A Proposal to Revise the Biology Major

College of Biological Sciences

November 2, 2005

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Name of the Major: Biology
Degrees: Bachelor of Science in Biology, Bachelor of Arts in Biology
Implementation date: Autumn 2006
Administrative Unit: College of Biological Sciences

Rationale

Over the past quarter century, biology has experienced dramatic change. Because of the introduction of new technologies, such as relatively inexpensive computers, site-directed mutagenesis, and polymerase chain reaction, we can examine biology from molecules to communities in far greater detail and volume than ever before. At Ohio State and around the world, monikers like "bioinformatics," "mathematical biosciences," and "biological engineering" indicate the increasingly interdisciplinary nature of biology, building on the older affiliations inherent in biophysics, geology, chemistry, and anthropology. The very nature of performing biological research has changed dramatically, often requiring more interdisciplinary collaboration and broader experience and expertise on the part of investigators, and the use to which that research can be applied has shattered boundaries of possibility and ethics. As a result, the National Research Council, in "BIO 2010: Transforming Undergraduate Education for Future Research Biologists" (2003, National Academies Press, Washington, DC), recommended a reevaluation of what we teach future biomedical researchers, and, most importantly, how we teach them. While all this has been occurring, the curricular structure of the biology major at Ohio State has changed little (though the courses themselves have changed dramatically to incorporate new information). On February 16, 2005, Dean Joan Herbers convened a committee of faculty, staff, and students, and charged that committee to examine the current biology major thoroughly and to determine whether and how the biology major should be restructured.

The biology major at Ohio State is unusual in that it is not housed in a single department, but is a college-wide major, overseen by the College Curriculum Committee and administered by staff within the college office. The core curriculum comprises courses from all of the six departments within the college (Appendix 1). Therefore, it is a broad-based, comprehensive, and demanding major.

The current biology major serves a large and diverse body of students. It is the largest of the eight majors in the college; indeed, as of autumn quarter, 2004, it is the largest single major in the university. In winter quarter of 2005, 1266 of the college's 2446 majors were biology majors (Appendix 2), and 13.5% of the students enrolled in the biology major were under-represented minorities (compared with 11.4% for the college as a whole, and 12.2% for all of the Colleges of the Arts and Sciences).

A large fraction of the students who complete the biology major go to professional school, not just in medicine, but also in law, dentistry, optometry, pharmacy, and other disciplines. Other students go to graduate school in biological sciences or education. Students are well prepared to follow a number of career paths because the biology major is flexible and can be tailored to the individual student's needs and aspirations. Its flexibility also allows students to schedule their curriculum quite flexibly and conveniently, permitting them to complete their degree in a timely manner.

Conversely, the biology major is also seen by some to be a hodge-podge of courses, often chosen for convenience in scheduling rather than for disciplinary depth or integrity, undermining the overall rigor of the major. Often, students find that particular bodies of information, such as cellular division, Mendelian genetics, or mitochondrial respiration, are presented in several of the courses they choose, often with the same or similar perspective and depth with each offering.

To build upon the strengths of the current biology major while ameliorating its shortcomings, the committee designed the proposed major (Appendix 3) to emphasize that biology is a single, broad, and complex body of knowledge. We believe that presenting the discipline in this way will enable students to understand more clearly the integrated, relational nature of each facet of the discipline. We designed a novel introductory sequence of courses (BioSci 401-403, Appendix 4) to present the material in this way. In addition, we emphasized the practical, quantitative skills integral to biology that are required for a student to truly understand and to begin to master the discipline. To encourage students to learn to participate more fully in the process of discovery and to synthesize their learning more completely, we proposed a sophomore colloquium-style seminar (BioSci 320, Appendix 5). Further, to encourage and guide students toward a cohesive, complete, and rigorous major, we developed the Specialization Areas (Appendix 6). These sets of courses allow individual students to focus their upper-level courses on an area of their choosing, while emphasizing the interdisciplinary nature of biology.

