

# Bite of Science



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ROANOKE COLLEGE

Center for  
Excellence in  
Education



# Who Am I?

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BS: Biology, Roanoke College

MPhil: Human Evolutionary Studies, University of Cambridge

PhD: Integrative Anatomy, University of Missouri

Certificate: Science Outreach

3 years full-time teaching experience

2 years Clinical Anatomy

1 year undergrad A&P

Evolutionary Biologist

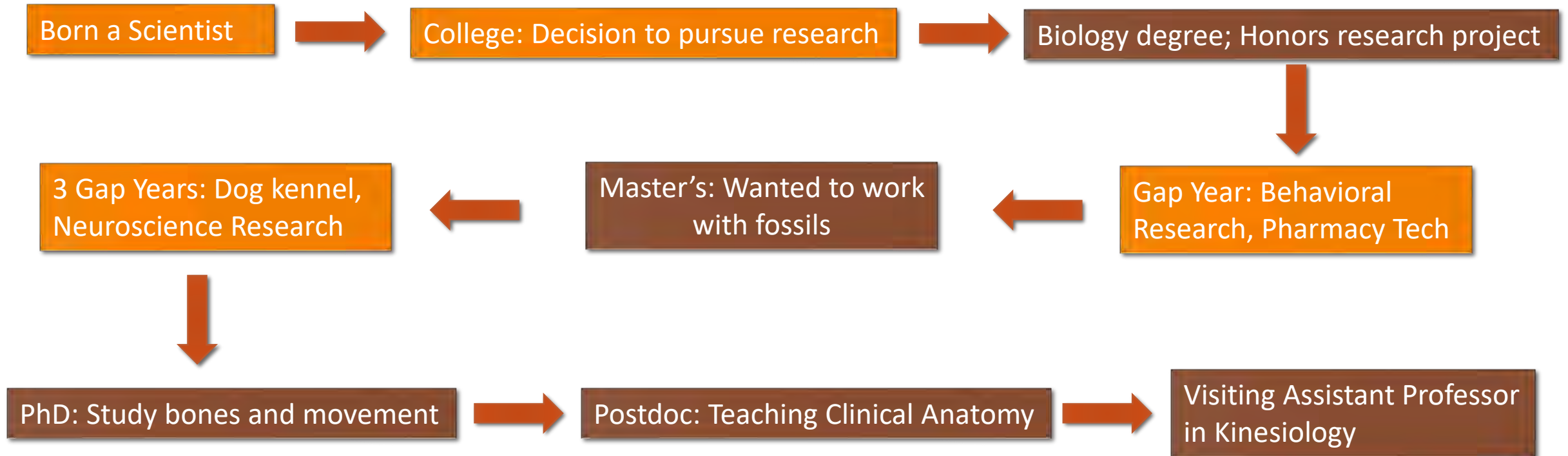
Anatomist

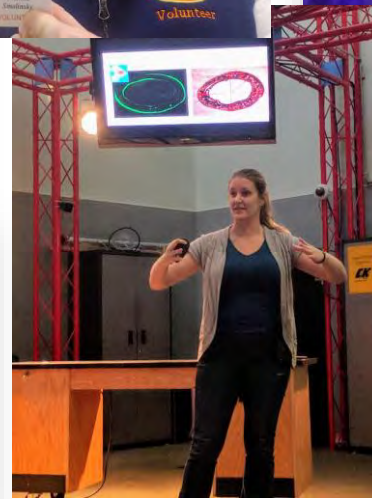
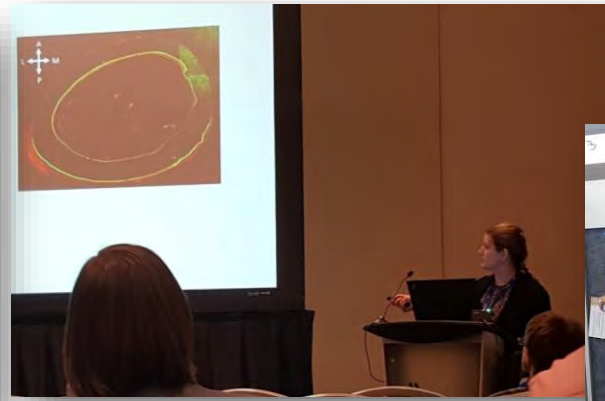
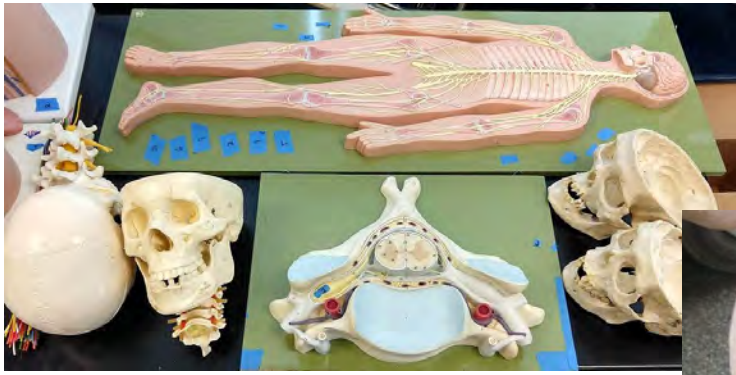
Functional Morphologist

