Studies of the cells and genes of the nematode *Caenorhabditis elegans* have become a cornerstone of current biology. Using this simple and malleable animal model, students will conduct their own biological investigations and, through this research learning, will gain an understanding of intermediary metabolism. Topics include major pathways of carbon, nitrogen, and lipid metabolism, structure and function of proteins, biological regulation and signaling, and longevity and aging.
1. **Course Information:**
Undergraduate Research in Metabolism and Biochemistry, BIOL 403 (4)
CRN: 73900; 79505
Meeting Times: Tuesdays and Thursdays 11:30 am – 1:00 pm, 103/105 Murie Life Sciences Building
Thursdays 2:00 – 5:00 pm; Tuesdays 2:00 – 5:00 pm 202 Murie Life Sciences Building
Prerequisites: BIOL 115; 116; CHEM 105X; 106X.

2. **Instructing Staff:**
Barbara Taylor, Ph.D., Associate Professor of Biology (Neurophysiology)
Office: Murie Life Sciences Building Room 113D
Research Lab: Murie Life Sciences Building Room 110
Phone: 474-2487 (office)
E-mail: betaylor@alaska.edu
Office hours: Mondays 2:30-4pm or by appointment

Skyler Hunter, Graduate Student
Office: Murie Life Sciences Building Room 113
Phone:
E-mail: schunter@alaska.edu
Office hours: TBA

Lena Vayndorf, PhD, Postdoctoral Researcher
Office: Murie Life Sciences Building Room 113A
Phone:
E-mail: lena.vayndorf@alaska.edu
Office hours: TBA

3. **Course Readings/Materials:**
**Resource Website:** *WormBook: The online review of Caenorhabditis elegans biology*
http://www.wormbook.org/

**Blackboard Page:** Students are expected to check the course webpage on Blackboard on a regular basis.
Login at http://classes.uaf.edu/webapps/login
Contact us by email if you are unable to access this site.

**Email Notifications:** On occasion, students will be contacted via email. We will assume that each student will check their university-assigned email address (username@alaska.edu) on a regular basis.

4. **Course Description:**
Welcome to Undergraduate Research in Metabolism and Biochemistry. The UAF Catalogue describes the topic of this course as follows: Studies of the cells, genomics and proteomics of the nematode *Caenorhabditis elegans* have become a cornerstone of current biology. Using this simple and malleable animal model, students will conduct their own biological investigations and, through this research learning, will gain an understanding of intermediary metabolism. Topics include major pathways of carbon, nitrogen, and lipid metabolism, structure and function of proteins, biological regulation and signaling, and longevity and aging.

The goal of this course is to provide an understanding of metabolism by studying its major pathways, regulation, and molecular components. **This course is designed as a research encounter with metabolism and biochemistry for**
students that have taken introductory biology and chemistry courses. It will cover the fundamental facts and principles of metabolism and biochemistry, and it will give students an opportunity to investigate metabolism in a simple and genetically tractable animal model, the nematode *Caenorhabditis elegans*.

Biochemistry is the chemistry of living things. All living things have in common that they are adapted to survive, grow, and reproduce. To do this they must produce a variety of biomolecules using resources they acquire from their environment. In this course we will strive for an understanding of how living organisms convert resources they acquire from their environment into more of themselves.

**Course Organization:** The course will lead the student in a consideration of the foundations of metabolism and biochemistry, which integrate with the distinguishing features of living organisms. Living organisms have in common six distinguishing features

1. their chemical complexity and microscopic organization;
2. their systems for extracting and transforming energy;
3. the defined functions of their components and the regulated interactions among their components;
4. their mechanisms for sensing and responding to the environment;
5. their capacity for self-replication and self-assembly;
6. their capacity to change over time.

