Below is a quote from Dean Betsy Dulin, College of Information Technology and Engineering, Marshall University who reviewed the IST five year self study report and external review and presented a written report of her findings to Marshall’s Academic Planning Committee. Dean Dulin’s report is a cogent presentation of the case for an additional full time permanent faculty position in Information Technology which is a component area of emphasis in our IST program. Although Dean Dulin was charged strictly with reviewing the IST program and did not comment in this report on related curriculum changes I must also point out that Marshall has been charged by the Chancellor with developing a traditional program in computer science and has in fact developed such a program under the joint administration of Dean Dulin’s College and my own. Marshall’s proposed Computer Science curriculum which has been reviewed and approved on campus creates several dozen new CS courses to be taught at least in some part by the current IT faculty in the College of Science. This puts an even greater burden of classroom instruction on the very faculty Dean Dulin points out are being currently overloaded before any classes in the new CS program have been scheduled. What follows is a verbatim transcription of Dean Dulin’s comments about the Integrated Science Program in general and its Information Technology area of emphasis in particular.

“This program continues to be a unique and popular program with the flexibility to respond rapidly to changing market conditions, and the University should continue to provide support for both its maintenance and growth. However, several concerns deserve special attention:

In general, faculty data sheets reveal exceptionally high teaching loads for technology and computing based fields of study. The most egregious example is a junior faculty member who reports a teaching load of 6-8 courses per semester in the IT field of study. Such loads make it difficult for faculty members, and especially non-tenured faculty members, to pursue their continued professional development in a rapidly changing discipline, advance scholarly interests, and respond to individual student needs. Ultimately, though, the students are the parties who are the most disadvantaged when teachers are over-committed.
Although the ABET accreditation criteria are not directly applicable to unaccredited programs, the criteria provide evidence of current industry standards with respect to faculty teaching loads. ABET’s Computing Criteria requires programs to employ enough faculty members “to provide continuity and stability, to cover the curriculum reasonably, and to allow an appropriate mix of teaching and scholarly activity.” In addition, faculty members must have sufficient time to pursue professional development, scholarly activity, and remain current in their discipline. ABET’s 2003/2004 criteria for Applied Science programs provides the following guidance on the subject: “[Teaching] loads should be compatible with the existing climate for research and professional development. Faculty members, regardless of their individual capabilities, cannot function efficiently either as teachers or seekers of new understanding if they are too heavily burdened with [course assignments].” All of the engineering, computer science, and technology programs of which I am aware interpret these criteria as requiring much smaller course loads than those required of IST faculty members, even those in institutions that do not have a research orientation.

As noted by various program reviewers, program faculty and administrators, the program is in serious need of additional faculty members and support.”
Marshall University
Department of Integrated Science and Technology
Program Review

PROGRAM DESCRIPTION for: Integrated Science and Technology

Date of last Review: October 1998 (Two year review)

Marshall University’s IST program

Marshall University’s IST program was begun in 1996 by President J.W. Gilley. The first class of 18 freshmen students enrolled in Fall 1997. In Fall 2003 IST enrollment was 170 majors. IST is located administratively within the Division of Mathematics and Applied Science which is part of the College of Science.

The IST Department is built on a model that originated at James Madison University in the early 1990’s. The Virginia state legislature challenged JMU to develop a program that would prepare students in a variety of fields to be readily employable upon graduation. Marshall’s IST program has a similar goal. IST students get solid grounding in oral and written communication, technology skills, team work and entrepreneurship. Social and natural science content and the use of technology are combined in many IST courses. Requirements for admission to the IST program are among the highest in the University. Retention and graduation rates are also among the highest at Marshall.

MISSION STATEMENT for INTEGRATED SCIENCE and TECHNOLOGY:

The Integrated Science and Technology Department uses a student centered, inquiry based, active learning approach to instruction. To this end faculty in the IST Department work to:
--develop communication skills
--develop critical thinking skills
--encourage team skills through collaborative learning
--develop real-world employment skills through service learning, internships, and mentoring
--emphasize hands-on experience
--provide students access to emerging technologies

IST offers students a degree program that provides intellectual growth as well as post-graduate employment skills. A secondary mission is to engage in economic development in our region through producing graduates who are immediately productive for their employers. We also offer students coursework in entrepreneurship to provide both the encouragement and the knowledge necessary to start new business in West Virginia and the Tri-State region.

With its current resources, faculty and space IST has the capacity to enroll 200 majors in Fall of 2004.

II ACCREDITATION INFORMATION.

There is no accrediting agency for IST programs at this time.
III PROGRAM STATEMENT on Adequacy, Viability, Necessity and Consistency with Mission.

A. ADEQUACY

1. CURRICULUM

Areas of Emphasis

All IST students earn a B.S. degree in Integrated Science and technology. There are currently three areas of emphasis that a student may specialize in – Computer and Information Technology, Biotechnology and Environmental Assessment and Policy.

Within the area of Computer and Information Technology, students can gain additional expertise by specializing in Software Development, Network Administration and Database Management.

Another Area of Emphasis “Manufacturing” was recently removed from the curriculum because the only faculty member with this expertise moved to another position within the University and there was little interest among students in this subject.

An additional Area of Emphasis (Transportation) is being studied at this time. It will very likely be a joint-venture with the Rahall Transportation Institute.

Course of Study

All IST students earn a B.S. degree in Integrated Science and Technology. To fulfill these degree requirements, IST students must complete 128 hours of coursework. The diversity of employment opportunities for IST graduates necessitates mandatory advising of students each semester to identify appropriate individual curriculum choices for their careers. Most IST classes require instructor’s permission for enrollment. IST majors have advisors within the discipline from their first year in the program. Juniors have a mandatory review of classes prior to senior year. Permission to enroll and a proposal are required for capstone research projects. Coursework includes the following components:

General Education requirements (37-46 hours) include:

- Communications/Connections courses (12 hrs)
- Social Sciences (9 hrs)
- Modern foreign language (3-12 hrs)
- Humanities (3 hrs)
- Art/Music/Theater Appreciation (3 hrs)
- Literature (3 hrs)
- Public service experience (1 hr)
- Elective course, not in science or math (3 hrs)

This compares favorably with the College of Science General Education requirement (36-45 hrs) and the General Education requirements of the College of Business (42-45 hours).
Not counted are the COS requirement of 3-6 hours of Math and 12 hours of Science or the COB requirement of 6 hours of Math and 7-8 hours of Science which we include as core courses.

**Core courses (33 hours)** consist of:

- Analytical Methods I-IV (Statistics, Differential Calculus, Integral Calculus, Differential Equations) equivalent to math courses,
- Natural and Physical Science courses (IST 111: Living Systems and IST 212: Energy). These are integrated science classes specifically developed for the IST department.
- Instrumentation courses (IST 160: Intro to Programming and either IST 163: C++ or another computer course (GIS, Bioinformatics or other). A new instrumentation course is under development.

**Strategic Sector courses** (24 hrs.) are begun in the junior year and allow students to begin work on their area of emphasis while examining other areas of the program. Most strategic sector course work is offered in the ISAT department, but some courses are drawn from elsewhere.

As a result of the 2000 Advisory Board meeting further emphasis has been placed on programming languages, including Visual Basic.net, C++, advanced C++ and Java.

Students are encouraged to take courses in biotechnology, environmental science and computer and information science to broaden their understanding of other areas of science and assist them in deciding on a career choice. Students may substitute courses with permission of an advisor.

**Concentration courses** (12-14 hrs.) are equivalent to an area of emphasis and are 3-400 level courses completed in the senior year.

**Science or Technology electives** (12-14 hrs) fill out the student’s degree requirements. In Biotechnology and Environmental Assessment and Policy these include Chemistry, Biology and Physics depending on the student’s interest in advanced study.

**Senior Project** (6 hrs.) The senior project is the capstone experience of the curriculum, and is considered to be an extension of the student's chosen concentration. Students typically form into teams of up to four members to work on a problem provided by industry or government. Students have the opportunity to solve a real-world problem, receive work experience in an industrial or governmental agency setting, and become directly acquainted with a particular organization that may offer post-graduation employment. The students are required to give a professional presentation to the faculty and students in the department and their internship mentors are invited to attend.

**Internship** (3 hrs) While not a graduation requirement, an internship is strongly recommended.

**Service Learning Experience** (1 hr) hour course requirement for IST students to volunteer his/her time to a community related project. This course is required of all IST students for graduation. This is different from an internship as the volunteer aspect and giving back to the community are what is emphasized, rather than getting significant job experience for future employment.
Computer and Information Technology Concentration

A degree in the Computer and Information Technology concentration within IST prepares students to contribute to industrial, governmental, and educational computing in the areas of:
- designing and building communications and networking infrastructures
- building or customizing software systems
- designing and building user interfaces for a corporate Intranet/Internet presence
- managing an organization’s data assets

Within the Computer and Information Technology concentration, IST offers three areas of emphasis:
- Software Development
- Network Administration
- Database Management

Students within the Computer and Information Technology concentration take a common set of courses during their first two years in the program, and then are given the opportunity to specialize in one of the area of emphasis tracks based on their preference and desired career paths. A brief description of each of these areas is included below.

**Software Development**
Students will learn the software development process, including computer programming languages such as VB.NET, C++ and Java and Web-based development languages such as ASP and PHP. Students are taught how to specify, design, and build software systems with an understanding of the development process. Through these processes, students will be taught how to develop application programs and understand project management and development issues. Students also have the opportunity to learn to develop Web compliant applications for E-commerce and to integrate multimedia into such applications.

**Network Administration**
Students within the network administration area of emphasis will learn specific skills in integrating computer hardware through the setup and installation of network systems. Students are also taught how to manage and troubleshoot computer networks and provide network infrastructure support for larger organizations. Students within the network administration area of emphasis will also have the option of obtaining the Cisco CCNA and CCNP certifications as part of their work in CIT.

**Database Management**
Students within the database management area of emphasis will learn to effectively use distributed database systems, such as mySQL and Oracle. They will also be taught how to perform data acquisition and organization through proper database design techniques. Students will be able to integrate distributed databases, and prepare data for presentation in business or via the World Wide Web.
a. Objectives of IST Curriculum

- To convey the value and excitement of science and technology.
- To develop communication skills that enhance post-graduate employment success.
- To demonstrate the importance of science and technology to the needs of society.
- To integrate the use of computers and expert systems as tools in learning decision-making, information gathering, and communication.
- To provide a broad, interdisciplinary curriculum that will fully prepare graduates to adapt to changing employment opportunities and success in their careers. Each student takes general education and core courses that provide a foundation for further learning, in greater depth in Strategic Sector and Concentration courses during their Junior and Senior years.
- To educate future professionals who have strong backgrounds in science and technology as well as the practical job skills, such as the ability to communicate and work effectively in teams, that provide the flexibility and adaptability necessary to meet the challenges of today’s rapidly evolving work environment.

b. Justification of IST Objectives

The IST approach to the curriculum is based on a number of published studies advocating educational reforms in Science, Technology Engineering and Mathematics (STEM) instruction including those by the NSF (1996), the Carnegie Foundation for the Advancement of Teaching (1998), and the National Research Council (1997, 1999, 2000, 2001, 2002a, 2002b, 2003a, 2003b). Specific citations are contained in the references section of the Appendix of this report. Recommendations contained in these studies include moving away from passive delivery of information requiring memorization of lecture and text contents which are less effective in achieving desired learning outcomes towards methods that promote conceptual understanding and the ability of the learner to apply knowledge in new situations (NRC, 2003b).

Employers need scientifically and technologically capable personnel able to apply this knowledge directly to problems of current interest, communicate effectively with colleagues and customers alike, work collaboratively, interact with people from different cultures in a global workforce and continually update and expand their knowledge and skills. The Accreditation Board for Engineering and Technology (2002-2003) includes among its standards the ability “to apply knowledge of mathematics, science and engineering to design and conduct experiments as well as to analyze and interpret data; to function on multidisciplinary teams and to communicate effectively.”

c. Relationship of MU and JMU’s IST programs

The JMU IST program was developed to initiate broad-based, integrated curriculum change through an innovative program to educate students to solve technologically based problems in a “real-world context.” JMU IST students are science generalists with technology specializations developed in the Junior and Senior years. Students who might not otherwise have considered a career in science or technology have been attracted by the IST approach to learning in these disciplines. The JMU IST model has been extremely successful, with very high student interest and post graduate employment and career success.
Initially, the entire JMU curriculum, including course names, was transposed to form the basis of the MU IST curriculum. Over the past six years, MU’s IST program has been modified and adapted in several significant ways to better respond to the needs of our students and their post-graduate career needs. MU’s IST program has an annual curriculum retreat to which all faculty, including adjuncts, are invited to discuss the integration of the courses and changes and redesign of the curriculum.

The IST curriculum as developed by JMU and adapted by MU emphasizes acquisition of strong quantitative, computer and scientific skills in an integrated, interdisciplinary program. The development of new models of teaching has been central to fulfilling the MU IST mission.

