

Invertebrate Zoology - BIO 322 – Section 01- 28481
Spring, 2022 Tentative Syllabus
College of Arts & Sciences Syllabus

(Not all the bugs are out of it yet, but it should give you an idea of what we will do.)

COURSE INFORMATION

Credit Hours: 4

Lecture & Lab time and location: 12:15 pm to 2:55 pm TR Location: Zoom

ZOOM INVERTEBRATE ZOOLOGY MEETING

Zoom Room Location:

<https://neiu-edu.zoom.us/j/88346998585?pwd=emNkek1ndzdxeS9kOWp1UjhKclFWUT09>

Meeting ID: 883 4699 8585 Passcode: 490645

One tap mobile +13126266799,,88346998585# US (Chicago)

Find your local number: <https://neiu-edu.zoom.us/j/88346998585?pwd=emNkek1ndzdxeS9kOWp1UjhKclFWUT09>

Special Fees: \$25.00

First Day of Classes: Tuesday, January 18

Course Description: Taxonomy and comparative morphology of the major phyla of invertebrates, organisms that comprise about 95% of animal life. Topics include life histories of representative species. Lecture and laboratory.

Course Prerequisites: BIO-150 minimum grade of C and BIO-201 minimum grade of C and BIO-202 minimum grade of C.

Other Important Dates for Our Class:

https://www.neiu.edu/sites/neiu.edu/files/documents/2020/10/05/Spring%202021%20Detailed%20Semester%20Calendar_0.pdf

First day of our Class: Tuesday, 18 Jan.

Friday, Feb 11, 12 Darwin's (Lincoln's) Birthday.

March 14-March 20: Spring Break.

Monday 9 May: Last day of classes.

Tues May 10- Thurs May 12 Finals.

Sunday, May 15: Grades Due

NB: If you stop attending without dropping, you will be issued a grade of F.

FACULTY INFORMATION

Instructor: Dr. Marijo Readey

Office Location: Zoom Office Only

Office Hours: 10:45-11:45 MW ZOOM Dedicated Office Hr for this class is at the same link as above.

Zoom Meeting office Hours

<https://neiu-edu.zoom.us/j/3038240479>

Meeting ID: 303 824 0479

NB: Office Hours are open to all, but priority will be given to Online Students or Upper Division Students as indicated on the schedule; If no one in the designated group is signed on, I will be happy to work with other students.

However, should a designated member sign on, I will need to attend to them. .

Spring 2022- Classes and Office Hours

	Su	M	T	W	R
10:00			<i>Open Office Hrs (no priority)</i>		<i>Open Office Hrs (no priority)</i>
10:30	<i>Office Hrs (300-level priority)</i>		<i>Open Office Hrs (no priority)</i>		<i>Open Office Hrs (no priority)</i>
11:00	<i>Office Hrs (300-level priority)</i>		<i>Open Office Hrs (no priority)</i>	<i>Office Hrs (online 104 priority)</i>	<i>Open Office Hrs (no priority)</i>
11:30	<i>Office Hrs (300-level priority)</i>		<i>Open Office Hrs (no priority)</i>	<i>Office Hrs (online 104 priority)</i>	<i>Open Office Hrs (no priority)</i>
12:00	<i>Office Hrs (online 104 priority)</i>		Invertebrate Zoology 12:15-2:55 pm	<i>Office Hrs (online 104 priority)</i>	Invertebrate Zoology 12:15-2:55 pm
12:30	<i>Office Hrs (online 104 priority)</i>		Invertebrate Zoology	<i>Office Hrs (online 104 priority)</i>	Invertebrate Zoology
1:00	<i>Office Hrs (online 104 priority)</i>		Invertebrate Zoology	<i>Office Hrs (online 104 priority)</i>	Invertebrate Zoology
1:30	<i>Office Hrs (online 104 priority)</i>		Invertebrate Zoology	<i>Office Hrs (online 104 priority)</i>	Invertebrate Zoology
2:00	<i>Office Hrs (online 104 priority)</i>		Invertebrate Zoology	<i>Office Hrs (online 104 priority)</i>	Invertebrate Zoology
2:30			Invertebrate Zoology 12:15-2:55 pm	<i>Office Hrs (online 104 priority)</i>	Invertebrate Zoology 12:15-2:55 pm
3:00		<i>Office Hrs (online 104 priority)</i>	Office Hours (Upper Division Priority) 3-4pm	break	Office Hours (Upper Division Priority) 3-4pm
3:30		<i>Office Hrs (online 104 priority)</i>	Office Hours (Upper Division Priority) 3-4pm	Office Hours (Upper Division Priority) 3:30-5:00 pm	Office Hours (Upper Division Priority) 3-4pm
4:00		<i>Office Hrs (online 104 priority)</i>	Animal Behaviour 4:15-5:30	Office Hours (Upper Division Priority)	Animal Behaviour 4:15-5:30
4:30		<i>Office Hrs (online 104 priority)</i>	Animal Behaviour	Office Hours (Upper Division Priority)	Animal Behaviour
5:00			Animal Behaviour 4:15-5:30		Animal Behaviour 4:15-5:30

Phone Extension: no telephone contact available due to pandemic. Private Zoom meetings can be arranged by appointment. Email is the best way to get me, but you can check to see if I am active on google chat (in email, and I can only respond within the NEIU system and only if I am not working with someone or in class).

E-mail: mareadey@neiu.edu

COURSE MATERIALS

NOTE ON SYSTEMATICS: Our understanding of evolutionary trees changes frequently because of new technologies and new studies. The materials on systematics presented in lecture will be close to state of the art. These will be the classifications that we will use and these lecture notes will cover the systematics and physiology for which you are responsible. **The systematics presented in class closely match the phylogenies given in Neilson's *Animal Evolution*, 3d ed. I will be providing you with sufficient information on systematics. Although highly recommended as a text, it is not required. (Due to Neilson's own research biases, this book goes into far more detail on evolutionary development than we will do in the class!) NB: *Because of the rapid evolution in our knowledge of animal systematics, there will be inconsistencies in classifications among sources. For exams, we will use the classification system that is presented in lecture.***

Books:

I have included various buying options here, including the choices of formats available on Amazon. Also, if a book is available for free on Hoopla (Chicago Public Library online site), I have noted it.