These common features will be explored through the cellular, physical, chemical, genetic and evolutionary foundations of metabolism and biochemistry as they occur in our model organism, *C. elegans*. There are 3 central concepts each divided into topics (readings will be posted on Blackboard). We will spend up to one class period on each topic. The first three weeks in lectures and laboratories, however, will introduce student to the basic biology and culture techniques for *C. elegans* and by the third week of the semester students will have identified a research project and begun culturing worms for that project. Questions and discussion throughout the course lecture and laboratory periods are encouraged and this syllabus should be considered flexible. We will begin with a general introduction to the chemistry of biological molecules and then consider the central concepts in more detail. The central concepts associated with this course are:

1. structure and catalysis;
2. bioenergetics and metabolism;
3. information pathways.

**Course Activities:** Four credits are assigned because each week the students must attend 1600 minutes of lecture and participate in 1600 minutes of laboratory activity and a combined 2400 to 4800 minutes of research practicum and/or supervised research activity. The combined 4800 minutes of research practicum and/or supervised research activity will be scheduled according to the student’s and supervisors’ availability.

The following standards establish the minimum requirements for an academic unit of credit:

1. 800 minutes of lecture (plus 1600 minutes of study)
2. 1600 or 2400 minutes of laboratory (or studio or other similar activity)
3. 2400 - 4000 minutes of supervised practicum
4. 2400 - 4800 minutes of supervised scholarly activity

Given the above information the formula used for computing credit/contact hours is 800 minutes (13.3 hrs) per credit. This equates to approximately 1 hour of lecture per week for a normal 14 week semester. The number of minutes required for one credit of laboratory (1600 or 2400) depends on the amount of instruction given during the lab. For this biology lab the faculty member will interact with students and provides feedback throughout the laboratory period, thus 1600 minutes (2 hours/week/credit for a 14 week semester) is used. In this biology course, students will also engage in research practica and supervised research activity, which differ from lab instruction in that there is no structured daily educational exercises nor daily instructor evaluation, and a significant portion of the activity is not supervised by the instructor of record.

Practicum activity is embedded in BIOL403 are to be a hands-on supervised research experience done by a student as part of the biology capstone experience, an educational strategy to attain the educational objective of synthesizing biological knowledge acquired from multiple courses. A faculty member, the class instructor or another knowledgeable
researcher, will supervise the work. The class instructor will establish the objectives and evaluation metrics, evaluate the outcome and assigns a final grade. Credit for practicum activity requires a minimum of 2400 minutes of work (3 hours/week for 14 weeks) per credit in addition to the contract hours of the associated class.

Supervised research activity (a type of supervised scholarly activity) is also embedded in BIOL403. In these activities, the student meets with the instructor to discuss research design research methods and progress and data analysis and presentation, but the work itself is basically unsupervised. The class instructor approves the work activities and goals, evaluates the outcomes, and assigns the final grade. The student prepares a final written and oral report on the work performed. Credits for supervised research activities are awarded at a rate of 2400 minutes of work (3 hours/week for 14 weeks) per credit.

5. Course Goals:
The overall goal of this course is for the student to gain a fundamental working knowledge of metabolism and to appreciate the impact of this field on other areas of biology. Specific areas of student development include achieving an understanding of:
1. the relationship between the structure and function of biological molecules;
2. the link between cellular metabolism and an organism’s overall metabolism;
3. the intermolecular interactions between macromolecules and their ligands;
4. the dynamics and regulation of metabolic pathways.
These specific areas will be addressed with references to and examples from the research project being conducted by students enrolled in the course.

Expectations: Over the semester certain information will need to be understood in order to reach the goals set above. A list of this information includes:
1. general recognition and understanding of biological molecules;
2. basic elements of protein structure;
3. basic understanding of metabolic pathways (especially those leading to energy production: glycolysis, glycogen metabolism, citric acid cycle, beta-oxidation, and the electron transport chain);
4. methods of metabolic regulation.
These information topics will be addressed with references to and examples from the research project being conducted by students enrolled in the course.

6. Instructional Methods:
1. Lecture and Discussion. Lectures and discussions will focus on the basic concepts of metabolism, which will be addressed with references to and examples from the research project being conducted by students enrolled in the course. An important source for this information is written material. Lehninger Principles of Biochemistry, Fifth Edition (David L. Nelson, Michael M. Cox, W. H. Freeman, NY). Lectures are designed to follow assigned readings from the text along with material from the online resource WormBook (www.wormbook.org). Primary research literature and review articles will also be made available on Blackboard to support the topics covered in the lectures as well as the student research projects. You are expected to complete the assigned readings, to attend the lectures, and take part in class exercises. The readings and the lectures together define the material covered in the exams.