The use of the computer as a problem-solving tool is a central feature of this curriculum, along with an emphasis on the collaborative (team) approach to problem solving. MU IST students rely on computers for data and information retrieval, data representation, and data analysis throughout their course work. MU IST students engage in teamwork in the laboratory, classroom, and in preparation for a senior project. The MU IST curriculum emphasizes application of science and technology and emphasizes internships and other experiential learning.

d. Similarities between MU’s IST vs. JMU’s IST Program

- Both are committed to exploring ways to improve delivery of instruction.
- Both emphasize solving interdisciplinary problems through team work.
- Both incorporate societal impact, business principles and economics in discussing technology and both emphasize creative solutions to real-world problems.
- Both have developed a strong interdisciplinary curriculum that includes natural science, information technology, mathematics, and computer models in classes such as GIS, bioinformatics and environmental assessment.
- Both programs emphasize oral and written communication, teamwork and project management skills.
- Both create early opportunities for students to engage in independent research and fieldwork and both incorporate meaningful laboratory experiences and projects into the curriculum.

e. Differences between MU and JMU’s IST programs.

- The MU IST program was started with a limited number of faculty members, many of whom were recruited from existing programs within the College of Science to teach one or two classes a year. This meant that course staffing depended on availability of faculty from other departments.
• MU’s IST Mathematics instructors were recruited from existing faculty nonetheless
  close coordination with the MU Mathematics faculty has enabled the MU IST program to
develop its applied mathematics focus while remaining academically challenging.
Interested MU IST students are encouraged to minor in Mathematics by taking Calculus II.

• MU’s IST social science requirements are based on the Marshall Plan (two International
  and one Multicultural course) and are taught by faculty in COLA departments. JMU’s
IST program offers social science classes within the program using only IST faculty.

• MU’s IST program requires students to complete 2 years (successful completion of the
  2nd year XXX204 course) of a modern foreign language. JMU’s IST program does not
require a foreign language. As a result MU’s IST students are better equipped for
interaction with people from other countries as well as those whose primary language is
other than English.

• MU’s IST program offers an innovative 12 credit Communications/Connections
  sequence satisfying the Humanities general education requirements of the College of
Science. These courses are team taught by writing and communications specialists and
science faculty to better integrate learning in these humanities into a science and
technology context. JMU’s IST program uses English Composition and Communications
courses to satisfy general education humanities requirements.

• MU’s IST program has expanded its Chemistry requirement by requiring 10 credits of
  Chemistry for environmental and biotechnology students. JMU’s program requires a
single 4 credit integrated Chemistry class taught by IST faculty.

• MU will reinstitute its Computer Science program which was suspended in 1998, one
  year after IST was begun. JMU has always offered both an IST and a Computer Science
program. The two programs cross-list many electives. The JMU IST program focuses on
Knowledge and Information Management and has been nationally praised for attracting
many young women to IST field because of its applied focus. JMU’s experience in
offering both baccalaureate programs should be an excellent model for Marshall now that
it will structure its undergraduate curriculum in a similar fashion.

• MU’s IST program offers more specialized classes beginning in year one of the program
  (IST 241, Introduction to DNA Cloning; IST 342: Bioscience Laboratory Methods; IST
160: Intro to Programming: Visual Basic and IST 163: C++). JMU only offers general
classes during the first two years of the program. In response to WV employers need for
more high technology employees MU IST students take “strategic sectors” curriculum in
their third year and specialized classes in their final year.

• JMU’s IST program offers core courses called Instrumentation and Measurement (IST
160/IST260). These courses provide students with experience in accurate, meaningful
measurement and data analysis in science and engineering and to ensure exposure to
hands-on, experimental science. In MU’s IST program, the IST 160 Instrumentation
course was changed to focus on programming languages that would be useful to students
in all three emphasis areas in applications such as bioinformatics and GIS. A new
instrumentation course is currently being developed for students in all 3 concentrations.

- As a result of discussions with faculty and employers we have evolved to giving students more specialized content earlier than at JMU. While this achieves the goal of having students better adapted to the needs of our area, we have lost some of the integration in the Junior and Senior year. MU IST faculty are encouraging interdisciplinary Senior Projects in order to improve integration in the upper division.

**f. Justification of shift in focus from original model**

Most of the modifications in MU’s implementation of the IST curriculum reflect the vastly different resources available to the two programs. Since the inception of its IST program, JMU has added concentrations in Energy, Health Systems, and Telecommunications to the original four areas of Environment, Biotechnology, Information and Knowledge Management, and Engineering and Manufacturing. These strategic sectors were developed from national critical technology lists and represent areas of current strategic importance in the world economy. MU has resisted expansion of its emphasis areas to focus on what it does best and the specific needs of employers in our state and region and to make more effective use of our limited resources.

However, MU’s IST program has not hesitated to make modifications in its programs as the need arises.

- Network Administration, Database Management and Software Development were incorporated into the Computer and Information Technology emphasis area in response to student needs when the old Computer Science program was suspended. IST will adapt again as the impact of the reconstituted CS degree becomes clear.

- Environmental Science area was adapted to the needs of students with an interest in this area who transfer in with advanced standing and want to engage in coursework in this area immediately without taking lower division preparation required of first time freshmen in the Environmental Assessment and Policy emphasis area. The Environmental Science baccalaureate includes many courses cross-listed with the EAP emphasis area.

- Biotechnology students have expressed strong interest in Forensic Science and take additional traditional science classes to satisfy the evolving professional standards of that discipline.

Although most MU IST majors are more tightly focused on coursework in the natural sciences than typical JMU IST students, a significant number of our students maintain an interest in becoming a scientific or technological generalist.

In Fall semester of 2002, MU’s IST program sent a team of faculty on a site visit to JMU and invited faculty members from JMU’s IST program to review our program. The JMU review report of the MU IST program is in the attached Appendix. This visit was constructive. In particular, the Communications/Connections class was singled out as an excellent innovation within our program. They encouraged us to continue to include social science content and current affairs within these classes. However, since our students also take traditional social
science courses in fulfillment of their general education requirements MU IST faculty do not feel additional integration of political science/government and economics in the MU IST Communications/Connections courses was necessary for our students.

The JMU external evaluation report on MU IST also suggested that we increase integration at all levels of the curriculum, which is being done through addition of interdisciplinary classes at the third and fourth year levels and by increasing flexibility of course requirements within the areas of emphasis. The report also encouraged us to continue team teaching and to improve collaboration between faculty teaching first and second year courses to enhance vertical integration of the curriculum.

The JMU feedback has resulted in our considering a number of curriculum improvements, including reinstitution of an instrumentation course, changing the placement of the Energy course from the Freshman to the Sophomore year, and the development of courses in Technology and Innovation and Bioethics/Rhetoric of Science. Other recommendations requiring significant financial investment in faculty and facilities will be discussed later in this report.

g. Communication/Connection Sequence is an Effective Innovation in IST Curriculum

IST recognizes that the ability to communicate effectively in written and oral forms is fundamental to success in the high technology workforce. Development of critical job skills is part of the Communications/Connections curriculum objectives. These include:

- Teamwork
- Project management
- Leadership
- Professional, ethical and legal responsibilities.

Assignments which develop these skills are integrated into the writing and presentation curriculum of most IST classes. The foundation of this integrated experience is the four semester Communications/Connections sequence (IST 101/120/201/220).

See the appendix for a fuller discussion of this innovation which was singled out for praise in JMU’s external review.

h. IST First Year Curriculum Builds a Learning Community

One of the greatest advantages of the Communications/Connections sequence is its role in creating Learning Communities. Many academics see learning communities as an effective approach to reduce Freshmen attrition (http://www.uc.edu/learningcommunities/Faculty.htm). Many first year students feel overwhelmed and under prepared for college. They fail to connect with campus resources designed to ease this transition (e.g. UNI 101, tutoring, HELP program, writing center, academic advising, etc.). The UNI 101 course at MU in particular is designed to connect students to the wider college community and IST students co-enroll in this class as part of their block scheduling.
Block scheduling places IST first year students in required classes with the same group of peers during the fall semester. Block scheduling facilitates a sense of belonging through creation of a small college atmosphere with greater possibility for personal connections. Students in the block scheduled classes learn to work successfully in groups and share expertise by building support networks and engaging in collaborative learning. Faculty members working within a learning community recognize individual students’ strengths and needs, facilitating mentoring, advising, and instruction. "Simply said, these learning communities work," according to Andrew Koch, senior project officer for the Lilly Endowment Retention Initiatives. "Research results at Purdue and programs across the country show that students who take part in a learning community earn higher grades, make friends faster, and are retained at higher rates than students who don't participate in a learning community (http://www.purdue.edu/PER/sp02.learn.html).

One difficulty in establishing learning communities through block scheduling is coordination of the schedules of faculty committed to such an approach. This is much less of a problem in IST as all faculty are committed to the learning community approach.

i. Graduate school

While preparing students for graduate school is not a primary mission of ISAT, we have had several students gain admission to graduate schools including Marshall, University of Massachusetts, University of Cincinnati, Clemson, and West Virginia University.

Employers often prefer applicants who have advanced skills in a discipline and some IST students would like to complete a Masters’ degree. This is especially true for IST students in the EAP area. A proposal is currently under review to develop a major within the Physical Science masters program for such students.

2. FACULTY

When IST was put in place in 1998, faculty were borrowed from other departments. With the growth of student interest in the program additional faculty are needed. For example, one very active member in Environmental Assessment and Policy is on a year-to-year temporary appointment as is one of our communications instructors.

The success of IST faculty in obtaining external funding has enhanced the opportunities for our students to gain direct experience in research. It also creates problems as the pool of replacement instructors for specialized upper division courses is extremely limited in this area. IST faculty members teach a normal load and are involved supervision of several senior projects. An interdisciplinary program requires instructors who can cover a broad curriculum while involving students in laboratory experimentation, fieldwork and development of a variety of computer based disciplinary applications.
The Full time IST Faculty are:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Tenure Status</th>
<th>Department/Tenure Track</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Ralph W. Taylor</td>
<td>Professor</td>
<td>Tenured in Bio. Science</td>
<td>Chair/ Environmental Assessment and Policy</td>
</tr>
<tr>
<td>Dr. Michael Little</td>
<td>Professor</td>
<td>Tenured in Bio. Science</td>
<td>Assoc. Chair/Environmental Assessment and Policy</td>
</tr>
<tr>
<td>Dr. Elizabeth Murray</td>
<td>Assoc. Prof.</td>
<td>Probationary - Tenure Track</td>
<td>Biotechnology</td>
</tr>
<tr>
<td>Dr. Alain Blanchetot</td>
<td>Assoc. Prof.</td>
<td>Probationary – Tenure Track</td>
<td>Biotechnology</td>
</tr>
<tr>
<td>Dr. Hamid Chahryar</td>
<td>Assoc. Prof.</td>
<td>Tenured in CSD</td>
<td>Computer and Information Technology</td>
</tr>
<tr>
<td>Dr. Daniel Dementiev</td>
<td>Asst. Prof.</td>
<td>Probationary – Tenure Track</td>
<td>Computer and Information Technology</td>
</tr>
<tr>
<td>Dr. Kannan Balasubramanian</td>
<td>Asst. Prof.</td>
<td>One year Temp.</td>
<td>Computer and Information Technology</td>
</tr>
<tr>
<td>Mr. Brian Morgan, M.A.</td>
<td>Asst. Prof.</td>
<td>Probationary – Tenure Track</td>
<td>Computer and Information Technology</td>
</tr>
<tr>
<td>Mr. Andrew Gooding, M.A.</td>
<td>Asst. Prof.</td>
<td>Probationary – Tenure Track</td>
<td>Communications/Connections</td>
</tr>
<tr>
<td>Ms. Caroline Gold-True, M.A.</td>
<td>Instructor</td>
<td>Year-to-Year appointment</td>
<td>Communications/Connections</td>
</tr>
</tbody>
</table>

Faculty members from other programs bring a greater breadth of disciplinary knowledge and much real-world experience. Dr. Jagan Valluri consults for the Army Core of Engineers. IST has particularly benefited from faculty in Mathematics who add expertise and rigor to the curriculum. The IST adjunct faculty, including those employed in relevant professions locally, have contributed much to the success of the program. Mr. Michael Bryant works as a software engineer for Strictly Business (a successful Huntington software design company), and Mr. Ted Smith is head of the WV State Police Forensic Science Laboratory. These individuals bring considerable real-world experience to IST.

The JMU report noted that the number of IST faculty were below “critical mass.” A specific recommendation of the JMU team was to enhance and improve team teaching and to increase integration of the curriculum through enhanced faculty communication. IST has adapted to the shortage of tenure track biotechnology faculty by encouraging students to enroll in Cell Biology, Molecular Biology, Microbiology, Genetics and Immunology classes in the Biological Sciences Department as well as in General Chemistry, Organic Chemistry and Biochemistry in the Chemistry Department.

Environmental Assessment and Policy track students have enrolled in Plant Taxonomy, Herpetology, Conservation of Forest, Soil and Wildlife in Biological Sciences as well as General Chemistry, Organic Chemistry and several Geology classes. The inclusion of coursework in other disciplines as electives is a cost effective approach to providing breadth to the IST degree. Generally IST students have been competitive in courses outside the program indicating their preparation has been adequate.
Below is a list of faculty by emphasis area. Adjunct faculty and those with appointments in other programs are shown in italics.

**Environmental Policy and Assessment**
- Dr. Ralph Taylor, Professor, Chair of IST and ISC programs. Teaches Connections and UNI 101.
- Dr. Michael Little, Professor. Coordinator of Environmental Assessment and Policy area and Environmental Science major. Teaches upper level Environmental courses.
- Dr. Thomas Jones, Visiting adjunct professor. Mostly teaches ISC courses.
- Dr. Jagan Valluri – Professor of Biological Sciences – teaches IST Risk Assessment.
- *Mr. Sam Colvin*, M.A. – Instructor – teaches the IST Living Systems and Nature of Environmental Problems courses as well as ISC courses.

