Text and Language planning unit but is likely to teaching physics only sporadically if at all.s. For a number few years, Clyde Barlow and Jeff Kelly have shared a single teaching position with their second salary line going to hire a visitor. They plan to continue this in the future. During the 1996-97 academic year, a philosopher of science affiliated with our specialty area resigned from the college. About 10 faculty affiliated with the Environmental Studies planning unit also teach biology. The biology taught in the Scientific Inquiry area is primarily laboratory biology, while the biology taught in the Environmental Studies area is primarily field biology. The ES planning unit also has two geologists and has hired an environmental chemist, Sharon Anthony who is likely to teach in SI fairly regularly.

G. Equipment and Instructional

Scientific Inquiry programs make use of two classroom/lab facilities the Computer Applications Lab and the Advanced Computer Classroom. In addition, various other labs and equipment are used for undergraduate research as well as more general teaching. This section of the report is generally divided by discipline to make it easier to organize. Some of the equipment is used in many different programs. A good example of this is the scanning electron microscope, which is used by students by some art students in addition to students in physics, chemistry, geology, and biology.

Computer Applications Lab

The computer applications lab (CAL) continues to be a showpiece, It is used mainly for scientific data analysis in many programs. See http://www.evergreen.edu/computing/cal/cal.htm for the mission and technical details. In addition, it is sometimes used for data acquisition in chemistry and physics. The lab contains 33 200MHz-pentium PCs running both Windows NT and Windows 95. There are 3 National Instruments data acquisition boards (in Ott's and Knapp's lab) and 16 Vernier "multipurpose laboratory interfaces" . These can be used with the many sensors we have: 12 sonic rangers, pH meters, oxygen probes, etc. All computers have Microsoft Office97 including Word and Excel. Other software in the CAL includes site-licensed copies of MathCAD, Stella Modelling Software, Web Browsers, MAT LAB, ARC VIEW, Idrisi, Image processing tools, CAD and digitizing software, scanners and large format plotter.

Chemistry

EQUIPMENT PRIMARILY USED IN UNDERGRADUATE RESEARCH LABS

Three labs do research in chemistry:

1. Kutter, Guttman, Neitzel on molecular biology
2. Barlow, Kelly in spectroscopy of biological systems
3. Bopegedera in infrared spectroscopy

During the last 10 years, we have acquired modern 200 MHz Fourier-Transform NMR, a GC-Mass Spectrometer, a plasma spectrometer for atomic absorption, an FT-IR apparatus, scintillation counters, scanning electron microscope and 3 silicon graphics workstations. The FT-NMR has not been used for the last 5 years due to lack of funding for liquid helium and nitrogen. The GC-MS gets very heavy use in environmental programs.

Kutter, Guttman, Neitzel	Barlow, Kelly	Bopegedera
Ultracentrifuges Freezers	10 PC's and 3 Macs HP diode array High resolution imaging facility Fluorescence spectrometer	Fourier-Transform Infrared spectrometer

EQUIPMENT USED PRIMARILY IN TEACHING

GC-MS and associated equipment such as columns
4 Diode Array Spectrometers
60 MHz NMR
about 10 analytic balances
about 20 top-loading balances (our equipment list says we have over 150 balances?)
10 gas chromatographs and accessories
about 12 vacuum pumps
Pipets, Ovens, Stirrers, Glassware
Atomic Absorption spectrometer

Biology

EQUIPMENT PRIMARILY USED IN UNDERGRADUATE RESEARCH LABS

Three labs do research in Laboratory Biology:

1. Kutter, Guttman, Neitzel - see above in chemistry section
2. Barlow, Kelly - see above in chemistry section
3. Ott - physiology and neurobiology

Jan Ott's lab contains several setups for EKG, EMG, EEG, and biofeedback measurements including pre-amplifiers and 4 copies of LabVIEW data acquisition software plus 10 PC's.

EQUIPMENT PRIMARILY USED IN TEACHING

~25 Nikon 1200x Microscopes with binocular optics
15 Dissecting Scopes
12 Water baths / Water circulators
Peristaltic pumps, Centrifuges, scintillation counter, autoclaves, balances (see chemistry), pipets, roughing pumps,

Physics

EQUIPMENT PRIMARILY USED IN UNDERGRADUATE RESEARCH LABS

Two groups do research in physics:

1. Knapp and Middendorf have outfitted room 2242 for measurement of all electrical and thermal flows. The room has a transfer switch so all electrical input can be provided by a generator (removed from the campus grid). There is a pentium notebook computer and two Fluke data loggers and associated software (including LabVIEW) for data acquisition and sensors for measurement of temperature and air flow. There is also a "microclimate analysis center" at the organic farm which contains a photovoltaic array and associated electronics for monitoring temperature, humidity, and efficiency of solar energy conversion. 5000 watt generator.
2. Zita does theoretical research on stellar dynamics and experimental work using the college's newly-acquired 10" Meade telescope.

EQUIPMENT USED PRIMARILY IN TEACHING

25 Digidesigner -Trainers for digital electronics
25 Elenco Trainers for analog electronics
20 200-in-1 analog electronic trainers
25 60MHz Tektronix Oscilloscopes
25 Multimeters
2 Rotational Dynamics Apparatus

Computer Studies

EQUIPMENT PRIMARILY USED IN UNDERGRADUATE RESEARCH

Judy Cushing's Scientific database lab

2 SunWorkstations, one development the other to support Web applications,
Silicon graphics workstation used for research on Scientific Visualization and to holds the Informix database for the forest canopy project

EQUIPMENT USED PRIMARILY IN TEACHING

The computer center contains three computer classrooms: the general computing classroom (GCC), the MacIntosh Classroom and the advanced computing classroom (ACC). The computer studies programs make extensive use of the ACC, which ACC consists of 24 networked computers organized into clusters of 4. It is designed for closed labs and is structured to facilitate group work. The computers are configured to support multiple operating systems, principally Windows NT and LINUX. The ACC is in need of equipment replacement, but due to budgetary constraints this will not occur before the 1999-2000 academic year. In the meantime, some expansion of memory is taking place. In addition, the Digital Electronics component of the *Data to Information* program uses lab space to assemble component chips into a simple prototype computer. Students are able to do additional work in graphics and graphic applications using the Graphics Imaging Lab.

II. ASSESSMENT of Outcomes:

How well does the Scientific Inquiry planning unit described succeed in delivering a curriculum that fulfills its vision of delivering high quality (lab) science education? This assessment of outcomes is based on a variety of sources:

i) student transcripts for students enrolled in area programs from 1991 to 1995 as well as all BS and BA/BS graduates for the spring 1997 ,
ii) faculty questionnaire and subsequent discussion conducted during the fall of 1997,
iii) responses to an alumni questionnaire during the summer of 1997, and
iv) results of the College Student Experience Questionnaire (CSEQ) and the 1997 ACE College Student Survey both administered during the Spring 1997.

The assessment of outcomes addresses two questions:

(A) Do the Students actually Follow the "Pathways" envisioned in the curriculum described in Section I of this report, and
(B) How well does the curriculum work in achieving its goal of delivering high quality science education in a manner that fulfills its vision?

Findings:

1) Students in the SI area generally follow pathways as constructed in the SI curriculum.
2) The faculty in the area are most committed to active learning and linking theory and practice among the five foci; there is strong but somewhat less commitment to interdisciplinary study and collaborative learning. The area is perplexed about how to realize a commitment to diversity. It is strongly committed to gender equality and attempts to teach across wide levels of preparation, but is unsure the extent to which this planning unit should focus on issues of cultural diversity.
3) There is significant agreement among faculty, students and alumni that programs in the area are very successful in delivering good scientific content, blending theory and practice and developing collaboration. In particular, this is shown in nationally normed responses in the CSEQ.
4) There is agreement among faculty and student respondents that the area is less successful in putting this content into context and in developing techniques for presenting results orally and in writing.
5) There is significant concern about how to deliver advanced work in an educationally innovative way given the increasing demand to handle more students

A. Do the Students Follow "Pathways" in the curriculum

The curriculum described in the first section of this report indicates that a generally well-defined curriculum is available to students. But since Evergreen does not have majors or even specific graduation requirements (except for the credit hour requirements for the BS degree), it is possible for students interested in the sciences to graduate without following any of the envisioned pathways. The data summarized in Figures 2, 3, and 4 indicate, however, that the envisioned SI curriculum is followed by a significant number of students. As these figures show there are some clear paths through the SI curriculum . These diagrams were assembled from transcript data for the four-year period from 1991 to 1996. It includes only transition from one year to the next. As a consequence, they do not measure cases in which a student transitions at some later time, as for example when a *Matter and Motion* student takes *Physical Systems* in the second year after participating in M&M.

As displayed in Figure 2, as expected, offerings in the area entry level programs feed more advanced programs. *Matter and Motion* provides sends 11% of its students to *Physical Systems* (a smaller program which obtains 41% of its students from *Matter and Motion*) as indicated on Figure 4. A larger proportion (24%) move from *Matter and Motion* into Molecule to Organism. Data to Information is a feeder into *Computability and Cognition* (10% of DtoI students go into C&C) and *Student Originated Software* (27% of DtoI students go into SOS). *Foundations of Natural Science* also feeds *Molecule to Organism* (29% of the FONS students make this transition) It also feeds environmental studies, and its successor, *Introduction to Natural Science,* can be expected to do so even more.