2. Term Assignment – The Research Project. Students will work in teams of two – four on a research project own chosen and designed in consultation with the instructional staff. These research projects will meet the biology program requirements for a capstone project; these requirements are listed at the end of this syllabus. Research topics can be inspired by any sub-discipline of biology, but each project must be approved by the course instructors, who will ensure the feasibility of each project. Research topics and experimental designs are due in the third scheduled laboratory period. For the remainder of the semester, students will work on their research projects during the scheduled laboratory periods, where they will learn and perform specific biochemical and metabolic assays on the
worms as well as during practicum and supervised research times they schedule themselves. Students are expected to schedule about 6 hours per week to work on their research project. Students are to record these times and the activities performed in a designated research notebook and have their efforts witnessed by a research supervisor. Students cannot work in the laboratory unsupervised. A list of supervisors (the instructor, TA and perhaps other appropriately trained individuals) and their scheduled presence in the laboratory will be posted at the beginning of the semester and updated weekly. The list will also include contact information for each supervisor so that students can make arrangements for additional time in the laboratory if necessary. During the scheduled laboratory periods for the last 10 weeks of the semester, in addition to performing specific assays on the worms (biochemical and metabolic or other physiological assays as listed in the Table of Laboratory Activities and Course Assignments), and thereby acquiring data for their projects, students will be graded on assignments/activities designed to aid students in conducting and completing their research projects. These assignments are listed in the Table of Laboratory Activities and Course Assignments.

Table of Laboratory Activities and Course Assignments

<table>
<thead>
<tr>
<th>Week #</th>
<th>Laboratory Activity*</th>
<th>Course Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Sept. 6)</td>
<td>observation and manual manipulation of worms</td>
<td></td>
</tr>
<tr>
<td>2 (Sept 13)</td>
<td>preparation of worm culturing plates</td>
<td></td>
</tr>
<tr>
<td>3 (Sept. 20)</td>
<td>fluorescent imaging of live worms</td>
<td>written summary of worm culture techniques</td>
</tr>
<tr>
<td>4 (Sept. 27)</td>
<td>mechanosensory assay</td>
<td>written summary of experimental methods</td>
</tr>
<tr>
<td>5 (Oct. 3)</td>
<td>locomotory assay</td>
<td>preliminary of data presentation</td>
</tr>
<tr>
<td>6 (Oct. 10)</td>
<td>mitochondrial functional assay and imaging</td>
<td>written description of background and potential significance of the research project</td>
</tr>
<tr>
<td>7 (Oct. 17)</td>
<td>protein aggregate assay</td>
<td>peer feedback on background and significance</td>
</tr>
<tr>
<td>8 (Oct. 24)</td>
<td>oxidative stress assay</td>
<td>full outline of research report</td>
</tr>
<tr>
<td>9 (Oct. 31)</td>
<td>RNA interference assay</td>
<td>data blitz – presentation of data collected to date</td>
</tr>
<tr>
<td>10 (Nov. 7)</td>
<td>hypoxic stress assay</td>
<td>draft of results section of research report</td>
</tr>
<tr>
<td>11 (Nov. 14)</td>
<td>hypercapnic stress assay</td>
<td>complete draft of research report</td>
</tr>
<tr>
<td>12 (Nov. 21)</td>
<td>thermal stress assay</td>
<td>peer feedback on research reports</td>
</tr>
<tr>
<td>13 (Nov. 28)</td>
<td>antioxidant assay</td>
<td>final draft of research report</td>
</tr>
<tr>
<td>14 (Dec. 5)</td>
<td>Reactive Oxygen species (ROS) assay</td>
<td></td>
</tr>
</tbody>
</table>

* the order of these laboratory assays will be adjusted to match the order in which students will use them in their projects

