SYLLABUS FOR FW316: SYSTEMATICS OF FISHES  (Generic)

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Office Telephone:  (541) 737-6789

Credits:      Three credits, one hour of lecture and four hours of lab per week, plus two Saturday field trips

Prerequisites: One year of introductory biology (BI 211/212/213 or BI 204/205/206)

Recommended Pre or Co-requisite: FW315, Ichthyology

FW316 is a standalone course, but students are strongly encouraged to enroll concurrently or previously in FW315 (Ichthyology) for increased exposure to topics in the anatomy, physiology, life history, diversity, evolution, behavior, biogeography and ecology of fishes. The two classes are designed to reinforce each other, and are offered simultaneously on campus each fall quarter.

Course Description and Objectives:

We will study the diversity, evolution, relationships and identification of the fishes, the most diverse of all vertebrate groups and the dominant group of vertebrates in aquatic habitats. Aside from introducing you to the evolution, anatomy and diversity of fishes from Oregon and beyond, this course will provide concrete lab skills and will help prepare you for careers in fisheries science, ichthyology, oceanography or vertebrate biology.

Student Learning Outcomes:

During this course you will learn to:

1) explain and demonstrate how scientists use phylogenetics, molecular biology and comparative morphology to understand evolutionary relationships, recognize species, classify the diversity of fishes, manage fisheries and conserve biodiversity

2) identify the defining characteristics and evolutionary relationships of the major fish groups

3) differentiate, compare, identify and name representatives of those groups from Oregon and elsewhere

4) infer the systematic placement of species that you have not studied explicitly by recognizing their possession of diagnostic features of major groups

5) explain how modern fish diversity reflects the major anatomical and ecological transitions that have occurred in their history, including the origins of the vertebrate body plan, the chondrichthyan/osteichthyan split and the proliferation of the teleosts

6) summarize life history and ecological characteristics of fishes covered in lectures, and

7) develop and practice skills general to ichthyology, including the collection, preservation, identification, description and comparison of specimens
Lectures:

During lectures I will introduce the theory and practice of modern systematic ichthyology, explain how scientists recognize and differentiate species, and infer their evolutionary relationships, and discuss why this information matters to science, management and conservation biology. You will also be given information covering the major groups of fishes worldwide, and oriented to the specimens that you will examine in lab. The presentation will work through the tree of life of fishes, beginning with jawless fishes and ending with the disparate percomorphs. Though we will emphasize local species, we will survey freshwater and marine diversity from a global perspective. You will be expected to know not only classification, but general habitat, ecology, anatomy and life history information as well. Any information presented in class, on the Canvas site or in assigned readings is fair game for exams.

Canvas:

The syllabus, slides, and other information will be available on course’s dedicated Canvas site: https://oregonstate.instructure.com/.

Assessment Methods (1000 points total)

- Practical 1: 50
- Practical 2: 100
- Practical 3: 200
- Practical 4: 250
- Worksheets (15 x 20) 300
- Writing Assignment 50

Participation 50

Grading:

Earning at least the total points specified below will earn you the corresponding grade.

- 930 A
- 900 A-
- 870 B+
- 830 B
- 800 B-
- 770 C+
- 730 C
- 700 C-
- 670 D+
- 630 D
- 600 D-

I may curve grades upwards if a given assessment ends up being too hard, but I will never curve grades downwards. You are not in competition with one another.
**Lab Assignments:**

To assist your learning of the morphological and taxonomic diversity of fishes, each lab I will provide new specimens from OSU’s teaching collection as well as a study aid/worksheet outlining some of the most important and interesting aspects of each.

During each lab session or field trip you will work in groups to answer the questions on each worksheet. Though you will discuss the problems and work together, **each person should complete his or her own worksheet.** The goal is to create a detailed study guide that will help you learn and remember the diagnostic features of the species and the groups to which they belong. If your worksheets contain accurate observations and you thoroughly examine each week’s specimens, you will earn a high mark. Because you will encounter these fishes again during the practical exams, well-executed worksheets will improve your performance on the exams. Note that the worksheets are study guides, not study-replacements. You will not be able to bring your completed worksheets into the quizzes and exams physically.

You will not be graded on artistic ability but your presentation does need to be sufficiently clear that we can interpret your figures.