Fig 2: Where Do SI Students Go? Flow in Area

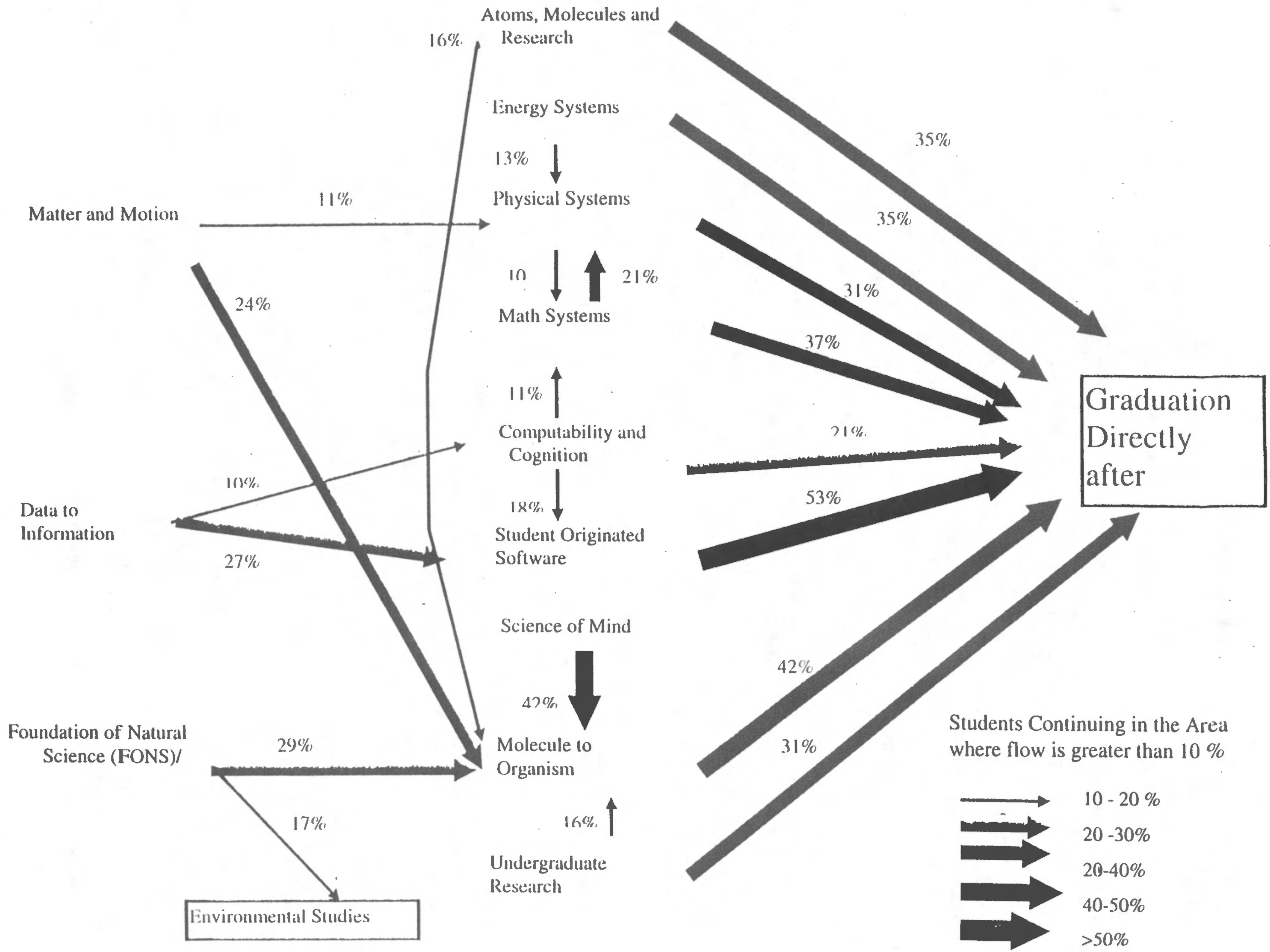


Fig 3: Where Do Entry-Level SI Students Come From?

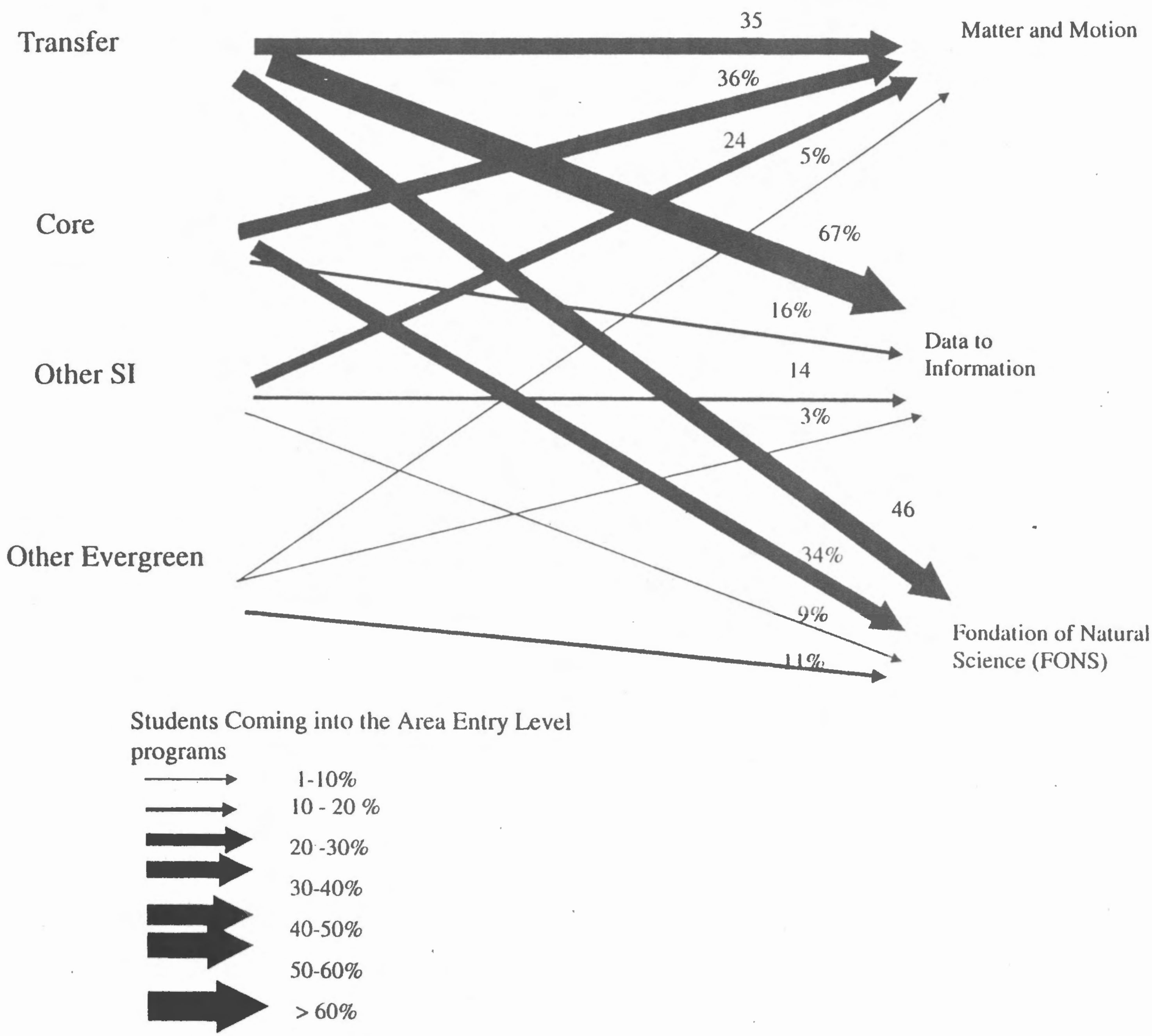


Fig 4: Where Do Students in more advanced SI Programs Come From? *(Sources > 10%)*

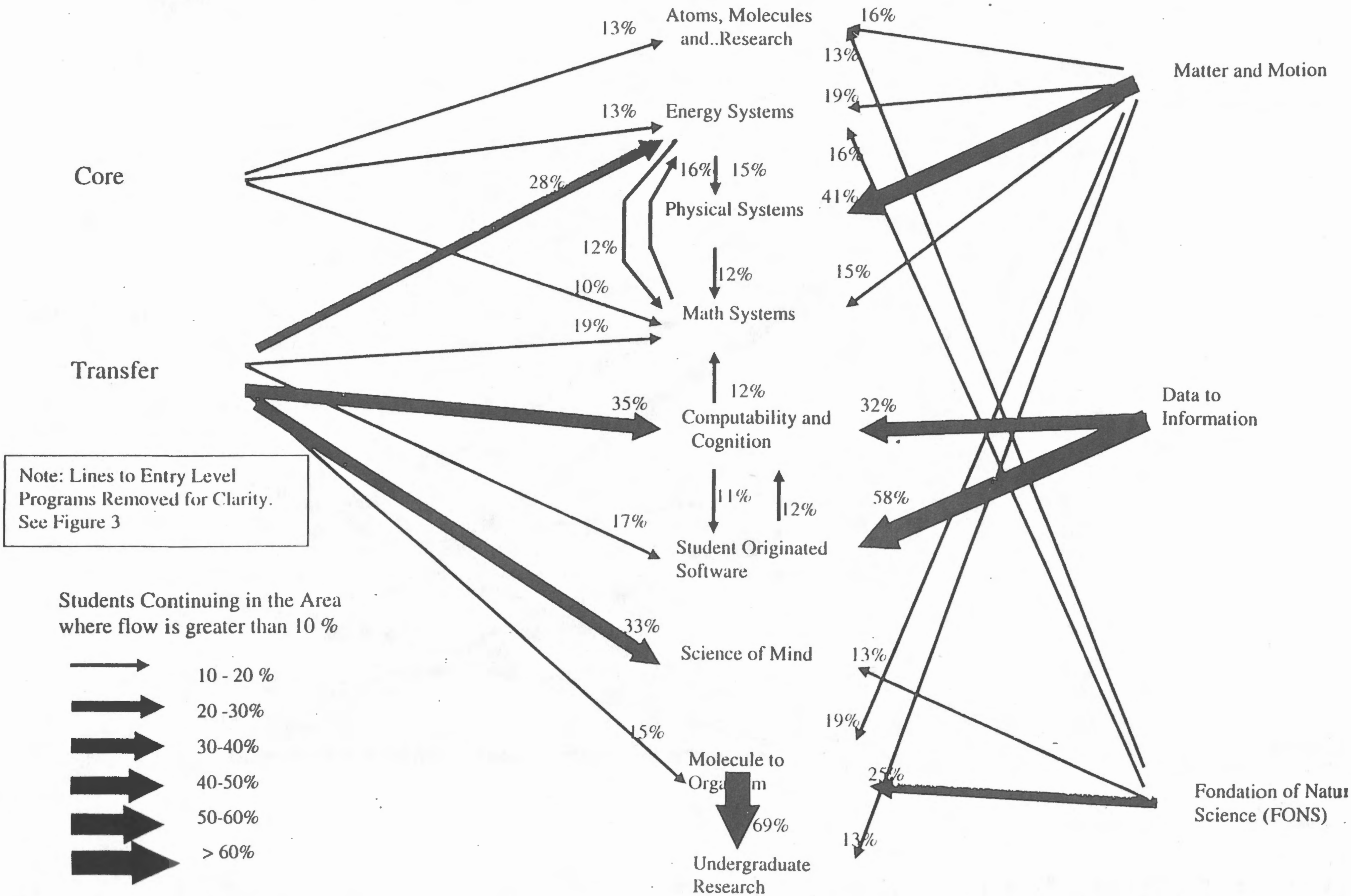


Figure 3 indicates the proportion of students in Entry-level programs from various sources. *Matter and Motion* obtains roughly equal proportions of students from Transfer, Core and other Non-Core programs, the bulk of them in the SI planning unit. Data to Information obtains more than two-thirds of its students from transfers. *`Foundations of Natural Science* consists of almost 50% transfers with another third coming from Core.