In keeping with its writing-intensive designator, Undergraduate Research in Metabolism and Biochemistry requires students to engage in numerous writing activities throughout the semesters. Writing-intensive elements are indicated by their corresponding letter: A) a majority of the final grade is derived from writing activities; B) a research paper/project; C) a personal conference with the student; D) drafts/revisions/feedback. The instructors (professor and TA) will regularly evaluate students’ writing and inform students of their progress (writing-intensive element D). The major written project (research project; writing intensive element B) that is part of the course is supervised in stages over the last ten weeks of the semester as seen in the schedule above. In addition, each student will have at least one personal conference (writing-intensive element C) with the instructors writing intensive element, which will be devoted to the student’s writing, and draft components of the research report will receive evaluation from the instructors and other students in the course (writing-intensive element D). Also, note that written materials comprise a majority (> 60%) of the graded work in the course (writing-intensive element A). This “written material” consists of exams with short answers, draft written components of the research report that are submitted during the semester (in weeks 3, 4, 6, 10 and 11; 5 written assignments each worth 3% or together worth 15% of the final grade), and the complete research report submitted at the end of the semester and worth 45% of the final grade. Note that the week 3 writing assignment “written summary of worm culture techniques” will serve as a diagnostic assignment to assess the students’ writing competency and determine what if any additional
resources might be made available to the students’ to ensure success in scientific writing. The rubric that the instructors will use to grade the term assignment (= research or capstone project) is included as the last page of this syllabus.

Blackboard Page. Several learning resources will be available on the course Blackboard Page:

a. A copy of the lecture slides will be posted just prior to class.

b. A manual for *C elegans* culture in the UAF laboratory will be posted.

c. Answers to the exam questions will be posted on Blackboard after the exams have been completed and graded.

d. The course Blackboard Page will contain links to other instructional and informative pages on biochemistry. Some of these will include practice quizzes and short movie clips, which are especially good learning aids.

e. A copy of this syllabus and the course calendar will be posted separately on Blackboard.

3. Exams. There will one midterm exam during the semester. It will test your knowledge of the lecture subjects to the depth covered in the readings. You must complete the readings to be fully prepared for the midterm exam. The midterm exam will consist of multiple choice and short answer questions and will count toward 10% of the final grade. Do not miss the scheduled exam time! If you miss the exam, your ONLY opportunity for a make-up exam will be the first lecture period following the exam.

4. Final Exam. The final exam will be held **Saturday, December 15 from 10:00 AM – noon**. The final exam will be a cumulative test of your knowledge of metabolism to the depth covered in the readings. The exam will consist of multiple choice and short answer questions. It will count toward 15% of the final grade.

7. Course Policies
As a UAF student, you are subject to the Student Code of Conduct. In accordance with Board of Regents’ Policy 09.02.01, UAF will maintain an academic environment in which the freedom to teach, conduct research, learn, and administer the university is protected. Students will enjoy maximum benefit from this environment by accepting responsibilities commensurate with their role in the academic community. The principles of the Code are designed to facilitate communication, foster academic integrity, and defend freedoms of inquiry, discussion, and expression among members of the university community. You should become familiar with campus policies and regulations as published in the student handbook.

UAF requires students to conduct themselves honestly and responsibly, and to respect the rights of others. Conduct that unreasonably interferes with the learning environment or that violates the rights of others is prohibited. Students and student organizations will be responsible for ensuring that they and their guests comply with the Code while on property owned or controlled by the university or at activities authorized by the university.

Disciplinary action may be initiated by the university and disciplinary sanctions imposed against any student or student organization found responsible for committing, attempting to commit, or intentionally assisting in the commission of any of the following prohibited forms of conduct:

A. cheating, plagiarism, or other forms of academic dishonesty;
B. forgery, falsification, alteration, or misuse of documents, funds, or property;
C. damage or destruction of property;
D. theft of property or services;
E. harassment;
F. endangerment, assault, or infliction of physical harm;
G. disruptive or obstructive actions;
H. misuse of firearms, explosives, weapons, dangerous devices, or dangerous chemicals;
I. failure to comply with university directives;
J. misuse of alcohol or other intoxicants or drugs;
K. violation of published university policies, regulations, rules, or procedures; or
L. any other actions that result in unreasonable interference with the learning environment or the rights of others.