Required Texts (neither are on Hoopla)

Nielsen, Claus (2012). *Animal Evolution*. Oxford University Press, 3d ed. 464 pages. ISBN-13: 978-0199606030 (We will follow the taxonomy in this book. Although not completely necessary, it is highly recommended.) Overview: https://www.academia.edu/31609250/Claus_Nielsen_Animal_evolution_interrelationsh_BookZZ_org_pdf?auto=download (Nielsen's book is available on Amazon as a paperback and as a hardcover)

Vogel, Steven. (2000). *Cats' Paws and Catapults*. W.W. Norton & Co. Inc. ISBN-13: 9780393319903 (This book provides a less technical overview of biomechanics than his formal text and can help you understand the applications we cover.) (Kindle and paperback formats available)

continued on the next page →

Suggested Texts for Additional Study:

Benyus, Janine M. (2002). *Biomimicry: Innovation Inspired by Nature*. William Morrow paperbacks. 320p. ISBN-13: 978-0060533229. (recommended, but not necessary; available as an audiobook, on kindle and as a paperback or hardcover) (On Hoopla as an audiobook.)

Biomimicry Overview:

https://www.academia.edu/38300413/Janine_M_Benyus_Biomimicry_Innovation_Inspired_by_Nature_2002_Harper_Perennial_1

Forbes, Peter: (2006). *The Gecko's Foot: Engineering New Materials from Nature* W. W. Norton & Company 288p. ISBN-13: 978-0393062236. (will be available on reserve in library) *Biomimicry. Overview:* <http://www.pforbes.org/the-geckos-foot.html> (recommended, but not necessary). (On Amazon, this one is available as a hardcover, paperback, and (cheapest option) as an eTextbook.) (Available on Hoopla as an ebook.)

Book Choices for Reading Groups:

Godfrey-Smith, Peter, (2017). *Other Minds: The Octopus, the Sea, and the Deep Origins of Consciousness*. Macmillan Publishers ISBN-13: 9780374537197 (available as audiobook kindle, and hardcover).

Wilcox, Christie. (2017 reprint ed). *Venomous*. Scientific American/ Farrar, Straus and Giroux ISBN-13: 9780374537104. (not on Hoopla)

Staff, Danna (2017) *Squid Empire: The Rise and Fall of the Cephalopods*. Tantor Media. ISBN: 9781977380883. (Hard cover and audio versions are available, and the audio is far cheaper!) (On Hoopla as an audiobook)

Barrie, David. (2019). *Supernavigators: Exploring the Wonders of How Animals Find Their Way*. The Experiment. ISBN-13: 9781615196692. (Available as Audiobook, Kindle, Hardcover and Paperback.) (On Hoopla as an audiobook and as an ebook.)

Berwald, Juli. (2017). *Spineless: The Science of Jellyfish and the Art of Growing a Backbone*. Riverhead Books. ISBN: 978073521126. Available as Audio, Kindle, hardcover and paperback book). (Not on Hoopla. Be careful to get the right book! Several with this title.)

Benton, Michael (2015 revised edition). *When Life Nearly Died: The Greatest Mass Extinction of All Time*. Thames & Hudson. ISBN-13: 978-0500285732. (Late addition to the list. Not ordered through Follett's. (Available as an Audio, Kindle, Hardcover and Paperback). (Available as an audiobook on Hoopla.)

Website links for Invertebrate Zoology:

There is one Zoology e-book that you will need to access during this semester. To get you started, bookmark the following page on your personal browsers. When studying an assigned link, you should also look at the links immediately downstream from this recommended entry site.

OUR LAB e-“BOOK”: We will be using one major on-line (a.k.a. free) lab books as we explore the anatomy and physiology of organisms (Link good as of 12/9/15): This

book was developed by Ruppert Fox for his students: Primary:
<http://lanwebs.lander.edu/faculty/rsfox/invertebrates/> (link confirmed as functioning on 2022-01-10)

In addition, you will use several biomimicry sites in your research. These include:

http://biomimicry.org/asknature/#.Vmh51L_mhsI

<http://www.asknature.org/>

(links confirmed as functioning on 2022-01-10)

Caution on other supplemental sources: *Systematics is a rapidly changing field of biology. Neilson Neilsen is among the most respected systematists currently working. His book looks at data from many sources, including embryology, anatomy, histology, genetics, and paleontology. This wide base gives his work a solid, multi-pronged foundation that many other books lack.*

Virtual Labs: Due to the ongoing health crisis, most of our labs will be virtual. You can opt for a virtual lab kit from the Department of Biology. ***These materials need to be returned to the department by the end of the semester.***

I will be doing demonstrations. We will also be using videos of dissections and demonstrations of principles through the semester.

COURSE OBJECTIVES / STUDENT LEARNING OUTCOMES

During this course, I will expect you to complete the following base-line learning tasks.

I. SYSTEMATICS AND TAXONOMY

- Understand the basic concepts of cladistic analysis and be able to classify organisms in accord with the principles of phenetics and of cladistics
- To understand the use of biomimicry taxonomy as a systematic system distinct from traditional taxonomy, and to be able to apply its principles
- Production of a parsimonious tree using these concepts
- To be able to identify animals to specific clades based upon their anatomy
- Be able to compare and to contrast systematics and taxonomy.