Specializing in Locomotion and Skeletal Biology

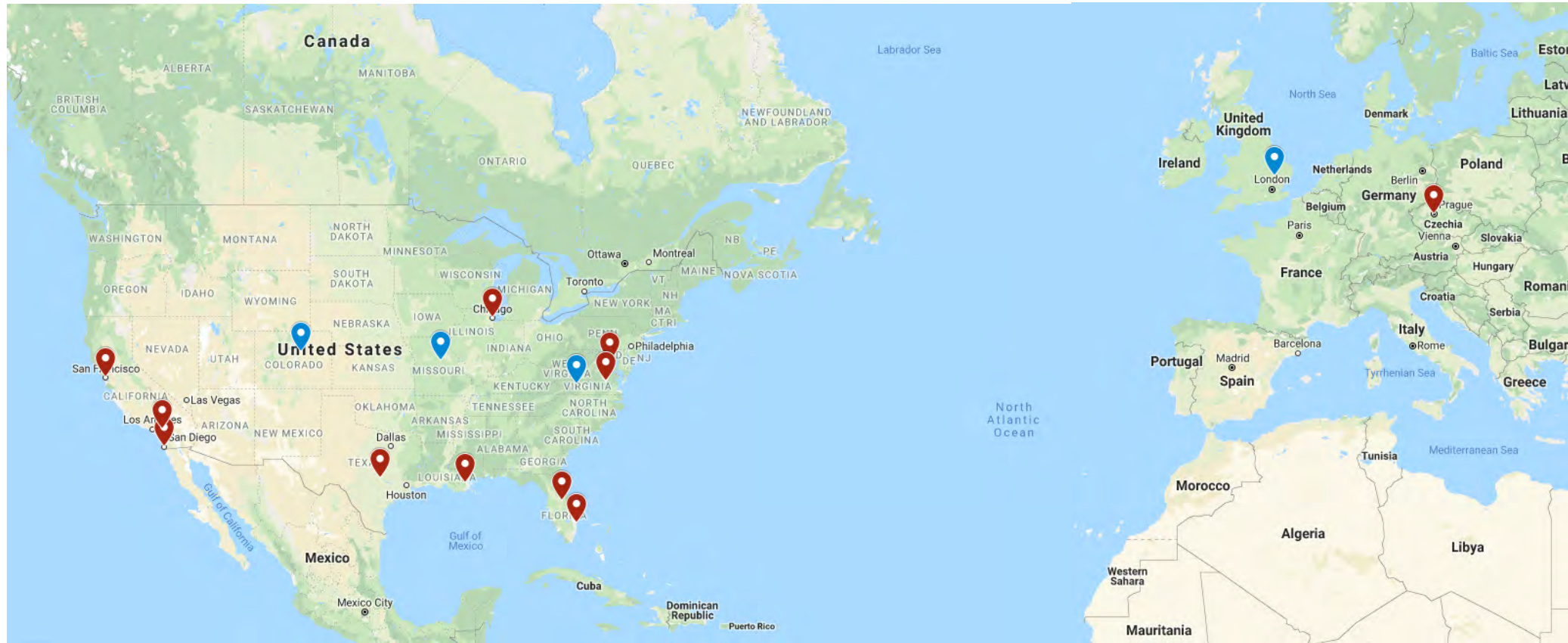
# My STEM Story

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# Oh, The Places You'll Go...



