

Assessment of Majors 2005

Department of Natural Science

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During 2005 the Department of Natural Science followed the same assessment format that was used since the early 90's. Consequently, the assessment will not conform to all the guidelines that have been recently adopted by the College. The Department is aware of this deficiency and has instituted the changes necessary to conform to the general standard.

This assessment report will focus primarily on mastery of the basic principles common to the major chosen, biology or chemistry. No environmental science majors graduated in 2005.

The assessments of scientific reasoning, computer, oral, and writing skills were submitted in separate reports.

Department Mission:

The Department of Natural Science supports the overall goals of the College by providing a variety of science courses for all students. These courses provide a basic understanding of scientific principles, a basis for the collection and analysis of data, and an appreciation of the importance of science in a modern society. The department offers degrees in biology (BS and BA), chemistry (BS and BA), environmental science (BS), and medical laboratory science (BS) which prepare students for careers related to science or admission to graduate degree programs. The Department also provides the courses needed to prepare students for a variety of professional programs such as medicine, dentistry, pharmacy, physical therapy, and veterinary medicine. Since many of our students return to the region after completing study in a professional school, our students play a vital role in improving access to quality healthcare in the region. All science majors must learn to access the primary scientific literature via on-line resources and to evaluate and interpret this literature. Students demonstrate this proficiency through oral presentations (seminars) and in written reports. These skills and the basic knowledge gained from required courses in the major provide students with the background needed and hopefully the desire to be life-time learners and good citizens. Over the past five years, 40% to 50% of science graduates have attended graduate or professional school after graduation. This fact seems to suggest that our science program is regionally if not nationally recognized for the quality of our graduates and their preparation for future study.

All majors except for the medical laboratory science (MLS) majors are assessed similarly. The number of MLS majors is small averaging less than one graduate per year.

Biology, chemistry, and environmental science majors are required to take the Major Field Assessment Test (MFAT) appropriate for their major. Environmental science majors take the biology MFAT with particular attention to the score on Subsection 4, population biology, evolution, and ecology. The MFAT is an objective measure of mastery of subject material. All majors are required to make a minimum of two oral presentations. The presentations are used to assess oral competency. The presentations are based upon a research project, research proposal, internship, or library research. Presentations are evaluated by appropriate science faculty using a standard rubric. Students are required to submit a written report summarizing and in some cases expanding on one of the oral presentations or another research paper. The written report is evaluated by two or more science faculty using a rubric developed for campus-wide use. Students with a severe writing deficiency are referred to the writing lab for remedial work before resubmitting the paper. There is no formal assessment of mathematical knowledge, but all majors are required to take multiple mathematics courses. Lab reports require majors to use spreadsheets, word processing, and other specialized software such as SigmaPlot and Minitab. Students are required to use Power Point and email comments in the seminar courses. In 2005 technological competency was evaluated by faculty based on student performance in course where substantial computer use is required.

The College's assessment coordinator periodically conducts an Alumni Survey which is used to gauge the success and overall satisfaction of science graduates. Science faculty informally communicate with majors and are often aware of a major's current professional status. Scientific reasoning is assessed using an instrument developed in 2002, but paired results have been limited. The assessment instrument will be modified in 2006.

Biology:

Goals:

1. Prepare students for graduate study or professions closely allied to or dependent upon biology, including teaching, medicine and allied health, dentistry, veterinary medicine, and physical therapy.
2. Provide general education courses for non-science majors that will increase their understanding and appreciation of scientific methodology and social issues such as genetic engineering, reproductive biology, and environmental relationships.
3. Provide courses to support majors in chemistry and environmental science.

Learning Outcomes:

1. Students should master the basic principles of biology including:
 - a. classification, evolution, and basic characteristic of kingdoms;
 - b. characterization of important biological molecules;
 - c. structure and function of cells;
 - d. organization of higher organisms and the structure and function of organ systems;
 - e. basic genetics and molecular biology;
 - f. basic organic evolution and ecology.
2. Students should score near the national norm on the biology MFAT.
3. Students should be able to find appropriate and desirable employment, or continue graduate or professional study.
4. Students should write and speak in a manner appropriate to science graduates and possess a level of mathematical skills essential to their profession.
5. Students should be able to use a variety of computer based resources such as Excel, Word, Power Point, internet browsers, email, and online literature searches.

To meet these objectives all majors take:

1. Biology 210 cellular and molecular biology, which includes the microscopic structure of cells and organelles, biochemical energetics and control, and the molecular biology of cellular functions;
2. Biology 360 genetics, including basic laws of heredity, the chemical basis of heredity, gene structure and function, and population genetics;
3. one course from a selection of courses which emphasize cell based, systems based, and ecology based content;
4. Biology 215 a biological laboratory techniques course in which students are expected to develop skills needed to perform standard laboratory procedures;
5. Biology 220 ecology and evolutionary processes including systematic behavior, population genetics, evolutionary theory, and ecosystem structure and function;
6. upper-level electives selected by the student according to their interest.