II. EVOLUTIONARY THEORY

- Be able to explain how systematics and evolutionary theory are related
- Explain systematics uses use various features of animals to explain patterns of evolution
- Be able to explain how simplification, rather than complexification, has been a dominant trend in much of animal evolution
- Interpret a cladistic or phenetic tree in terms of evolutionary theory, describing the relationships among the branches.
- To understand the efficiency of nature and to apply their biological solutions to design and engineering problems

III. ANATOMY AND PHYSIOLOGY

- Be able to compare and contrast different physiological adaptations to similar environments across the animal kingdom.

- Be able to explain how organisms use different means to complete the same tasks of life, and to compare, contrast, and explain the function, the presence, and the structure of specific organ systems in different clades.
- Be able to place these organ systems and their functions within a context of evolution and adaptation to specific environmental constraints

IV. BIOMIMICRY**

- Understand the physical constraints placed upon objects and systems, and be able to relate these to the engineering aspects (e.g., size, mass, force, surface area, tension, strain) that constrains the design of organisms.
- Be able to relate physical adaptations with millions of years of product-testing to physical, ecological, and energetic problems in human products.

V. PRACTICAL SKILLS

- Explain how the knowledge of the evolutionary relationships among organisms applies to other branches of biology, chemistry, pharmacology, medical science, and product engineering
- Understand how the anatomy and physiology of organisms influence their use of niches, and how these features can be used to design and improve the efficiency of products for human use (biomimicry)
- Produce hypotheses about animal ecology and behaviour based upon their anatomy, physiology, and systematics.
- Be able to apply the principles of biomimicry to a specific economic or engineering problem by designing a new product or improving an existing one (your project). I.e., Be able to apply the engineering found in the animal kingdom to practical engineering problems in daily and commercial life.
- To see adaptations of organisms as design solutions for their specific environmental challenges, and to recognize similar adaptations across clades.

VI. LABORATORY SKILLS

- Be able to identify the major groups of animal tissues across the animal kingdom
- Be able to identify organisms studied in class to the levels of organization indicated in class, with the additional goal of understanding the phylogenetic (evolutionary) relationships among the animals.
- Be able to identify major organs and organ systems in diverse clades, and explain their form and their function within that clade.
- Be able to apply those functions to basic design problems
- Be able to compare and to contrast organ systems across clades.
- Conduct a dissection of preserved or fresh specimens and identify designated organs and organ systems. This information should combine with your readings to develop an understanding of the organisms
- Be able to produce a basic biomimicry design based upon the materials discussed in class and within project groups.

IMPORTANT:

To discourage cramming, I do not answer questions on the material for two days prior to an exam. If you have questions on the material, bring them to me at least three days before the exam, and preferably right after we cover the materials!

NB: I may have another exam after our final, so the time limit on the examination must be firm.

BIOMIMICRY PROJECT EXPLANATION: During this semester, you will be responsible for completing a biomimicry project and presenting at least part of it to the class. **Consult with me frequently as you work on your project so I can help keep you on track.**

The project is broken into two portions:

PART 1: Background research into one aspect of biomimicry, bio-inspiration, or bioengineering design. and how it has been applied to a particular problem. This information is critical to the second portion, and should not be minimized. DO NOT TRY TO DO THIS RESEARCH AT THE LAST MINUTE!!! **If you try to slide-by on last-minute work, you will not be very happy with your grade. It should be in APA format and it should be well organized, as if you were going to present it to a funder to get development funds.**

PART 2. Development of a new application or design based upon that biomimicry. The application does not need to be wildly new and complex. It does have to be your own work and your own passion. Check with me to see if you missed something in your initial research. Try to approach this topic by looking at problems in your own daily life. Ask questions like “*What animal needs to do the same thing,*” or “*How does this problem relate to animal niches?*” Visit the biomimicry websites (given earlier in this syllabus) early in the semester, and return to them often for inspiration. If you just copy someone else’s design, you won’t learn very much.

Presentation of Part 1: When working on the background project, (which will be the one presented in class) first explore solutions to ecological, economic, medical or architectural problems based upon the solutions found in the natural world. This portion of the project will be due around the middle of the semester, and it will be presented to the class in **no more than 5-10 minutes (plus 5 min for questions)**. The projects should be thoroughly researched and existing biomimicry solutions should be included as part of your presentation. Although you may include biological systems other than invertebrates, some invertebrate innovations should be included in the group project. This first portion and presentation will be reviewed for spelling, grammar, and organization at this time. *Ten of your 150 points is based upon your presentation.*

For the remainder of the term, refocus your efforts. The remainder of your project should extend the general theme researched in the first part of the semester. You may go another direction with prior approval, but I discourage it. During this time, you should try to develop one aspect of this project in a new, novel direction. ***Consult with me frequently as you work on your project so I can help keep you on track and make certain that you are not just reinventing the wheel.***

Limitations on projects: The project should NOT have molecular biology or biochemistry as its focus. You get enough of this material in other classes. Instead, focus on the physical and design aspects of living systems!

MAKE-UP POLICY: *Due to the ongoing covid crisis, you can take to 1 exam or quiz up to 1 week late without an excuse.* After that accommodation, there will be no make-ups for missed exams or quizzes. Exceptions to this rule will be at the instructor's discretion and will require a verification of extreme circumstances in advance of the exam. (E.g., death in the immediate family or hospitalization count. Minor illness only with a doctor's excuse or from a walk-in clinic. In the case of such crises and emergencies (that you can document and that are considered a valid excuse by your instructor), *talk to me (or phone me) before the to make arrangements.*

Course Outline:

Logic of the schedule.