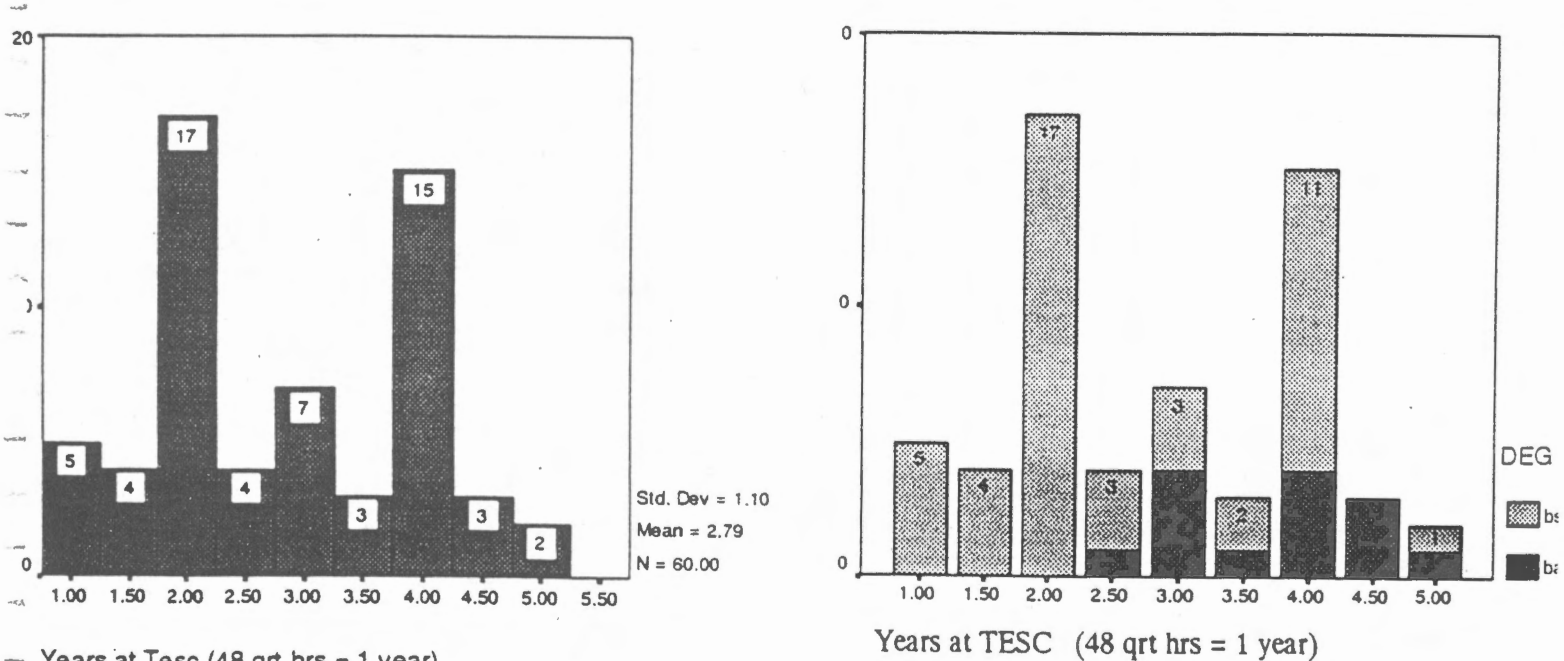
Figure 4 indicates the sources of students for more advanced level programs. Note that the flow to entry level programs as been removed for clarity (see Figure 3 for this information) . As is shown, *Atoms Molecules and research* ōbtains a sizeable number of students from a variety of sources as does Energy systems. A large proportion of *Physical Systems* students come from *Matter and Motion. Math Systems* draws *from Energy Systems, Physical Systems* and *Computability and Cognition. Computability and Cognition* consists of about a third transfers and a third from DtoI. Student Originated Software obtained nearly 60% of its students from *Data to Information. The Science of Mind* (now an Interarea program) consisted of about a third transfers (many with an interest in psychology). *Molecule to Organism* consists of 25 % from FONS, 19% from Matter and Motion and 15% transfers.

As is clearly indicated in Figures 3 and 4 above as well as the additional data on 1997 BA and BA/BS students presented in Figure 5 below, transfer students constitute a very significant portion of our enrollment. The BS data in particular, shows that half (30/60) of the 1997 BS, BA/BS students spent less than 2 ½ years at Evergreen. For them, the SI curriculum could consist of no more than two programs.

In answer to question A, posed at the beginning of this section, students in Scientific Inquiry follow some distinct pathways through its curriculum.

Figure 5

Years at Evergreen for 1997 Scientific Inquiry BS and BA/BS students



a) combined BA and BA/BS Students

b) distibution of BS and BA/BS Students

B. How well does the curriculum work?

In visiting classes, labs, conference rooms and offices in which science teaching goes on at Evergreen, the most obvious indication that the way knowledge is organized for delivery at Evergreen has been successful is reflected in the enthusiasm of both faculty and students." (1989 reaccreditation report) Although we might take issue with the wording "the way knowledge is organized for delivery", it seems fair to say that the statement above is still true today. This is remarkable given the increased class size and relative decreases in funding for equipment and instructional support.

Responses from faculty as well as students (past and present) reflect a high degree of satisfaction with central features of (lab) science education at Evergreen. This data includes nationally normed results (compared with other general liberal arts colleges) indicating a statistically significant higher level of reported gains in understanding new scientific theories and technology, quantitative thinking, acquiring specialization for further education, familiarity with the use of computers, ability to think analytically and logically, ability to put ideas together and see relationships as well as the ability to learn on ones own, pursue ideas and find needed information. (See especially, CSEQ results below). The data presented below provide a remarkably consistent picture of Evergreen (lab) science education from both the faculty and student perspective.

1. Faculty Perspective

(i) Judgements of Importance: What the faculty find <u>important</u> in their teaching.

Faculty expressed considerable commitment to teaching that reflected the five foci in Evergreen's mission as well as the specific elements of the planning unit "vision" statement as it applies the students. The results were somewhat more mixed concerning the importance of various aspects of the vision statement relating directly to faculty. The data was collect as anonymous responses to a questionnaire administered during first planning unit meeting of the 1997-98 academic year, twenty (20) (all but 1) members of the planning unit responded. As indicated in Table 5, most *Scientific Inquiry* faculty find active learning through personal engagement and linking theoretical principles with practice very important in their teaching. They also hold interdisciplinary study and collaborative-cooperative learning important. Teaching across significant differences, though held important by 80% percent of the SI faculty, is not judged the same importance as the other foci for their teaching in the area..

Table 5: Faculty Judgments of Importance: Number of Responses in each category from the SI faculty questionnaire concerning the <u>importance</u> of the "five foci" teaching in the SI planning unit. (N=20, 95% of Unit)

How important are the "five foci" to you in your teaching in SI?

	Not Important	Moderately Important	Very Important
Interdisciplinary Study	1 (5%)	4 (20%)	15 (75%)
Personal Engagement in Learning		1 (5%)	19 (95%)
Linking Theoretical Principles with Practice		2 (10%)	18 (90%)
Collaborative—Cooperative Learning		8 (40%)	12 (60%)
Teaching Across Significant Differences	4 (20%)	11 (55%)	5 (25 %)

As indicated in Table 6, SI faculty are strongly committed to the importance of the student learning components of the area "vision" statement. There is less agreement on the importance of some of the statements related to faculty ,in particular, regarding the importance of research.

Table 6: Faculty Judgment of Importance: Number of Responses in each category from the SI faculty questionnaire concerning the <u>importance</u> of specific elements in the SI "Vision" statement (N =20, 95%)

How important do you find these additional aims from our "vision" statement?

	Not Important	Moderately Important	Very Important
(1) SI Students have a working understanding of the field ability to apply concepts and ideas in areas different from the context in which learned			20 (100%)
(2) Students develop a natural confidence in the workplace—feel "at home: in the lab, at the computer, in the library and in technical discussion		2 (10%)	18 (90%)
(3) Students attain a liberal perspective—to have a knowledge of other areas as well as the relationship of ones field to society and other cultures.		4 (20%)	16 (80%)
(4) Students have the ability to clearly explain subject matter in one's field—to present material coherently, both orally and in writing		1 (5%)	19 (95%)
(5) Students at the advanced level know a specialty within the filed well enough to be able to formulate significant questions and design experiments or procedures for answering these questions.		4 (20%)	16 (80%)
(6) faculty keeps current in their fields		4 (20%)	16 (80%)
(7) faculty is able to work with new technologies that students are using		9 (45%)	11 (55%)
(7) faculty has meaningful joint teaching experiences with faculty outside the subgroup and planning unit		9 (45%)	11 (55%)
(8) faculty is able to carry out research in conjunction with students in our specialty and present the results to students and audiences outside of Evergreen.		10 (50%)	10 (50%)

(ii) Judgements of Success: How well do the SI faculty believe they are doing in achieving their teaching goals ?
The faculty questionnaire also asked the SI faculty how well they believed the programs in the area fulfilled the expectations found in the "five foci" used to characterize teaching in general at Evergreen as well as the more specific additional aims found in the vision statement. The self-report data is presented in Tables 7 and 8. It indicates that the SI faculty believe they do a generally quite good job in promoting active learning through personal engagement and linking theory and practice (100% indicate we do this very well or fairly well). The response is more mixed on the remaining foci. 79% indicate that collaborative-cooperative learning is addressed generally well in the area, but 58 % indicate that the area does a generally good job with interdisciplinary study and only 17% indicate that we address teaching across significant differences. These judgments of success roughly parallel the judgements of importance for these foci presented in Table 5 above. The greatest disparity between area aspiration as indicated in judgments of importance and achievement is in interdisciplinary study, and to a lesser extent with respect to teaching across significant differences.