Ideally, you should aim to complete each worksheet by the end of class so that we can grade them and return them to you in a timely manner, but they can be turned in at the beginning of the following lab session if you wish to spend some additional time on your drawings and such.

**Writing Assignment:**

Systematics is an active and vibrant field: hundreds of new species are described each year and we are constantly revising our understanding of their tree-of-life. To help you understand how the species names and taxonomic classification presented in class results directly from this ongoing science, you will write a brief (2 pages) report explaining a recent discovery in systematic ichthyology (either the description of a new species, or the inference of a new phylogeny). More detail on this assignment will appear in a separate handout.

**Participation:**

Success in this course depends critically on being an active learner and engaging fully in and out of lab. To give you extra incentive to dive into the material, 5% of your grade is based upon participation. You are expected to attend class regularly, arrive on time, complete all assignments, discuss the answers to each week’s questions with your partners and others in class, ask questions, and focus during each lab session. This means that cell phones should be silenced, and that except for emergencies, you should not be texting, emailing, Facebooking, Googleplussing, Twittering, surfing the web, RateMyProfessoring, etc. during class. I may ask you to leave class if I find you focused on topics outside of it.
Testing:

Your learning will be tested with four practical exams, which means that preserved or dissected specimens, slides or images will be displayed at stations. You will be given a few minutes at each station to answer questions about the display. Most stations will include at least one question about identification, classification or relationships, and may include other questions on anatomy, ecology, habitat, collection methods, preservation, life history or the theory and practice of systematics as covered in the lectures, study guide, readings or worksheets. Questions might ask you to recognize and name the specimens and place them in a phylogenetic context, identify anatomical structures and discuss their evolution, homology, or function, or infer aspects of the probable ecology of a species from its anatomical specializations. Most stations will include species that you have seen before; a few will confront you with new organisms in major groups that you have studied. Overall, these exams will test your ability to think critically and apply general anatomical, ecological and evolutionary principles as well as your learning of specific anatomical structures, fish nomenclature, and local and global fish diversity. Each exam is cumulative, though each will emphasize material covered since the last quiz or exam. No notes or keys may be brought into the exams.

For each group above the genus level that is covered in class (family, order, class, superclass, etc.) you should be able to recognize a member even if you have not seen that particular species. For example, if given a lamprey you should be able to place it in the order Petromyzontiformes, or if given a trout you should know it belongs in family Salmonidae. Unless told otherwise, you should know both the scientific and common name for species covered. Scientific names will be emphasized MUCH more than common names. SPELLING COUNTS. You will lose 0.25pts per letter for each incorrectly spelled name if it is still recognizable but off by a letter or two. Gross misspellings will be marked as completely wrong.

Note on Higher Level Taxonomy:

The taxonomy of fishes is replete with odd and unfamiliar levels of the taxonomic hierarchy: superclass, grade, division, subclass, superorder and so forth. Some groups (Neoteleostei, Acanthomorpha) don’t even have formal ranks! For groups above the level of order, it is much more important to know what does and does not belong in that group than to memorize the rank of the group. For example, it is critical to know that all the jawed fishes belong in Gnathostomata, but you don’t need to memorize the fact that Gnathostomata is a superclass.

Note on Studying and Lab Work:

Due to the hands-on nature of this course, it is highly recommended that students allot time outside of their normally scheduled lab to come in and look over the specimens. This will help ensure a high grade for this course, and will likely be necessary in order to really learn how to identify the fishes. You will learn the diversity of fishes more efficiently in many short practice sessions than in a few long cramming sessions. The lab will be open most weekdays between 9 and 5, and you are strongly encouraged to stop by between, before or after other classes in your schedule to review the specimens. Other than reading, studying, and the single writing assignment, this is the only homework assigned in the class. I strongly recommend assembling a
set of flash cards with sketches or photographs of the fishes and labels for their diagnostic characteristics on one side, and the name of the species or group on the other. Remember that you need to recognize the diagnostic characteristics of whole groups of fishes (e.g. jaws as the defining characteristic of superclass Gnathostomata), not just the features that will let you identify individual species.

**IMPORTANT:** In past years, the single strongest determinant of performance in this course has been whether or not students have studied for exams in lab with the specimens in front of them.