**Biotechnology**
- Dr. Elizabeth Murray, Assoc. Professor – coordinator of Biotechnology.
- Dr. Alain Blanchetot, Assoc. Professor. – teaches Biotechnology upper level classes.
- *Dr. Marcia Harrison*, Professor Biology. teaches Plant Biotechnology.
- *Mr. Ted Smith*, M.S. Director of WV State Police Forensic Laboratory, teaches Forensics.

**Computer and Information Technology**
- Dr. Daniel Dementiev – Asst. Professor – teaches upper level CIT courses.
- Mr. Brian Morgan, M.S. Asst. Professor – Coordinator of CIT, teaches lower and upper level CIT courses and advises upper level CIT students.
- Dr. Hamid Chahryar – Assoc. Professor – teaches entry and upper level CIT classes.

**IST General Education Faculty**
- Mr. Andrew Gooding, M.A./ABD – Asst. Professor – teaches Communications and Connections classes. Freshman advisor.

**IST Core Curriculum Faculty**
- *Dr. Ralph Oberly* – Professor of Physics – teaches IST Energy class.
- *Dr. Ashok Vaseashta* – Assoc. Professor of Physics – teaches IST Energy class.
- *Dr. Laura Adkins* – Prof. of Mathematics – teaches IST Analytical Methods classes
- *Dr. Bonita Lawrence* – Assoc. Prof. of Mathematics – teaches IST Analytical Methods
- *Dr. Clayton Brooks* – Asst. Prof. of Mathematics – teaches IST Analytical Methods
- Dr. John Lancaster – Full Prof. of Mathematics – teaches IST Analytical Methods
- *Dr. Peter Saveliev* – Asst Prof. of Mathematics – teaches IST Analytical Methods
- *Dr. Judy Silver* – Professor of Mathematics – teaches IST Analytical Methods

There are currently no Graduate Assistants assigned to IST.
Relationship of the IST Department to the Marshall Plan ISC Curriculum

Currently the Chair of ISAT also coordinates and staffs ISC classes but the programs are otherwise separate in terms of finances, scheduling and personnel. This administrative arrangement is accidental and not ex officio and could change depending on willingness of others to take on the ISC responsibility. The ISC curriculum and its implementation are under the supervision of the ISC committee which is composed of representatives from each of the departments in the College of Science.

The JMU review team suggested that ISAT and ISC be more closely integrated as they are at JMU because of the similarities in the instructional philosophy (e.g. issue-based, integration of science and technology content with perspectives and content of other disciplines served by ISC) but such a proposal would have to be approved by the ISC committee as well as the governance structure and administration of the University.

3. Students

a. Entrance Standards
All students admitted to the College of Science must have minimum ACT (or SAT Equivalent) scores of 21 on the Mathematics section and a 21 overall composite score.

If a student is interested in IST but fails to meet minimum requirements he/she is advised to enroll in MTH 130 (College Algebra).

For the years covered by this review, incoming IST students have an average Math ACT score of 24.6 and an average composite ACT score of 25.05 (cf. Appendix) which places IST students in the 80th percentile of ACT scores nationally. The College of Science average composite ACT score is 23.26 which is the highest of all Colleges (cf. Appendix)

IST freshmen students enrolled during the last five years have a mean high school G.P.A. of 3.50

b. Exit Standards

4. Resources

a. Financial – ISAT is unique in that it receives partial funding from an annual grant from the WV Office of Economic Development. The grant award has remained relatively constant at $500,000 with the Department’s share at just under $400,000 the remainder being used for other campus costs associated with offering the program (e.g. utilities, etc.).

The program also charges a Technology Fee to all IST students and a lab fee of $50.00 per student for each student enrolled in a laboratory class.
The Technology Fee currently generates $8,000 annually and Lab Fees amount to $15,000 annually. ISC Lab Fees are kept separate and administered by the ISC coordinating Committee. ISC lab fee revenues may not be used to support the IST program.

As a laboratory intensive program IST is a costly program but no more so than other natural sciences with the one exception of the CIT track which must provide extensive computer access with concomitant chargeback for network connections and software licenses. Maintenance of equipment, especially the instructional computing labs requires a full time technician in addition to considerable use of the time of the College of Science’s Instructional Technology Coordinator.

Faculty supplement much of the expense of laboratory and field experience with grant and contract funds which both provide stipend and salary support for students and defray equipment supplies and other costs associated with the experimental curriculum.

The following is a list of sponsored projects involving IST faculty many of which include student co-workers.

<table>
<thead>
<tr>
<th>P.I./co-P.I.</th>
<th>Project Title</th>
<th>Funding Agency</th>
<th>Dollar amount</th>
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<tr>
<td>Tom Jones</td>
<td>Crayfish of New River</td>
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<td>Mike Little</td>
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<td>W.V. Dept. of Transportation</td>
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<td>Mike Little</td>
<td>Virtual Transportation System</td>
<td>Rahall Transportation Institute (RTI)</td>
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<td>Highland Park</td>
<td>Appalachian Regional Commission</td>
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<td>Mike Little</td>
<td>DNA Sequences of rare fish</td>
<td>WV Department of Natural Resources</td>
<td>$6,000</td>
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<td>Little and Edwards (USFS)</td>
<td>Fish Migration in Stony River</td>
<td>Dominion Power Co.</td>
<td>$48,000</td>
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<tr>
<td>Little and Morgan</td>
<td>Development of Educational Materials</td>
<td>WV Department of Education</td>
<td>$12,500</td>
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<tr>
<td>Little, Jones, Morgan</td>
<td>Using Highland Park as Virtual Learning Community</td>
<td>No Child Left Behind</td>
<td>$30,000</td>
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<td>Little, Jones, Taylor et al.</td>
<td>Stream Structure and Fish Migration in Southern WV</td>
<td>WV DOH and RTI</td>
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<td>Little, Brumfield (BSC), Sanderson (GEOL)</td>
<td>Effects Transportation Systems on the Env’t.</td>
<td>Rahall Transportation Institute</td>
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<td>Elizabeth Murray</td>
<td>Vandalia Project</td>
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<td>Transgenic Plants in RIPS</td>
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<td>Elizabeth Murray</td>
<td>Hydroponically Grown Strawberries</td>
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<td>Name</td>
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<td>Flow Cytometer Acquisition</td>
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<td>Center for Teaching Excellence</td>
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<td>Summer Research Grant</td>
<td>Research Committee</td>
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<td>Andrew Gooding</td>
<td>Course Improvement Grant for Connections</td>
<td>Center for Teaching Excellence</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

**b. Facilities**

IST is distributed in several buildings around campus which was a subject of concern in the recent campus master plan study. The recommendation is to bring administrative and faculty offices together with instructional spaces in a single area to promote cohesion, increase communication and generally make the conduct of the department’s programs more efficient and effective.

The departmental offices are located on the second floor of Prichard Hall along with six faculty offices. Other faculty offices are located in the basement and newly renovated first floor of Morrow Library along with offices for Math faculty collaborating with IST faculty in the bioinformatics area.
Although IST does not have priority access to lecture halls it does have priority scheduling in the University’s Science and Technology Learning Center. The STLC is an open space that can be configured in a variety of ways to accommodate different class formats and technologies. It is outfitted with white boards, projectors, and carts with computer and other instructional technologies. A GIS Lab and an image analysis lab are located in adjacent rooms. The STLC also serves pre-college students and their teachers and organizations such as state agencies interested in training their employees on environmental issues.

IST has limited wet lab access. G-18 in the basement of Morrow Library has been recently renovated and currently serves as the primary teaching lab for Environmental Assessment and Policy courses. A projection system, microscopes, field equipment etc. are all available for instruction. The EAP track also has access to field equipment including an electroschok fishing boat and a 43’ converted houseboat being acquired and equipped by the MU Research Corporation as a floating laboratory for big river studies. It will be outfitted with laboratory facilities and will allow Marshall environmental programs to study the Ohio and Kanawha Rivers as well as accommodate field trips for primary and secondary students from around the state and the Tri-State region.

Science Hall 108 and 118 are shared laboratories that primarily support instruction and research in molecular and cellular biology but are used in the closely related IST biotechnology program as well. The biotechnology program also uses the University Greenhouse located adjacent to the molecular and cellular biology labs.

IST has priority access to an electronic classroom (Prichard 200) with 28 state of the art computers which is the department’s principal space for IT instruction. Prichard 207 is equipped with 12 computers and is primarily used by students for developing IT projects. As mentioned GIS and image analysis laboratories are located in the refurbished first floor of Morrow adjacent to the STLC. Each of these laboratories has 20 computer stations and IST has priority in scheduling. IST employs a full-time instructional technologist to service its computer laboratories and has access to an additional instructional technology support staff funded by the College of Science.

Smith Hall 511 is the primary IST Analytical Methods teaching classroom. This room has been fully equipped with audio-visual presentation equipment by the IST Department and is shared with the Department of Mathematics.

5. Assessment Information

- To be admitted to the department IST students must have an ACT composite score of 21 and a Math score of 21.
- Students who ask to be allowed to transfer into IST after the freshman year are evaluated by the Chair of IST and if adequate preparation in Math is demonstrated (completion of Math 127 or higher) the student is admitted.
- Data are gathered each fall following Orientation to see if scores are higher or lower to monitor the quality of students who are applying. The Chair monitors freshman G.P.A.’s at the end of their first year.
- Graduation rates are constantly monitored. It is a primary mission of IST to
graduate a student in four years. This is facilitated by systematic advising.

- Syllabi for all classes are collected and evaluated by the Chair each semester and maintained in the Departmental office.
- Faculty attend Senior Project presentations and all are involved in evaluating each project. Projects are evaluated on presentation, professionalism and content.
- IST students are involved in research (from library, to the lab to field research) and hands on projects (experiential learning) almost from day one in their freshman year. The impact of Technological advances on society and the environment is discussed in classes like “Connections”. All students must complete at least one programming class (Visual Basic.Net) and most take other classes like Database Management or C++. All students complete at least statistics two calculus courses and Differential equations.
- Student evaluations are carried out in every IST class. These evaluations are an important measure of the effectiveness of instructor communication with students. Evaluations are collected and maintained in the Departmental Office.

**Program Goals of IST Computers and Information Technology**

The mission of the IST Computer and Information Technology concentration is to prepare Marshall University graduates for a career in computer technology fields such as software development, network administrator, database administration, or Internet application development. Students in each area of emphasis take a broad spectrum of courses across other areas of emphasis, but have four key courses that they take within their particular area of emphasis, helping them to specialize in that area. This mission is accomplished similarly to Biotechnology’s mission through strong individualized advising and individualized mentoring to help students achieve a balance of IST core courses and computer and technology related courses so that a student can achieve their career plans.

**Goals:**

- To prepare graduates for a career in the Computer and Information Technology field.
- To create a stimulating classroom environment for educating students in interdisciplinary fields of study which are critical to computers and information technology.
- To cultivate and maintain productive relationships and collaborations with the emerging computer science program at Marshall University and technology employers within the Tri-State to place students into internships, graduate school, and jobs.
- To stay abreast of current Computer and IT trends to provide for continuous updates of course content and program areas of emphasis to take advantage of the rapid changes in the technology field, and continue to supply employees to employers based on their needs.
- To assist students through advising and mentoring in planning an appropriate curriculum to achieve their employment and educational goals.

**Learning Outcomes/Objectives**

Where can IST Computer and Information Technology graduates go with their degree?
1. Some graduates will elect to pursue a career upon graduation. Some options for employment include:
   - Software Engineer (average salary - $45,000 - $57,000)
   - Software Tester (average salary - $43,000 - $68,000)
   - Software Programmer (average salary - $37,000 - $48,000)
   - Database Administrator (average salary - $58,000 - $78,000)
   - Certified Network Engineer (average salary - $70,000 - $90,000)
   - Network Administrator (average salary - $41,000 - $57,000)
   - Telecommunications Analyst/Manager (average salary - $29,000 - $38,000)
   - Web-based Application Developer (average salary - $52,000 - $67,000)

2. Some graduates will elect to prepare for graduate school in a Computer Science, Information Systems, or Technology-related field. Some options for graduate school include:
   - MS/PhD in Computer Science
   - MS in Technology Management
   - MS in Information Systems
   - MBA in Business Administration

3. The diversity of employment opportunities for IST-CIT graduates necessitates mandatory advising of students each semester to identify appropriate individual curriculum choices for their careers.
   - Most classes require instructor’s permission for enrollment.
   - Junior review of classes prior to senior year.
   - Permission and proposal required for capstone research projects.
   - In Communications 201, students profile a company at which they wish to obtain employment, write a resume and have a practice interview for that company.
   - Students work with their advisor to apply for internships and jobs after graduation.