The revisions proposed here for the biology major are in line with the recommendations of the NRC "BIO 2010: Transforming Undergraduate Education for Future Research Biologists" report. Specifically, the BIO 2010 report included recommendations that universities reexamine their curricula with an eye toward preparing students for an area that is increasingly interdisciplinary; that concepts from math and the physical sciences be included in biology courses; that cross-departmental teaching collaborations be encouraged; and that students have access to seminar-style courses that

communicate the excitement of biological research.

Relationship to other programs

The proposed major will directly replace the existing biology major, one of eight majors offered by the College of Biological Sciences. The other seven majors are: biochemistry, entomology, evolution and ecology, microbiology, molecular genetics, plant cellular and molecular biology, and zoology. The current biology major depends on the course offerings of the departments within the College of Biological Sciences. The core of the major consists of five courses chosen from an assortment of courses offered by all six departments in the college. The new 400 series of three courses proposed for the new major will replace this core and will reduce the enrollments in the courses designated by the current core. The teaching staff that will offer the new Biological Sciences courses (320, 40x) will be drawn from the staff within the college, thus any reduction in the teaching loads for the departments created by reduced enrollments in the current core courses may be absorbed by the requirements of the new major. Electives within the major are also chosen from all of the courses taught by the departments in the college and from several other courses offered by units such as the College of Medicine and Public Health, the College of Human Ecology, the College of Social and Behavioral Sciences, and the College of Mathematical and Physical Sciences. The electives for the proposed major will be chosen from the current array of courses and will be enlarged by allowing and designating courses from additional colleges. These electives will comprise what we call the "Specialization Area" in the new major.

This proposal was developed by a committee named by Dean Herbers during the Winter of 2005; the committee has met to develop the proposal during Winter Quarter through Summer Quarter, 2005. The members of that committee were: Caroline Breitenberger, Associate Dean; Joseph Conroy, graduate student and alumnus; Chuck Daniels, Professor of Microbiology; David Stetson, Associate Professor of EEOBiology and honors biology advisor, chair; Peggy Strow, college advisor for biology majors; Deshpal Verma, Professor of Molecular Genetics; and John Wenzel, Associate Professor of Entomology. The committee convened a panel of five current undergraduates in order to assess the opinion of the students on the current major and to obtain their reaction to the proposal.

Student enrollment

At present (Sp05), approximately 1200 of the college's 2400 undergraduates are biology majors. If this proposed major is successful, we expect that that number may grow by attracting students from other majors outside the college and also by attracting students to Ohio State who might otherwise enroll at other universities. We expect that attraction to the new

biology major will be based on the strength and relevance of the new 400-level courses and the clear path to the degree defined by the specializations within the major.

Administration

The Dean of the College will administer the new biology major through the College Curriculum Committee, with the assistance of the Associate Dean charged with oversight of the curriculum. The College Curriculum Committee will approve any and all changes to the curriculum, including new and altered specializations. Ultimately, the Dean will be responsible for recruiting the teaching staff for the 400 series of courses and for the 320 seminar course, although, in practice, that responsibility may be delegated to the Associate Dean. The committee considered folding the administration of the new major into the present Introductory Biology Program as well, but we believe the mission of the Introductory Biology Program would need to be redefined and expanded if it were to take on administration of the core courses for the new major.

Advising

The advising of majors will continue as it is now. Two professional advisors in the College office (Peggy Strow and David Wells) are the primary contacts for students; those advisors report to Caroline Breitenberger, the associate dean charged with curricular oversight. Honors students will be advised by one of three designated faculty members; currently, those three faculty are Neil Baker (Microbiology), David Stetson (EEOB), and Tom Wilson (Entomology).