This list is not intended to define prohibited conduct in exhaustive terms, but rather to set forth examples to serve as guidelines for acceptable and unacceptable behavior.

Honesty is a primary responsibility of you and every other UAF student. The following are common guidelines regarding academic integrity:
1. Students will not collaborate on any quizzes or exams that will contribute to their grade in a course, unless permission is granted by the instructor of the course. Only those materials permitted by the instructor may be used to assist in quizzes and exams.
2. Students will not represent the work of others as their own. A student will attribute the source of information not original with himself or herself (direct quotes or paraphrases) in compositions, theses and other reports.
3. No work submitted for one course may be submitted for credit in another course without the explicit approval of both instructors.

Alleged violations of the Code of Conduct will be reviewed in accordance with procedures specified in regent's policy, university regulations and UAF rules and procedures. For additional information and details about the Student Code of Conduct, contact the Dean of Student Services or web www.alaska.edu/bor/ or refer to the student handbook that is printed in the back of the class schedule for each semester. Students are encouraged to review the entire code.

A Few Words on Plagiarism: In general, DO NOT present someone else's ideas or data as your own: you are expected and required to give credit where credit is due. Plagiarism is a violation of the law and may lead to serious repercussions! Please follow the following guidelines: for any written assignments, if you use someone else’s ideas, data, or other information, write it in your own words and include the reference in parentheses directly following that information. Avoid copying someone else’s text. If, however, you feel you have to include an exact copy of that text, put it in quotation marks followed by the reference in parentheses. Of course, include all cited references in the Literature Cited section. During oral presentations, please acknowledge the sources by mentioning their name(s) and year of publication or by printing them on overheads, slides, or handouts. Also be aware that you need to cite earlier work by yourself. Any substantial use of any written or other materials that was used for another course or that was generated in any other circumstances will not be accepted for credit in this course. Only minor contributions from earlier work with appropriate citation(s) will be accepted.

8. Evaluation
The final grade will be based on the average of all assignment marks according to the following fixed scale:

<table>
<thead>
<tr>
<th>Required Component</th>
<th>% value of final grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lecture Exam (1)</td>
<td>10%</td>
</tr>
<tr>
<td>2. Laboratory Research (weekly assignments and activities)</td>
<td>30% (3% each assignment/activity; assignments/activities are done one per week for the last 10 weeks of the course; half these assignments require a written product and contribute 15% of the final grade))</td>
</tr>
<tr>
<td>3. Term Assignment</td>
<td>45%</td>
</tr>
<tr>
<td>4. Final Exam</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

The class will be graded on a straight percentage basis: 90-100% is an A, 80-89.9% is a B, 70-79.9% is a C, 60-69.9% is a D, and < 60% is an F. We will not grade on a curve. This means that, in principle, it will be possible for everyone to get an A in this course.
Missed exams and presentations:
Times for exams and presentations are designated well in advance. Completion of these tasks at the designated time will be the responsibility of the student. Accommodations will only be made for legitimate and documented contingencies.

9. Disabilities Services
At UAF, the Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. We will work with the Office of Disabilities Services (fysdo@uaf.edu, 474-5655) to provide reasonable accommodation to students with disabilities.
10. Course Calendar (subject to change)

Undergraduate Research in Metabolism and Biochemistry

Section I. C elegans a model for biological research
1. Sept. 3   Class introduction
2. Sept. 8   C elegans biology & Metabolism overview
3. Sept. 15  Trends in C elegans research
4. Sept. 22  Research Design and Scientific Writing

Section II. Molecular properties of biomolecules
4. Sept. 24  Amino acids, protein structure
5. Oct. 6    Carbohydrates and lipids
6. Oct. 13   Biosignaling

7. Oct. 20   Bioregulation

Section III. Intermediary Metabolism
8. Oct. 27   Exam
9. Oct. 29   Glycolysis and gluconeogenesis
10. Nov. 3   Citric acid cycle
11. Nov. 10  Fatty acid oxidation and synthesis
12. Nov. 17  Amino acid oxidation and synthesis
13. Nov. 24  Oxidative phosphorylation