The invertebrate zoology class will separate the schedule based upon two themes: evolutionary systematics (phylogeny), and biomimicry/ bioinspiration systematics. Although we will attempt to follow the major lines of animal evolution and to understand them, this class will also focus on the mechanisms employed by invertebrates to meet the challenges of life and the in a pattern that reflects these needs. ***Because we lack the time, we will only be able to do a quick overview of the organisms in the major or more diverse clade.*** We will focus on looking at the variety of form and function rather than on a comprehensive overview of the animal kingdom. (That's another class.) Thus, we will focus instead on a few representative clades that accomplish tasks of life by employing different solutions across the clades.

Tentative Schedule: *The following schedule is subject to revision to allow for more or less time on various topics as needed or because of potential school closures such as snow days. Some lab time will also be devoted to additional lecture material.*

The lecture and lab will ***not*** be on opposite days. Part of each day will be dedicated to lecture, and part of each day will be dedicated to laboratory work.

Week of:	LECTURE TOPICS:	LAB Topics
Week 1 Jan 18	Introductory Material: Focus of the class, expectations and demands. Introduction to Diversity in the animal Kingdom: Overview of the Animal Kingdom's three traditional major divisions Our first Few Clades Introduction to Biomimicry/ Bio-inspiration	Our First few clades Porifera and Placozoa I; slides of porifera; origami 101 Prelab work: http://www.youtube.com/watch?v=eC5-y_oTI2Q Preliminary video (watch before class):
Week 2 January 25	Porifera and Placozoa II; slides of porifera review;	Unit IZ-002 Cnidaria; Introduction to the Bilateria and Introduction to Biomimicry.

<p>Week 3 Feb 1</p>	<p>Test 1; Patent Search Lab Feb1 or 3</p> <p>IZ-002 Cnidaria and Ctenophora Aurelia Dissection; slides of cnidaria Cnidaria and Ctenophora</p> <p>Urochordates: https://www.youtube.com/watch?v=KRVdGam3G2U https://www.youtube.com/watch?v=e8jM94pNssc https://www.youtube.com/watch?v=5EQGA4BZ5s</p> <p>Echinoderms: http://www.youtube.com/watch?v=Pe-LDh6IG8 (urchin) http://www.youtube.com/watch?v=1HmQDKKD55E (urchin) https://www.youtube.com/watch?v=TioCree5axI (Sea Star)</p>	<p><i>At the beginning of Class, start by sharing! Pre-presentation: run your ideas by another group for 10-15 minutes</i></p> <p>IZ-003 Platyhelminthes. Animal diversity 3: Bilateria I: Platyhelminths and basal protostomes Finish slides from last time; Start the Major Bilaterian Clades I: tapeworms, planaria, and flukes</p> <p><i>Preliminary Project Ideas due: 1-2 pages for review</i></p> <p>Patent Search Lab Feb1 or 3</p>
<p>Week 4 Feb 8</p>	<p>Animal Diversity 3: IZ-004 Deuterostomia I: The water vascular system and the skeletons of echinoderms Lab: Urochordates and Echinoderms (Sea star or sea urchin) Sea Star Dissection: if we can get them: Prelab work: http://www.youtube.com/watch?v=TioCree5axI (part 1) and http://www.youtube.com/watch?v=Xm2mF2IgLrA (part 2) http://www.youtube.com/watch?v=ZJ7BzlZ5QW4</p>	<p>IZ-005 Deuterostomia II: The Chordate Lineage</p> <p>Lab: Deuterostomia and catch up</p> <p><i>Test 1 closes.</i></p> <p><i>Practical 1 Opens (Through the Flatworms)</i></p>

NB: Traditionally, the Deuterostomes are the last clade presented. I am presenting them early to emphasize that they are not some pinnacles of animal development., Instead, think of them as just one branch of animal evolution. The Deuterostomes will thus be the next topic for discussion. We will then slide back to the branching point and pick up the remaining Protostomes (post Platyhelminths) and Ecdysozoa (skeleton shedders) After this point, we return to the branching point, the Acoelomorpha and Platyhelminthes, and we will follow the other branch of animal life, i.e., the major branch that includes most of the animals. As members

of this clade, the “Protostomia” (from Greek *πρωτο-* proto- "first" and *στόμα* stoma "mouth") develop, they make their mouth before they make their anus. The largest and most successful clades of animals fall within this branch, including the arthropod (over half of all animals and plants combined), the nematodes, the mollusks, and the annelids all fall within the Protostomia.

<p>Week 5 Feb 15</p>	<p>Test 2 Opens</p> <p>Animal Diversity: Lophotrochozoa IZ-006 Nemertea; IZ-007 Annelida 1</p> <p>The proboscis of the Nemertea, the water balloon of the animal world</p> <p>Digging Annelids!</p> <p>Much about Molluscs: Bivalves, Gastropods, Cephalopods</p> <p>Prelab work for Wednesday: http://www.youtube.com/watch?v=u9HHS1uPFS0 http://www.youtube.com/watch?v=LEmzQeMe9cY http://www.youtube.com/watch?v=a7RAoJ_2W5g http://www.youtube.com/watch?v=C-3GqvLswc8</p>	<p><i>Practical 1 closes.</i></p> <p>IZ-008 Annelida 2</p> <p>Dissection and slides: Annelids: <i>Lumbricus</i>, <i>Nersis</i> (Earthworm xs, earthworm ls)</p> <p>Nematode xs, nematode LS</p> <p>Clam xs, clam ls, gastropod slide</p> <p>IZ-009 Molusca</p> <p>Prelab work:</p> <p>Recognizing major clades: Molluscs: Clams xs / insect slides</p> <p>Firmed Project Ideas Due</p> <p><i>End materials for first lecture exam ends with the annelids.</i></p>
<p>Week 6 February 22</p>	<p>IZ-009 Mollusca</p> <p>Squid dissection Prelab work: http://www.youtube.com/watch?v=OueQ9kU36i0</p> <p>Shell architecture: nautilus, whelk, bivalve, & corrugated cardboard</p> <p>The beauty of cone shells.</p> <p>IZ-010 Ecdysozoa</p>	<p>The shedding of cuticles</p> <p>Cycloneuralia 1: Nematodes and other ecdysozoans without legs</p> <p><i>Test 2 Closes</i></p> <p>IZ-0010 Ecdysozoa</p>
<p>Week: 7 March 1</p>	<p>Test 3</p> <p>IZ-011 Pararthropods</p> <p>IZ-012 Arthropods 1</p>	<p>Arthropoda 2 IZ-013 Crustacea and IZ-014</p> <p>Spider dissection 1</p> <p>Laboratory Review</p> <p>Catch-up & review day for lab: Consultations on projects</p>