4. IST Computer and Information Technology graduates will develop a broad background in traditional mathematics and scientific disciplines (Biology and Physics) through specific math and science courses.
   - All IST Computer and Information Students are required to take two semesters of Physics (IST212 – Energy and PHY314 – Electronic Physics)
   - All IST Computer and Information Technology students are required to take one semester of Biology (IST111 – Living Systems)
   - Many IST Computer and Information Technology students will take introductory Biotechnology courses to broaden their understanding of other areas of science and assist them in deciding on a career choice.
   - All IST Computer and Information Technology students are currently required to take 19 hours of mathematics courses, which includes the traditional 16-hour IST Analytical Methods sequence of courses and MTH340 – Discrete Structures, a course common to many computer science programs.
   - IST Computer and Information Technology students interested in other postgraduate education should work with their advisor to identify appropriate courses based on admissions requirements for specific programs.
5. IST Computer and Information Technology graduates will develop individual proficiency in oral and written communication skills and scientific research as well as effective teamwork skills.
   - Communications and Connections curriculum was specifically developed to build individual research and communication in year one and foster teamwork and business communication in year two.
   - Written projects similar to the work product of their intended career are required in most classes.
   - Marshall Plan requires at least one writing across the curriculum class which can now be in a Computer-related discipline.
   - Students work in teams in advanced Computer and Information Technology classes.
   - Students present senior projects orally and in a written format at the IST Senior Research Symposium.

6. IST Computer and Information Technology graduates are prepared to evaluate technological innovation and their impact on society.
   - Strong emphasis on the impact of technology on society within Communications and Connections Classes.
   - Bioethics and Rhetoric of Science Classes are offered with a focus on Computer and Information Technology-related topics.
   - Discussion of technological impacts on society in other classes.
   - IST Computer and Information Technology students are required to take an ethics/philosophy class.
   - Marshall Plan requirements for two International classes and one multicultural class broaden the student’s understanding of other cultures.
   - The IST Computer and Information Technology requirement for three classes in Social Sciences also broadens student’s knowledge of society and social issues.
   - IST requirement for Community Service establishes the need for highly trained individuals to participate in their community.

Analysis
Additional analysis is needed to assess the impact of the IST Computer and Information Technology program, especially with the addition of an undergraduate Computer Science degree to Marshall University’s curriculum. A degree in Computer Science lends itself more to generalization of computer fields, teaching, or pursuing an advanced degree in the computer sciences, while the Computer and Information Technology options that we offer are preparing students to not only be generalists across the IT field, but also allow them to specialize in a given area. Because of this, students are immediately receiving jobs either just before graduating or upon graduation. The job placement rate and the pay that the graduates have been receiving are exceptional for this area. Depending on the outcome of the Computer Science curriculum development during the Spring of 2004, our Computer and Information Technology curriculum may need to be refined to place us in an even better position than we are now to recruit elite students who want four years of education and then to move immediately into the job market. We plan to continue to send surveys to employers of IST Computer and Information Technology graduates to assess the quality and relevance of the curriculum to both employers and job candidates. Hands-on computer skills learned within class are contributing to successful job
placement.

**Action Taken**

Curriculum continues to be updated yearly with the addition of new courses and areas of emphasis based on employers’ needs. The IST Computer and Information Technology concentration is currently in the process of having a fourth area of emphasis – Internet Technologies – added to its curriculum for Fall 2004 offering.

**Program Goals of IST Biotechnology**

IST Biotechnology’s mission is to prepare Marshall University Graduates for a career in Biotechnology by combining an up-to-date research and technology-rich curriculum built on specialized biotechnology classes with appropriate introductory and advanced classes in traditional scientific disciplines (biology, chemistry, computer science, mathematics, and physics). IST Biotechnology’s Mission is accomplished through strong individual advising and mentoring to achieve an appropriate balance of Core IST classes and technical and science electives suited to an individual student’s career plans.

**Goals:**

- To prepare graduates for a career in Biotechnology field.
- To create a stimulating research environment for educating undergraduate students in interdisciplinary fields of study that are critical to biotechnology in the post-genomic era.
- To seek extramural funds in support of our research and teaching missions.
- To cultivate and maintain productive relationships and collaborations with high-tech and Biotechnology industries and with other research institutions in order to place students and graduates of the program in internships and jobs.
- To stay abreast of current developments in biotechnology and continually update course content to reflect the rapid changes in this area.
- To assist students through advising and mentoring in planning an appropriate curriculum to achieve their employment and educational goals.

**Learning Outcomes/Objectives**

Where can IST Biotechnology graduates go with their degree?

1. Some graduates will elect to prepare for a career in biotechnology laboratory setting with a B.S. degree. Some options for employment include:
   - University labs
   - Government labs (USDA, NIH, DOE, NASA, CDC, etc)
   - Forensics labs
   - Industrial labs
   - Genetic Testing Labs
   - Military Labs (Army, Navy, Air Force)

2. Some graduates will elect to prepare for research training in graduate school in a biotechnology field. Some options for graduate school will include:
   - MA/MS/PhD in Biotechnology
   - MA Program in Genetic Counseling
- MD/PhD programs in Molecular Biology/Molecular Genetics
- MA in Forensic Science
- MA/MS/PhD program in Biomedical or Biological Science
- Biotechnology, Bioinformatics or Clinical Laboratory Sciences post-baccalaureate certificate programs.

3 Some graduates will elect to continue in a non-laboratory career based on their strong understanding of biotechnology. Some options for employment and/or graduate training include:
  - MA/MS/PhD in Bioinformatics
  - Biotechnology and other high technology MBA degrees (e.g. UW-Madison and Northwestern University)
  - Law degree (especially in patent law or criminal prosecution)
  - MA/PhD. programs in Bioethics
  - Biotechnology high school teacher (with additional Post-baccalaureate Education Certification).
  - Regulatory QA/QC positions with agencies like FDA.
  - Technical Writer or Journalist
  - Patent Examiner
  - Grants administration
  - Technical sales and marketing
  - Technical support
  - Technology or laboratory management
  - Purchasing agent for biotechnology company
  - Technology analyst (government or private sector)

4 The diversity of employment opportunities for IST-biotechnology graduates necessitates mandatory advising of students each semester to identify appropriate individual curriculum choices for their careers.
  - Most classes require instructor’s permission for enrollment.
  - Junior review of classes prior to senior year.
  - Permission and proposal required for capstone research projects.
  - In Communications 201, students profile a company at which they wish to obtain employment, write a resume and have a practice interview for that company.
  - Students work with their advisor to apply for internships and jobs after graduation.

5 The strong research component in the IST Biotechnology curriculum prepares graduates for involvement in laboratory employment including:
  - Two semester Research Capstone experience mandatory for all seniors
  - Summer internship placement with opportunity for credit
  - Participation in competitive university research opportunities such as SURF, American Heart Association, other NSF REU experiences etc.
  - Participation in competitive government research programs such as NIH, NASA, DOE and WV Governor’s Internships.
  - Research/technical employment as undergraduates on grants.
  - Student participation as laboratory assistants for technology classes in which they have excelled.
  - Research scholarships like NASA scholarships, Scholarships etc.
Technical and research emphasis in all communications and connections classes.

Research emphasis in specific project based research classes to include:
- Genetic Systems
- Genomic Cloning and Cytogenetics

Laboratory/Experiential Learning with other more lecture based classes including:
- Introduction to DNA Cloning
- Bioscience Laboratory Methods
- Human Genetics
- DNA Technology
- Forensic DNA analysis
- Protein Biotechnology
- Scientific Crime Scene Investigation
- Plant Biotechnology (cross listed from Biology)
- Bioinformatics

Independent study research projects

Technology and Innovation class which emphasizes commercializing technological innovations

6 IST Biotechnology graduates will develop a broad background in traditional scientific disciplines (Biology, Chemistry, and Physics) through specific science courses and development of a course of study supplemented with additional science electives appropriate to the student’s career plans.

All IST Biotechnology Students are required to take two semesters of Chemistry (211, 212) with labs (217, 218).

IST Biotechnology students are encouraged to take additional IST courses in environmental science and computer and information science to broaden their understanding of other areas of science and assist them in deciding on a career choice.

All IST biotechnology students interested in applying for a forensic science MA program should take electives in chemistry (CHM 355, 356, 361), physics (PHY 211, 202, 213, 204 or equivalent) and biology (BSC 120, 121, 324) as per recommendations of the program they will apply for. Students and their faculty advisors will determine which IST requirements can be substituted for by these courses.

IST Biotechnology students interested in working in a forensic science lab with a BS degree should be aware of the TWG-ED recommendations for forensic science as well as the FBI’s requirement that DNA analysts must take coursework in Statistics, Genetics, Cell Biology and Biochemistry. Many state Forensic science labs have an extensive chemistry credit requirement (16-21 credits). Students and their faculty advisors should keep up-to-date on changes in minimum requirements for these positions.

IST Biotechnology students with an interest in medicine or other post-graduate health sciences degree should also be advised about appropriate courses by the pre-medicine/pre-health profession advisors in the College of Science.

IST Biotechnology students interested in other postgraduate education should work with their advisor to identify appropriate courses based on admissions requirements for specific programs.
7 IST Biotechnology graduates will learn research design and quantitative analysis of graphical, numerical, and textual data.
   o Sequence of 4 mathematics classes with applications emphasis and laboratory component including statistics, differential and integral calculus, and linear equations with opportunity to continue for Mathematics minor.
   o Requirement for all biotechnology students to have minimum of one programming course and one other computer class.
   o Opportunity for biotechnology students to dual enroll in both biotechnology and CIT and additional mathematics courses to prepare them for bioinformatics careers.
   o Emphasis on laboratory automation and using computers to collect data.
   o Emphasis is placed in classroom instruction on research design and data analysis.

8 IST Biotechnology graduates will develop individual proficiency in oral and written communication skills and scientific research as well as effective teamwork skills.
   o Communications and Connections curriculum was specifically developed to build individual research and communication in year one and foster teamwork and business communication in year two.
   o Written projects similar to the work product of their intended career are required in most classes.
   o Marshall Plan requires at least one writing across the curriculum class which can be in a Biotechnology discipline.
   o Students work in teams in advanced biotechnology research classes. Final projects include scientific posters of research performed during the class.
   o Students can present talks and posters at Sigma Xi research Day at Marshall and West Virginia Academy of Science as well as national meetings.
   o Students present senior projects orally and in a written format at the IST Senior Research Symposium.

9 IST Biotechnology graduates are prepared to evaluate scientific and technological innovation and their impact on society.
   o Strong emphasis on the impact of technology on society within Communications and Connections Classes.
   o Bioethics and Rhetoric of Science Classes are offered with a focus on Biotechnology.
   o Discussion of technological impacts on society in other classes.
   o IST Biotechnology students are required to an ethics/philosophy class.
   o Marshall Plan requirements for two International classes and one multicultural class broaden the student’s understanding of other cultures.
   o The IST Biotechnology requirement for three classes in Social Sciences also broadens student’s knowledge of society and social issues.
   o IST requirement for Community Service establishes the need for highly trained individuals to participate in their community.

10 IST faculty have experience in Interdisciplinary and Multidisciplinary Research

Assessment Measures
Assessment Measures: Local Major Codes in Program:

**Internal Measures**
1. Written Examinations S
2. Quizzes S
3. Term Papers S
4. Oral Presentations S + VA + F
5. Discussion Groups F
6. Team Projects S + F
7. Pre/Post Tests F
8. Portfolio Assessment F
9. Standardized Tests VA
10. Observation in laboratory F
11. Senior Project F + S + VA
12. Faculty Evaluations F
13. Exit interview with transfer students F
14. Senior project work in lab F

**External Measures:**
1. Graduate Surveys F
2. Exit Interviews with graduates F
3. Employer Surveys F
4. Professional Group Recommendations VA
5. Employer Focus Groups F
6. External examinations for placement in graduate or professional school (GRE, MCAT, LSAT) S
7. Acceptance graduate or professional school VA
8. Acceptance for NASA research scholarships VA
9. Acceptance for student summer internships VA
10. Acceptance for student work in publication VA
11. External Advisory Board F
12. Job placement within field VA

**Evidence**

NASA research scholarships awarded in IST:
NASA research scholarships are competitively awarded to science and engineering students at Marshall University. Sponsorship is limited to two students or teams of students per faculty member.

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<tr>
<td>1999</td>
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Summer Internships:

IST biotechnology students have participated in 15 summer internships over the last five years of the program. These internships have included competitive programs at external institutions such as Woods Hole Oceanographic Institute and M.D. Anderson Cancer Research Center. Two IST Biotechnology students were awarded Governors Internships with the WV State Police and one has been awarded two Governors Internships at the Institute for Scientific Computing. Recently two IST students were awarded a grant from NCIIA to research a biotechnology invention. These two students and four others are currently working on this project during the school year. Two other IST biotechnology students are working on a project on genetics of cardiovascular disease this year.

Internships in IST:

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Graduation in IST:

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<tr>
<td>2003</td>
<td>2</td>
<td>5</td>
<td>7</td>
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</table>

Employment of IST Biotechnology graduates:
Five of the seven IST Biotechnology graduates are currently employed in a biotechnology field directly related to their interest and two remain to be contacted. These jobs include:

- Crime scene evidence processing for the WV State Police.
- Technician working for a Biology faculty member at Marshall University, who is included as co-author on scientific publications.
- Technician on a DNA mapping project at the University of Pittsburgh.
- Two Technicians working for The Armed Forces DNA Identification Laboratory in Rockville Maryland developing high throughput DNA typing assays and performing quality assurance.