The Core Curriculum

As the committee began the discussion to revise the biology major, we reached consensus very quickly concerning the principal goal of any revision: to present biology as a single, integrated body of knowledge. The current major tends to present biology as a series of compartmented topics because of the five categories of courses within the core (biochemistry, genetics, cellular biology, organismal biology, and evolution and ecology; Appendix 1) and because of the rather discrete partitioning of the knowledge among the six departments in the college. We propose the core 400-level courses as a single yearlong course that covers the broad range of biology in a single unit, and incorporates concepts from mathematics, chemistry, and other relevant scientific disciplines. Furthermore, we recommend that writing and related skills be integrated across the core 400-level courses. A topical outline for the proposed course is presented in Appendix 4. (We do not recommend that the core include a laboratory component for three reasons: First, the laboratories in the required 100-level Biology are being revised and updated and should provide an adequate general exposure to the breadth of laboratory techniques used in biological research.

Second, the sophomore seminar, BioSci 320, exposes biology majors to the methods of biological inquiry as related by active research scientists. Third, there is a requirement for three laboratory or data analysis courses within the specialization area and electives in the major, thus providing students with hands-on experience with more advanced techniques.)

A single faculty member who participates in all three quarters of the offering should coordinate the BioSci 40x courses (Appendix 4). An additional two or three faculty members drawn from various departments and with complementary expertise will participate with the coordinator as a team in teaching the courses. We do not intend that the instructors simply deliver their assigned lectures, but that they participate in the planning of the curriculum for the complete sequence and that they remain in touch with the progress of the course. We are aware that the kind of team-teaching most prevalent now is not received well by the students, often because each instructor has a distinct style, both in lecturing and in designing and administering examinations, and students feel they must shift gears with each instructor. We would like to see the potential advantages of team-teaching (for example, experts presenting the material, an energetic and vital interaction between faculty and students, an imaginative and enthusiastic approach to and presentation of the material) realized through a real *team* approach to the course. In some ways, this approach is similar to the manner in which chemistry and physics are presented (a year-long sequence taught by several faculty), but the nature of biology will demand even more integration because a bit of knowledge presented early will be relevant to other topics throughout the year, continuing into the electives in the major (and indeed in other aspects of the students' lives). For example, evolution is fundamental to biology and will be presented early in the first quarter of the sequence. The principles of evolution are as relevant to the structure of DNA and proteins as they are to the structure and dynamics of populations and communities of organisms.

This sequence of courses is intended to provide a broad but thorough foundation for students choosing to continue into any sub-discipline in the biological sciences. After completing the three-course sequence, students should be prepared to transfer into any of the seven other majors in the college if they choose to change majors.

As far as the committee is aware, no one is offering this kind of course in the biological sciences at Ohio State or at any other university. (There are institutions that offer courses entitled "Integrated Biology," but in the cases we have examined, the topics are not truly integrated in the way we envision.) The lack of such courses can present a problem for students transferring to Ohio State; there may be no equivalent core to accept in transfer and it will not be

possible to give students credit for any individual component of this sequence because of its unitary structure. Each transferring student will be expected to complete the entire sequence to gain the full benefit of the offering. It is likely that any intermediate or advanced courses that a transferring student brings with him/her can be included in the major specializations. During the transition to the new major, students who declared their biology major before the activation date of the new major will be able to choose to complete the major according to the earlier curriculum.

The proposed core also includes a required second-year seminar. We believe students must be encouraged to become involved in discussion and be presented with original research early in the process because these experiences are so fundamental to the process of learning and creating information in biology. We propose the creation of a new course, BioSci 320 (Appendix 5), to accomplish this, but we also encourage other departments within the college to create similar courses if they do not already have such courses, and to allow biology majors to take those departmental seminars.

Specialization Area

In consultation with his or her advisor, each student should decide on an area of specialization within the broader field of biology. Each specialization area will consist of a series of courses or course options that have been approved by the College Curriculum Committee. Some possible specialization areas are listed below, and three detailed examples are provided in Appendix 6. If these do not meet a student's needs, he/she may work with College of Biological Sciences faculty and advisors to choose a series of at least three advanced courses (300 and above, excluding 591 and 597) in the biological sciences with a coherent theme, and present a proposed specialization to the College of Biological Sciences Curriculum Committee for approval.