During the remains of the semester, we will shift our focus from the traditional systematics and anatomy within clades to a comparative approach of the biomechanics and physiology among clades. By this point in the semester, you should have a basic knowledge of the ingredients on the shelves (the clades). Now, you can begin to use this shopping list to explore the possibilities of life and its operational constraints. Without the prior information, you would not have a basis for what comes next. We finished this first section with a brief tour of the arthropods. Now we can begin to apply what we have learned.

<p>Week 8 March 8</p>	<p>IZ-015 Crustacea, Rotifers and Fluid Dynamics 1 Solving Diffusion Problems: Protonephridia, metanephridia, eunephridia Prelecture work: Protonephridia: http://www.youtube.com/watch?v=Rb_3KI_B4CmE metanephridia http://www.youtube.com/watch?v=O87xYjhCiA8</p>	<p>IZ-015 Trachea, gills, and lungs: Closed and open circulation http://www.youtube.com/watch?v=JbGQE2CEGfI and http://www.youtube.com/watch?v=HZ9Et5TyJXM (just for fun) Insect circulatory system: http://www.youtube.com/watch?v=Lv781axxV5o Complete and incomplete digestive tracts <i>Test 3 closes</i></p>
<p>Week 9 March 13-20</p>	<p style="text-align: center;">SPRING BREAK</p>	<p style="text-align: center;">SPRING BREAK</p>
<p>Week 10 March 22</p>	<p><i>Test 4 opens</i> Introduction to mechanical units in biological systems; conserved and non-conserved quantities <-- Prep for lecture and lab: Trachea gills & book lungs: http://www.youtube.com/watch?v=quwhcgkVO3c, http://www.youtube.com/watch?v=V65cbxJmROg https://www.youtube.com/watch?v=wfQqk03joS4 https://www.youtube.com/watch?v=GYdPn8DCI8A Book lungs: http://www.youtube.com/watch?v=0H8iNclLAE0 http://www.youtube.com/watch?v=AaPIiqoqmg4 https://www.youtube.com/watch?v=j_4h1xTf224</p>	<p>IZ-016 Gasses, Fluids, and Circulatory Systems / Paddles and rakes: Bristles and other extensions on organisms; Biomechanics preliminaries: Size and scaling; scaling factors Physical limits on size; why specific shapes keep popping up <i>Pre-submission review for grammar or major errors and communication problems</i></p>

Week 11 Mar 28	IZ-017 Bioengineering Applications Simple diffusion and branched digestive tracts: <i>Dugesia</i> (planaria) and <i>Taenia</i> (pig and beef tapeworm); Closed circulatory systems and complete digestive tracts: <i>Lumbricus</i> (earth worm; annelids);	Practical 2 Opens Presentation of Background Research (10-15 min per group) Open circulatory system with haemocoels and complete digestive tract: insects What about Squid? Sea Stars? Paddles and Rakes: Naupilus larvae, Zoe larvae, daphnia, and diving beetles Test 4 closes.
Week 12 April 5	Test 5 Opens IZ-018 Skeletal Supports Struts and supports: Biological materials	Practical 2 Closes Biomimicry Taxonomy: A change in Gears How to Filter: Using Biological systems to better design engineered filters (<i>gills and rakes revisited</i>)
Week 13 April 12	Bivalve gills; Insect trachea, spider book lungs, Horseshoe crab book gills, urochordate pharyngeal baskets.	IZ-019 Non-New Tonian Fluids in Invertebrate systems. Viscoelasticity: mesoglea of anemones and the mucus of slithering slugs Test 5 Closes
Week 14 April 19	Test 6 Opens Fibres: Making fibres stronger with multiple materials	Connective tissue revisited Mesoglea and anatomy of jellies, hydroids, and sea anemones (<i>Aurelia</i> , <i>Obelia</i> , <i>Metridium</i>); hagfish slime
Week 15 Apr 26	Test 7 Opens IZ-020 Fractals in Invertebrate Design Spider dissection with primary focus on silk glands and spinneret's	IZ-021 Nonlinear systems: Chaos and Automata as models Fractals and Cellular Automata in Invertebrates Test 6 Closes
Week 16 May 3	IZ-022 Vision and optics: Pigment cup, pinhole, and lensed eyes. Visual pigment, lens types, polarized lenses and what animals see Cube Jellies: Why do animals see and why?	Understanding the eye through photographic principles Exploring pinhole camera principles <i>Dugesia</i> eyes, <i>Nautilus</i> eyes, insect eyes; Stomatopod eyes; diving beetle eyes Test 7 Closes Test 8 Opens Practical 3 Opens

Week 17 May 3	IZ-023 (optional unit if we have time) Wiring: Nervous systems and wiring patterns. II	Wiring: Nervous systems and wiring patterns. Test 8 Closes Tuesday, May 10, 2022 Practical 3 Closes Tuesday, May 10, 2022
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COURSE POLICIES AND STATEMENTS

Absence Policy:

ATTENDANCE: Department instructors may reassign a student's seat in a class if the student does not attend the first class session and neglects to inform the instructor in advance of the intended absence. The student will be responsible for any financial consequence if the course is not dropped officially by the student before the appropriate refund deadline. Failure to officially withdraw from class will result in a grade of F." NB: Cited from the Schedule of classes, inside front cover: "POLICY ON FIRST CLASS SESSION":

Attendance is mandatory; Missing laboratory and lecture time leads to reduced grades. If you must miss class because of religious, family or medical obligations, please let me know so we can find a way to keep you on tract. Be aware that class participation points and random attendance points cannot be earned or made up if you are not present in class.