**Field Trips:**

The course includes two weekend field trips, one in which we collect fish specimens for systematic study from locations around Corvallis, and one in which we explore the fish diversity on display at a public aquarium. Both are official components of the course and illustrate concepts that will be tested during exams, and both are accompanied by a worksheet that forms part of your grade for the course. For those who cannot make the field trips due to other commitments (e.g., work or family obligations) an alternative assignment is available. The alternative assignment must be requested by 5:00PM on the Friday before the field trip.
Calendar:
Monday sessions are large lectures (all sections combined), Tuesday and Thursday sessions are broken into lab sections with a maximum of 24 students.

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<thead>
<tr>
<th>Day</th>
<th>Week</th>
<th>Topic</th>
<th>Required Readings (Dauble)</th>
<th>Recommended Readings (Love)</th>
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| Mon.  | 1    | Course introduction  
Fish anatomy 1  
Fish diversity 1 | 8: 109-112 | i-xiv  
1-83 |
| Tue.  |      | Introduction to fish phylogeny and taxonomy                           |                            |                            |
| Thu.  |      | Agnathans and Chondrichthians                                        |                            |                            |
| Mon.  | 2    | Methods for field collection of fishes  
Scientific naming conventions  
Fish diversity 2 | Chapter 6  
8: 112-115  
Chapter 4  
Chapter 5 | 83-87  
88-92 |
| Tue.  |      | Basal Osteichthians                                                  |                            |                            |
| Thu.  |      | Neopterygians and basal Teleosts: (Holostei through Elopomorpha)      |                            |                            |
| Sat.  |      | **Field Trip: Collecting Fishes near Corvallis**                     |                            |                            |
| Mon.  | 3    | Fish anatomy 2  
Fish diversity 3 | 8: 115-116  
8: 136-153 | 93-108 |
| Tue.  |      | Otocephala I: Clupeomorpha and Ostariophysi                         |                            |                            |
| Thu.  |      | **Practical #1**  
Material through Week 2                                                  |                            |                            |
| Mon.  | 4    | Fish diversity 4  
Use of dichotomous keys  
Curation and sorting protocols | Chapter 7  
8: 116-136 | 109-149 |
| Tue.  |      | Otocephala II: Focus on Cypriniformes                                |                            |                            |
| Thu.  |      | Curation of material from collecting trip  
Protacanthopterygii: Focus on Salmoniformes                           |                            |                            |
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<th>Day</th>
<th>Activity</th>
<th>Reading Ranges</th>
<th>Notes</th>
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<td>Mon.</td>
<td>5 Fish diversity 5</td>
<td>8: 155-158</td>
<td>150-186</td>
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<td>Fish anatomy 3</td>
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<td>Tue.</td>
<td>Neoteleostei: an introduction</td>
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<td>Stomiiformes through Gadiformes</td>
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<td><strong>Practical #2</strong></td>
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<td>Material through week 4</td>
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<td>Mon.</td>
<td>6 What is a species?</td>
<td>8:154-155</td>
<td>191-214</td>
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<td>Fish diversity 6</td>
<td>8: 167-170</td>
<td>281-352</td>
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<td>Tue.</td>
<td>Acanthopterygii: an introduction</td>
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<td>Mugiliformes through Gasterosteiformes</td>
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<td>Thu.</td>
<td>Scorpaeniformes 1</td>
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<td>Mon.</td>
<td>7 Fish diversity 7</td>
<td>8: 158-167</td>
<td>187-190</td>
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<td>Morphological approaches to phylogenetics</td>
<td>352-550</td>
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<td>Tue.</td>
<td>Scorpaeniformes 2</td>
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<td>Thu.</td>
<td><strong>Practical Exam #3</strong></td>
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<td>Material thorough week 6</td>
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<td>Mon.</td>
<td>8 Fish diversity 8</td>
<td>8: 158-167</td>
<td>187-190</td>
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<td>Molecular approaches to phylogenetics</td>
<td>352-550</td>
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<td>Morphology/molecular conflicts</td>
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<td>Tues</td>
<td>Perciformes 1</td>
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<td>Thu.</td>
<td>Perciformes 2</td>
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<td>Sat.</td>
<td><strong>Field Trip: Oregon Coast Aquarium</strong></td>
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<td>Mon.</td>
<td>9 Fish diversity 9</td>
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<td>552-614</td>
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<td>Systematics, conservation and management</td>
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<td>Tue.</td>
<td>Weirdest of All: Lophiiformes, Pleuronectiformes and Tetraodontiformes</td>
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<td>Thu.</td>
<td>Thanksgiving</td>
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<td>Mon.</td>
<td>10 New frontiers in systematics</td>
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<td><strong>Writing Assignment Due</strong></td>
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<td>Tue.</td>
<td>Study and Review Day</td>
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<td>Thu.</td>
<td><strong>Practical #4</strong></td>
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<td>Comprehensive</td>
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Required Text:
**Fishes of the Columbia Basin: A Guide to their natural history and identification**
Contains a nice key to local fishes and other general information on their natural history.