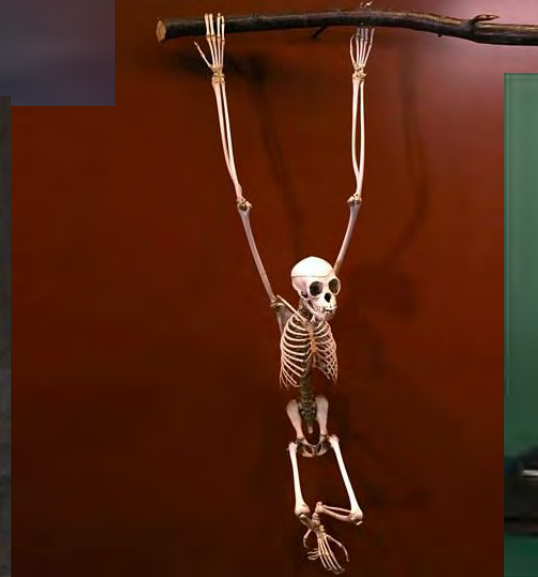
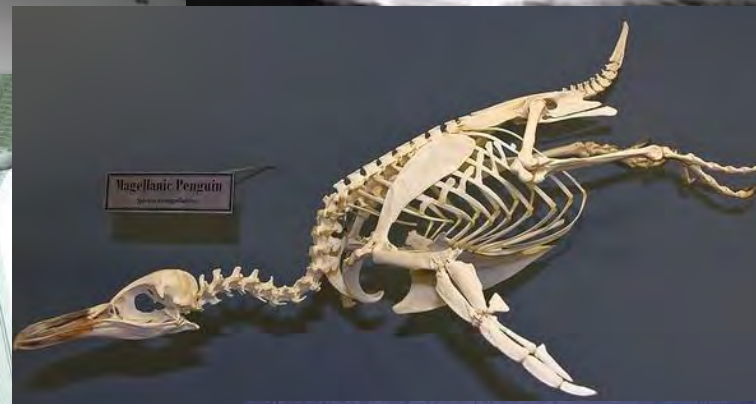
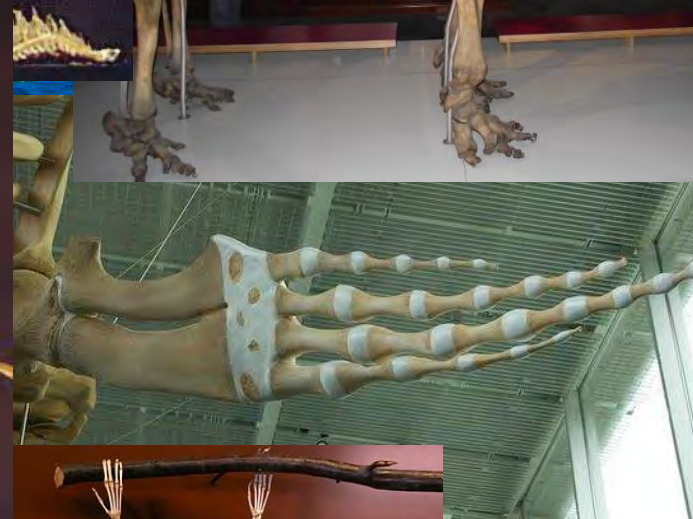
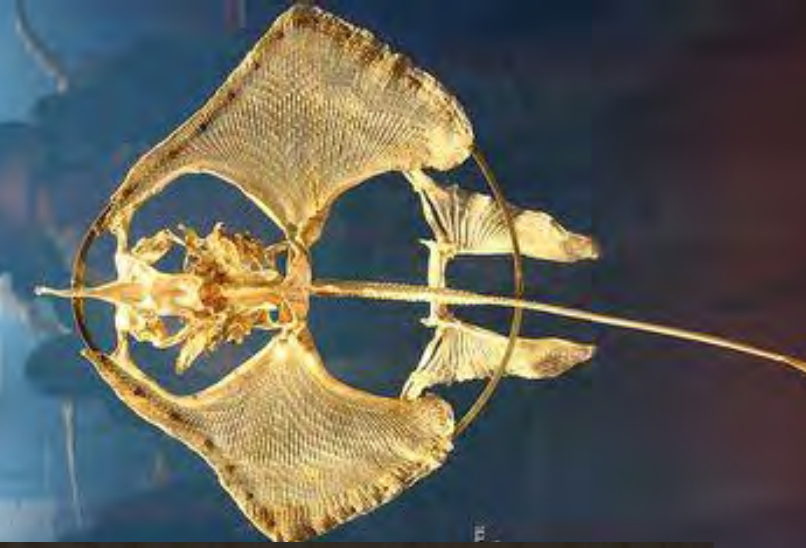
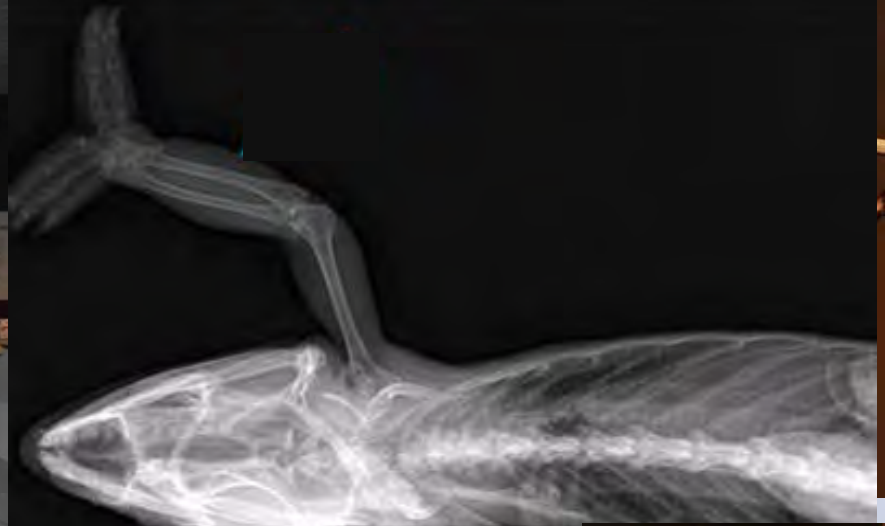
 School/ Work  Scientific Meeting/ Research Work

