

## Seminars on Science

# THE DIVERSITY OF FISHES

## Syllabus

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### Course Title

The Diversity of Fishes: Classification, Anatomy and Morphology

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### Course Description

With well over 24,000 species alive today, the world's fishes comprise by far the largest and most diverse of all vertebrate groups. This seminar provides an introduction to this incredible diversity and looks at how scientists study fishes. Our examination asks us to re-evaluate and finally ask: what exactly is a fish?

This course takes you into the lab with Museum scientists. Students are led through the steps of an actual investigation of a group of South American catfish (*Hypoptopoma*). Using the rules of cladistics (a system of classification) we seek to determine if a lab specimen is a new species.

Specimen photos from the AMNH Ichthyology Department Collections, scientist-authored essays, video and web resources, allow students to explore the evolution, ecosystems, and biogeography of this group of animals and examine questions such as the meaning of biological success.

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### Class Schedule

This is a six-week online graduate course with an additional week for assignment completion. The course is asynchronous and does not have specific meeting times. Assignments and discussions change on a weekly basis. Students are expected to complete work within the specific week it is assigned.

For the current schedule of offerings, please visit [www.amnh.org/learn/calendar.php](http://www.amnh.org/learn/calendar.php).

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### Instructors

This graduate course is co-taught by an experienced educator along with a research scientist. **For example**, a recent course featured:

**Mr. Jonathon Maletta**  
Huntington High School  
Huntington, NY

**Dr. Adriana Aquino**  
Department of Ichthyology  
American Museum of Natural History

For current instructor information, please contact [seminfo@amnh.org](mailto:seminfo@amnh.org).

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## Format

1. **The Diversity of Fishes** is a six-week online graduate course with an additional week for assignment completion. Enrollment is restricted to current or future educators. No prior course in evolutionary science is required.
2. **Weekly activities** give learners practice in describing and identifying fishes and introduce the technologies, tools and processes scientists use to study the diversity of fishes. Computer interactives, image galleries, and videos will help learners visualize and master the content.
3. **Online discussions** encourage reflection on course content, support and model the inquiry process, and sustain interaction between the offering scientists, seminar instructors, and course members.
4. **Final course projects** support either the development of a proposal planning how you might research a question related to a seminar topic you find particularly interesting or the creation of inquiry-based lesson plans focused on a key course concept that you might incorporate into your teaching practice.

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## Required Textbook

This course requires the following textbook.

**The Science Times Book of Fish**

by Nicholas Wade, ed.

Paperback: 231 pages

Publisher: Lyons Press (September 1997)

ISBN: 1558216049

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## Support Services

Technical support is available for technical issues on a 24/7 basis. Please call (303) 873-0005 or email [helpdesk@amnh.college.com](mailto:helpdesk@amnh.college.com).

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## Grading

**Assessments** are based on a detailed grading rubric developed for this course:

Course Assignments	30%
Course Participation & Communication	40%
Final Project	30%

1. **Course assignments** will include reflection questions and written assignments.
2. **Class participation** will be evaluated based on the quality and consistency of contribution to the discussion forum. The grades for participation will be posted two weeks after each question opens.
3. **Final Project:** There are two options for the course project:

**Option I: Teaching Practice**

This option is for learners who would like an opportunity to develop an application based on the course content that could be taught to students or other educators. The final form may be a unit or

workshop plan (if it will be used as part of a professional development experience).

### **Option II: Research Question**

This option is for learners who would like an opportunity to further explore and grapple with the science and skills presented in this course. The task is to develop a research question of interest based on some element of the content presented in the course.

- 4. Policy:** Everything submitted as an assignment, project, or discussion post must be an original work. References to resource materials are expected and proper citation is required.

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## **Weekly Overview and Expectations**

### **Week 1: Why Study Fish?**

This week provides an introduction to the *Diversity of Fishes*. Dr. Melanie Stiassny discusses "diversity" presenting fishes as the most diverse vertebrates on Earth and gives an orientation to the Ichthyology Department at the American Museum of Natural History.