Recommended Text:
**Certainly More Than You Want to Know About the Fishes of the Pacific Coast**
You don’t absolutely have to buy this and read it, but it is probably the most magnificent, informative and funniest book on Pacific fishes published in the last twenty years, and it is also really cheap. Skim it or read it as you see fit, but the more time you spend with it, the more you’ll internalize about local marine diversity. Did I mention that it is really, really funny?

What about the FW315 text?

**The Diversity of Fishes: Biology, Evolution and Ecology**
Many of you will already have this text for use in FW315, Ichthyology. Chapters 2 and 11 through 15 are relevant to this course, and provide good additional readings if you can’t get enough fish literature.

Highly Recommended References:
All of the following are extremely useful identification guides.

- **Peterson Guide to Freshwater Fishes, Second Edition**

- **Keys to Oregon Freshwater Fishes**
  Bond, 1994. OSU Bookstores. PDF available on course website.

- **Coastal Fishes of the Pacific Northwest, Revised and Expanded Second Edition**

Other Helpful References:

- **Fishes: A Field and Laboratory Manual on Their Structure, Identification and Natural History**
  Gregor M. Cailliet, Milton S. Love, Alfred W. Ebeling

- **Fishes of the World, 4th Edition**
Freshwater Fishes of Canada

Guide to Northeast Pacific Rockfishes, genera Sebastes and Sebastolobus

Helpful Websites:

Dictionary of Ichthyology
Brian W. Coad and Don. E. McAllister

FishBase
http://www.fishbase.org
Course Policies:

Make Ups, Attendance and Late Work:

Because of the specialized nature of testing in this course, make-ups for the practical exams are extremely difficult to arrange and can require up to a day of extra work for the course staff. If you have a documented legitimate excuse for missing an exam (e.g. health-related or family emergency), you MUST contact me in advance of the test by email, phone or in person to work out an accommodation. No makeup exams will be granted if you fail to contact me in advance of the scheduled exam. Extensions on the due dates for regular lab worksheets can be arranged if you have a valid need to miss a session. If you wish to avoid a penalty for late work (5% per day), you must contact me to discuss the need to miss the session in advance of class.

Incompletes:

Incompletes will be granted on a case-by-case basis and only in extreme circumstances in which you have a documented legitimate (e.g., health-related) excuse for not being able to take the last practical exam. If you think that you will need to request an incomplete, please contact me with the details of your case as soon as possible. No incompletes will be granted post-hoc after the last practical exam has occurred. You must have completed 70% of the course requirements to request an incomplete.

Discussion Boards:

If you have questions regarding general course logistics or the course material, please post your question to one of the discussion boards that I’ve set up on Canvas. This will allow me to respond where the whole class can benefit from the answer. Personal concerns, extension requests, etc. can of course come through email.
Communications:

- Please check the Announcements area and the course syllabus before you ask general course "housekeeping" questions (i.e. how do I submit assignment step 3?). If you don't see your answer there, then please contact me.
- If the answer to your question would be relevant to everyone in the class, ask it by posting on the Canvas site, not via personal email.
- We will try to respond to all course related emails sent during the work-week within 48 hours. Response times may be longer over the weekend; believe it or not, we don't always work on Saturday! If more than 48 hours elapses and you have not received a response, please feel free to send a gentle reminder.
- We aim to have all work graded within one week of submission, with the exception of the final practical, which may take ten days to grade and return.
- Remember that online threaded discussions are public messages, and all writings in this area will be viewable by the entire class. If you prefer that a communication to be private, send it by email, and be sure to identify yourself and the class.
- All communications with others in the course need to be composed with fairness, honesty and tact.