These five students are working in a hands-on laboratory setting, which has been a goal of the
Employment of IST CIT graduates:
The CIT coordinator has been able to keep track of 19 of the 23 graduates from the CIT concentration. Twelve of these nineteen IST Computer and Information Technology graduates are currently employed in a computer/technology related field directly related to their interests. Four of the nineteen are currently enrolled in a graduate degree program at Marshall University. One is in the military, and two are employed, but out of field. Jobs of the twelve within the field include:

- Network administrator in Boston, Massachusetts
- Associate Analyst/Programmer for Nisource of West Virginia (formerly Columbia Gas)
- Software Developers across the state of WV
- Software Project Manager for a software development firm in Beckley, WV
- Network Administrator and Programmer/Analyst for a software development firm in Charleston, WV which works directly with the state government
- Database administrator with the Corps of Engineers in Huntington
- Network Administrator for the Air National Guard, Charleston, WV
- Network Administrator for Public Debt, Parkersburg, WV

c. Provide information on how assessment data are used to improve program quality.

- One of the most mentioned criticisms of IST was limited coursework in some areas. Biotechnology and Environmental Assessment and Policy had for a period only one faculty member. We have hired an additional faculty member in Biotechnology and one in Computer and Information Technology. The problem still exists in Environmental Assessment and Policy and we borrow faculty from Biological Sciences and from ISC.
- Some of the students were having difficulty in the statistics and Calculus class because in most instances the student had not had an Algebra class in several years. We listened and have instituted a policy that will move statistics to a later semester and afford some students to take MTH 137 (Algebra Advanced) if they need some refreshing.
- Some students had a problem with Physics (our “Energy” course) in the first year. Beginning this year Energy is moved to the second year after a semester of calculus.
- Environmental Assessment and Policy students had little need for a second Programming class so we developed a set of courses involving Geographic Information Systems and Mathematical Modeling classes to better meet their needs.
- Biotechnology students are no longer required to take C++ and now take Bioinformatics.
- IT students seemed to have a hole in their mathematics preparation so as of last year IT students are now required to complete MTH 340 Discrete Math.

d. Graduate and Employer Satisfaction

Since we are a relatively new department we have had a limited number of graduates. We try to maintain contact with as many of these graduates as we possibly can. Last summer I contacted all of the graduates that we could find (23 total) and solicited comments on the following questions:

1. Give an honest appraisal of their IST experience at Marshall
2. Where were they employed and what was their job description
3. Within certain ranges what was their salary
4. Could they either ask a supervisor for a letter on their performance or give me a name
   so that I could contact their employer

Generally the student responses were quite good. The level of satisfaction was high. Students also pointed
out shortcomings that we have taken under consideration and are trying to improve. Many of the comments
of CIT students indicated that in the beginning they were upset with all of the courses they were required
to take outside of computer studies. Upon graduation, to the person, they all indicated that the work in
speech and writing, the mock interviews and working on a large group project like Senior Project better
prepared them for getting a job and doing well once the job was landed. Almost everyone of our graduates
in employed in their field and earning a pretty fair salary (range $28,000 - $65,000).

I have had letters or phone calls from four employers all of whom indicated that they were very satisfied
with the work of our grads. Two of them said that they would hire every student that we graduate. Another
indicated that their IST hire required only one month of mentoring on the job in a position that usually
requires six months of training for new employees.

**Employment of IST CIT graduates:**
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  which works directly with the state government
• Database administrator with the Corps of Engineers in Huntington
• Network Administrator for the Air National Guard, Charleston, WV
• Network Administrator for Public Debt, Parkersburg, WV

6. Previous Reviews: Bill Denman’s Oct. 1998 review (see Appendix)

7. **Strengths/Weaknesses**

a. **Strengths**

   The greatest strength of this program is the integrated way we bring together the sciences and
   technology. We have a great group of committed faculty who believe in what we are doing. Student/faculty
   relationships are for the most part excellent. Faculty put in enormous amounts of time outside of classroom
   activity in advising, counseling and otherwise just “caring “ for the students. Senior Projects, Independent Study
   and undergraduate research are all done above and beyond an already heavy teaching load.
Another strength is our openness to student views. We have a student advisory board that meets with the Chair and other faculty each semester. We discuss the curriculum, problems, job opportunities and needs of the students. Questions and answers flow freely both ways.

IST has a good relationship with and support from the College and University administration. The support staff consisting of a departmental secretary and an Instructional Technologist both of whom are excellent. They are also committed to the concepts behind IST and work exceptionally well with both faculty and students.

We currently have adequate facilities with the new renovations of Morrow Library. With the transfer of Dr. Hamid Chahryar to IST and the addition of a new faculty member in Biotechnology (fall 2002) and a new IT faculty member (Fall 2004) we will have adequate faculty in Biotechnology and Information Technology.

While we are a rapidly growing program we have been able to keep class sizes relatively small. Our largest class in fall 2003 is “Living Systems” and has approximately 72 students enrolled. These students will then break down into units of 24 for their laboratory activity. All other classes are limited in size with most having fewer than 24 students.

b. Weaknesses

We have not had to recruit previously although word of mouth has attracted many students. We still have a shortage of faculty in the Environmental area of specialization. Budgeting is the greatest weakness for our program. Existing on soft money is potentially a dangerous thing. With additional declines in the state’s economy, the money from the Department of Economic Development could vanish. The University should move rapidly to wean itself from this grant.

The ISAT Department at Marshall recently underwent an external review by several faculty from James Madison University. They pointed out several perceived weaknesses. They were:

1. Improve assessment procedures
2. Enhance and improve team teaching
3. Increase integration at all levels of the curriculum
4. Most of our majors are CIT students – we need to find ways to increase numbers of Biotech and Environmental students
5. The JMU team also thought that there needed to be a strengthening of our social content areas – economics, politics etc. within our regular courses.
6. There are few women in IST. One of our stated goals is to increase opportunities for young women – we aren’t doing very well in that area.
7. Recruiting materials are outdated and not very useful. We are currently developing a CD that will be distributed to local high school Counselors and should help tell our story.
8. There is a perception by other faculty in the College of Science that we don’t do “hard Science”.
9. The number of faculty is “below critical mass” (JMU Review Report)
10. By having faculty offices and classrooms in different buildings it is difficult to develop and teach integrated classes. Competition for space on campus is
intense and as a result of being a very young program, ISAT has no dedicated lecture rooms. This becomes a nightmare as scheduling for each semester gets underway.

These items IST faculty and administration can work on to improve our program:
  a. Prepare better brochures and recruiting literature for future students
  b. Recruit more in the local high schools
  c. Intensify our approach to recruiting women and minorities
  d. Tell our story better. Let the other departments know that we have the best students in the university (based on ACT/SAT scores), that we have the most rigorous requirement for mathematics classes in the university (disregarding mathematics or Physics majors) and that we have a very high retention and graduation rate.
  e. enhance the level of integration in higher level coursework.

These issues must be dealt with at a higher level than the department.

  a. IST is grossly understaffed, under funded and has far too little dedicated instructional space for a department with 170 majors.
  b. More faculty would increase the opportunity for team teaching and new innovative teaching techniques which are cornerstones of this degree.
  c. Teaching and research laboratory space available to IST faculty is woefully inadequate.

B VIABILITY

1 **Off-Campus/Distance Delivery Classes:** IST does not currently offer any off-campus/distance delivery classes.

2 **Service Courses:** IST does not currently offer any service courses. The Chair of IST is also the coordinator of the “ISC” program. ISC (Integrated Science) classes are required of all students in all colleges other than Science and Nursing. These are in reality service courses and are routinely taught by IST faculty members (Jones, Little and Murray) as part of their normal teaching load. IST 160 (Intro. To Programming) is often taken by students in other colleges and introduces them to the world of Computer Programming.

3 **Articulation Agreements:** None

4. **Program Course Enrollment** : These data are listed in Appendix V. The number of courses in this program, and the content of coursework, is always changing. This flexibility is mandatory as our mission is to stay current with new developments and technological advances. Some courses are tried and don’t seem to work. These courses are not offered again. As our student numbers have increased the number of courses has increased.
The program started out with an area of emphasis titled “Manufacturing”. It proved out that there was little interest in the subject and the main instructor in that area is no longer with the program so that area of emphasis was discontinued.

Shortly after the department was formed an interest developed in the advanced (5,6,7,8) “Cisco” networking classes. These classes were developed, a laboratory was established and an instructor hired. This worked well for some of our students and fit nicely following the lower level classes offered by the Community and Technical College and coursework offered in local high schools. Beginning with fall semester this coursework will be discontinued as part of ISAT and will be transferred to the Community and Technical College. Few of our students were taking advantage of this opportunity and it was quite expensive to offer. All ISAT – IT students get a good dose of Networking theory and should be able to function as a network specialist with this background.

As we are a very young department many of the classes (Appendix V) appear to be under enrolled. As we started with just 18 students when we began, it is obvious that as these students became juniors and seniors their classes would be quite small. Numbers are picking up in all classes as the number of majors approaches 200. Fall enrollment in 2003 exceeded 170 students!

The smaller number of students in Biotechnology and Environmental Assessment and policy is a concern. The department is aware of this concern and will be working harder to recruit students. We must tell potential students of these interesting subjects and the job opportunities that would be available to them upon completion of a degree with this emphasis.

5. **Program Enrollment:** Enrollment data are located in Appendix VI. In the beginning class (Fall 1998) there were 18 students. In the intervening five years the total enrollment has grown to approx. 170 majors. It is difficult to break out the actual number of students in each of the three areas of interest (Biotechnology, Information Technology and Environmental Assessment and Policy) because many of the students do not identify their specialization until the junior year. Information Technology students make up approx. 70% of our students. The remaining 30% of our students is about evenly divided between Environmental Science and Biotechnology.

6. **Enrollment Projections:** The freshman class of Fall 2003 was the largest in the history of the program at 57. There are several factors that will probably affect enrollment over the next few years. I see no reason why the department should not have 200 majors within two years. That may be
The establishment of a B.S degree in Computer Science in our sister College (CITE) may very well have a negative impact on enrollment. Numbers of students in IST – CIT will probably drop initially. The name Computer Science is more recognizable than Integrated Science and Technology – Information Technology. Many students will continue to prefer to be part of IST because of the creative non-traditional approach to teaching and learning that is our strong suite. Our emphasis on hands on learning, a learning community approach to teaching and a strong support system will continue to appeal to many students. As CS and IST have different missions I see no reason why the two departments cannot co-exist and thrive as they do at our model institution – James Madison University.

The hiring of additional faculty and the development of new and better laboratory facilities in the area of Biotechnology, along with the impending construction of the Bioscience building on campus, will create vast new opportunities for our Biotechnology faculty and students. The Department with additional support from the College of Science has made major equipment purchases this year in support of laboratory research and teaching. This will without doubt increase enrollment in Biotechnology.

Exciting opportunities in Environmental Assessment are also developing. This past year ES faculty have visited a good number of local high schools and told our story to seniors. ISAT has been approved to purchase a 45 ft. houseboat which will be remodeled and become a floating laboratory for the study of commerce on, and the history and ecology of, large rivers. Students (graduate and undergraduate) are involved in very interesting faculty research projects currently and as this story spreads we will generate greater numbers of students in the near future.

C NECESSITY: There is no accrediting agency for this type of program

1 Advisory Committee: The advisory committee met for two days in summer of 2000. There were folks here from industry, medical school and state and federal agencies to discuss our various areas of emphasis. The advisory committee membership is in Appendix VIII. The computer industry recommended the addition of coursework to the curriculum. This resulted in the development of twenty-one new courses. The thinking at that time was that as the “Old CSD program” was being phased out ISAT would fill in the gap and take a leadership role in Computer Science at Marshall University.

2 Graduates: Provide information on graduates in terms of places of employment, starting salary ranges (where appropriate and known),
number employed in field of specialization, and/or acceptance into baccalaureate or graduate programs. (NOTE: Do not identify students by name.)

Need something here

3 **Job Placement:** If the job placement rate reported above is low, can a course of action be identified that would improve this situation? Provide a summary of procedures utilized by the institution to help place program graduates in jobs or additional educational programs. Include activities supported by both the student’s academic department as well as the institution’s placement office. This summary should include the institution’s procedures and program organization for continuing contact and follow-up with graduates.

Need something here

**D CONSISTENCY WITH MISSION:**

**Provide State-of-the-art classrooms** – The Integrated Science and Technology Department has several state-of-the-art classrooms. Prichard Hall 200 and Morrow Library119 have new computers, projection systems and new furniture to provide the ultimate learning space. The Department has also provided funding for Smith 509 to establish an electronic lecture room that is shared with Mathematics. The Newly renovated Learning Commons in Morrow Library will be a focal point for workshops, public lectures, presentations etc.

**Foster outreach through service** – The Integrated Science and Technology Depart has a required course IST 301 “Public Service Experience” that must be completed in order to graduate. This course requires a minimum of 30 hours of volunteer work within the community.

**Instruction is available using all modes of delivery** -- ISAT faculty utilize a variety of delivery systems. Power Point, WebCT, E-mail and Chat Room discussions are all modalities utilized by ISAT faculty. The Analytical Methods (Math) classes are often taught in a computer classroom as many examples are solved through the use of computers. One of the AM classes has a laboratory component where a Physics activity is demonstrated and then the Math that is needed to explain the activity is taught/discussed.

**Promote Economic Development** – The ISAT course in Entrepreneurship (IST 350: Technology and Innovation) encourages students to develop new ideas, learn how to patent these new ideas and how to bring them to market.