<u>Possible Specializations for the Biology Major</u> (details to be planned and approved by the College of Biological Sciences Curriculum Committee):
Aquatic Biology
Biophysics
Computational Biology
Education in Life Sciences
Forensic Biology
Molecular and Cellular Ecology
Molecular and Cellular Evolution
Organismal Biology
Pre-health Professions
Psychobiology
Quantitative Biology

Systematics

Appendix 1: Current biology major program

The biology major provides a structured program that includes the major areas of importance to modern biology, as well as an in-depth concentration of study in one of the six departments in the College of Biological Sciences.

Part A. Required Prerequisites or Supplements to the Major (Do not count toward the 45 hour major)

- Biology 113 or H115, 114 or H116
- Mathematics 148, 150, 151, 152 or 161
- Chemistry 121 or H201, 122 or H202, 123 or H203
- Chemistry 251, 252, 254 or 245, 255 or 246
- Physics 111 or 131, 112 or 132, 113 or 133

Part B. Core Requirements

Choose one course from each of the five groups below.

1. Molecular (choose one):
   - Biochemistry 511, or 613 and 614
2. Genetic (choose one):
   - Microbiology 581
   - Molecular Genetics 500, or 605 and 606
3. Cellular (choose one):
   - EEOB 415 or 630
   - Microbiology 509, or 520 and 521
   - Molecular Genetics 602 or 607
   - Plant Biology 648
4. Organismal (choose one):
   - EEOB 410, or 405.01 and 405.02
   - Entomology 500 or 611F
   - Microbiology 661
   - Plant Biology 436, or 630 and 631
5. Ecology/ Evolution (choose one):
   - EEOB 370 or 400 or 413.01 or 413.03
   - Entomology H444 or 641
   - Microbiology 664 or 665
   - Molecular Genetics 640

Part C. Electives within the Major

- At least three additional courses at the 300 level or above from one biological science department.
- At least two of the three courses must be lecture-based courses

- When courses are taken as a sequence to satisfy a Core requirement (part B), all but one of the courses in the sequence may also be used to satisfy the three additional courses requirement.
- Independent study is strongly recommended (693 or H783), with up to five credit hours counting towards the 45 hour major.

Requirements - Parts B and C together

- A minimum grade of "C-" in each course and a 2.0 overall GPA in the major.
- At least three courses must have a laboratory.
- Total: 45 or more hours at the 300 level or above.
- COURSES IN THE MAJOR MUST BE APPROVED BY YOUR BIOLOGY ADVISER.

Appendix 2: Student enrollments in the College of Biological Sciences

Winter quarter enrollments

	Biochem	Biology	Entomol	Evol & Ecol	Microbiol	Mol Genetics	Plant CMB*	Zoology	BIO Headcount**
2002	149	993	7	25	149	227	11	285	2004
2003	150	1067	10	45	156	251	10	291	2121
2004	188	1171	14	37	175	285	13	306	2317
2005	196	1266	13	34	219	264	15	310	2446

Winter quarter Honors enrollments

	Biochem	Biology	Entomol	Evol & Ecol	Microbiol	Mol Genetics	Plant CMB*	Zoology	BIO Headcount**
2002	58	280	1	9	41	91	1	54	579
2003	65	274	0	21	43	120	0	68	620
2004	78	319	3	13	44	124	2	66	649
2005	73	329	3	13	57	120	2	52	651

* Formerly Plant Biology

** Includes BIO-Undecided students; students with double majors within the College are counted just once in the headcount

Appendix 3: The proposed biology major

Biology Major Program

The biology major provides a survey of the essential areas of study in modern biology, an individually-tailored focus of study, and an emphasis on methods of communication in the discipline.