Table 7: Faculty Judgment of Success: Number of Responses in each category from the SI faculty questionnaire on how well the "five foci" are addressed in the SI planning unit programs.

In general how well do the programs in the area, in your experience, actually fulfill these "foci" ?

	poorly	modestly	fairly well	very well	N	% fairly/very well
Interdisciplinary Study	1 (5%)	7 (37%)	10 (53%)	1 (5%)	19	58%
Personal Engagement in Learning			5 (28%)	13 (72%)	18	100%
Linking Theoretical Principles with Practice			9 (47%)	10 (53%)	19	100%
Collaborative—Cooperative Learning		4 (21%)	4 (21%)	11 58%)	19	79%
Teaching Across Significant Differences	6 (33%)	9 (50%)	3 (17%)		18	17%

As indicated in Table 8, the faculty is much more critical about whether the area achieves the specific aims in the vision statement than the more general foci of the college. There is agreement that the area does a generally good job in getting the students to have a working, flexible understanding of their field of study, which enables them to be confident and feel at home in lab and in using the computer. But the questionnaire results suggest that faculty feel themselves much less successful in promoting understanding of the philosophical and social context of science, in developing student communication skills and in providing advanced-level knowledge in special fields. (Only about 50% of the faculty see the area as generally successful in achieving these aims). With the exception of being aware of new technologies (which garners only 50% rating in the "Fairly Well" and "Very Well" category), the faculty is quite critical of their ability to keep current with the cutting edge of their fields, to have successful teaching experiences outside the area and to carry out research in conjunction with their teaching. This is reflected as well in the open-ended portion of the questionnaire (as indicated in Table 9) which asked for important strengths and problems in the area. These comments spoke to the heavy teaching load and its effect on professional development as well as what is perceived as understaffing of the area which restricts the ability to provided a solid curriculum which empowers the students in science and to participate actively in Core and Interarea programs.

Table 8: Faculty Judgment of Success: Number of Responses in each category from the SI faculty questionnaire on how well the elements of the SI "vision" statement are addressed in the SI planning unit programs.

How general how well do you or the programs you teach address these vision items? (N= 19)

	Poorly	Modestly	Fairly Well	Very Well	%Fairly/Very Well
(1) SI Students have a working understanding of the field ability to apply concepts and ideas in areas different from the context in which learned		3 (16%)	23(68%)	3 (16%)	84%
(2) Students develop a natural confidence in the workplace—feel "at home: in the lab, at the computer, in the library and in technical discussion		2 (10%)	12(64%)	5 (26%)	80%
(3) Students attain a liberal perspective— have a knowledge of other areas as well as the relationship of ones field to society and other cultures.	5 (26%)	6 (32%)	8 (42%)		42%
(4) Students have the ability to clearly explain subject matter in one's field—to present material coherently, both orally and in writing		8 (42%)	8(42%)	3(16%)	58%
(5) Students a the advanced level know a specialty within the field well enough to be able to formulate significant questions and design experiments or procedures for answering these questions.	2 (10%)	8 (42%)	6(32%)	3 (16%)	48%
(6) faculty keeps current with latest developments in their fields	4 (21%)	9 (47%)	5(26%)	1(5%)	31%
(7) faculty is able to work with new technologies that students are using	1 (5%)	8 (42%)	8 (42%)	2 (10%)	52%
(8) faculty has meaningful joint teaching experiences with faculty outside the subgroup and planning unit	3 (16%)	10(53%)	3(16%)	3 (16%)	32%
(9) faculty is able to carry out research in conjunction with students in our specialty and present the results to students and audiences outside of Evergreen.	7(37%)	6(32%)	5(26%)	1 (5%)	31%

Table 9 SI FACULTY SURVEY: RESPONSES TO OPEN ENDED QUESTIONS*

Strengths

1 Integration of science and math; 2,3,4,5interdisciplinary connections; ,6, 7,8 team teaching of coordinated studies.
1 Engage students in current and "real-world" developments, 2 integrate theory and practice; 3 especially in projects: 4, 5 actively involved students
1 Collaborative work, exploratory atmosphere;2 work cooperatively yet independent of faculty; 3,4 group work 5 getting students to do collaborative learning well
1 Structure—full time no fragmentation; 2,3 full time
1 Emphasis on hands-on labs; 2,3 leading to engagement
1 Presentation of science in social, historical and philosophical context; 2 history and philosophy of science; 3 science in cultural contexts
1 Solid subject matter knowledge by faculty; 2 excellent and devoted faculty
1 Faculty engagement in teaching; 2 inventiveness and responsiveness at the micro level of teaching
1 Facilitation of conceptual understanding; 2 ability to analyze in students
1 Involving students in their own education; 2 getting students to take an active role in their education through oral presentations, research, seminar
1 Even beginning students get access to good equipment; 2 significant lab experiences
1,2 Make science accessible to poorly prepared students

Fostering of creative problem solving
Close student faculty interaction
Focus on explanation in writing and oral presentations
Provide Basic numeric skills for non-quantitative students
Narrative evaluations
Opportunity for open ended projects
"try to keep up with field"
predictability of offerings
No departments,
Generate interest in subject matter..
Lab Support in CAL and ACC

PROBLEMS

1,2,3,4,5,Student Faculty Ratio; 6 especially in lab
1 Overworked Faculty; 2 out fault; 3,4,5,6 trouble keeping up with field
1 Difficulty in doing research; 2 balancing research and teaching; 3Facutly lose touch with their fields, 4 not enough opportunities for faculty to refresh in their own disciplines
1 Too small a number of faculty (to enable rotation in core); 2 core and across areas
1 Demand for coverage; 2 Squeeze between coverage and quality explications in scientific fields
1 Not enough advanced work; 2 upper divisional work

1 Diverse Level of Preparation of students; 2 Wide range of student abilities
1 Student prerequisites not met for advanced programs; 2,3 quality of students recruitment
1 Poorly prepared students especially in writing and math ; 2 students lack quantitative skills
1 Not enough upperclass students; 2 advanced offerings lack coherence, predictability

Area does see interdisciplinarity beyond the sciences enough
No exposure to real liberal arts experience
Providing significant engage in ethical issues

Difficulty in coherent student planning beyond 1 year at a time
Library resources, students need to learn how to use it more effectively
Institutional stumbling blocks, access to resources, media loan
Getting training with new technologies
How do we grow
"Too many SI faculty that want others to teach in specific ways that they are not always willing to do themselves
Unwillingness or inability to entertain large –scale ideas for reconceiving what we do
Widespread use of hard-edge language in public discussions, without corresponding filtering at the listener end

*numbers indicate how many faculty made a similar responses

(2) Student Perspective.

The students in the area have indicated considerable agreement with the faculty about what aspects of teaching and learning in SI area programs are most successful. Evidence comes from three sources : (i) the alumni survey conducted during the summer of 1997, (ii) the results of the College Student Experiences Questionnaire administered during the spring 1997, and the (iii) the American Council on Education/Astin 1997 College Student Survey Area Specific Questions also carried out during the spring 1997 quarter.

(i) **ALUMNI SURVEY.** Questionnaires reflecting the SI "vision" statement were sent to a sample of alumni of the college who had done work in the area (all but 2 had taken at least one advanced program). Sixty-eight (68) alumni returned the questionnaire (yield rate was about 20%, which was about the yield for questionnaires sent by other planning units.) As indicated in Table 10, the student judgments about relative success are generally similar to the faculty. The students acknowledge that they were able to apply what they learned in new contexts and attained a working understanding of their field and had become at home with the use of the computer and the lab. Like the faculty they were less positive about their preparation in oral and written communication and in understanding the relationship of the science they studied to society and other cultures. They were more positive than the faculty in assessing how well they learned to work collaboratively. As indicated in Table 7 above, 79% of the faculty thought that SI did a fairly or very good job in promoting collaborative learning in SI programs. The alumni rated it higher than any other option.

Table 10: Alumni Survey Response Summary. Rank ordering by mean of response.

Rank Ordering of Responses (Scale 1-4, from 1 strongly disagree to 4 strongly agree) Difference of > .20 generally statistically signficant. Complete questionnaire in Appendix 2

3.74	Skills in working collaboratively
3.63	Prepared to apply concepts
3.52	Prepared to use the computer
3.50	Working understanding of field
3.45	Competent in at least one area at advanced level
3.44	At home in technical discussion
3.40	Prepared to form questions, design experiments
3.40	At home in the lab
3.35	Explain in writing
3.31	At home in library
3.26	Explain orally
3.25	Relation of field to society, culture

(ii) **CSEQ Questionnaire Results.** One hundred and sixty one (161) student in SI programs were among the 1068 respondents from the college as a whole who provided responses to the "Life Long Learning Scale" as part of the College Student Experience Questionnaire (CSEQ) during the spring quarter 1997. The proportion of the area participating in the survey was somewhat lower than actual enrollment in area programs (actual 15%, participating

12%). We should remember that results reflect respondent self reports, but a normed comparison group is available. See Table 11.