**Strive to improve instruction through the use of innovative teaching methods** – The entire ISAT program is an innovative strategy. We are by our very nature a learning community. All of our students take a core curriculum during the first
year. Most of them are in several classes together and get to know each other and form study groups readily.

Our students learn through hands-on participation to a degree far greater than they would have the opportunity to do in a traditional program. The case study approach and inquiry based learning are used in a number of classes.

Andrew Gooding is WAC certified and teaches IST 442: Bioethics (Previously IST 483: Topics in the Rhetoric and Ethics of Science) as a Writing-Intensive course. Other faculty have been WAC trained and need to become certified.

All classes are built around research, discovery and writing. Syllabi and lecture notes are available for students in most ISAT courses.

**Place a high priority on scholarly and creative activities** – Library research, discussion groups, and participation in real-world and simulated research projects are a part of the first year experience.

Every ISAT student must be involved in a long-term senior project. These projects may be done individually or in groups but all must participate in the production of a presentation of their work before the faculty and other students. Senior Project day is a special day when the student’s work is highlighted. Students dress for the day and a professional attitude is maintained throughout.

Many students (from the freshman year on) are involved in faculty members’ research and are supported financially.

**Regularly Review the Curriculum and make changes as necessary** – The Chair of ISAT has brought to campus outside teams of professionals and asked them to review what we are doing and make comments for the benefit of the program. The IT area of specialization was reviewed during the summer of 2001. As a result of the recommendations by the review team, the IT sector deleted some classes and added others to better reflect the needs of industry today.

Fall of 2002 brought exchange visits with James Madison University funded by a Hedrick Foundation grant from the Center for Teaching Excellence. MU- IST faculty had invited them to assess and make comments on our program. JMU’s ISAT was the model around which our program was built.

Additionally we asked, during spring 2003, Dr.’s Paul Hill (WV state EPSCOR Director) and Eli McCoy consultant and former Director, WV Division of Water Quality at WV DEP. to look at our Environmental Assessment and Policy sector. I have included their report as Appendix No. ______.

**IV PROGRAM OF EXCELLENCE.**

If this option is marked as the institutional (program) recommendation, include a statement of justification. This statement should be a document (limited to two
pages) that provides detailed information on the strengths of the program and reasons why the program should have the designation of excellence. Identify the aspects of your program that qualify it as a Program of Excellence (e.g., accreditation, honors, special recognition, unique characteristics, etc.). All supporting documents must be provided to the Committee. The guidelines “Statement on Criteria for Designation of Excellence” are attached for reference.
Appendix I  
Required/Elective Course Work in the Program

Degree Program: **B.S. Integrated Science and technology**  
Person responsible for the report: **Ralph W. Taylor**

<table>
<thead>
<tr>
<th>Courses Required in Major (By Course Number and Title)</th>
<th>Total Required Hours</th>
<th>Elective Credit Required by the Major (By Course Number and Title)</th>
<th>Elective Hours</th>
<th>Related Fields Courses Required</th>
<th>Total Related Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>IST 101 Fund. Of Communication</td>
<td>4</td>
<td>Social Science coursework</td>
<td>9</td>
<td>3-12 hrs</td>
<td></td>
</tr>
<tr>
<td>IST 120 Connections I</td>
<td>2</td>
<td>Modern Language – completion of the fourth course in any language offered</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IST 201 Fund. Of Communication II</td>
<td>4</td>
<td>Humanities</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IST 220 Connections II</td>
<td>2</td>
<td>Literature</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IST 301 Public Service Experience Statistics</td>
<td>1</td>
<td>Arts</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IST 111 Living Systems</td>
<td>4</td>
<td>The Computer Literacy component of the Marshall Plan is met within the content of the classes in this program.</td>
<td></td>
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<tr>
<td>IST 160 Visual Basic.Net</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>IST 131 Analytical Methods II Differential Calculus</td>
<td>4</td>
<td></td>
<td></td>
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<tr>
<td>IST 212 Issues in Energy</td>
<td>3</td>
<td></td>
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<tr>
<td>IST 230 Analytical Methods III</td>
<td>4</td>
<td></td>
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<tr>
<td>IST 231 Analytical Methods IV</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Elective Coursework within the Area of Concentration</td>
<td>28-36 hrs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IST 490 Senior Project I</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IST 491 Senior Project II</td>
<td>3</td>
<td></td>
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<tr>
<td>Multicultural and International coursework is taken as part of the Liberal Arts component of the IST curriculum.</td>
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<tr>
<td>The writing requirement may be met within the department or external.</td>
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</tr>
</tbody>
</table>

Professional society that may have influenced the program offering and/or requirements: None
### Marshall University
### Assessment of Student Outcomes: Component/Course/Program Level

**Component Area/Program/Discipline:** Computer and Information Technology Concentration of IST

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Person or Office Responsible</th>
<th>Assessment Tool or Approach</th>
<th>Standards/Benchmark</th>
<th>Results/Analysis</th>
<th>Action Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Students should be able to assess the IT need of a business and give IT solution suggestions</td>
<td>IST – CIT Faculty</td>
<td>Assignment of projects in various courses where students must study a problem and come up with a solution on their own</td>
<td>Results of students work is compared to what has been done in industry in the same situation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. All students will be able to program in 2 high-level languages</td>
<td>IST</td>
<td>Requirement of the student to sufficiently complete at a minimum IST160 and IST163</td>
<td>Students should earn a C or better in both courses.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Students from DBA track will be able to install an SQL server, design databases for varying companies, and create complex business related reports from those databases.</td>
<td>IST Faculty teaching IST365, IST430, IST466, and IST467</td>
<td>Each of the courses – IST365, IST430, IST466, and IST467 – will require students to participate in real-world projects to gain experience working with database management systems</td>
<td>Database designs and reports will be tested against a set of requirements given to students to ensure their quality and accuracy.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4. Students from the Network Admin track will be able to recommend, install, and administer computer networking technologies

| IST Faculty teaching IST362, IST363, IST464, and IST465 | Each of the courses – IST362, IST363, IST464, and IST465 – will require students to participate in real-world projects to gain experience working with computer networking technologies | All network designs and setups will be tested for vulnerability and accuracy to ensure students understand the correctness of their work. |

5. Students from the Software Development track will be able to complete all steps of the software development lifecycle in creating computer applications for business and industry.

| IST Faculty teaching IST163, IST236, IST238, IST332, IST333, and IST334 | Each of the courses – IST163, IST236, IST238, IST332, IST333, and IST334 – will require students to participate in real-world projects to gain experience writing computer applications, following the software development life cycle | All computer programs that are created are checked for validity, and verified against all steps of the software development process for correctness. |
Appendix III
Off-Campus Classes

(Note: List courses offered at locations other than the Huntington Campus, or the South Charleston Campus.) Please include the courses offered in the past 2 years.

The Integrated Science & Technology Department does not currently offer off-campus courses.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Courses Offered</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Appendix IV
Service Courses

The Integrated Science and Technology Department does not offer traditional service courses. Several courses are occasionally taken by students from other majors or other colleges as a way of meeting graduation requirements or learning material in a new area.

IST 101 and 120 are accepted by other colleges as a replacement for ENG 101 and CMM 103. This option is used most often by students who start in college in the IST department but then transfer to another college.

IST 160 Introduction to Programming – Visual Basic.Net is frequently used to meet the Computer Programming requirements for other departments in COS and departments in other colleges.

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Year 1 1998</th>
<th>Year 2 1999</th>
<th>Year 3 2000</th>
<th>Year 4 2001</th>
<th>Year 5 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sp  Su  Fa</td>
<td>Sp  Su  Fa</td>
<td>Sp  Su  Fa</td>
<td>Sp  Su  Fa</td>
<td>Sp  Su  Fa</td>
</tr>
<tr>
<td>IST 101</td>
<td></td>
<td>52  38  S9</td>
<td>46  45</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IST 160</td>
<td></td>
<td>42  40</td>
<td>52  63  21</td>
<td>72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Appendix V
### Program Course Enrollment

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Course Name</th>
<th>Required/Elective</th>
<th>Year 1 1998</th>
<th>Year 2 1999</th>
<th>Year 3 2000</th>
<th>Year 4 2001</th>
<th>Year 5 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Su</td>
<td>Fa</td>
<td>Sp</td>
<td>Su</td>
<td>Fa</td>
<td>Sp</td>
</tr>
<tr>
<td>IST 101</td>
<td>Fund. Of Communication</td>
<td>12</td>
<td>35</td>
<td>35</td>
<td>34</td>
<td>42</td>
<td></td>
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<tr>
<td>IST 111</td>
<td>Living Systems</td>
<td>13</td>
<td>47</td>
<td>38</td>
<td>37</td>
<td>42</td>
<td></td>
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<tr>
<td>IST 112</td>
<td>Chemistry in the Environment</td>
<td>9</td>
<td>29</td>
<td>20</td>
<td>28</td>
<td></td>
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<tr>
<td>IST 120</td>
<td>Connections</td>
<td>13</td>
<td>48</td>
<td>37</td>
<td>39</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>IST 130</td>
<td>Analytical Meth. I</td>
<td>13</td>
<td>49</td>
<td>38</td>
<td>42</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>IST 131</td>
<td>Analytical Meth. II</td>
<td>13</td>
<td>35</td>
<td>31</td>
<td>44</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>IST 160</td>
<td>Intro. To Programming</td>
<td>38</td>
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# Appendix VI
## Program Enrollment

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<th>Year 5 2002</th>
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<td><strong>Grand Total of Students Enrolled</strong></td>
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<td><strong>Graduates of the program</strong></td>
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*If known. This information is not completely accurate at this time, as students often do not declare a second major until the junior evaluation or the student has her/his primary major in another college.

**If known. This information is not completely accurate at this time, as students often do not declare minors until the junior evaluation or senior application for graduation.
Marshall University
Assessment of Student Outcomes: Component/Course/Program Level

Component Area/Program/Discipline:

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<th>Student Outcome</th>
<th>Person or Office Responsible</th>
<th>Assessment Tool or Approach</th>
<th>Standards/Benchmark</th>
<th>Results/Analysis</th>
<th>Action Taken</th>
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<td>1. Students will meet admission requirements</td>
<td>IST Chair</td>
<td>ACT/SAT scores will be checked for appropriate level</td>
<td>Composite score of 21 and Math score of 21 or equivalent</td>
<td>All students currently meet this criterion</td>
<td>None necessary</td>
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<tr>
<td>2. Students will demonstrate the ability to work in teams</td>
<td>Faculty</td>
<td>Faculty observations</td>
<td>All IST courses will have at least one team activity required</td>
<td>Most classes currently meet this obligation</td>
<td>Working toward having all classes with team projects</td>
</tr>
<tr>
<td>3. Students will demonstrate the ability to effectively communicate orally and in written form</td>
<td>This responsibility will fall on the instructors in the 12 hr. communications/connections block of courses</td>
<td>Weekly written papers and term papers in addition to oral presentations will be the tool</td>
<td>1 A grade of “C” or better on the Communications classes 2 A pass on the senior presentation</td>
<td>This outcome will be put in place for incoming freshmen this fall</td>
<td>N/A</td>
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<tr>
<td>4. Students will have an appreciation and an understanding of the benefit of science and technology to the human condition</td>
<td>Faculty</td>
<td>Successful completion of IST “Connections” courses</td>
<td>A grade of “C” in IST 120, 220</td>
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<td>5. Students will have the ability to utilize traditional and non-traditional library research methods</td>
<td>IST Faculty</td>
<td>Research capability will be required in all upper division classes</td>
<td>A grade of Pass on the senior project</td>
</tr>
<tr>
<td>6. Department will seek additional funding to enable adequate student seating in critical IST courses</td>
<td>IST Chair</td>
<td>Number of overloads given and students turned away without being able to take a needed class</td>
<td>All students get the classes they want and need</td>
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Appendix VII

SITE VISIT FOR PROGRAM ASSESSMENT AND EVALUATION
MARSHALL UNIVERSITY, HUNTINGTON, WEST VIRGINIA
8 October 2002

INTEGRATED SCIENCE AND TECHNOLOGY PROGRAM

Program Description. **Environmental Assessment and Policy Program.** This concentration integrates IST math and computer expertise with knowledge of environmental law, regulation, and policy and provides students with the most current skills used to assess environmental quality and develop environmental policies. The program emphasizes a “hands on” approach as students learn current practices in environmental practice by such activities as assessing the impact of deer populations on forest regeneration, quantifying bacterial contamination of local waters, and using satellite imagery to measure a wetland impacted by road construction. Graduates will be prepared for work in such fields as risk assessment, modeling and GIS systems, and environmental documentation. Further, this concentration prepares students for careers in environmental compliance work, evaluating environmental impacts, and developing environmentally responsible polices and plans. Four course options are offered.

Introduction

In September 2002 Dr. Ralph Taylor contacted Drs. Eli McCoy and Paul Hill to ask that they conduct an evaluation of the IST program which would be included in his five year program review. The request to McCoy and Hill was limited to the Environmental Assessment component of the IST program as described above. As a part of this review, McCoy and Hill visited the campus on October 8, 2002. The site visit included in-depth discussions with Dr. Taylor and faculty members as well as review of materials and a facilities tour of the campus.