Section III. Metabolic Integration

Dec. 17 (Thursday)  10:15AM - 12:15pm

Biology 403  Fall 2013

Ecology of Caenorhabditis species, Kiontke et al 14pp
Intermediary metabolism, Braeckman et al 24pp

Three recent reviews will be selected and pdfs posted on Blackboard

Lehninger Principles of Biochemistry p71-147
Lehninger Principles of Biochemistry p235-263; 343-362

Signal transduction - Iva Greenwald, ed. WormBook pdf
Introduction to signal transduction - Iva Greenwald
WormBook pdf
Genomic overview of protein kinases - Gerard Manning
WormBook pdf
RTKras/MAP kinase signaling - Meera V. Sundaram
WormBook pdf
Heterotrimeric G proteins in C. elegans - Carol Bastiani
and Jane Mendel WormBook pdf

Exam includes all topics previously covered
Lehninger Principles of Biochemistry p527-558
Lehninger Principles of Biochemistry p615-637
Lehninger Principles of Biochemistry p647-668; 805-845
Lehninger Principles of Biochemistry p673-700; 851-894
Lehninger Principles of Biochemistry p707-762

Disease models and drug discovery - Andres V. Maricq
and Steven McIntire, eds. WormBook pdf
C elegans and volatile anesthetics - P.G. Morgan, E.-B.
Kayser and M.M. Sedensky WormBook pdf
Anthelmintic drugs - Lindy Holden-Dyce and Robert J.
Walker WormBook pdf
Obesity and the Regulation of Fat Metabolism - Kaveh
Ashrafi WormBook pdf

COMPREHENSIVE FINAL EXAM
Capstone Project in Biological Sciences

Some changes to the capstone project requirements will take effect Fall semester 2015. Please note that there are two sets of guidelines below. One refers to projects to be completed before Fall semester 2015, the other for projects to be completed Fall 2015 or later.

Capstone Project – Fall 2015 and later

These guidelines apply to all students who will complete a biological sciences capstone project during Fall 2015 or later. The two most important changes are as follows. (1) A student taking a capstone course must receive a passing grade on the capstone project itself, regardless of the course grade. In other words, a passing course grade will no longer ensure a passing grade on the capstone. (2) Students intending to complete a capstone, whether in a class or through individual study with a mentor, should register for BIOL F400. Details follow.

What is the capstone project requirement in Biological Sciences?

The intent of the Biological Sciences capstone project is to integrate knowledge and skills learned in previous courses, including scientific knowledge, quantitative literacy, and communication skills, and to apply these products of the university education to a creative activity. For a biologist, a fundamental expression of applied knowledge, creativity, and critical reasoning is to engage in scientific inquiry.

The capstone project in Biological Sciences consists of a mentored research project on a biological topic that is completed in the junior or senior year. The capstone project must be designed or chosen by the student in consultation with a faculty mentor. The faculty mentor must approve the project before work begins. The project must include evaluation of data and communication of the study intent, methods, results, interpretation, and conclusion in the context of existing literature and knowledge. All capstone projects will be assessed using a common set of expectations (see Final Evaluation of Capstone Project). The capstone project requirement may be met in two ways, detailed below.

How can I satisfy the capstone requirement?

First, a student may perform a capstone project within a designated capstone course in Biological Sciences or Wildlife Biology and Conservation. Capstone courses are offered across a range of sub-disciplines within biology. A list of capstone courses in Biological Sciences can be found in the UAF catalog. All capstone courses include the expectation that the student will complete a biological research project. Typically, the capstone course instructor will introduce one or several model study systems and methodologies that will form the basis for the student’s project. The course instructor will assist the student to design a study and analyze the results. The capstone project will include a major written assignment, which may be fulfilled as a research proposal and/or a final report formatted as a scientific paper. It is recommended that written assignments have a minimum length of 8 double-spaced pages (excluding figures and references) with at least 10 references. If a research proposal is used as the written assignment, students will also be required to communicate their research findings through an oral presentation, poster presentation, or final written report. The course instructor may require additional means of communicating the research results as well, such as an oral presentation or a poster. All projects will be assessed using the standard capstone project rubric. The capstone requirement will be fulfilled only if the capstone project is evaluated as adequate or better for all criteria identified on the Final Evaluation of Capstone Projects rubric. Thus, it is possible for a student to pass a capstone course without receiving credit for the capstone project, and to receive credit for the capstone project without passing the course. At the end of the semester, instructors will provide the Biology and Wildlife Department Chair with a copies of evaluation forms and written assignments, to be archived by the department.