Part A. Required Prerequisites or Supplements to the Major. (Do not count toward the 45 hour major)

Courses	**Credit Hours**
Biology 113 or H115, 114 or H116	10
Mathematics 148, 150, 151, 152 or 161 (or Honors versions)	5-19
Chemistry 121 or H201, 122 or H202, 123 or H203	15
Chemistry 251, 252, 254 or 245, 255 or 246 (or Honors versions)	10-12
Physics 111 or 131, 112 or 132, 113 or 133 (or Honors versions)	15

Part B. Core Requirements. (14 credit hours)

Biological Sciences 401 – Integrated Biology I	4
Biological Sciences 402 – Integrated Biology II	4
Biological Sciences 403 – Integrated Biology III	4
Sophomore Colloquium: Biological Sciences 320 – Biological Inquiry	2

Part C. Specialization Areas (Individually-designed areas of further study totaling at least 15 hours)
In consultation with his or her advisor, each student must decide on an area of specialization within the broader field of biology. Certain series of courses have already been approved for specialization and are listed below. If these do not meet a student's needs, he or she may work with College of Biological Sciences faculty and advisors to choose a series of at least three advanced courses (300 and above, not including 591 and 597) in the biological sciences with a coherent theme, and present the proposed specialization to the College of Biological Sciences Curriculum Committee for approval.

<u>Approved Specialization Areas for the Biology Major</u>
Aquatic Biology
Biophysics
Computational Biology
Education in Life Sciences
Forensic Biology
Molecular and Cellular Ecology
Molecular and Cellular Evolution
Organismal Biology

Pre-health Professions
Psychobiology
Quantitative Biology
Systematics

[This list of specializations includes topics that are not included in Appendix 6, "Specialization Areas." Those listed in Appendix 6 represent the pattern that we expect to see. The additional areas listed above are possible, but they are not as well developed. We anticipate that a broad range of specializations will be available. In any case, according to our proposal, the College Curriculum Committee must approve all specializations.]

Part D. General Requirements for the Biology Major

45 or more credit hours beyond the prerequisites to the major (some students may need additional courses at the 300-level or above after completing the Core and Specialization Area)
Three courses in the major must have a laboratory or data analysis component
Independent Study, e.g. Biol 693 or H783, can be included to a maximum of 5 hours, and may be counted towards the laboratory/data analysis component
A minimum of C- in each course in the major
An overall GPA of at least 2.0 in the major
Courses in the major must be approved by a biology advisor

Appendix 4: A proposed outline for BioSci 401, 402, and 403

The following is a tentative outline of topics for the sequence of courses that will be the core in the proposed revision of the biology major. The outline includes lecture topics and organizing models; those models are intended to illustrate the relationships between topics, to provide specific opportunities to bring current research into the classroom, and to serve as the focus for discussion.

I. BioSci 401: Integrated Biology I — Evolution of Organization

A. The Organization and Integration of Biology: hierarchies, systems of systems, and understanding at multiple scales

B. ***Ecosystem ecology - energy & nutrient flow in environments***

1. The biome
2. Types of ecosystems; survey of the world and global perspective (it's not all temperate deciduous forest!)
3. Macrogradients in creating ecosystems (light, temperature, precipitation)
4. The niche as the arena for selection
5. Organizing model: increased CO2 in the environment and outcomes
6. Organizing model: cultural eutrophication of lake ecosystems

C. Community ecology - the structure of the ecosystem

1. Producers, consumers, and recyclers; general strategies in systems
2. Trophic structure in ecosystems
3. Effect of various trophic patterns in energy and nutrient flow
4. Maximizing return as an organizing principle in systems
5. Organizing model: the HSS hypothesis (Hairston, Smith, and Slobodkin, 1960) or is the world really green?
6. Population ecology - how populations are regulated
7. Intraspecific relationships; the "struggle for survival"
8. Interspecific relationships; predation, parasitism, symbiosis
9. Quorum sensing

10. Decomposers and detritivores: what happens to all the dead bodies?
11. Intro to the use of models in biology: simple population models
12. Organizing Model: what limits lions on the savanna? (Hint: it's not what you think)

D. Phylogenetics - taxa and how they relate historically

1. Principles of geology (uniformitarianism, Earth history)
2. Tripartite symmetry: Linnean hierarchy, paleontological appearance of taxa, von Baer's ontogenetic parallels.
3. Modern reconstruction of phylogeny

