Biol 111: Comparative Vertebrate Anatomy

Clark University
Spring 2014
Lecture: Lasry 237
Lab: Lasry 150
Office Hours: Thurs 10:15-11:15
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Assistant Professor, Clark University
Simpson Postdoc, University of Arizona (2000-2010)
Ph.D. University of Massachusetts Amherst (2008)

Philip Bergmann - Research
The evolution of body shape and segmentation
- Evolution of vertebral number and diversification
- Evolutionary correlates of body shape
- Growth of segments/vertebrae
Primary focus is lizards
Phylogenetic perspective

Philip Bergmann - Personal
Canadian
Parents Czech
Interests:
- Road Biking
- Climbing
- Yoga
- Running
- Hiking
- Cooking
- Reading

Topic 1: Introduction
- Instructors
- Syllabus
- What is comparative anatomy?
  - Worksheet
  - Approach
  - Anatomical directions
  - Some examples

TA: Gen Morinaga
E-mail: gmorinaga@clarku.edu
Office: Anatomy Lab
Office hours:
- TBA
- Or by Appointment
B.S. University of California Santa Cruz
Functional morphology and ecology of lizards
Biol 111 Syllabus

Textbooks
- Functional Anatomy of the Vertebrates, 3rd Ed.
- The Dissection of Vertebrates, 2nd Ed.

De Iulis & Pulera 2010
Liem et al. 2001

Biol 111 Syllabus – Grades

Lecture
- Midterm 1 – Feb 6
  - 100pts, 10% of grade
- Midterm 2 – Mar 11
  - 100pts, 10% of grade
- Midterm 3 – Apr 3
  - 100pts, 10% of grade
- Final Exam – TBA
  - 200pts, 20% of grade

Total
- 1000pts
- 100%

Laboratory
- Lab Exam 1 – Feb 25, 27
  - 120pts, 12%
- Lab Exam 2 – Apr 22, 24
  - 120pts, 12%
- Graded Dissection
  - Mar 25, 7
  - 100pts, 10%
- Lab Quizzes – ongoing
  - 60pts, 6%
- Lab Participation
  - 100pts, 10%

Biol 111 Syllabus

Lecture Exams
- 75 minutes
- Midterms during lecture
- Fill-in-the-blank
- Short Answer
- Long answer (up to 1/4 page)
- Half of Final will be cumulative

Laboratory Exams
- ~90 minutes
- During lab time
- Timed stations with demo material
- Fill-in-the-blank
- Short answer
- Not cumulative
- Will be given a term list

Graded Dissection
- Shark brain and cranial nerves
- One week to do it
- Quality of dissection
  - Undamaged
  - Clearly visible

Lab Participation
- Show up
- Do the dissections
- Participate in discussions
- Complete your lab worksheets

Biol 111 Syllabus

Expectations
- Show up to lecture and lab
- Do the dissections
- Ask questions
- Be engaged
- Work hard
- Come to open lab**
- Open Lab Policy
  - By request (to TA or Professor)
  - During week or weekend
  - Lab closed 45 min before a scheduled lab
  - Day prior to lab exams

Biol 111 Syllabus

Other topics
- Class schedule
  - In syllabus
  - Lists topics and chapters relevant to each lecture
- Plagiarism
  -Copying, cheating, not citing sources
  - DON'T DO IT!
What is Comparative Anatomy?

1. What is comparative anatomy?
2. What is functional anatomy?
3. What kinds of things can these fields tell us?
4. What kind of evidence or data do they use?
5. Why take this course?

We can combine these approaches to study how a phenotype works in different organisms.
Approaches to Comparative Anatomy

- Regional
  - Head
  - Thorax
  - Abdomen
  - Limbs
- Taxonomic
  - Fish
  - Amphibian
  - "Reptile"
  - Mammal

Ten Vertebrate Organ Systems

- Integumentary
- Skeletal
- Muscular
- Nervous (incl. sense organs)
- Endocrine
- Digestive
- Respiratory
- Circulatory
- Excretory
- Reproductive

Anatomical Directions

- Directions/ Positions
- Planes of section
  - Sagittal Plane
  - Transverse Plane

For humans, planes are the same. Directions are different. Why? Yes.

- Dorsal = ___________
- Ventral = Anterior
- Anterior = ___________
- Posterior = Inferior
- Crania = ______
- Posterior

Functional Anatomy – Bird Flight Muscles

- Which muscles are involved in bird flight?
- What is role of:
  - m. pectoralis major
  - m. supracoracoideus
  - m. scapulohumeralis

For Downstroke:

- m. pectoralis major
- m. supracoracoideus
- m. scapulohumeralis

End of Downstroke

For Upstroke:

- m. supracoracoideus
- m. scapulohumeralis

End of Upstroke

Functional Anatomy – Cell Morphology

- Nucleus in the middle
- Mitochondria for ______
- Contractile Sarcomeres
- Nucleus out of the way

Skeletal Muscle

Intestinal Epithelium
The evolution of hearing

- Swimbladder increases sensitivity to low frequency vibrations
- Weberian ossicles increase frequencies heard and

Comparative Functional Anatomy –
Inner Ear Morphology

- Comparing structure between species
- Known evolutionary relationships
- Increasing complexity of structure gives:
  - Better sense of ______
  - Better sense of head ______

Comparative Functional Anatomy –
The evolution of hearing

- Hearing in fishes:
  - Swimbladder resonates
  - Vibes deform window
  - Vibes transmitted via Weberian ossicles to fluid in sinus impar
  - Vibes finally go to endolymphatic sac and inner ear
  - Ligaments increase of the system

Comparative Functional Anatomy –
The evolution of hearing

- Fish diversification:
  - Fish being able to detect vibrations with high acuity is important to survival
  - Weberian ossicles are an adaptation for this
  - Taxa with Weberian ossicles are more diverse

Comparative Functional Anatomy –
The evolution of hearing

- Bones switch function from jaw suspension to hearing.
- Hearing acuity increases with ratio of tympanum SA to columnella footplate SA.
- Malleus and incus act as lever system to further increase acuity.

Comparative Functional Anatomy –
Important bones in the fish skull

Liem et al., 2001, Fig 22-3
Liem et al., 2001, Fig 22-4A
Liem et al., 2001, Fig 22-6
Liem et al., 2001, Fig 7-9A
Liem et al., 2001, Fig 12-16 (modified)

1/9/2014