As might be expected, SI students indicated that they made substantially greater gain or progress than the average of student respondents at Evergreen and the General Liberal Arts college comparison group in those areas involving *understanding scientific theories and technology, quantitative thinking, acquiring specialization for further education,* and *familiarity with the use of computers.* In addition, students in the area programs differed from the general liberal arts college peer group in making greater reported gains in *ability to think analytically and logically. Ability to put ideas together and see relationships* and *ability to learn on ones own and to pursue ideas and find needed information.*

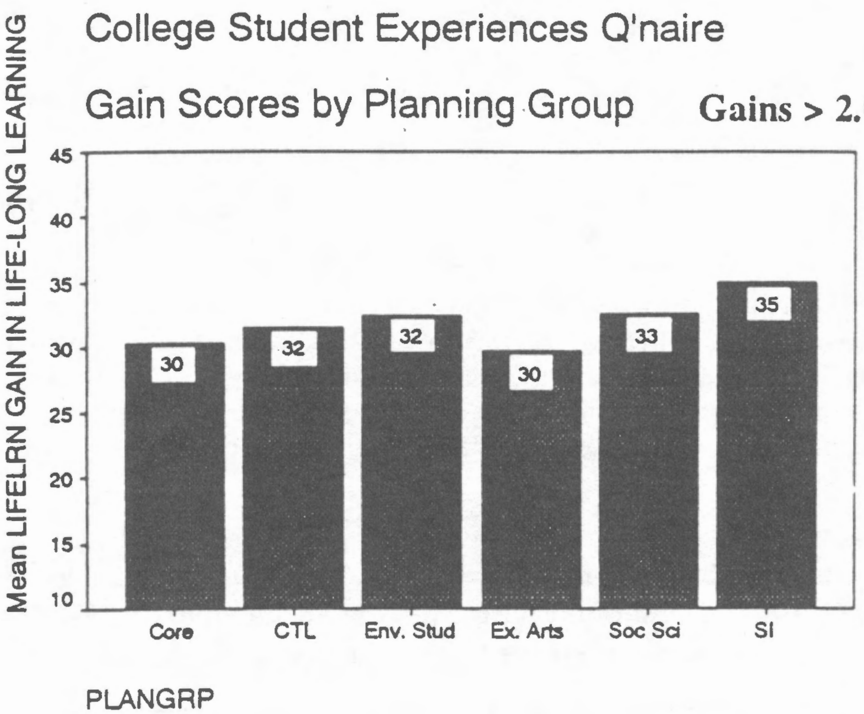
The areas of less gain than the college average are consistent with the areas of concern expressed by the faculty and reflected in the alumni survey. Although response from area students is not statistically significantly different from the college average, it is in a negative direction. (It should be noted, however, that even in these cases the SI students have high gains reported the general liberal arts peer group. In particular, SI students report less gain in understanding and getting along with different people, which reflects the faculty judgment we don't address teaching across significant differences as well as we might. The response concerning writing again comports with faculty and alumni concerns. And the response concerning broad general education is consistent with the faculty and alumni observations that the area doesn't address philosophical and social issues in the sciences as effectively as it does other topics.

Table 11: Comparison of mean responses of students in Scientific Inquiry programs to TESC and General Liberal Arts College means of the elements of the "Life Long Learning Scale" from the *College Student Experiences Questionnaire* administer during the Spring quarter 1997 Means and difference of means displayed. Shaded difference > .30 are statistically significant.

		SI	TESC	SI -TESC	Gen LA	SI-GenLA
1	Understanding New Scientific Theories and Technology	3.28	2.29	+.99	2.05	+1.22
2	Quantitative Thinking	2.99	2.34	+.65	2.35	+ .64
3	Acquiring Specialization for Further Education	3.41	2.92	+. 49	2.63	+ .78
4	Familiarity with Use of Computers	3.20	2.73	+.47	2.58	+ .62
5	Ability to Think Analytically and Logically	3.34	3.09	+.25	2.73	+ .61
6	Ability to Function as a Team Member	3.06	2.90	+.16	2.82	+ .24
7	Ability to Put Ideas Together, See Relationships	3.36	3.28	+.08	2.79	+ .52
8	Ability to Learn on Own, Pursue Ideas & Find Needed Information	3.46	3.38	+08	2.94	+.42
9	Understanding & Getting Along with Different People	2.99	3.05	-.06	2.94	+ .05
10	Writing Clearly and Effectively	2.91	2.98	-.07	2.74	+ .17
11	Gaining Broad General Education	2.88	2.99	-.11	2.77	+ .11

Overall, the SI students reported statistically greater gains on the Life long Learning Scale than other areas in the college as shown in Figure 6.

Figure 6:



Gains > 2.00 statistically significant

(iii) American Council on Education/Astin 1997 College Student Survey. Ninety-one(91) students in SI programs were among the 942 respondents from the college as a whole who provided responses to the Astin Survey (slightly less than our proportional representation in the college). This survey was less focused on issues relevant to this planning area self study, but several responses are relevant. In keeping with the overall, very positive assessment of teaching in the area , over 90% of SI students indicated that they were consistently or usually satisified with the expertise of the faculty and compares well with the ES students who indicate over 85% high satisfaction as shown in Table 12

Table 12: Astin Survey Question on Satisfaction with Faculty Expertise

How satisfied have you been with the disciplinary expertise of your faculty in the sciences?

	SI responses =79	ES responses = 163
A. Consistently satisfied	53.2%	38.7%
B. Usually satisfied	38.0%	47.9%
C. Satisfied about half of the time	6.3%	10.4%
D. Usually dissatisfied	2.5%	1.2%
	0.0%	1.8%

The Survey also contained a question concerning perceived gain in knowledge, skills and abilities in a variety of areas. Although the question was phrased in terms of overall experience at Evergreen, we can assume that the responses of SI students are particularly relevant to their experience in the area. This is even more likely given the large number of transfer students whose experience is largely in the area. As indicated in Table 13, SI students like those in ES and the college as a whole feel personally engaged and responsible for their education and feel able to collect and use information and ideas from different areas to solve problems, apply concepts and theories to the solution of practical problems as well as work cooperatively with others. As might be expected area students feel themselves better able to use the computer in their academic work than others at the college. This presumably reflects the computer science students in the sample as well as the emphasis paid to developing computer skills in other area programs. As noted in the previous sections, the area rates lower in its ability to promote understanding and appreciation of cultural and gender differences and its ability to foster presentational skills.

Table 13: Response to the question: "Since you have been a student at Evergreen, how much have you developed your knowledge, skills, and abilities in each of the following areas:") ***Ordered in terms of SI rating (where difference of approximately .25 is statistically significant)***

	SI mean*	ES mean*	TESCmean*
Feeling personally engaged and responsible in your education.	4.51	4.50	4.53
. Collecting and using information and ideas from different areas to solve problems.	4.33	4.24	4.21
Using computer applications, such as spreadsheets, graphics, or the Internet, in your academic work.	4.19§	3.87	3.50
Applying concepts and theories to the solution of practical problems.	4.12	4.03	3.99
Working cooperatively with others.	4.02	4.19	4.10
Understanding and appreciating cultural and gender differences.	3.64§	3.64	3.94
Using visual presentations such as illustrations, charts, or video in your academic work.	3.29§§	3.68	3.55

* 5 = "A great deal," 1 = "Not at all."
§ Statistically significant difference between SI and TESC average
§§ Statistically significant difference between SI and ES, TESC averages

III. Issues and Areas of Concern

The student and faculty responses in the previous Assessment of Outcomes sections suggest a number of issues and areas of concern for the Scientific Inquiry planning group

- Implications of increase in class size,
- Staffing and the 40% expectations
- Dealing with Diversity
- Match of Students and Curriculum
- Teaching the context of science
- Building Communication Skills
- Advanced Work
- Research and Teaching
- Special Concerns of the pathways

A. Implications of Increase in Class size. The open-ended portion of the faculty survey (summarized in table 9 above) indicates that many SI faculty identify increase in student faculty ratio as an important problem. The patterns of enrollment presented in Table 4, indicate a generally consistent increase in program enrollment over the period 1991 to 1997, especially in terms of headcount. At the beginning of this period, many of the programs were under-enrolled compared to expected yearly average of about 20 FTE students per FTE faculty (with Fall expectations 125% of the average or 25 FTE students). Today most of the programs are at or above this level.

In a position paper to the deans and provost founding Evergreen faculty member (and retiring SI faculty) Fred Tabbutt, stated that the "planning faculty would never have designed the curriculum we are now trying to maintain" with class sizes of 25 to 1 as we have now. The increase in class size will undoubtedly continue over the next decade because the need for additional student spaces is increasing without a correlative increase in funding for higher education.. In just the 5-year period from 1989 to 1994, funding dropped 9% while enrollment increased 8%. This was before Initiative 601 (passed in 1993) passed, so further decreases seem likely. In addition, the administration tried to protect the academic side of the college during the first years of the decreased funding by cutting in areas like custodial, maintenance, and facilities. As funding levels continue to drop, cuts are being made in the academic side of the college and at the same time the decreases in maintenance which effect teaching are beginning to show up.

The local, Evergreen decision to maintain approximately the same student faculty ratio across the college means that we don't have large lower division courses to support smaller upper divisional offerings as at more traditional institutions. The increase in class size is particularly detrimental to our labs. As an area, it seems likely that our greatest effect on student learning is in our innovative labs. Our labs are rarely "cookbook" and they often run considerably longer than comparable lab sessions at other colleges or universities. This is a major benefit of our "program" approach. At an NSF-sponsored workshop taught here a few years ago involving physicists and chemists from around the country, participants stated that one of the biggest impediments to collaborative teaching was undergrad research, which demanded smaller classes and make it difficult to have more than one faculty involved.

Some preliminary discussion of how to address the issue of student faculty ratio has taken place and some additional help has been made available, particularly for labs. Evergreen science techs and computer staff have taken over some responsibility for help delivering lab portions of the program. Conceivably, more use of such staff and hiring of additional staff would help alleviate this problem to some extent.

B. Staffing and the 40% Expectation. The 1996-1997 academic year was the first year of the new planning unit structure. As part of the dtf recommendations the college adopted, planning units were expected to provide approximately 20% of their faculty to core and another 20% to interarea programs. The expectation was that this requirement would need to be phased in with new hires. According to this "rule", we should provide roughly 8 of our twenty faculty to meet these expectations. This left the area with 12 faculty to staff the area, which at a 25-1 fall ratio means that we should be serving 300 students in our area. The actual number fall 1997 number was 392, for the recurring programs only, not counting contracts and other assignments. These calculations, of course, assume that all members of the area are teaching full time. As is indicated in Table 13, this was not the case. Part of the short-fall was made up by visitors or the use of faculty from other planning units. But, historically the primary means of covering short-fall has been to reduce the number of SI faculty available for Core and for Interarea programs. The responses to SI faculty survey showed both a strong commitment to integrative, interdisciplinary programs and a concern that faculty felt torn between expectations for delivering programs in the area and their desire to participate in Core and Interarea programs. (See Tables 7, 8 and 9). This was particularly apparent during faculty discussions over the last several years, which consistently pointed to the importance of having science faculty in Core. The faculty was especially concerned about institutional research that showed a need for more work on quantitative skills as well as a recognition that Evergreen needed to provide an opportunity for "non-science" students (i.e. those who would not continue studying science) to have high quality exposure to science in their Freshman year. This responsibility is shared by faculty in Environmental Science as well as some science faculty in CTL, but overall, the Scientific Inquiry faculty recognized that in many years, the area could not supply enough faculty to help staff at least three programs with "scientific themes." Several faculty point to years in which they were scheduled to teach in Core but were pulled to staff enrollment within the area. Of course, participation in Core programs also expose Freshman students to area faculty and can serve as "recruitment" into more advanced work in the area.