E. Selection - how populations change through time

1. Population genetics
2. Principles of natural selection
3. Principles of sexual selection
4. Kin selection
5. Social organization

II. BioSci 402: Integrated Biology II — Molecular basis of life

A. The cell and its constituents

1. Universal features of all cells, the tree of life, genomes define cells/organisms
2. Molecules of life: macromolecules (proteins, nucleic acids, polysaccharides and complex lipids) and their building blocks; chemical reactions in the cell, energy conservation
3. Proteins as catalysts, molecular motors, and proteins as structural components.
4. Organizing model: glycolysis and the citric acid cycle as a transducer of energy
5. Protein diversity, orthologs-paralogs, basic concepts of comparative genomics
6. Intracellular trafficking: cytoskeleton, intracellular membrane compartments, nuclear pores
7. Signal transduction
8. Organizing model: sonic hedgehog and cell-cell communication

B. Membranes and organelles

1. Membrane structures: prokaryotes, eukaryotes, and organelles
2. Membrane function (general): transport, electrochemical gradients, proton motive force, trafficking
3. Organizing model: osmoregulation, salt glands and kidneys

C. Information processing systems

1. DNA Replication
2. The genome
3. Transcription and the transcriptome
4. Protein synthesis, roles of RNA
5. Epigenetics, microRNAs
6. Organizing model: regulation of the cell cycle
7. The proteome and the metabolome

III. BioSci 403: Integrated Biology III — Systems biology and model organisms

A. Evolution of complexity

1. Protein networks and the coupling of complex systems: an introduction to systems biology
2. Organizing model: glycolysis and the citric acid cycle as the core of a networked system of syntheses
3. Microbial genomes: E. coli to yeast; the prokaryote-eukaryote transition
4. Intracellular symbionts and pathogens

B. ***Development***

1. *Caenorhabditis elegans*, *Arabidopsis*, and *Drosophila* as model systems for developmental biology
2. Organizing model: Hox genes, determination, differentiation

C. ***Methods in molecular life science***

1. DNA sequencing and genome analysis: genotype to phenotype
2. Omics: arrays, genomics, and proteomics
3. Bioinformatics: GenBank, data mining
4. Genetic engineering: viruses, bacteria, and enzymes as tools

5. Manipulating eukaryotes: transformation, cloning

D. The present and future of molecular life science

1. Ethics, Earth, and Homo
2. Engineering the environment
3. Human screening
4. Human cloning

Appendix 5: Proposed BioSci 320 syllabus

Biological Sciences 320
Biological Inquiry

Objectives: A seminar-style class designed to introduce sophomores majoring in biology to methods of inquiry in the biological sciences, to foster faculty-student interactions, to develop appropriate professional behavior, to develop life-long learning skills in the sciences, and to stimulate critical thinking skills.

Course structure*:* Class meets once per week for 1h 48 min. Students receive 2 credit hours. Class offered Au, Wi, Sp quarters, with different coordinators and speakers each quarter. Maximum enrollment: 100 students each quarter. Class is graded S/U.

Prerequisites: Biology 114 and Rank 2 status (student has earned at least 45 credit hours); restricted to students with a major in the College of Biological Sciences; not open to students with credit for Biochem H200 or MolGen H220, or other similar departmental freshman or sophomore seminars to be developed; or by permission of the Course Coordinator.

Course coordinator: The Course Coordinator is a faculty member in the College of Biological Sciences. Each offering of BiolSci 320 should be widely publicized to student listservs, College of Biological Sciences advisors, and Arts and Sciences advisors at least one quarter in advance. The Coordinator is responsible for inviting and scheduling seminar speakers, preparing and distributing handouts and limited background materials describing the next week's seminar (typically 3-5 pages), working with discussion leaders to make sure class discussion is appropriate, evaluating each discussion group, and collecting and grading reflection papers each week. All College faculty are expected to participate in BiolSci 320 (as speakers and/or coordinators).