#### **Expectations**

- Review the course orientation.
- Examine specimens and photos from the AMNH Ichthyology Department Collections.
- Reflect on why fishes are the most diverse vertebrates on Earth.
- Learn about the work of biologists who study species biodiversity (systematists).
- Practice observation and description of fishes.
- Participate in the Icebreaker Discussion
- Respond to the Discussion Question: What is Biological Diversity?
- Complete the Assignment: Fish Market Observation

### **Week 2: What are the Implications of Living in Water?**

Most of the energy spent by swimming fishes is required to overcome drag. This week introduces the constraints and complexities of life in water. Explore the evolutionary innovations that allow fishes to live in their aqueous environments.

#### **Expectations**

- Review the advantages and limitations of living in water.
- Reflect on how the diversity of fishes is related to the diversity of aquatic environments.
- Explore the importance of scientific journals, scientific language, and scientific illustration.
- Identify fish species through observation and description.
- Respond to the Discussion Question: Fish Evolution
- Complete the Assignment: Fish Description Part 1

### **Week 3: How is the Diversity of Species Studied?**

Learners are introduced to the scientific discipline of systematics that describes the diversity of living forms in terms of species, history, and distribution. They learn how to interpret cladograms and construct dichotomous keys. This week outlines the significance of systematics within the biological sciences. While the content may be unfamiliar to some learners, these are the foundations for much of the rest of the course.

#### **Expectations**

- Discover the significance of systematics as a discipline within the biological sciences.
- Study the processes for identifying and classifying organisms.
- Explore how systematics is related to taxonomy, the Linnaean system of classification, and nomenclature.
- Determine why systematists may also be historians and geographers.

- Define cladistics, and learn to interpret cladograms.
- Review the history of *Natural History*.
- Consider the significance of studying the historical and geographical distribution of species (biogeography).
- Respond to the Discussion Question: Linnaean vs. Modern Systematics
- Complete the Assignment: Fish Description Part 2
- Present preliminary thoughts on the Final Project

#### **Week 4: What Evidence is Useful in Understanding Fish? The Case of *Hypoptopoma* Part 1**

Learners join Dr. Adriana Aquino on a directed tour through her study of *Hypoptopoma*. This week's content will familiarize learners with the first steps in the real work of systematists. Learners will be asked to closely observe images and use them to draw conclusions or answer questions in order to discover the characters unique to *Hypoptopoma*.

##### **Expectations**

- Join a scientist-directed tour of systematics in action.
- Interpret and analyze data using the perspective of systematics.
- Determine the importance of study, observation, description, classification, data analysis, and comparisons to understanding the diversity of fishes.
- Study the research objectives of a case study.
- Learn how to test the monophyly of a genus.
- Respond to the Discussion Question: Building a case for monophyly
- Complete the Assignment: Constructing a Dichotomous Key Part 1

#### **Week 5: What Evidence is Useful in Understanding Fish? With The Case of *Hypoptopoma* Part 2**

Learners continue their investigation into *Hypoptopoma* with Dr. Aquino. They learn how the characters observed in contemporary species of *Hypoptopoma* give clues that help develop insight into their history. For example, their distribution over time mirrors the formation of major geographical features in South America.

##### **Expectations**

- Study the process of determining original research questions.
- Interpret the results of a research-based case study (data analysis).
- Examine the basic questions addressed in a systematic study.
- Respond to the Discussion Question: Wearer of many hats.
- Complete the Assignment: Constructing a Dichotomous Key Part 2
- Complete an outline of the Final Project

#### **Week 6: What Threatens the Diversity of Fish?**

This week, students learn that systematics and the classification of organisms that result from this kind of research is fundamental for conserving diversity. To make informed decisions about conservation initiatives, there must first be an accurate representation of what exists in the world's ecosystems. The biological "success" of lineages is discussed and debated.

##### **Expectations**

- Connect systematic studies and strategies for designing conservation efforts.
- Define biological success.
- Evaluate the success of fishes.
- Respond to the Discussion Question: The legacy of fish.
- Complete the Final Project