All students present research, either laboratory/field research or library research, in seminars before peers and faculty. These presentations are intended to demonstrate mastery of a specific topic of interest and oral competency.

Evaluation:

The MFAT was administered in April, 2005 to biology majors expected to graduate in May, August, and December 2005. The MFAT is used to measure mastery of the subject material listed as objectives. Majors are expected to score within one standard deviation of the national norm. The data in the table above show that the 12 biology majors taking the test in 2005 met this objective. The mean composite score of 145 was nine points lower than the 2000-2005 national mean of 154, but within the standard deviation of 13. In 2005 were below the national mean for sub-scores 1. cell biology, 2, molecular biology and genetics, 3, organismal biology, and 4, population biology, ecology, and evolution. However, the 2005 graduates were within one standard deviation for all sub-scores.

The table on the following page provides a summary of the results of the Major Fields Assessment Test from 1990 to 2005.

MFAT Scores for Biology

Year	Number Students	Total Score	Subscores*								
			SD	1	SD	2	SD	3	SD	4	SD
1990	4	171	7	64	10	69	8	75	7		
1991	10	161	11	57	11	62	12	64	11		
1992	5	157	9	58	8	52	10	59	6		
1993	7	164	9	66	11	59	5	64	12		
1994	8	147	8	53	10	44	8	47	14		
1995	18	151	12	53	13	54	12	50	14	48	9
1996	14	146	9	50	9	52	9	44	7	43	11
1997	19	145	9	49	9	51	12	46	11	41	10
1998	11	158	11	58	9	63	10	56	15	52	12
1999	13	152	10	54	11	53	10	53	11	49	9
2000	15	146	11	50	11	54	9	46	14	42	13
2001	16	154	13	56	14	55	12	53	15	53	12
2002	17	153	7	54	8	51	8	56	11	51	10
2003	14	152	12	51	10	55	12	51	13	51	12
2004	20	150	12	54	9	51	11	50	12	50	14
2005	12	145	10	45	8	47	11	43	15	52	9
National Norms											
1995-1998	15858	154	14	54	13	55	13	53	14	54	14
2000-2005	20649	154	13	56	13	55	12	52	14	54	14

- * 1990 –1994 Subscore 1: Cellular and Subcellular Biology
 Subscore 2: Organismal Biology
 Subscore 3: Population Biology, Ecology, and Evolution

- 1995 – 2000 Subscore 1: Cell Biology
 Subscore 2: Molecular Biology and Genetics
 Subscore 3: Organismal Biology
 Subscore 4: Population Biology, Ecology, and Evolution

Status of Graduates:

Seventeen biology majors graduated in 2004. Currently one graduate is in medical school, two are in biology related graduate programs, two work as veterinary assistants, two are in pharmacy school, three are in medically related professional programs, two are employed in science related positions, one is employed in non-science related positions, and the status of three students is unknown. Biology majors continue to meet the department's goal of preparing students for, science-related employment and acceptance to professional and graduate schools.

Changes and Future Plans:

In 2001, the introductory biology course sequence was extensively revised and four new or extensively revised courses were added to the sophomore year to complement the revised requirements for the BA and BS biology. The revised requirements for the biology major and new courses were fully implemented in fall 2002. Future MFAT scores will be monitored as these changes become fully established over the next two to three years to assess the effectiveness of the curricular changes.

Chemistry:

Goals:

1. Prepare graduates for chemistry related careers in academia, industry, and related fields or for further study in graduate or professional school. Offer a chemistry major which closely follows the guidelines established by the American Chemical Society.
2. Provide general education courses for non-science majors that will increase understanding and appreciation of scientific methodology, scientific reasoning, and provide a basis for understanding many important issues such air, soil, and water pollution and food production.
3. Provide a variety of chemistry courses in support of biology, environmental science, and MLS majors.
4. Score at or above the national norm on the chemistry MFAT.

Learning Outcomes:

1. All graduates should learn the fundamentals of chemistry which include:
 - a. properties and uses of the more important elements;
 - b. periodic relationships;
 - c. valence bond and molecular bonding theory including molecular structure;
 - d. basic atomic theory including fundamental quantum mechanics;
 - e. theoretical, synthetic, industrial, and biological aspects of carbon chemistry;
 - f. reaction equilibrium in aqueous solution and the gas phase;
 - g. separation, qualitative and quantitative analysis of elements and compounds using both classical and modern methods;
 - h. thermodynamics of pure substances, mixtures, chemical reactions, and phase changes;
 - i. electrochemistry;
 - j. chemical kinetics and dynamics;
 - k. quantum mechanics and spectroscopy.
2. Students should write and speak in a manner appropriate to science graduates and possess a level of mathematical skills essential to their profession.

Learning Outcomes:

3. Students should be able to use a variety of computer based resources such as Excel, Word, Power Point, internet browsers, email, and online literature searches.

