**INDEPENDENT RESEARCH PROJECTS IN BIOLOGY FOR COURSE CREDIT (BIOL 499)**

The Biology Department encourages students to do an independent research project during their junior or senior year. Students who opt to do so should possess initiative and interest, have adequate course background, and show evidence of strong conceptual knowledge in the area of the research. The project may receive one course credit toward graduation (does not count towards the biology major) and a grade given by the Hendrix biology instructor who supervised the project. The Biology Department has good potential for independent studies both on and off campus and can fulfill the needs of most projects. Faculty members can be of great help in formulating such projects. Faculty should be consulted early for ideas, approaches, and planning. Results that have sufficient merit should be presented at professional meetings or other appropriate scientific forums. Course credit may be given for a maximum of two independent research projects; however, only one may be done off-campus. To earn two course credits, the research must involve separate projects from different areas or sub-disciplines of biology.

There are three approaches that can be used to carry out an independent research project: A student may undertake a research project that is directly related to the area of interest of a specific Hendrix faculty member, a student may design a project that is independent of work conducted by a professional mentor, or a student may petition the Biology Department to award course credit for an off-campus research experience. The detailed requirements for each approach are presented below.

**REQUIREMENTS FOR AN INDEPENDENT RESEARCH COURSE**

1) As early as possible (preferably before the end of the sophomore year), students should select a faculty member from the Biology Department who will oversee the research project and act as a project advisor, or who will act as a co-advisor if the research is to be supervised in an off-campus laboratory. After the student completes the project and turns in the final paper and journal, the faculty advisor will evaluate the research and assign a grade for the course.

    a) Students who wish to undertake a research project that is directly related to the area of interest of a specific Hendrix faculty member should consult that faculty member who will advise in the preparation of a Research Proposal. The research proposal must be submitted to the Faculty mentor and to the Biology Department by one of the two formal application deadlines (third Friday of September for projects starting in the Spring semester or summer, or last Friday of January for projects starting in the summer or Fall semester). The faculty mentor, in conjunction with the Department, will then decide which of the proposed projects can be supported.

    b) Students who wish to research a topic that is independent of work conducted by a professional mentor must turn in a typed Research Proposal to their selected advisor and to the Department before the start of the Independent Research. Projects cannot be initiated without this proposal. These proposals will generally include a more comprehensive and detailed description of the research to be conducted than those prepared for research that is directly related to a Hendrix faculty's area of interest (see "a" above). Along with other important information necessary for the assessment and

commencement of the project, this proposal defines the formal research requirements for successful completion of the Independent Research course. The Research Proposal should address the following:

i) A concise Introduction addressing the purpose and significance of the proposed research, the specific hypotheses being tested, and the relevant background information, including a brief review of the pertinent literature.

ii) A detailed statement of the Materials and Methods. This section needs to address, in addition to the general experimental paradigm(s):

(1) A protocol of all experimental procedures;

(2) The requirements for space (animal room, greenhouse, laboratory), and equipment (to avoid conflicts with other courses or research) unless the research is to be carried out in another laboratory;

(3) Estimated time requirements and calendar for the research;

(4) A statement of the nature of the data to be collected and how the data will be analyzed, including specific statistical procedures;

(5) A list of all materials that will be required, the quantities of each, and in the case of materials or supplies not on hand for the project, where the materials can be obtained and their cost;

(6) If the proposed research involves use of animal subjects, approval of the Institutional Animal Care and Use Committee must be obtained.

iii) A bibliography of the relevant literature.

c) Students may also petition the Biology Department to award Independent Research course credit for an off-campus research experience, such as that gained during summer employment. In such instances, the scholarly level and duration of the experience must be equivalent to that of any other Independent Research course. The petitioning procedure requires that the student obtain the permission of a departmental faculty advisor familiar with the research area. This petition must document that the role of the student in the research with the off-campus supervisor goes beyond that of a technician; thus that the student's role involves participation in designing and implementing the experiment and in interpretation of the results, and that the student possesses a solid theoretical understanding of the research prior to undertaking the project.
The faculty advisor will, on the basis of discussion with the student about the project, assist the student in the submission of a formal departmental petition form. The advisor will then meet with the other departmental faculty for consideration of the petition. Once approval has been granted, standard Independent Research requirements (see 3 below), including a modified research proposal, must be met and evaluated by the faculty advisor.

Under some circumstances a student may petition the department to award Independent Research credit for research already completed or in progress. Under such circumstances a similar petition procedure will be required of the student and biology faculty advisor. Hendrix faculty co-advisors and off campus co-advisors are urged to have a conference call or meeting including the student in order to insure that there is a clear understanding of all expectations and a process for evaluation of the project.

2) While the research is being conducted, students should meet regularly with their advisor to discuss and assess the progress of the research. Such discussions may involve changes in design, direction, or nature of the project form the original proposal. On the basis of these meetings, the student and advisor may modify the original research requirements.

3) The final course requirements are:

    a. The preparation of a formal <u>research report.</u> This report must be typed and organized in appropriate scientific format. Such format usually includes an abstract, introduction, materials and methods, results, discussion and literature cited sections. Depending on the student's own knowledge and skill in scientific writing and on the nature of previous editing, <u>one or more revisions</u> of this report typically will be required.

    b. Submission of a <u>journal</u> documenting the day-by-day research activities, including a summary of seminars attended or other scholarly activities related to the research project.

    c. An oral or poster presentation of the research to the Biology Department (such as a Senior Seminar) and/or at a *bona fide* scientific meeting, such as the National Conference on Undergraduate research (NCUR), the Arkansas Academy of Sciences, etc…

**INDEPENDENT RESEARCH WITHOUT COURSE CREDIT**

Students may be interested in doing projects of a truncated or exploratory nature that will not count for course credit. Within the realm of available faculty time, space and materials, the Biology Department encourages such independent research. Students are encouraged to approach individual faculty members from the Biology Department to inquire about opportunities for research without course credit.