RELIGIOUS CONFLICTS: I have done my best to avoid scheduling exams on religious holidays. However, in our multicultural society, it is not always possible to be aware of every holiday for every religious denomination. *Check the class schedule against your own schedule of religious holidays as soon as possible.* If you have a religious obligation that conflicts with exam schedule, arrangements can be made, but must be made in advance. Given that each exam will remain available for a week, I foresee few conflicts that cannot be worked out.

Late assignments:

Assignments late by one day will receive a 10% grade reduction. Any assignment that is more than one day late will not be graded and will be recorded as a zero unless there is a verifiable excuse.

Missed Examinations:

Typically, there will be no make-ups on examinations without a serious, acceptable, and verifiable reason—except for the one time only “covid special” that allows you to take one exam (other than the final) or quiz up to a week late without the need for verification.

The 2-day Lock-Out Period

To discourage cramming, I will not answer any questions about examination material starting the day before an examination.

Academic Integrity Policy:

By enrolling in this course, you are bound by the NEIU Student Code of Conduct: <http://www.neiu.edu/university-life/student-rights-and-responsibilities/student-code-conduct>.

You will be informed by your instructor of any additional policy specific to your course regarding plagiarism, class disruptions, etc.

ACADEMIC DISHONESTY includes giving, receiving, or using unauthorized aid on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. Any student guilty of cheating—including-- plagiarism will receive a grade of F.

ADA Statement:

Northeastern Illinois University (NEIU) complies with the Americans with Disabilities Act (ADA) in making reasonable accommodations for qualified students with disabilities. To request accommodations, students with special needs should make arrangements with the Student Disability Services (SDS) office, located on the main campus in room D104. Contact SDS via (773) 442-4595 or <http://www.neiu.edu/university-life/student-disability-services>.

Campus Safety:

Web links to Campus Safety: Emergency Procedures and Safety Information can be found on NEIUport on the MyNEIU tab or as follows:

http://homepages.neiu.edu/~neiutemp/Emergency_Procedures/MainCampus/.

Web Link to Emergency Information

It is recognized that a safe university environment is a shared responsibility of faculty, staff, and students, all of whom are expected to familiarize themselves with and cooperate with emergency procedures. Web links to Campus Safety: Emergency Procedures and Safety Information can be found on NEIUport on the MyNEIU tab or as follows:

(a) For the Main campus:

http://www.neiu.edu/~neiutemp/Emergency_Procedures/MainCampus/

(b) For El Centro(English version):

http://www.neiu.edu/~neiutemp/Emergency_Procedures/ElCentro/

(c) For El Centro(Spanish version):

http://www.neiu.edu/~neiutemp/Emergency_Procedures/ElCentro_Spanish/

(d) For CCICS:

http://www.neiu.edu/~neiutemp/Emergency_Procedures/CCICS/

(e) For Chicago Teachers Center(CTC):

http://www.neiu.edu/~neiutemp/Emergency_Procedures/CTC/

COLLEGE POLICY CAN BE FOUND AT:

<http://www.neiu.edu/about/sites/neiu.edu.about/files/documents/arrempas/E2.1%20Emergency%20Notification.pdf>

ADDITIONAL ELECTIVE INFORMATION

Warnings:

Warning I: This class requires dissection of animal specimens. These organisms are already dead, so whatever you do, you cannot hurt them or inflict pain of any sort. If you have ethical, religious, or other objections to the dissection of dead animals, then this class is not for you. You have been warned about this feature of the class, and you will not be excused from dissection.

Warning II: Preserved specimens are typically preserved with formaldehyde and/or glycerol. If you have a known chemical allergy or sensitivity to these chemicals, then you should consult your physician or allergist before taking this class. You may require special precautions.

Warning III: Formaldehyde is considered a contact poison. It can penetrate vinyl gloves. When handling specimens, you should use *latex* gloves (exam gloves, not dish-washing gloves). If you are allergic to latex, there are substitutes available at drug stores. You must, however, wear gloves whenever handling preserved specimens.

Warning IV: If you are pregnant, think you might be pregnant or are considering becoming pregnant, you would normally need to consult your ob-gyn before taking this class. Contact with chemicals, including formaldehyde, may adversely impact the foetus. *However, because the labs will consist largely of online work, that will not be an issue this semester.*

Warning V: This class will involve a little mathematics and physics. The necessary concepts will be taught within the context of the class, but a basic understanding of algebra is expected. If you have a math phobia (common among biology majors), you will be responsible for making appointments with your instructor or with another resource professional to help you past those bumps.

Other Stuff

1. If you are in the honours section, additional criteria will apply.
2. There is no policy of required attendance. *However, it is unlikely that you will earn an acceptable grade if you do not attend class regularly, because my lectures are key components of the exams.* Attendance alone does not guarantee a passing grade..
3. It is important that you take complete and comprehensive notes of the lecture material.
4. It is also essential that you study regularly. The material in this class does not lend itself to cramming.
5. One cannot learn to recognize organisms and their systems by site during crammed class periods. **Expect to spend 5-9 hours per week studying the materials on your own. (Typical for an upper-division class.)**
6. Reading the assigned websites or texts beforehand will help you better understand the lecture material.
7. **The taxonomy that I will expect you to know is the one in the PowerPoint's.** That taxonomy is based upon the most up to date systematics that you are likely to find.
8. *Look over the study guides prior to class whenever possible.* Then use the study guide to organize your notes after class. The sooner you reinforce material, the more likely it is to stick.
9. *After each lecture, you should reread and/or rewrite your notes and read the material in the websites again to make sure that you correctly took the notes and fully understand the material that was covered.* Rewriting the material longhand is a far more effective memory tool than

typing into a computer. Try using two columns, the first listing broad concepts, and the second containing a list of facts and supportive evidence linked to that concept.