Second, the student may satisfy the capstone requirement by conducting a research project with a faculty mentor, typically a member of the UAF Biology & Wildlife faculty. A student may receive course credits for the research
project by enrolling in independent study (BIOL F397 or F497) or undergraduate biology research (BIOL F490 or URSA F488); however, course credits are not necessary for completion of the capstone project requirements. A more informal arrangement, in which the student performs a project and communicates the results under the supervision of a member of the Biology & Wildlife faculty, may satisfy the capstone requirements as well. The capstone project will culminate in a written report, formatted as a scientific paper. It is recommended that the report have a minimum length of 8 double-spaced pages with at least 10 references. Reports must be assessed by the research mentor using the standard assessment rubric, and must be evaluated as adequate or better for all criteria. The student or research mentor should provide to the Biology and Wildlife department a copy of the final paper and a copy of the Final Evaluation of the Capstone Project form, signed by the research mentor.

**Students intending to complete their capstone should register for BIOL F400**

Regardless of how the capstone project is completed, within a course or by working individually with a mentor, the student must signal his or her intent to complete the capstone project within a semester by enrolling in BIOL F400, Capstone Project. This is not a traditional course. It confers no credit and requires no additional work by the student. Rather, it is a way for the administration to track which students are in the process of completing their capstone projects, and which have successfully completed a project and therefore have satisfied the capstone requirement for graduation. Such a tracking system is necessary because the capstone can be completed in a variety of ways.

A capstone project might extend across several semesters, or an initial project may be abandoned in favor of a new one. In these cases, there is no need to register for BIOL F400 repeatedly. If the capstone project is not completed, or not completed satisfactorily, within a semester, the BIOL F400 grade will be deferred (DF grade) until a later semester. The DF will be changed to P when the student passes the capstone project. A DF grade will convert to an F only if it remains on the record for more than 3 years. This conversion can be prevented by request if the student can demonstrate she or he is actively working to complete the project.

Catalog description:

**BIOL 400 Capstone Project**

*0 Credits* Offered Fall and Spring

This course should be taken by students during the semester they initiate a capstone research project. The capstone project may be completed within a designated course or by working individually with a faculty mentor; see the Biological Sciences program description for more information. The duration of the capstone project may exceed one semester. **Prerequisites: Junior or senior standing.** (0+0)

All capstone projects will be assessed using a common set of expectations. The rubric used by mentors to grade capstone projects may be viewed here [https://www.bw.uaf.edu/undergraduates/capstone.php](https://www.bw.uaf.edu/undergraduates/capstone.php).
# Final Evaluation of Capstone Project by Research Supervisor

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes (excellent)</th>
<th>Somewhat (adequate)</th>
<th>No (inadequate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is the capstone project the product of data collection and/or analysis by the student?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Does the capstone paper make a compelling argument for the significance of the student’s research within the context of the current literature?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Does the capstone paper clearly articulate the student’s research goals?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Are the methods appropriate given the student’s research agenda?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. Is the data analysis appropriate and accurate?</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Does the author interpret the results skillfully and accurately?</td>
<td>☐</td>
<td>☐</td>
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<td>7. Are the tables and figures clear, effective and informative?</td>
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<td>8. Is there a compelling discussion of the implications of findings?</td>
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<td>9. Is the literature review appropriate and complete?</td>
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<td>10. Are the citations presented consistently and professionally throughout the text and in the list of works cited?</td>
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<td>11. Is the writing appropriate for the target audience?</td>
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<td>12. Is the paper clearly communicated and free of language errors?</td>
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Research Supervisor’s Signature ________________________________