Grading policy:
Attendance and class participation: 30 points
Journal: 30 points
Discussion leader group activity: 40 points
There is no final exam for this class.
≥ 75 points = Satisfactory
< 75 points = Unsatisfactory

Attendance and class participation*:* For each absence, no matter what the excuse, the student will receive a 5 point penalty. Under certain circumstances (e.g. serious and unexpected health problems, family emergency), the Course Coordinator may choose to give a student a special assignment to make up

points missed due to class absences (*e.g.* attend a different seminar and prepare a written report). Participation points will be awarded based on each student's interaction with the seminar speakers, *i.e.* whether they occasionally ask questions and participate in class discussions – quality of the interaction is more important than quantity.

Journals will be collected at the end of the quarter, and may also be collected and reviewed during any class period by the course coordinator. The journal entries have three parts: questions based on the background reading, answers to those questions, and reflections on the significance of the seminar. Each week, students should bring to class their journal, in which they have written at least one question based on their reading of the background material. Questions may include topics such as the significance of the research; the research methods; interpretation of results; how this research relates to specific findings by others; ethics of the research; *etc.* Before the next class period, each student should briefly answer their own questions, whether or not they were addressed during the seminar or the post-seminar discussions. In addition, students should comment on how the seminar has affected their understanding of the topic addressed.

Discussion leader group: A group of 10-12 students each week will be assigned to introduce the speaker and lead the discussion at the end of the seminar.

Responsibilities of the group include:

- Seek out additional background readings and materials (including Internet, textbook, and peer-reviewed publications)
- Post significant readings on the course website, accompanied by a 1-2 sentence synopsis of each posted reading written by one of the group members
- Each individual group member should send the Course Coordinator 2-3 questions for discussion by 4:00 pm 2 days before the seminar [The Course Coordinator will compile and edit the questions, possibly adding a few, and distribute the compiled list to the entire group the day before the seminar]
- Assign responsibilities within the group, such as introducing the speaker, leading the discussion, and thanking the speaker
- Introduce the speaker at the beginning of class (introductions should include the speaker's name, educational background, current position, and seminar title -- some creativity is acceptable, but speakers should be treated with respect and courtesy)
- At the end of the seminar, ask for questions from the class, seed the discussion by asking questions for the Coordinator-approved list, and steer the class discussion in appropriate directions
- Conclude the classroom discussion and thank the speaker (again, some creativity is acceptable, but speakers should be treated with respect and courtesy)

- Meet with the Course Coordinator to discuss their performance and to document the group's activities for the Course Coordinator

Discussion leader group participants will receive up to 20 points as a "group" grade and up to 20 points as an individual score. It is expected that, at a minimum, each student in the group will have asked one question during the discussion and will have summarized one significant paper for the website

Sample class schedule:

Week 1 (Speaker: Course Coordinator):

Course expectations and mechanics
Traditions and expectations in biological inquiry
How do scientists choose a research topic?
How is research supported?
What is a peer-reviewed publication?
Research databases
Explain theme for the quarter; background information
Distribute background reading for Week 2 seminar speaker
Assign discussion leader groups for weeks 2-10

Weeks 2-10:

3:00 Start of class – Discussion leaders introduce speaker
3:10 Seminar speaker and title TBA
4:00 Speaker concludes - Discussion leaders ask questions and lead discussion -- each discussion leader should ask at least one question; discussion leaders should also watch for questions from the audience; seminar speaker may be involved in discussion, or may stand back and let students engage each other in discussion
4:35 Speaker summarizes student discussion, adding his/her own perspective and knowledge to the discussion
4:40 Discussion concludes – Discussion leaders thank speaker
Course Coordinator hands out materials for next week's speaker and provides a brief transition to the next speaker's topic
4:45 Class dismissed

Course Coordinator meets 5-10 min with group discussion leaders to review their performance

Academic Misconduct: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Signing attendance sheets and/or turning in assignments for students not in attendance are also examples of

academic misconduct. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).

Disability Services: Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated, and should inform the Course Coordinator as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.