Initial Information Gathering

Dr. Taylor, as per the dean’s suggestion, provided a brief overview of the entire IST program and concluded with a detailed discussion of the EA&P program. Following this, Drs. Mike Little and Tom Jones joined the group for a tour of the facilities. The tour included existing facilities and those currently under construction. Dr. Joe Bragin, Dean of the College of Science joined the group for lunch where further aspects of the program were discussed. Following lunch, reviewers met with two of the communications (English) instructors. They provided, in great detail, the principals employed in their teaching efforts and the techniques employed to evaluate student performance. Dr. Taylor discussed the financial support that currently supported the program. During this discussion, he explained how Jones and Little had obtained funding from other sources to support their efforts. Following this, McCoy and Hill had the opportunity to meet with three students in the program. (Students were those present in the Morrow laboratory facility during the visit, and were selected at random). Dr. Taylor removed himself from the room during these interviews. The review session ended at the conclusion of the interviews.
It is interesting to note that many on-campus peers have derided the IST program calling it a trade-school or “bunny” curriculum. This perception-based conflict between traditional and and applied programs is better assessed through review of coursework and student metrics. Traditional science degrees in biology and chemistry were generally compared to that of the IST while test scores and post-degree advancement were also discussed by the reviewers.

Dr. Taylor later forwarded to Drs. McCoy and Hill copies of specific program requirements, course descriptions or syllabi, and other information that was reviewed for this report. The seven-page “Integrated Science and Technology Program – Environmental Assessment and Policy” document is included as an attachment.

It should be noted that McCoy and Hill both knew Taylor and Little previously, as undergraduate or graduate students when they completed biology degrees at Marshall University. McCoy has had a professional relationship with Jones. Jones provided contract macroinvertebrate identification services to the McCoy’s current employer, Potesta and Associates, Inc. of Charleston, WV.

The following categories will be utilized to organize our general areas of observation. In each area we will discuss program deficiencies, positive attributes and propose recommendations.

Facilities
Facilities have grown with the program. New space is currently being remodeled and expanded in the Morrow Library facility. In fact, underutilized and low-quality space is now good-quality, well-illuminated, laboratory and instruction areas filled with active students and faculty. Facilities in Prichard Hall have also been improved to accommodate computer equipment and web-based instruction. While constructed as a dormitory, this space has been renovated quite effectively.

STUDENTS
The growth of the program participants, from 19 in 1997 to the current number of 172 in 2003, indicates a definite interest on the part of a significant segment of the student body in such a program. Discussions with three individual students revealed enthusiastic support for the program as well as for Drs. Little and Jones. This support for the leadership and professorial capabilities of Drs. Little and Jones was adamantly expressed and was not the result of coxing. Dr. Taylor was not in the room during these discussions.

When asked why the students were so enthusiastic about the program, they thought the practical nature of the course work and the way it related to work opportunities were key to their feeling of support. Assessment of the test scores of these students indicates an above-average range, dismissing the notion that the IST program is somehow “watered down science.”

CURRICULUM
Curriculum consists of 33 semester hours in IST labeled courses in the 300-400 range and a complement of 15 additional hours in interdisciplinary sciences including chemistry (6 hours), public administration and management (6 hours), and physical geology (3 hours). As mentioned
previously, the program provides for four options or ‘minor’ emphasis areas. Option #1 includes traditional science curriculum in BSC coursework and allows the student to focus on interests in terrestrial, plant, aquatic systems or chemistry, data or geographic information. Option #2 provides a biotechnology focus. Option #3 provides a Geographic Information Systems (GIS) focus with emphasis on geography and physics; option #4 offers emphasis on environmental regulation and management. The reviewers agree that the coursework is sufficiently rigorous and that all options have career applications in the local job market.

QUALITY OF EXPERIENCE
In support of the curriculum, quality experiences for students off campus during this course of study, is viewed as a positive. Opportunity for project activities outside the classroom were much appreciated by the students interviewed. They felt this gave them a head start in the field of environmental science and real knowledge about career choices---before graduation. They also enjoyed the broad scientific education emphasis over the “pipeline” or traditional degree tracks.

IMAGE
In McCoy’s current position, V.P. of an environmental consulting firm, he has several (6) graduates of Marshall University’s traditional graduate biology program. These individuals tend to view graduates of the IS&T program as technicians. McCoy and Hill understand that there are similar issues with the more traditional departments on campus. It is worth noting that two of the three students interviewed were planning to attend graduate school. Therefore, IS&T graduates are as prepared as their traditional counterparts for graduate degree programs.

Further evidence was provided by Dr. Little, who gave a summary of what graduates of the program had gone on to do. An impressive number of them have elected to attend graduate school. Further, SAT scores of IS&T students average higher than many traditional programs. On both points, this contradicts the current perception of the program.

These reviewers, both having undergraduate and graduate degrees from Marshall University, do not see a significant difference between the programs that would justify graduates of IS&T being considered technicians, any more than graduates of the traditional program. For practical purposes individuals graduating with a four year degree in either program will likely start employment, at least in the consulting sector, as field technicians. Only after several years of experience can they reasonably expect to secure an upper level scientist position. The abundance of individuals in the current job market with master’s degrees makes it just as easy to hire someone with a graduate degree as an undergraduate degree. Of the individuals working for Potesta & Associates, Inc. (McCoy’s firm) as environmental scientists, two have doctorates, thirteen masters, ten undergraduates and one no degree.

Since the Marshall IS&T program traces its origins to James Madison University, it would be interesting to see if this same image prevails at the JMU campus between the two programs. JMU or other similar programs may have addressed this perception issue in some way. It is recommended that Marshall contact JMU officials to determine if there are positive steps that
can be taken to alleviate the current view of program graduates. The solution may simply be the test of time and the success of program graduates. The potential for use of various university publications to improve the image of the program should be evaluated also.

RECOMMENDATIONS / REVIEWER COMMENTS

**Facilities:**
Facilities are improving for implementation of this program. Laboratory space, a requirement of any science program, is also advancing in quantity and quality. MU is recognized for this growth emphasis and is encouraged for its continuation. Additional space should be considered as such space may come available in conjunction with growth in the program. Construction of the new biotechnology facility adjacent to the current Science Building, may result in additional space availability for consideration by the program’s directors.

**Students:**
Students tend to be somewhat non-traditional, above average, and very enthusiastic—which is a distinct advantage. Those who do not envision academic careers are energized by this program which emphasizes hands-on experiences. Some have dropped out of traditional career tracks to pursue the IST degree for this reason. MU should be able to attract a continuous growth in student numbers entering this program by increasing outreach to high school counselors. Viewing the program as a workforce development opportunity, existing businesses in the tri-state area should be encouraged to further participate in internships and on-site experiences.

**Curriculum:**
Curriculum is adequate and builds on the JMU experience. As with all technological advances however, the experiences provided to students in various courses should carefully keep pace with changes implemented in current and future job markets. The options in traditional BSC disciplines, biotechnology Geographic Information Systems and environmental management are each viewed as viable career paths. The integrated array of scientific coursework accompanied by management and public administration provides IS&T graduates with a grounding in basic principles they will face in the current job markets primarily in government agencies and private consulting firms.

**Communications / Image:**
Marshall University should work to improve public understanding of this program—especially among on-campus peers. Facts about the high achievement levels of students, their job-placement potential, satisfaction and graduate school going rate should be amplified. This could lead to diminishing the inaccurate “bunny” image or that “watered down science” is being taught. Also see comment above on high school counselor outreach. Further, alumnae have strong outreach potential as word spreads through experience and job satisfaction. Positive indicators are already present in this regard and alumnae should be considered for additional outreach activities. Collectively, such efforts may lead to further growth of the program necessitating facilities expansion. Therefore many of these items are interrelated and the University is advised to plan accordingly.

**Continuation and Growth Potential:**
Currently this program seems to be attracting a large number of students but also seems to have distinct potential for growth. Marshall is encouraged to strengthen institutional
support, building on the initial positive results and growing interest in IS&T. Since the quality of this program is not lacking and traditional College of Science curricula are geared toward more academics, additional students are likely to gravitate to IS&T. This is especially true of those who do not plan to acquire more than a master’s degree. Also due to the quality of the curriculum however, students would not be prohibited or unprepared if, at a later date, they chose to pursue a doctoral program. Lastly, the university’s programmatic support must keep pace with incoming student demand while remaining sensitive to the ongoing evolution of current markets and workforce needs.

INDIVIDUAL GENERAL OBSERVATIONS

Dr. McCoy

Reviewer McCoy has worked with individual is the Virginia Division of Environmental Quality regional office in Harrisonburg, Virginia. These individuals have had high praise for graduates of James Madison University’s integrated program. They evidently use the graduates of that program to meet many of their needs. They were highly complementary of the program.

Dr. Hill

Reviewer Hill views this degree program as reflective of Marshall University’s efforts to meet modern needs of the 21st century job market. Not only are employers demanding a broadly-trained scientist and well-rounded individual, they also seek those with hands-on experience (I’ve hired many science and technology degreed employees in federal, state and private settings). This program further exemplifies the trend toward the interdisciplinary nature of work teams and complex problem solving in general. Scientific investigation, from environmental perturbation to disease investigation to solving the human genome, has employed interdisciplinary education to tackle persistent problems. Even those students with “traditional” career tracks are forced to interface in a meaningful way with their peers from other disciplines. Even traditional degree programs change over time to reflect current needs (I recall a recent declaration by a Dean of Engineering that “all engineering majors will be required to take Biology” before graduation. Ten years ago this would have been considered heresy. ) Graduates with this type of training (broad, interdisciplinary, hands-on) are better prepared for the current job market. The MU Integrated Sciences program addresses this need.
Appendix VIII

Program Goals of IST Computers and Information Technology

The mission of the IST Computer and Information Technology concentration is to prepare Marshall University graduates for a career in computer technology fields such as software development, network administrator, database administration, or Internet application development. Students in each area of emphasis take a broad spectrum of courses across other areas of emphasis, but have four key courses that they take within their particular area of emphasis, helping them to specialize in that area. This mission is accomplished similarly to Biotechnology’s mission through strong individualized advising and individualized mentoring to help students achieve a balance of IST core courses and computer and technology related courses so that a student can achieve their career plans.

Goals:

- To prepare graduates for a career in the Computer and Information Technology field.
- To create a stimulating classroom environment for educating students in interdisciplinary fields of study (especially Biotechnology and Environmental Science) that are critical to computers and information technology.
- To cultivate and maintain productive relationships and collaborations with the emerging computer science program at Marshall University and technology employers within the Tri-State to place students into internships, graduate school, and jobs.
- To stay abreast of current Computer and IT trends to provide for continuous updates of course content and program areas of emphasis to take advantage of the rapid changes in the technology field, and continue to supply employees to employers based on their needs.
- To assist students through advising and mentoring in planning an appropriate curriculum to achieve their employment and educational goals.

Learning Outcomes/Objectives

Where can IST Computer and Information Technology graduates go with their degree?

2. Some graduates will elect to pursue a career upon graduation. Some options for employment include:
   - Software Engineer (average salary - $45,000 - $57,000)
   - Software Tester (average salary - $43,000 - $68,000)
   - Software Programmer (average salary - $37,000 - $48,000)
   - Database Administrator (average salary - $58,000 - $78,000)
   - Certified Network Engineer (average salary - $70,000 - $90,000)
   - Network Administrator (average salary - $41,000 - $57,000)
   - Telecommunications Analyst/Manager (average salary - $29,000 - $38,000)
   - Web-based Application Developer (average salary - $52,000 - $67,000)
3. Some graduates will elect to prepare for graduate school in a Computer Science, Information Systems, or Technology-related field. Some options for graduate school include:
   • MS/PhD in Computer Science
   • MS in Technology Management
   • MS in Information Systems
   • MBA in Business Administration

7. The diversity of employment opportunities for IST-CIT graduates necessitates mandatory advising of students each semester to identify appropriate individual curriculum choices for their careers.
   o Most classes require instructor’s permission for enrollment.
   o Junior review of classes prior to senior year.
   o Permission and proposal required for capstone research projects.
   o In Communications 201, students profile a company at which they wish to obtain employment, write a resume and have a practice interview for that company.
   o Students work with their advisor to apply for internships and jobs after graduation.

8. IST Computer and Information Technology graduates will develop a broad background in traditional mathematics and scientific disciplines (Biology and Physics) through specific math and science courses.
   • All IST Computer and Information Students are required to take two semesters of Physics (IST212 – Energy and PHY314 – Electronic Physics)
   • All IST Computer and Information Technology students are required to take one semester of Biology (IST111 – Living Systems)
   • Many IST Computer and Information Technology students will take introductory Biotechnology courses to broaden their understanding of other areas of science and assist them in deciding on a career choice.
   • All IST Computer and Information Technology students are currently required to take 19 hours of mathematics courses, which includes the traditional 16-hour IST Analytical Methods sequence of courses and MTH340 – Discrete Structures, a course common to many computer science programs.
   • IST Computer and Information Technology students interested in other postgraduate education should work with their advisor to identify appropriate courses based on admissions requirements for specific programs.
   • Many IST Computer and Information Technology students will take advanced courses in Environmental Policy and Assessment or Biotechnology to develop skills in GIS, Bioinformatics, environmental modeling, high throughput assay development and other areas of synergy.

9. IST Computer and Information Technology graduates will develop individual proficiency in oral and written communication skills and scientific research as well as effective teamwork skills.
Communications and Connections curriculum was specifically developed to build individual research and communication in year one and foster teamwork and business communication in year two.

Written projects similar to the work product of their intended career are required in most classes.

Marshall Plan requires at least one writing across the curriculum class which can now be in a Computer-related discipline.