SI faculty were also concerned with providing opportunities for non-area students to study science in non-Core, Interarea programs. The Science of Mind program does this on a regular basis, but faculty are eager to generate a variety of non-recurring programs with science themes that would be attractive to students who might study in the area for only one year. The need to develop such programs for the "non-science" student is even more important given increased controversy in society at large over issues of science and technology.

It is sometimes argued (by colleagues outside the area) that SI could meet the 40% expectation by simply cutting the number of offerings within the area. SI faculty believe this would be very bad policy. They regard the current offerings as a minimal number of options for a liberal arts college. In fact Evergreen science students tend to graduate in 4 years, a considerably shorter amount of time than their counterparts at other Washington institutions. Cutting back on programs in SI could undermine this success. Further as continued enrollment growth suggests, our present offerings are barely adequate to meet current demands. Interest in the sciences, particularly among women, has been growing in colleges and universities across the country. This suggests that enrollment in the area will continue to be strong.

Given that the SI faculty and the Evergreen faculty as a whole believe that the 40% expectation is desirable and given that we also need to maintain at least the current level of enrollment for area offerings, new hires are necessary. As Table 3 indicates four (4) new "continuing" hires would be necessary to achieve the "ideal" level of continuing staffing for 1999-2000 academic year. This is a fairly conservative measure and assumes that we want to retain a 10% RIF cushion for visiting hires. It also assumes that leaves or service in the Deanery will be replaced by visitors or non-SI Evergreen faculty. Assuming the projected growth at Evergreen of about 1000 FTE students (to an enrollment about 5000 FTE students) of which SI will cover about 10% as we do now, an additional 4 FTE faculty will need to hired at the 25-1 student faculty ratio. This total of 8 new hires (4 to meet 40% expectation and 4 for growth) is over and above any replacements for faculty retiring beyond the current academic year. If general enrollment trends continue and a greater proportion of undergraduate students seek education in the sciences (even if they are not "science students taking advanced work in the area), an even great number of hires might be necessary.

Table 14: Faculty Short-Fall given the 40% Expectation 1997-1999 given anticipated hiring, retirements and Faculty staffing

	Full-time Teaching	Less than Full Time Teaching	Other	Vistors Other TESC
1997-98 Faculty: SI Continuing Teaching Fac 14 FTE SI Vistors + 4 FTE Other TESC in SI + 1 FTE TOTAL 1998 FACULTY TEACHING IN SI = 19 FTE Faculty Needed to Meet 40% Expectation - 27 FTE **Short-Fall in Teaching Fac. = - 8 FTE** *Maximum continuing Faculty** 19 FTE* *Short-Fall Continuing Faculty*** -4 FTE*	Bopedgedera Judy Cushing Dimitroff Guttman Kahan Leisenring Middendorf Neitzel Ott Paulsen Stroh Zita	Barlow ½ Kelly ½ Marvin 2/3 Tabbutt 1/3	JOCushing (Dean) Knapp (Dean) Kutter (leave) Shulman (lwp)	Reed (CTL) Nelson Pessiki Schuler Verhey
1998-99 Faculty: SI Continuing Teaching Fac 18 FTE SI Vistors + 1 FTE Other TESC in SI + 3 FTE TOTAL 1998 FACULTY TEACHING IN SI = 22 FTE Faculty Needed to Meet 40% Expectation - 27 FTE **Short-Fall in Teaching Fac = - 7 FTE** *Maximum continuing Faculty** 20 FTE* *Short-Fall Continuing*** -4 FTE*	Bopedgedera JudyCushing Dimitroff Guttman Kahan Kutter Leisenring Middendorf Neitzel Nelson Ott Paulsen Scholfield Soto Stroh Shulman Zita	Barlow ½ Kelly ½	JOCushing (Dean) Knapp (Dean)	Beug (ES)† Cole (ES)† Anthony (ES) Lange (Visitor)

*Assumes 400 FTE SI Students = 16 FTE Faculty
20% Core 20% Interarea = 11 FTE Faculty
EXPECTED FACULTY 27 FTE Faculty

**Assuming that every SI faculty member taught full time, there were no leaves and no SI faculty in the deanry, but that Barlow/Kelly count as 1 continuing faculty

***Assuming a 10% RIF cushion = 3 FTE visiting faculty, the short-fall in continuing faculty is 27 – Number of continuing faculty – 3 Vistors

† Added with the assumption that INS is an SI program

A similar conclusion emerges when we examine the area's ability to meet expectations for the 1999/2000 academic year. For that year, Scientific Inquiry is expect to contribute its "fair share' to Core as well as to create area programs to serve 400 FTE. The following analysis of these expectations is based on the best available current estimates of faculty for 1999/2000 (as of 3/30/98). It takes as a given starting point that the areas need to plan for 650 students in Core. It assumes that each area should supply faculty for core in proportion to the number of faculty available in it. This number is used to calculate the number of faculty available for area and InterArea programs and then compares this to the Deans expectation for the area. The analysis clearly indicates that some planning units allow much greater opportunity for faculty to teach interarea programs than others.

Table 15 provided below is based on the Faculty distribution presented in an analysis of Faculty Assignment by Planning Unit including Post retirement contracts. This listing is the "best estimate" of the faculty in the planning units for the 1999/2000 academic year as of March 30, 1998. It includes all continuing faculty in the areas, including recent hires, as well as those that have already been designated for the 1998-98 academic year. It also includes a listing for post-retirement-contract faculty in each planning unit, who will be available for at least a quarter a year. Faculty who have "Officially" retired have been removed. Column (1) is derived from the listing. It indicates the faculty FTE available after Deans, graduate program faculty and professional leaves are removed. Column (2) indicates the percentage of the total available teaching faculty for 1999-2000 for each planning group.

The Deans indicate that we need to produce 650 student FTE for Core. At a student faculty ratio of 23 to 1, this translates into 28+ faculty FTE. Column (3) uses the percentage of available faculty given in Column (2) times 28.26 to generate the number of faculty FTE needed from each area. This number is used to generate the number of faculty available for non-core assignments. Column (4) is generated by subtracting a rounded version of (3) from the faculty available in Column (1). This in turn can be used to generate the number of non-core student FTE that can be generated by multiplying Column (4) by 25 students per FTE Faculty as given in Column (5). Column (6) presents the Deans' student FTE expectation for each area. Column (7) indicates the number of student FTE that could be generated by the each area if it supplied its fair share to core and meet the expectations for its area. Note that some areas can't even meet this minimum at current staffing levels. Column (9) indicates how many faculty FTE are available for interarea programs, and column (10) indicates the percentage of available faculty that can teach in interarea programs.

Table 15 ANALYSIS OF 1999/2000 Faculty and Student Distribution by Planning Units

	(1) FTE Available See "Faculty Assignments PU..."	(2) % of Available FTE (1)/ 129	(3) Number in Core per PU Percentage * Faculty Needed (*Faculty FTE needed = 650 FTE Students/ 23 Students per FAC =28.26 TOTAL FTE faculty fall quarter}*)	(4) Non-Core FTE FAC (1)-(3)	(5) Non-Core Student FTE (4)*25	(6) 99-00 Area Needs	(7) Student FTE for Interarea (5)-(6)	(8) FAC FTE for Interarea (7)/25	(9) % FAC for Interarea (8)/(1)
CTL	39.67	30.5	8.62 – 9	30.67	767	500	267	10.68	26.9%
ES	18.00	13.8	3.92 – 4	14.00	350.	375	-25	(-1.00)	(- 5.6%)
EA	25.33	19.5	5.51 – 5.5	19.83	496	350	146	5.84	23.1%
SI	18.33	14.1	3.98 – 4	14.33	358	400	-42	(-1.67)	(-9.1%)
SS	25.67	19.7	5.56 – 5.5	20.17	501.	375	126	5.04	19.6
NAS	3.00	2.3	.65 – 0	3.00	75	125	-50	(-.2.00)	(-66.6)
	130		28.26 – 28	102	2547	2125	422		

These results are summarized in Table 16 which reflects the percentage of faculty in the various planning units that would be available for each type of assignment, assume core is assigned first, area programs second and remaining faculty are available for InterArea programs. Without additional hires, visitors or faculty from other planning units, Scientific Inquiry clearly would not have an opportunity to participate in InterArea programs.

Table 16 Percentage of Planning Unit Faculty Available for Core, Area and Interarea

Planning Unit	*% CORE*	*%AREA*	*%INTERAREA*
CTL	22.7	50.4	29.6
ES	22.2	77.8*	(- 5.6)
EA	21.7	55.2	23.1
SI	21.9	78.1*	(- 9.1)
SS	21.4	59.0	19.6
NAS	0	100.0*	(-66.6)

*Maximum Available after Faculty in Core removed—less than required by Deans—so visitors or new faculty are needed to meet targets

C. **Dealing with Diversity.** The college commitment to diversity encompasses a variety of concerns. Most explicitly it relates to issues of race, gender and class, though it also raises issues about level of student preparation as well as heterogeneity in student learning style as well. It can be thought of in terms of content as well as in student and faculty demographics and approaches to teaching and learning. Discussion of the results of the faculty survey (see Tables 7 and 8) indicate that "teaching across significant differences" is interpreted in a wide range of ways. For some faculty, it relates primarily to issues of race, gender and class with particular focus on increasing the number of women in the area programs and among the faculty.. The area has had fairly good success in including women in the area. . During the 1997-98 academic year 33% of the continuing positions were held by female faculty (compared to 37% for the college as a whole). The SI percentage will increase to at least 40% for the 1998-99 academic, given the three new hires in the area and retirement by male faculty. Of 60 students (who took a substantial proportion of their upper divisional science credits in SI programs) receiving a BS, 40% were female. (50 % of the SI students receiving a BS/BA were female). Additional female students take one or another program in the area but do not get a BS degree. The distribution of female students, however, is not consistent across the SI curriculum. As at other institutions, women are more likely to be found in biology and more recently chemistry programs than in physics, mathematics or computer science. Recruitment and retention of women in these areas continues to be a concern. The area has held student/faculty forums to address issues of women in science. There are on-going discussions, especially among the computer faculty about how to make the "culture" more attractive to female students. In addition, with new hires made for the 1999-2000 academic year 10% of the continuing hires in the area are faculty of color.