The Syllabus as Semi-Flexible Contract:

This syllabus represents a form of contract between us and outlines what I expect from you and what you can expect from me. Nevertheless, there may be room for midcourse corrections. If a session was confusing or if the whole class is falling behind, please bring the issue to my attention as soon as possible (anonymously if necessary) and we can open a dialogue on potential resolutions.
University and Departmental Policies:

Technical Assistance:

If you experience computer difficulties, need help downloading a browser or plug-in, assistance logging into the course’s Canvas site, or if you experience any errors or problems in Canvas, contact the OSU Help Desk for assistance. You can call (541) 737-3474, email osuhelpdesk@oregonstate.edu or visit the OSU Computer Helpdesk online. It is not the course instructor’s responsibility to handle technical difficulties.

Disabilities:

Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.

Expectations for Student Conduct:

In an academic community, students and faculty, and staff each have responsibility for maintaining an appropriate learning environment, whether online or in the classroom. Students, faculty, and staff have the responsibility to treat each other with understanding, dignity and respect. Disruption of teaching, administration, research, and other institutional activities is prohibited by Oregon Administrative Rule 576-015-0015 (1) and (2) and is subject to sanctions under university policies, OSU Office of Student Conduct.

Therefore, we expect you to conduct yourself in the course (e.g., on discussion boards, email postings) in compliance with the university's regulations regarding civility. Treat all others with the same respect that you would want to be afforded yourself. Disrespectful behavior to others (such as harassing behavior, personal insults, inappropriate language) or disruptive behaviors in the course (such as persistent and unreasonable demands for time and attention both in and out of the classroom) is unacceptable and can result in sanctions as defined by Oregon Administrative Rules Division 015 Student Conduct Regulations.

Naturally, you have a right to expect the same civility and respect of us, your instructors, that we expect of you, our students!

Academic Dishonesty:

(i) CHEATING - use or attempted use of unauthorized materials, information or study aids, or an act of deceit by which a Student attempts to misrepresent mastery of academic effort or information. This includes but is not limited to unauthorized copying or collaboration on a test or assignment, using prohibited materials and texts, any misuse of an electronic device, or using any deceptive means to gain academic credit.
(ii) FABRICATION - falsification or invention of any information including but not limited to falsifying research, inventing or exaggerating data, or listing incorrect or fictitious references.

(iii) ASSISTING - helping another commit an act of academic dishonesty. This includes but is not limited to paying or bribing someone to acquire a test or assignment, changing someone's grades or academic records, taking a test/doing an assignment for someone else by any means, including misuse of an electronic device. It is a violation of Oregon state law to create and offer to sell part or all of an educational assignment to another person (ORS 165.114).

(iv) TAMPERING - altering or interfering with evaluation instruments or documents.

(v) PLAGIARISM - representing the words or ideas of another person or presenting someone else's words, ideas, artistry or data as one's own, or using one's own previously submitted work. Plagiarism includes but is not limited to copying another person's work (including unpublished material) without appropriate referencing, presenting someone else's opinions and theories as one's own, or working jointly on a project and then submitting it as one's own. Cheating or plagiarism by student is subject to the disciplinary process found at the Student Conduct Regulations website: http://studentlife.oregonstate.edu/studentconduct/offenses-0

At a minimum, Academic Dishonesty will result in a grade of zero for the assignment or exam, and may result in failure of the course.

OSU Student Evaluation of Teaching:

Course evaluation results are extremely important and are used to improve the course and the learning experience of future students. Results from the multiple choice questions are tabulated anonymously and go directly to instructors and department heads. Student comments on the open-ended questions are compiled and forwarded confidentially to each instructor, per OSU procedures. The online Student Evaluation of Teaching form will be available toward the end of each term. You will login to Student Online Services to respond to the online questionnaire. The results on the form are anonymous and are not tabulated until after grades are posted.

Acknowledgments:
Much of the organization and ideas reflected in this syllabus are based on courses in comparative anatomy, biodiversity, systematics or ichthyology taught by a variety of mentors, including Barry Chernoff, Michael LaBarbera, Amy McCune, Mark Westneat, Bruce Collette and Doug Markle.