Appendix 6: Examples of Specialization Areas

Specialization Areas for the Biology Major

Note that courses may be approved in the Specialization Areas below which would not otherwise be approved for the Biology major. Students are responsible for checking course prerequisites; not all are included in the lists below. Where several courses are listed with an "or," only one of those listed may be counted toward the Biology major. When two courses are linked with an "and," both must be taken to satisfy the requirement within the specialization.

Education in Life Sciences (≥ 31 credit hours beyond the core)
Students wishing to pursue a career as a high school science teacher are encouraged to complete a bachelor's degree in the content area (e.g., biology) and apply to the Master's of Education (M.Ed.) program through Ohio State's College of Education. For additional information about entrance requirements to the M.Ed. program, please refer to www.coe.ohio-state.edu.

Required: Introduction to Biological Chemistry, Biochemistry 511 (5 cr.)
Required: General Genetics, Mol Gen 500 (5 cr.)
Required: Evolution, EEOB 400 (5 cr.)
Required: Basic and Practical Microbiology, Micro 509 (5 cr.)
Required: General Plant Biology, PCMB 300 (5 cr.)
Additional Coursework: Choose at least two courses from the following list or consult with a Biology major advisor for additional options.

- General Entomology, Entomology 500 (5 cr.)
- Introduction to Ornithology, EEOB 322 (5 cr.)
- Diversity and Systematics of Organisms, EEOB 405.01 (4 cr.) (*strongly recommended*)
- Ichthyology, EEOB 621 (5 cr.)
- Mammalogy, EEOB 625 (5 cr.)
- DNA Fingerpinting Workshops in Columbus Public Schools, Mol Gen, Biochem, or Micro 591 (2 cr.; may be counted only once)

Forensic Biology (≥ 20 credit hours beyond the core)
Recommended additional prerequisite: Introduction to Physical Anthropology, Anthropology 200 (5 cr.)

Required: an introductory course or sequence in biochemistry, Biochemistry 511 or Biochemistry 613 and 614 (5-8 cr.)
Required: an introductoru course or sequence in molecular genetics, Mol Gen 500 orMol Gen 605 and 606 (5-8 cr.)

Additional coursework in molecular biology and forensic science: choose at least three courses or series from the following list:

- Biological Anthropology of the Human Skeleton, Anthropology 603.01, 603.02, 603.03, or 603.04 (5 cr.)
- Forensic Anthropology, Anthropology 640.04 (5 cr., Anthro 603.01 prereq.)
- Third course in Biochemistry and Molecular Biology, Biochemistry 615 (4 cr.)
- Eukaryotic Molecular Genetics Laboratory, Mol Gen 601 (5 cr.)
- Cell Biology, Mol Gen 607 (3 cr.)
- Molecular Genetics, DNA Transactions, Mol Gen 701 (3 cr.)
- A course or sequence in microbiology, Micro 509 or Micro 520 and 521 (5-10 cr.)
- DNA Fingerpinting Workshops in Columbus Public Schools, Mol Gen, Biochem, or Micro 591 (2 cr.; may be counted only once)

Pre-Health Professions (≥ 23 credit hours beyond the core)
Required: an introductory course or sequence in molecular genetics, Mol Gen 500 or Mol Gen 605 and 606 (5-8 cr.)
Additional coursework: choose at least four courses from the following list:

- A course or sequence in biochemistry, Biochemistry 511 or Biochemistry 613 and 614 (5-8 cr.)
- Evolution, EEOB 400 or H400 (5 cr.)
- A course or sequence in microbiology, Micro 509 or Micro 520 and 521 (5-10 cr.)
- Principles of Animal Cellular and Developmental Biology, EEOB 415 or H415 (4 cr.)
- Vertebrate Histology, EEOB 630 (5 cr.)
- A course in human or comparative anatomy, Anatomy 200 or EEOB 410 or H410 (4-5 cr.)
- A sequence in human physiology, Physiology CB 311 and 312 or Physiology CB 601 and 602 (10 cr.)