To meet these objectives all majors take Chemistry 301, 302, 308, and 309, organic, Chemistry 311, inorganic, Chemistry 321 analytical, and Chemistry 331 or 333-334, physical chemistry. All Chemistry major take Chemistry 498 and 499, Chemistry seminar 1 and 2. Oral presentations are required in both courses.

Most chemistry courses include laboratory where students learn proper laboratory technique, safety practices and to use modern instruments. As an integral part of some lab experiments chemistry majors are required to use molecular modeling software, HyperChem. Most lab reports require students to use a variety of computer software such as, SigmaPlot, spreadsheets, and word processing.

Evaluation:

The MFAT for chemistry was administered in April, 2005 to all chemistry majors expected to graduate in May, August, and December 2005. The MFAT is used to measure mastery of the subject material listed as objectives. Our goal is for students to score near the national norm and no lower than one standard deviation from the national norm. The MFAT results for 1992 through 2005 are summarized in the table on the next page.

The four chemistry majors who took the MFAT in April 2005 scored four points above the national norm and exceeded the 2002-2003 national norm for all subscores: physical, organic, inorganic, and analytical chemistry. Chemistry graduates in 2005 easily met the goal of scoring near the national norm.

Seven chemistry majors graduated in May 2001. Three are in graduate school studying chemistry, one volunteered for military service, one is employed in law enforcement and plans to do graduate work in forensic science, one is employed by a pharmaceutical company, and one is employed in a non-science area. Three chemistry majors graduated in 2002. One is in pharmacy school, one works in a laboratory, and the status of one graduate is unknown. Seven chemistry majors graduated in 2003. Two are in graduate school, one is in

MFAT Scores for Chemistry

Year	Number Students	Total Score	Subscores*								
			SD	1	SD	2	SD	3	SD	4	SD
1992	6	146	15	46	5	51	7	41	4	28	6
1993	7	142	7	48	6	47	4	34	3	30	3
1994	7	150	18	50	8	52	6	44	7	35	6
1995	6	147	11	49	3	46	6	37	5	35	5
1996	10	138	8	45	2	37	4	32	8	24	7
1997	10	134	10	40	8	42	12	38	8	35	13
1998	4	150	7	45	9	53	9	51	5	50	4
1999	4	140	4	42	17	45	17	42	8	41	11
2000	6	146	12	53	11	38	8	47	7	51	18
2001	4	145	8	50	13	47	8	40	7	49	9
2002	3	136	4	41	7	36	5	37	5	34	13
2003	7	148	7	48	8	49	7	46	10	51	10
2004	8	148	17	50	19	47	14	46	15	50	18
2005	4	151	15	53	21	49	10	50	8	50	16
National Norms											
1997-1998	1985	147	13	48	14	44	13	49	13	49	13
1998-2000	3803	147	13	48	14	44	13	49	13	49	13
2002-2005	4051	147	14	47	14	48	14	47	14	47	14

Subscores: 1. Physical Chemistry 3. Inorganic Chemistry
 2. Organic Chemistry 4. Analytical Chemistry

dental school, one is teaching science and math, one works for an analytical lab, one is employed in a non-science area, and the status of one is unknown. Six chemistry majors graduated in 2004. One is in graduate school, one is in pharmacy school, one is employed as an EMT, one is in retail sales, and the status of one is unknown. Four chemistry majors graduated in 2005, one is in graduate school, one is in medical school, and two are in pharmacy school. Chemistry majors, 2001-2005, have met the department's goal of preparing graduates for professions related to chemistry or graduate and professional study.

Changes and Future Plans:

Chemistry majors continue to meet learning outcomes. No significant changes are planned for the chemistry degree program or courses in 2006 – 2007. The chemistry faculty will review the requirements for the majors and perhaps some modifications will be made for the 2007-2008 catalog.

Department of Natural Science

Survey of Alumni:

The most recent data from a survey of the University of Virginia’s College at Wise alumni in 2004 and 2005 included a total of 15 science alumni, 10 biology, 3 chemistry, and 1 environmental science. The average response on the survey indicated that science alumni are well satisfied with the education they received and find the education received to be very useful in their workplace. The survey also indicated that the Department of Natural Science is very effective in advising its majors. Alumni were well satisfied with the extent to which they were prepared to use technology and with the relationship between their major and current occupation.

If the information provided by the limited number of respondents is significant, it seems that the department is meeting its goal of successfully preparing its majors for careers related to their major or for admission to graduate and professional schools. The survey results are summarized below

**Summary
Alumni Survey 2004**

Question	Mean Response
Satisfaction with education received	3.7
Satisfaction with advising	3.2
Relationship of degree to occupation	2.8
Extent that degree helps in workplace	3.1
Extent that degree prepared for technology	3.5
Extent that degree prepared for graduate school	3.2*

N=15 * N=6

Possible responses: 4 very well 3 well 2 very little 1 not at all

The limited sample size makes extensive analysis of alumni satisfaction difficult, especially for individual majors.