IST Computer and Information Technology students are encouraged to work on interdisciplinary teams with other IST areas of emphasis for their senior projects.

Students work in teams in advanced Computer and Information Technology classes.

Students present senior projects orally and in a written format at the IST Senior Research Symposium.

10. IST Computer and Information Technology graduates are prepared to evaluate technological innovation and their impact on society.

- Strong emphasis on the impact of science and technology on society within Communications and Connections Classes.
- Bioethics and Rhetoric of Science Classes are offered with a focus on Computer and Information Technology-related topics.
- Discussion of technological impacts on society in other classes.
- IST Computer and Information Technology students are required to take an ethics/philosophy class.
- Marshall Plan requirements for two International classes and one multicultural class broaden the student’s understanding of other cultures.
- The IST Computer and Information Technology requirement for three classes in Social Sciences also broadens student’s knowledge of society and social issues.
- IST requirement for Community Service establishes the need for highly trained individuals to participate in their community.

Analysis

Additional analysis is needed to assess the impact of the IST Computer and Information Technology program, especially with the addition of an undergraduate Computer Science degree to Marshall University’s curriculum. A degree in Computer Science lends itself more to generalization of computer fields, teaching, or pursuing an advanced degree in the computer sciences, while the Computer and Information Technology options that we offer are preparing students to not only be generalists across the IT field, but also allow them to specialize in a given area. Because of this, students are immediately receiving jobs either just before graduating or upon graduation. IST Computer and Information Technology graduates will also have significant opportunity to develop a second specialization in either Environmental Science or Biotechnology, which will expand their job opportunities. The job placement rate and the pay that the graduates have been receiving are exceptional for this area. Depending on the outcome of the Computer Science curriculum development during the Spring of 2004, our Computer and Information Technology curriculum may need to be refined to place us in an even better position than we are now to recruit elite students who want four years of education and then to move immediately into the job market. We plan to continue to send surveys to employers of IST Computer and Information Technology graduates to assess the quality and relevance of the
curriculum to both employers and job candidates. Hands-on computer skills learned within class are contributing to successful job placement.

**Action Taken**
Curriculum continues to be updated yearly with the addition of new courses and areas of emphasis based on employers’ needs. The IST Computer and Information Technology concentration is currently in the process of having a fourth area of emphasis – Internet Technologies – added to its curriculum for Fall 2004 offering.
Appendix IX

Program Goals of IST Biotechnology

IST Biotechnology’s mission is to prepare Marshall University Graduates for a career in Biotechnology by combining an up-to-date research and technology-rich curriculum built on specialized biotechnology classes with appropriate introductory and advanced classes in traditional scientific disciplines (biology, chemistry, computer science, mathematics, and physics). IST Biotechnology’s Mission is accomplished through strong individual advising and mentoring to achieve an appropriate balance of Core IST classes and technical and science electives suited to an individual student’s career plans.

Goals:

- To prepare graduates for a career in Biotechnology field.
- To create a stimulating research environment for educating undergraduate students in interdisciplinary fields of study that are critical to biotechnology in the post-genomic era.
- To seek extramural funds in support of our research and teaching missions.
- To cultivate and maintain productive relationships and collaborations with high-tech and Biotechnology industries and with other research institutions in order to place students and graduates of the program in internships and jobs.
- To stay abreast of current developments in biotechnology and continually update course content to reflect the rapid changes in this area.
- To assist students through advising and mentoring in planning an appropriate curriculum to achieve their employment and educational goals.

Learning Outcomes/Objectives

Where can IST Biotechnology graduates go with their degree?

4  Some graduates will elect to prepare for a career in biotechnology laboratory setting with a B.S. degree. Some options for employment include:
   o University labs
   o Government labs (USDA, NIH, DOE, NASA, CDC, etc)
   o Forensics labs
   o Industrial labs
   o Genetic Testing Labs
   o Military Labs (Army, Navy, Air Force)

5  Some graduates will elect to prepare for research training in graduate school in a biotechnology field. Some options for graduate school will include:
   o MA/MS/PhD in Biotechnology
   o MA Program in Genetic Counseling
   o MD/PhD programs in Molecular Biology/Molecular Genetics
   o MA in Forensic Science
   o MA/MS/PhD program in Biomedical or Biological Science
Biotechnology, Bioinformatics or Clinical Laboratory Sciences post-baccalaureate certificate programs.

6 Some graduates will elect to continue in a non-laboratory career based on their strong understanding of biotechnology. Some options for employment and/or graduate training include:

- MA/MS/PhD in Bioinformatics
- Biotechnology and other high technology MBA degrees (e.g. UW-Madison and Northwestern University)
- Law degree (especially in patent law or criminal prosecution)
- MA/PhD programs in Bioethics
- Biotechnology high school teacher (with additional Post-baccalaureate Education Certification).
- Regulatory QA/QC positions with agencies like FDA.
- Technical Writer or Journalist
- Patent Examiner
- Grants administration
- Technical sales and marketing
- Technical support
- Technology or laboratory management
- Purchasing agent for biotechnology company
- Technology analyst (government or private sector)

5 The diversity of employment opportunities for IST-biotechnology graduates necessitates mandatory advising of students each semester to identify appropriate individual curriculum choices for their careers.

- Most classes require instructor’s permission for enrollment.
- Junior review of classes prior to senior year.
- Permission and proposal required for capstone research projects.
- In Communications 201, students profile a company at which they wish to obtain employment, write a resume and have a practice interview for that company.
- Students work with their advisor to apply for internships and jobs after graduation.

6 The strong research component in the IST Biotechnology curriculum prepares graduates for involvement in laboratory employment including:

- Two semester Research Capstone experience mandatory for all seniors
- Summer internship placement with opportunity for credit
- Participation in competitive university research opportunities such as SURF, American Heart Association, other NSF REU experiences etc.
- Participation in competitive government research programs such as NIH, NASA, DOE and WV Governor’s Internships.
- Research/technical employment as undergraduates on grants.
- Student participation as laboratory assistants for technology classes in which they have excelled.
- Research scholarships like NASA scholarships, Scholarships etc.
Technical and research emphasis in all communications and connections classes.
Research emphasis in specific project based research classes to include:
  - Genetic Systems
  - Genomic Cloning and Cytogenetics
Laboratory/Experiential Learning with other more lecture based classes including:
  - Introduction to DNA Cloning
  - Bioscience Laboratory Methods
  - Human Genetics
  - DNA Technology
  - Forensic DNA analysis
  - Protein Biotechnology
  - Scientific Crime Scene Investigation
  - Plant Biotechnology (cross listed from Biology)
  - Bioinformatics
Independent study research projects
Technology and Innovation class which emphasizes commercializing technological innovations

7 IST Biotechnology graduates will develop a broad background in traditional scientific disciplines (Biology, Chemistry, and Physics) through specific science courses and development of a course of study supplemented with additional science electives appropriate to the student’s career plans.

- All IST Biotechnology Students are required to take two semesters of Chemistry (211, 212) with labs (217, 218).
- IST Biotechnology students are encouraged to take additional IST courses in environmental science and computer and information science to broaden their understanding of other areas of science and assist them in deciding on a career choice.
- All IST biotechnology students interested in applying for a forensic science MA program should take electives in chemistry (CHM 355, 356, 361), physics (PHY 211, 202, 213, 204 or equivalent) and biology (BSC 120, 121, 324) as per recommendations of the program they will apply for. Students and their faculty advisors will determine which IST requirements can be substituted for by these courses.
- IST Biotechnology students interested in working in a forensic science lab with a BS degree should be aware of the TWG-ED recommendations for forensic science as well as the FBI’s requirement that DNA analysts must take coursework in Statistics, Genetics, Cell Biology and Biochemistry. Many state Forensic science labs have an extensive chemistry credit requirement (16-21 credits). Students and their faculty advisors should keep up-to-date on changes in minimum requirements for these positions.
- IST Biotechnology students with an interest in medicine or other post-graduate health sciences degree should also be advised about appropriate courses by the pre-medicine/pre-health profession advisors in the College of Science.
- IST Biotechnology students interested in other postgraduate education should work with their advisor to identify appropriate courses based on admissions
requirements for specific programs.

8 IST Biotechnology graduates will learn research design and quantitative analysis of graphical, numerical, and textual data.
- Sequence of 4 mathematics classes with applications emphasis and laboratory component including statistics, differential and integral calculus, and linear equations with opportunity to continue for Mathematics minor.
- Requirement for all biotechnology students to have minimum of one programming course and one other computer class.
- Opportunity for biotechnology students to dual enroll in both biotechnology and CIT and additional mathematics courses to prepare them for bioinformatics careers.
- Emphasis on laboratory automation and using computers to collect data.
- Emphasis is placed in classroom instruction on research design and data analysis.

9 IST Biotechnology graduates will develop individual proficiency in oral and written communication skills and scientific research as well as effective teamwork skills.
- Communications and Connections curriculum was specifically developed to build individual research and communication in year one and foster teamwork and business communication in year two.
- Written projects similar to the work product of their intended career are required in most classes.
- Marshall Plan requires at least one writing across the curriculum class which can be in a Biotechnology discipline.
- Students work in teams in advanced biotechnology research classes. Final projects include scientific posters of research performed during the class.
- Students can present talks and posters at Sigma Xi research Day at Marshall and West Virginia Academy of Science as well as national meetings.
- Students present senior projects orally and in a written format at the IST Senior Research Symposium.

10 IST Biotechnology graduates are prepared to evaluate scientific and technological innovation and their impact on society.
- Strong emphasis on the impact of technology on society within Communications and Connections Classes.
- Bioethics and Rhetoric of Science Classes are offered with a focus on Biotechnology.
- Discussion of technological impacts on society in other classes.
- IST Biotechnology students are required to an ethics/philosophy class.
- Marshall Plan requirements for two International classes and one multicultural class broaden the student’s understanding of other cultures.
- The IST Biotechnology requirement for three classes in Social Sciences also broadens student’s knowledge of society and social issues.
- IST requirement for Community Service establishes the need for highly trained individuals to participate in their community.
1 IST faculty have experience in Interdisciplinary and Multidisciplinary Research

**Assessment Measures**

*Code: F=Formative Assessments; S=Summative Assessments; VA=Value Added Assessments*

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<th>Assessment Measures:</th>
<th>Local Major Codes in Program:</th>
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<td>2. Quizzes</td>
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<td>3. Term Papers</td>
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<td>4. Oral Presentations</td>
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<td>5. Discussion Groups</td>
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<td>7. Pre/Post Tests</td>
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<td>8. Portfolio Assessment</td>
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<td>9. Standardized Tests</td>
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<td>10. Observation in laboratory</td>
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<td>11. Senior Project</td>
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<td>12. Faculty Evaluations</td>
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<td>13 Exit interview with transfer students</td>
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<th><strong>External Measures:</strong></th>
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<tr>
<td>1. Graduate Surveys</td>
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<td>2. Exit Interviews with graduates</td>
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<td>3. Employer Surveys</td>
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<td>7. Acceptance graduate or professional school</td>
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<td>10. Acceptance for student work in publication</td>
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<tr>
<td>11. External Advisory Board</td>
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12. Job placement within field

Evidence

NASA research scholarships awarded in IST Biotechnology:
IST students have been awarded ten NASA research scholarships. Sponsorship is limited to two students or teams of students per faculty member. In 199 Dr. Little sponsored one team of three students. In 2000, Dr. Little sponsored one student and Dr. Murray sponsored one student and a team of student researchers. In 2001 and 2002 Dr. Murray supervised three student researchers.

1999: 3
2000: 4
2001: 2
2002: 1

Summer Internships:
IST biotechnology students have participated in 15 summer internships over the last five years of the program. These internships have included competitive programs at external institutions such as Woods Hole Oceanographic Institute and M.D. Anderson Cancer Research Center. Two IST Biotechnology students were awarded Governors Internships with the WV State Police and one has been awarded two Governors Internships at the Institute for Scientific Computing. Recently two IST students were awarded a grant from NCIIA to research a biotechnology invention. These two students and four others are currently working on this project during the school year. Two other IST biotechnology students are working on a project on genetics of cardiovascular disease this year.

1999: 1
2000: 5
2001: 3
2002: 4
2003: 5

Graduation:
Seven students have graduated with a concentration in IST Biotechnology to date.

2001: 1
2002: 3
2003: 3

Eleven seniors will enroll in Senior Project in fall 2003.

Employment of IST Biotechnology graduates:
Five of the seven IST Biotechnology graduates are currently employed in a biotechnology field directly related to their interest and two remain to be contacted. These jobs include:

- Crime scene evidence processing for the WV State Police.
- Technician working for a Biology faculty member at Marshall University, who is included as co-author on scientific publications.
• Technician on a DNA mapping project at the University of Pittsburgh.
• Two Technicians working for The Armed Forces DNA Identification Laboratory in Rockville Maryland. developing high throughput DNA typing assays and performing quality assurance.

These five students are working in a hands-on laboratory setting, which has been a goal of the curriculum.

**Analysis**

Additional analysis is needed to assess the impact of IST Biotechnology program. We plan to send surveys to employers of IST Biotechnology graduates as the graduates themselves to assess the quality and relevance of the curriculum to both employers and job candidates. Recent graduates are obtaining employment within two months of graduation. Computer skills and hands-on laboratory experiences are contributing to successful job placement.

**Action Taken**
Appendix X

References:

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