For other faculty, diversity in background and training are of special importance. . SI programs, even when they have prerequisites, typically include students with a wide range of preparation, especially in mathematics. The college has had a long-standing difficulty in providing mathematics preparation. The use of student math tutors has helped to some extent, but additional effort needs to be paid to advising, to developing better ways of preparing students before they enter our programs in Core, Summer courses and modules as well as in dealing with under-prepared students once they enter.

D. **Match of Curriculum and Student** Perhaps the most serious problem for the Scientific Inquiry area for the next few years is recruiting more *capable* students and finding ways of working more effectively with the diverse range we have. Although unsubstantiated with extensive data, there is agreement among the SI faculty that the average level of mathematical and analytical skills among students in the entry-level programs has decreased over the past decade. This has led to problems of retention and in some cases limited the amount and type of material that could be included. Similar problems arise in more advanced programs, when transfer students enter the college with some but not all of the preparation these programs expect. This concern is shown in the faculty survey, Table 9.

Two new programs aimed at first year students will be offered in the Spring quarter of 1998 (*Springtime in Science* and *Concepts of Computing*) specifically to provide more preparation of Evergreen students for our entry level programs. These new offerings plus an assortment of 4 and 8 quarter hour modules typically offered during the spring and summer quarters can help as well. It is yet to be seen whether this will improve the quantitative skills of students in our Entry Level programs. Given that many of our entry level students are transfers (as indicated in Fig 4, 35% of Matter and Motion Students, 46% of FONS/INS students and a whopping 67% of Data to Information Students), we are faced with the problem of recruiting better prepared transfers, especially from Washington Community Colleges. One step would be to talk with representatives of science programs at community college that send many of our students to help them better advise their students about what background is appropriate and what students are likely to do well in our science programs. The relationship between community college and upper divisional offerings, particularly in science, is a statewide issue.

E. **Teaching the social and philosophical context of science.** Faculty survey results indicate that although 80% of SI faculty find issues of science and society very important, 58% believe that we address them poorly or only modestly well. This is borne out by the alumni survey that ranked this aspect of SI programs lowest of those aspects polled. The area proposes to address this concern by replacing two faculty who have taught in programs in the area but have retired or left the college. We propose to hire a faculty with a degree in philosophy of science and another in history of science and technology, who have substantial background in one of the scientific disciplines in the area.

Such hires would be expected to teach some "technical" content as well as to help shape and deliver those aspects of team-taught programs concerned with issues of science and society (particularly at the entry level). In addition, they could participate in Core and Interarea programs and thereby help deliver science programs to students who might not be concentrating in the sciences.

The area has used several lecture series in the past to further introduce larger issues of science and society. In particular, the Plato Lecture Fund has brought in speakers on topics related to computer science and technology, and the Science Stories lecture series as allowed a variety of Evergreen faculty to talk about the implications of work in their areas of expertise. These series could be more regularly scheduled and explicitly directed to issues of science and society. If they are integrated into several, SI area programs they could help provide a rich resource to the area.

In the CSEQ survey students from SI area programs indicated a lower level of exposure to ethical issues than students from some other areas, especially the Expressive Arts which makes a special effort to stress issues of ethics and diversity. Perhaps we could more regularly introduce topics concerning ethical issues as well as more thematic programs concerned with morally charged topics such as human cloning.

F. **Building communication skills.** In keeping with the College commitment to "writing across the curriculum" the SI area has a responsibility to build upon the writing work provided in Core or at other institutions from which our students transfer. We have a special responsibility to develop student technical writing skills as well as their ability for oral communication of scientific results. Several programs in the area, including *Atoms, Molecules and Research* and the *Science of Mind* (see portfolio materials), contain significant opportunity for technical writing and presentation of research results. Other programs rely on writing associated with the seminar portion of the program. Some programs demand only a relative small amount of writing. The results of the faculty survey indicates that 95% of the area faculty holds that it is very important that students have the ability to clearly explain subject matter in their field by presenting material coherently both orally and in writing, but 42% believe that we only modestly attain this goal. The alumni survey and the CSEQ questionnaire indicate that past as well as current students though giving positive response to questions about communication skills, rank it lower than other aspects of their experience in SI programs at Evergreen. This is borne out as well in the Astin survey

The area can address these concerns in several ways: (i) We can emphasize the importance of good writing in all of our programs. This need not include additional writing work, but more faculty emphasis on the quality of what is produced for lab reports, seminar response writing and essay exams. (ii) We can structure the oral presentations of group work to emphasize effective communication. (iii) We could have better exchange of information about what kinds of writing exercises work in science oriented programs. And (iv) we could foster a (spring quarter) offering on technical writing and scientific journalism.

G. Providing Advanced work. There is concern among the SI faculty as well as alumni about our ability to offer advanced undergraduate work (especially for four-year students). This concern varies among different pathways in the planning unit. The computer studies subarea is generally satisfied with the availability of advanced offerings through its two, alternating upper divisional programs, one of which (Computability and Cognition) focuses on formal aspects of computer science and the other (Student Originated Software) focuses on software development. The area is continuing to examine how it can provide an appropriate level of interdisciplinary advanced work in other pathways.

One avenue for advanced work is to make more use of the Undergraduate Research option. When the option was first introduced it consisted primarily of students working with faculty in molecular biology. Over the last few years more faculty have opened labs carrying out on-going research that have created opportunities for students to work in other scientific disciplines. Faculty contribution to teaching through the *Undergraduate Research* option has been used to lower the expected enrollment in their full-time program.

Concern also emerges in the discussion of requirements for the BS degree. Currently it demands 72 quarter hours work in science and mathematics of which 48 must be at an advanced level. Faculty are left free to determine how many of the credits they offer are to be considered "upper divisional science credit." As indicated in Figure 5, the distribution of credit hours for 1997 SI BS and BS/BA graduates is bimodal with 43% taking about 2 years or less. Of those who graduate with the BS or BS/BA, 60% took 48 credit hours or more in recurring upper division programs (excluding modules taken outside the area as well as individual study within the area). Almost 90% took 32 credit hours or more in these programs. The issue of whether appropriate levels of "upper division science" is given to our students is primarily an issue of the "level" of science and math content of these programs and how to treat their seminar component.

A second question is whether the BS students have an adequate foundation in the sciences. 40% of the 1997 BS students did at least 32 quarter hours work in SI entry level programs (FONS/INS, DtoI, M&M). Of course, since many of the students in the area are transfers, they did lower divisional work at other institutions, which may or may not have provided them with the same foundation as our entry level programs. More study is needed to determine whether transfers who go directly to our more advanced programs have the same kind of preparation as students who take SI entry level programs.

H. Research and Teaching. As indicated in Tables 8 and 9 faculty are quite concerned about balancing research and teaching. Research is not a part of the contract expectations for faculty, but a growing number are interested in research—especially as it can relate to their teaching. The heavy teaching load at the college (16 or more "expected contact hours", plus program activities such as the business meeting and the faculty seminar, as well as college governance) make sustained research during the teaching year very difficult.

Faculty, who have obtained grants to open labs or carry out projects, have been able to carry out research programs by "buying out" some of their teaching. Other faculty have obtained Institutional Sponsored Research grants. Some faculty are able to build work springing from their research into their teaching (especially, for students taking the Undergraduate Research option), but for the rest, research has been relegated to the summer.

The SI planning unit holds that it is very important that faculty are current in research related to their area and that this is reflected in their teaching. Given the heavy teaching load, there is not as strong an expectation that research will lead to publication in specialized fields. Clearly, research, especially that which is "interdisciplinary," can play an important role in enabling the planning unit to deliver high quality science education. But the college needs to explore alternative ways of making room for faculty research without sacrificing the college's strong commitment to teaching.

I. Special Concerns of the pathways: Critique of the current situation in the pathways

1. Computer Science. In general faculty teaching in the computer science pathway are quite pleased with its three programs. It believes that any two of these programs (but particularly *Data to Information (DtoI)*, , with either of the others) offer an outstanding liberal-arts-oriented undergraduate computer science concentration. The programs (particularly *DtoI*) generally fill fall quarter-recently they have over-filled. . *Student Originated Software (SOS)* has very good retention, sometimes losing only one or two students to graduation, but all programs take a very enthusiastic cadre of students through three full quarters. The computing center has recently hired a manager of the Academic Computer Center, primarily to support computer science programs (David Metzler), and computing support for computer science has improved dramatically over the last few years. That said, *DtoI* is probably too intense and compact, and its content should be re-examined, with the critical aspects of computer science retained, and space for individual experimentation by particular teams in any given year. In addition, teaching this program is as extraordinarily demanding for the faculty as for the students, particularly the computer science faculty if the math faculty cannot teach a significant part of the programming or seminar lectures. Rather than reinventing the wheel each year, we should develop a series of materials (labs, lectures, programming examples, etc.) that can be re-used and refined from year to year, and a cadre of student aids who can help faculty deliver labs to students. The seminar themes should perhaps be thought through so that they offer both a respite from unrelenting technical topics, but also support of the ideas. Another problem is the occasional "super majors" -- students who take only computer science programs. For these students, as well as for transfers without a liberal arts background, the issue arises about how to broaden students' limited or highly specialized background. This has typically been done in seminar with varying degrees of success. *Computability and Cognition (C&C),* for example, has included a philosophy of mind seminar.