10. After reviewing the lecture notes, go to the assigned textual readings in the library. I recommend the following method of reading the materials to minimize the amount of time you need to spend on them.

1. Find a quiet corner away from the main routes. (You do not need to know the comings and goings of everyone in the library at this time.)

2. Orient your self to the materials first by reading the chapter headings and the summary/ summaries of the assigned reading.

3. Read the captions and look at the figures.

4. Then preview the text one more time, and this time also read the first line of each paragraph.

5. Now read the text. Because you have already oriented yourself to the materials, the actual reading should take less time than you might otherwise have spent on it.

11. Prior to the exam, use the study guide to re-assess whether you have learned the material, but do not depend on this guide as a quick way to cram.

12. Study Suggestions for Introductory Biology from other universities. Try some of the following links (available on line): E.G.: [University of Miami](#)

13. Talking or other disruptive behaviour during lecture will not be tolerated, and you may be asked to leave.

14. Academic dishonesty includes giving, receiving, or using unauthorized aid on any academic work. This includes a person who has taken a test discussing what was on a test with a person who has not taken the test. Any student guilty of cheating—including-- plagiarism will receive a grade of F.

Learning Support Center

The Learning Support Center (LSC) provides peer-directed academic tutoring for individuals and groups in the following areas:

- General Education courses
- Writing
- Reading
- Math Development and college level math
- Academic Coaching

The primary emphases are promoting active learning strategies, encouraging student engagement, and providing content support. Academic support is provided to students who are seeking assistance with understanding course concepts and preparing assignments, along with developing an improved learning system for college which includes motivation, academic engagement, brain-based habits for college learning, and learning strategies for note taking, textbook reading, and test taking.

Tutors are graduate and undergraduate students who are carefully selected on the basis of their own academic achievement by faculty and given supervision, training, and support to serve as

tutors, mentors, and academic coaches. Additionally, the LSC provides all NEIU students an area for learning groups and an opportunity to learn with other students. Appointments are strongly encouraged, and students are welcome to drop in to discuss their individual academic support needs.

For more information, visit the LSC website at www.neiu.edu/lsc or, to schedule an appointment with a tutor, call 773-442-4568.

Center for Academic Writing

The Center for Academic Writing (CAW) provides peer tutoring for students enrolled in officially-designated Writing Intensive Program (WIP) courses. WIP peer tutors, who are recommended by faculty and hired and trained by CAW, are affiliated with specific WIP courses and provide discipline-specific writing support. WIP peer tutors help students of all abilities become better writers by helping them focus on every step of the writing process - from brainstorming ideas, prewriting, and outlining, to drafting, revising, and editing. Students do not need to have a completed draft to meet with a WIP peer tutor. WIP peer tutors can provide the most effective help if students come early in the assignment process and return throughout the semester.

Students should speak with their WIP course instructor and/or contact CAW for more information about WIP peer tutoring. Information is available on the web at www.neiu.edu/caw. Students can stop by CAW on the fourth floor of the Ronald Williams Library or call 773-442-4492 to make an appointment.

Course Communication

All pertinent class communications between the instructor and students is conducted exclusively through NEIU e-mail. Thus it is the responsibility of students to check their NEIU e-mail account for all significant information and updates on class cancellations in the event of threatening weather conditions. Communication between the instructor and students via personal e-mail accounts (e.g., @gmail.com or @yahoo.com) will not occur.

Incompletes

An “I” (incomplete) may be given if a student is absent from the final examination or fails to complete a special research or individual study project because of some unavoidable circumstance such as illness.

Students will have two semesters (including Summer) after the incomplete grade has been assigned to remove the incomplete. Incompletes that have not been removed within two semesters will be changed to an “F” grade. This policy does not apply to Thesis Seminars or master’s project seminars.

MAKE UP AND LATE POLICY: To accommodate for online learning and the health and familial responsibilities of the Corona pandemic, you are permitted ONE late submission on an exam or quiz without a penalty. Everyone gets to make up ONE quiz or exam without an excuse up to two weeks late (one quarantine period). *A second missed quiz must have a verifiable excuse.* If you do not use this benefit by the end of the semester, you can use this option to retake an exam or quiz during the week before the final. THERE CAN BE NO MAKE-UPS OR EXTENTIONS ON THE FINAL EXAM!!!!

Additional Late Work Policy Late work is strongly discouraged. Turning in work late can impair your chances of success in the course. This late work policy applies to all graded assessments (including the final examination) in the course. Because class discussions require us all to participate during the week when they are active, no make-up or late credit will be allowed for discussion participation. I understand that unexpected things can come up, so the late-work policy for our course is outlined below.

Serious Emergencies: For serious emergencies beyond your one late pass, your instructor will decide whether your late work may be accepted for full or reduced credit. Serious emergencies include things like verifiable serious illness, accidents, natural disasters, and university server outages. E-mail your instructor the information about your emergency *and with verification*. and request approval to make up the assignment, lab, quiz, or exam. If you receive approval, make up the work according to the plan set by you and your instructor.

All Other Unexcused Late Work: Unexcused late work includes course work that is turned in late because of things like job-related, technical, or other personal issues. Your instructor will decide whether your late work may be accepted. *Your instructor (Readey) will impose a per diem late penalty of 5% of the assignment points per day, up to seven days. After seven days, the assignment will be recorded as a zero percent.* To request an extension on an assignment, please request approval BEFORE the final deadline.

