Objectives – The aim of BIO 3800 is to involve students in an independent research project under measured instructor supervision that fosters both the individual responsibility and cooperation necessary to develop hypotheses, design and conduct an experiment, analyze the data, and communicate the results in appropriate form - e.g. report, poster, oral presentation. Specifically, students will demonstrate the following skills:

1. Responsible behavior in meeting project goals and deadlines.

2. Correctly performs accepted laboratory and/or field techniques and follows protocols

3. Implements procedures to generate and analyze data using recognized protocols

4. Conducts literature review and analysis to identify and inform the research project

5. Acts in a responsible manner to cooperate with professor (or internship mentor) and peers

6. Comprehends the theory and concepts of the biological system that pertains to the project.

7. Communicates the results of the research project using a written report, research poster, or oral presentation.

8. Correctly explains the ethical and/or philosophical implications of the topic or system(s) under investigation.

Considerations:

1. An important creative part of the learning experience in BIO 3800 is the development of research goals, an appropriate investigative approach, and a reasonable timetable for completion. In this respect, BIO 3800 differs from the more structured course (See p. 2).

2. Evaluation criteria will be tailored the nature and goals of the project undertaken; and periodic evaluations and feedback will be provided during the term (see pp. 2-3)

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3. Personal accountability will be established with mutual respect between student and professor. Working hours and conditions will be arranged with respect to necessary time commitment, laboratory safety, and personal safety and well being during field studies.

4. Outcomes are sometimes beyond the control of both student and faculty mentor. However, course objectives are still accomplished as a result of good adjustments that arise from steady commitment to task and desire to learn from unexpected turns of events.

Evaluation:

Based upon evidence of active participation and engagement in the research effort and efforts to accomplish the course objectives (See slso pages 2 and 3). Letter grade will be determined based upon quality of research effort and quality of written report or other product appropriate to the research project (e.g. research poster, oral presentation)

BIO 3800 Biological Research – Philosophy of the Course

Basic Skills	→	Maturing Outcomes
1. Procedural: Follows procedures carefully and consistently; records observations/data in a systematic way (e.g. data log book, field journal)		Participates in experimental design and selection of procedures appropriate for hypothesis testing. Suggests alterations in procedures which improves precision and/or efficiency.
2. Personal Commitment: Exercises faithful commitment to accomplish the experimental objectives in the allotted time of a given laboratory period.		Demonstrates a goal-directed commitment to experimentation in which reasonable objectives are defined and achieved as measured not only by time committed but by the valued results achieved.
3. Approach to Learning: Demonstrates commitment to learning from a textbook, lab manual, and the instruction of a professor.		Demonstrates the ability to use "basic learning tools" as the springboard to launch an effort to locate additional sources of information and methods – e.g. periodic journals articles, experts in the field.
4. Data Analysis: Collects data carefully, conducts statistical analysis of data sets, and makes conclusions about means.		Evidences an ability to judge the quality of data based on degree of soundness of the experimental design and statistical analysis; detects possible flaws out of a familiarity with the data – e.g. over multiple replications of an experiment.
5. Scope of Project: Understands the objectives and procedures of an assigned project.		Learns to view the objectives and procedures of an individual project as a part of a larger context which may have major significance – biologically, ethically, politically, etc.
6. Understanding of the System: Follows procedures carefully and consistently; records data, and makes conclusions based upon data analysis.		Approaches the biological system under consideration (e.g. green plant, watershed) with an awareness that it is a wondrous, dynamic system which will challenge the best biologists to capture "what is going on." Out of this sense of "scientific humility" gains a greater awareness of how to inquire into its workings.

*J.E. Silvius (2004)

BIO 3800 Biological Research Name _____

Evaluation of Research Involvement/Contribution

This evaluation is based upon the performance objectives and expectations outlined in the Syllabus and in "Developing Research Skills & Attitudes." Consideration is given to the nature of the research project(s) in which the student was involved and the particular opportunities afforded. The following numerical scale is used to express student attainment of objectives/expectations:

4 — *Superior* achievement of objectives; demonstrates "Maturing Outcomes" in essentially all of the skills relevant to this semester's research as described in "Philosophy of the Course."
3 — *Above Average* achievement and demonstrates "Maturing Outcomes" in most basic skills.
2 — *Average* achievement; deficient in the attainment of one or a few "Maturing Outcome".
≤ 1 – *Unsatisfactory* achievement of objectives and intended "Outcomes."
NA - *No opportunity* to evaluate this criterion.

___ 1. Approaches research experience with a committed effort to understand overall project goals and to acquire a personal commitment reflecting an understanding of the value of the project. Where choice of project is possible, he/she chooses a project compatible with interests/goals.

___ 2. Cooperates with professor and any fellow students through arrangement of weekly schedule so that appropriate time and effort could be given to the research project.

___ 3. Devotes sufficient time and energy to achieve the objectives outlined for the project.

___ 4. Demonstrates the ability to manage time and energy through anticipation of time lines, competing responsibilities, and unforeseen interruptions.

___ 5. Demonstrates the ability to perform tasks under instructor supervision but also under conditions where the student must be more individually responsible for proper completion.

___ 6. Exercises care to achieve correct, safe handling of equipment, and consistent performance of techniques and protocols.

___ 7. Displays traits necessary for good scientific inquiry–accurately records data; demonstrates good insight and intuition that minimizes chances of error.

___ 8. Performs appropriate statistical analyses and graphic or tabular presentation of the data.

___ 9. Provides insightful contribution to discussion of experimental results during attempts to interpret data that stems from a thorough understanding of the theory and research goals/hypothesis surrounding the research project.

___ 10. Demonstrates cooperative, team spirit with research peers and professor; provides polite and helpful supervision of occasional volunteers or younger students involved in limited roles in the project.

___ 11. Utilizes the experience to expand knowledge of the research area though such activities as locating relevant information in the published literature, locating and suggesting researchers with whom networking could be established, conversing intelligently with off campus persons to whom he/she is introduced.

___ 12. Demonstrates an ability to articulate the significance of the research project as it relates to its potential benefit to our neighbor, the church/community, or stewardship of God's creation.