The faculty well understands, but is powerless to act on, the following drawbacks primarily because of lack of staffing or funding. (This might improve when two deans who have in the past taught computing return to the faculty. However, Evergreen faculty are free to "change areas" when they wish, and these faculty are not automatically replaced. If one or both of those faculty "leave computing", we will remain hard pressed.)

(a) There are few ways within the current curriculum for students who think they have a strong interest in computer science to try it out before signing on for a year-long, intensive and very demanding *DtoI.* Thus, a number of students drop out, discouraged after (or even during) the fall or winter quarters, leaving space that could have possibly been filled by students who could have made it through. We need a brief and light "Taste of Computing" such as the *Concepts of Computing* (offered for the first time in the spring of 1998) program, but do not have the faculty to staff it regularly. Such a program could also be taken by students who drop out of *DtoI* or *C&C* (though we expect more entering students would complete those programs if there were a lighter taste available.) The *Concepts of Computing* program can give students an opportunity to test their interest and obtain appropriate faculty advising. The permanent,, part-time faculty position, which emphasizes computing applications and social issue of technology, filled in the spring of 1998 could also help.

(b) Faculty can rarely teach outside the area, in freshman or advanced interdisciplinary programs, or in short courses. A freshman program *Society and the Computer* (SoC) was offered for many years during the 80's, but was discontinued because of lack of staffing and because its particular original themes were somewhat outmoded. We have not had staff to design and deliver such a new program though the current socio-political-cultural milieu suggests excellent thematic material. New hires in Computing, return of computing faculty from the Deanery as well as additional hires such as an historian of science and technology may help. Such a program would be an excellent place for students who want to understand the uses and possible abuses of computing, but do not want to "become" computer scientists. Furthermore, because computer science is primarily a quantitative science, faculty who teach computing, if available to teach more broadly, would be well suited to help the college address the major problems of quantitative literacy in other students.

(c) Computing is becoming ubiquitous on campus, and there is much need on campus for faculty with expertise in computing to serve on hiring committees (for faculty and staff where there is a desire for some skill in computing, e.g., director of computer services, dean of the library), college-wide committees and projects that involve computing (e.g., distance learning, faculty access to electronic student records, wiring the campus). In addition, faculty rotations such as those in the library or student advising can rarely be undertaken by faculty in this area. Our faculty feel beleaguered and too busy to go wherever there is a need for their expertise, and have to choose among them. Thus, faculty in other areas sometimes feel we are "not interested" in their use of computing, and decisions are made by the college that impact computing curriculum -- without our being able to offer our expertise.

(d) Computer science is a fast paced, fast moving area, and maintaining currency in the discipline and tools is difficult for faculty with heavy teaching loads. Our grants have helped in this regard. However, faculty in computing who have taken paid, grant leave to maintain their skill level, are not always replaced in the curriculum by computer scientists or mathematicians. Faculty thus feel conflicted about taking time off, knowing that their leaving may impose additional responsibilities on their colleagues, and a lack of support for current students.

2. **Physics and Chemistry.** The physical science pathway has been particularly concern with strengthening the areas ability to teach upper divisional science to the large number of transfer students in the area as well as to improve Evergreen's ability to offer opportunity for undergraduate research both within programs and within faculty labs. Some new initiatives such as the *Atoms, Molecules and Research* have clearly addressed these needs. But such innovative moves have put a strain on the area. Some insight into the hard choices being made during the decade of growth in student numbers, but no growth (or even attrition in some disciplines) in faculty in the Scientific Inquiry planning unit can be demonstrated by a comparison of the approach taken by the physicists and the chemists. For (at least) the past 10 years, chemistry at Evergreen has been understaffed in terms of faculty on continuing appointments. There have been one or two visiting chemistry faculty during most years. At least one year of chemistry is needed by students interested in any of the following areas: biology, environmental science, medicine, geology, physics and, of course, chemistry or biochemistry. Given the shortage of faculty available for teaching chemistry, the chemistry faculty have made the difficult decision to continue offering two or three entry-level programs and one advanced program in most years. This does not include the advanced chemistry offered in Environmental Studies. In addition 4 of the 5 chemists have active research programs with several advanced students on contracts. Because of their dedication to covering the chemistry needed and wanted by students, the faculty were often unavailable for teaching in Core and even less available for interdivisional offerings. An alternative approach was taken by the physicists who decided that they would comply with the college's requirements for teaching "outside of the area" 3 of each 8 years, but doing so meant (1) hiring a 5th physicist in 1989 and (2) that the junior-level *Physical Systems* program would only be offered in alternate years. Students wanting junior or senior level physics in the alternate years were disappointed. (The *Energy Systems* program offered in the alternate years was oriented more toward energy policy and many of the students had not taken calculus or even introductory physics.)

It is important to point out that the chemists were not trying to avoid Core or interdivisional offerings. In fact, they were eager to do so and several times they were not allowed to teach in Core (by either the curriculum dean or by agreement within the specialty area). It is also important to point out that the physicists did not drop their junior level offering due to low enrollments. The *Physical Systems* program had an average fall enrollment of 22 students for the 5 years prior to making it an alternate-year offering. The physicists simply worked out the mathematics of the then-current policy that faculty teach "out of the area" (includes Core) 3 of 8 years. With only 4 physicists, only one is free to teach out-of-area (includes Core) each year since one is required for *Matter and Motion* (calculus-based introductory physics), one for *Foundations of Natural Science* (algebra-based introductory physics) and one for either *Energy Systems* or *Physical Systems* (offered alternate years). Thus, a particular physicist could teach out-of-area only 2 out of 8 years if we only had 4 continuing physics lines. In recent years, as the number of physicists on continuing appointments has dropped below 4, they have elected to not always staff the *Foundations of Natural Science/Introduction to Natural Sciences* program in order to be able to continue to teach Core and interdivisional programs at the rate of 3 of 8 years. This means that even with 4 physicists at the college, we were unable to offer algebra-based introductory physics each year. In 1995, one of the chemists took on this responsibility.

We envision changes within the current pathway taken by students interested in physics. Student research and project work is a key element of most SI programs, including current physics programs. Ironically, *Energy Systems/Physical Systems* offers very few advanced lab opportunities, and there is very little ongoing research by physics faculty. Current faculty have been doing serious planning for increased physics research, and have made some concrete progress. (We recently acquired a new (small) telescope and will build a small observatory, have acquired access to large research telescopes locally and via the Internet, have invested in a couple of turnkey modern physics experiments, and continue outfitting the Energy homeroom for monitoring energy flux.) More research opportunities are required to adequately serve students interested in physics. Our advanced programs, *Energy Systems* and *Physical Systems*, are currently stronger on theory and weaker on experiment/practice, except for small-scale and usually ephemeral student projects. (The weather station is an exception.)

For example, the optics room is underutilized. There is a nice big optical table, several lasers, and a decent collection of mirrors and other optics, which are rarely used except for holography demonstrations. One option in our vision would be to hire a new faculty member with experience involving students in optics research, to make intensive use of this facility. Optics is a fertile and growing area of study in physics, and can provide useful practical experience as well as enrich theoretical study, with modest additional investment in equipment.

Replacing our two missing physicists with new faculty who can build ongoing research projects that involve students will strengthen the good work already done by current faculty. This will enable all of us to do more coteaching in truly interdisciplinary program. We are committed to fairly sharing staffing of introductory, advanced, Core, and interdisciplinary programs.

3.Lab Biology. The lab biology area has been debating the structure of its recurring, more advanced program. For a number of years, the *Molecule to Organism* (M2O) program has was the center piece for studying biology at the intermediate level. It served a fairly diverse range of student interests, including the "pre-med" student. This program often had difficulty in serving this mixed audience. During the 1997-98 academic year the planning unit experimented with a new format. Two new offerings replaced it: :*Vital Stuff: The Chemistry and Biology of Food* and *The Structure of Life: Functional Interrelationships from Molecule to Ecosystem.*" Each program will be available for 20 to 48 credits with Organic Chemistry being available to both separately. This is an attempt to get at problems with too much material in the Molecule to Organism program that traditionally has tried to cover organic chemistry, biochemistry, cell biology, molecular biology and physiology. The new programs will try to use a theme to make the new programs more cohesive and less like a loose assembly of related courses as students and some faculty often found the M2O program to be. Ironically, this splits organic chemistry off into a separate course instead of being directly integrated into any program. This course is taught by a faculty from *Vital Stuff* as well as an organic chemist.

4. Mathematics. One of the main conclusions of the last reaccreditation report was that the teaching of mathematics was a serious problem at the college. It stated that "current planning to at least inject a meaningful math-across-the-curriculum component into the Evergreen experience deserves strong encouragement and rapid implementation. The 1994 Interim Report addressed this goal by pointing out that a math coordinator was hired, specific modules were offered and many innovative approaches were taken by faculty (6 of the 7 innovative approaches were by faculty currently in the Scientific Inquiry Planning Unit). However, the conclusion of the interim report (p.29) was as follows. "While sufficient to show an expanded and continuing effort compared to that in place at the time of the 1989 evaluation team's visit (particularly if one includes the activities of the math coordinator), the college's successes in overcoming math avoidance have clearly been limited and inconsistent. It remains easy for students to avoid exposure to mathematics, though we find that student demand and faculty concern have motivated more offerings and more consistent discussion regarding program planning. As in many areas, the Long-Range Curriculum DTF intends to review the college's efforts in mathematics and quantitative studies. Additionally, an academic dean's position has been partially dedicated to reviewing the same issue during 1994-1995. We hope that a concerted strategy and commitment will arise from this review. Mathematical and quantitative education remains a distinct challenge to the college's interdisciplinary format."

This report clearly has implications for hiring priorities. With sufficient numbers of faculty in chemistry, physics, mathematics, computer science, geology, (and other quantitative fields including some areas of psychology, economics, etc.), we could place enough faculty in core or interdivisional offerings so that students would be virtually certain of seeing "math-across-the-curriculum". It is very unlikely that we would hire anyone who would not be able and willing to teach "writing-across-the-curriculum", but we do not focus on an ability and willingness to teach "math-across-the-curriculum" in the same way. Student tutors have been used recently to provide individualized math support for students. Currently, student math tutors are available under the supervision of a dean, who is also a mathematician and will continue to supervise when he leaves the Deanery in spring 1998. But the college needs to have a well organized program to help students with limited quantitative background .