Submission of Assignments: Students are expected to complete all assignments on time. Failure to submit any assignment will result in a zero on that assignment and an additional deduction of 10 points per missing assignment. If homework solutions are shared with the class, your instructor reserves the right to decline to accept late work after the sharing of the solutions, or to require that an alternative assignment be completed, if one is available. Only one unexcused, non-emergency late submission will be allowed per student per course.

Submission of Materials

Final Written assignments will be submitted electronically *and* as a typed copy. Any student file submitted electronically that does not meet the requirements listed will not be graded. Please ensure that files are

- appropriately named (last name-Document title), (Do not simply label your paper "Invertebrate Zoology Paper". I may get up to 24 papers with that same title!)
- Label your paper with your *Name-Date-Topic* format.
- submitted in Microsoft-Office format (e.g., .doc, .xls., .ppt),* and
- submitted to the corresponding Dropbox folder.
- Up until the final submission, I will willingly work with you on google docs to help you get your paper in shape.

While you are not required to use Microsoft Office products, please ensure your productivity applications are able to import/export into the compatible file

Final Notes on the Biomimicry Projects:

Biomimicry is a relatively new branch of science that combines engineering, physics, and biology. This spring will be the first semester I have assigned a biomimicry project. This semester you will be doing a biomimicry or bio-inspiration project that focuses on your ability to apply what you learn about invertebrate anatomy and physiology to commercial or engineering applications.

For the first part of your project, you will choose a branch of biomimicry using the chart of biomimicry taxonomy that I will provide, or by exploring the books provided in the library. I prefer that you take a physical rather than a chemical approach to the project. You get chemistry in many of your other classes. Our curriculum introduces you to little to no biophysics or bioengineering outside this classroom. (This proviso does not mean you cannot discuss molecules-- but try to look at them from their physical properties, not just their chemical composition.)

The first part of the project should be an overview of how different organisms approach a problem of life not addressed in class, or a refinement and an extension of one of the problems explored in class. You will develop a reference list, a paper, and a presentation on any aspect of biomimicry. The presentation should be approximately 10 minutes in length. It should present the engineering or commercial problem, how industries normally approach that problem, and how a biomimicry approach could approach the problem. Show how specific clades of organisms solve this problem! *NB: You do not need to solve all the engineering or mathematical hurdles to do this project: Just present the approaches used and/or feasible ones.*

You will earn points for both the presentation at this time. The remaining points will be based upon your research and on your paper. Grammar, style, and content all count toward your point total.

You will use your research base to go in one of two directions. Either you can focus on a bioengineering or biomimicry you chose for the first half, or you can start over based upon something else that has captured your imagination during the semester. (I recommend the former because most of the background research would already be completed.) This project allows you to explore your own creativity in this field. *It is unlikely that you will develop a new technology in your first attempts at this new field, so do not be too worried about being scooped!* However, in case you do develop a really cool new million-dollar idea, be assured that this part of the project is not part of your class presentation! (I can point you in several directions should you solve the battery storage problem or find a cure for Alzheimer's.)

I expect you to keep me in the loop as you work. (I do have a bit more information readily available than you probably have at your command.) I can point you in different directions, recommend search patterns, or help you expand or limit your focus. If you do not keep me in the loop and you simply reinvent the wheel, you will not get a good grade. If I also miss the relevant materials on line, you have an excuse to fall back upon!

Final Examination Schedule Spring 2019

Examination Periods	Tuesday, May 10, 2022	Wednesday, May 11, 2022	Thursday, May 12, 2022
	Class Time During the Term	Class Time During the Term	Class Time During the Term
8:00-9:50 a.m.	9:25-10:40 a.m. TR	8:30-9:20 a.m. MWF	8:00-9:15 a.m. TR
10:00-11:50 a.m.	12:15-1:30 p.m. TR	9:30-10:20 a.m. MWF	10:50-12:05 p.m. TR
12:00-1:50 p.m.	12:55-2:10 p.m. MW	10:30-11:20 a.m. MWF	8:00-9:15 a.m. MW
2:00-3:50 p.m.	1:40-2:55 p.m. TR	11:30-12:20 a.m. MWF 11:30-12:45 p.m. MW	2:20-3:35 p.m. MW
4:00-5:50 p.m.	4:15-5:30 p.m. TR 4:15-6:55 p.m. T	4:15-5:30 p.m. MW 4:15-6:55 p.m. M	4:15-6:55 p.m. R
6:00-7:50 p.m.	5:40-6:55 p.m. TR	5:40-6:55 p.m. MW 4:15-6:55 p.m. W	7:05-8:20 p.m. MW 7:05-9:45 p.m. W
8:00-9:50 p.m.	7:05-9:45 p.m. T 8:30-9:45 p.m. TR	8:30-9:45 p.m. MW 7:05-9:45 p.m. M	7:05-8:20 p.m. TR 7:05-9:45 p.m. R

Final examinations for **Saturday** only classes: **Saturday, May 14, 2022** at the same time and place as class meetings during the term.

Final examinations for **Friday** only classes: **Friday, May 13, 2022** at the same time and place as class meetings during the term.

If the University is officially closed or not conducting business during the scheduled examination period, examinations will be at the same time and in the same location as follows:

Tuesday, May 10, 2022 Exams	held on Monday, May 16, 2022
Wednesday, May 11, 2022 Exams	held on Tuesday, May 17, 2022
Thursday, May 12, 2022 Exams	held on Wednesday, May 18, 2022

If a student identifies a schedule conflict affecting a formal examination, (s)he should contact the professor within two weeks of the beginning of class to make alternative arrangements for taking the examination. Reasonable accommodations will be made if: a) the conflict arises because of a religious belief, or b) the conflict is created by the examination pattern.

Please note that in recent memory, the university had to use these alternative days because of excessive closures due to extreme weather during the semester and once to make up for the doubled spring break at the beginning of the Covid-19 pandemic. Keep these dates open!