# Scientific Research

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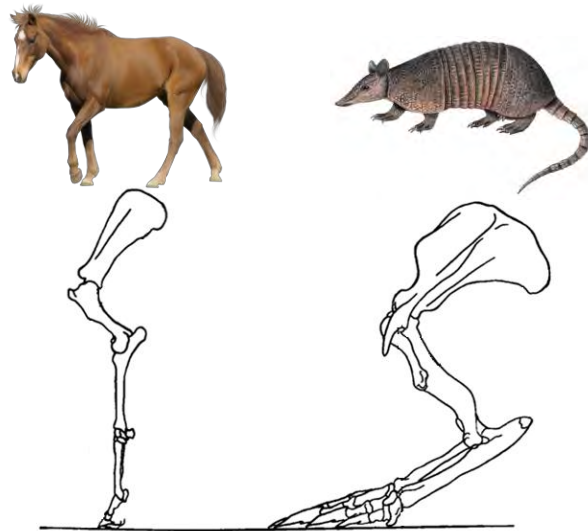
- Job requirements beyond teaching
  - Conduct scholarly research, bring in grant money
  - Publish papers and present at scientific conferences
  - Mentor students in research experiences



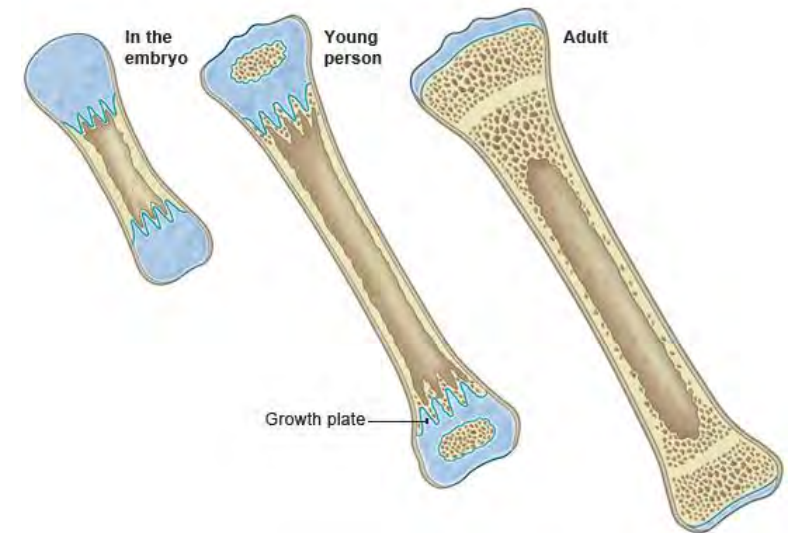
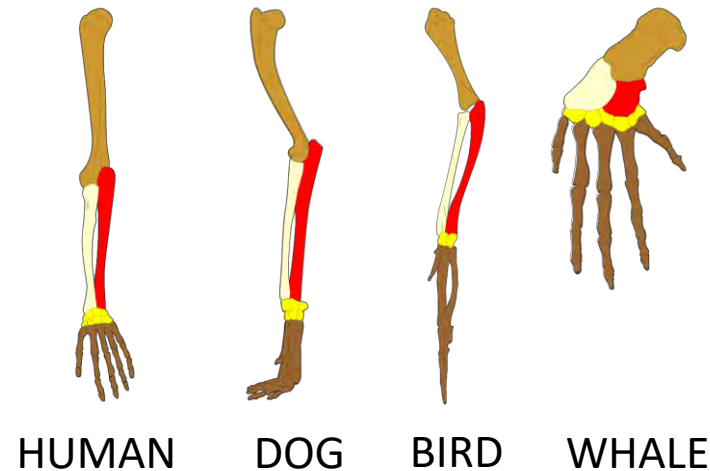


# Research Interests

- What does the shape of a bone tell us about how an animal moved around?
- How do bones change as animals adapt to new environments?
- How do bones grow and change over an animal's life time?



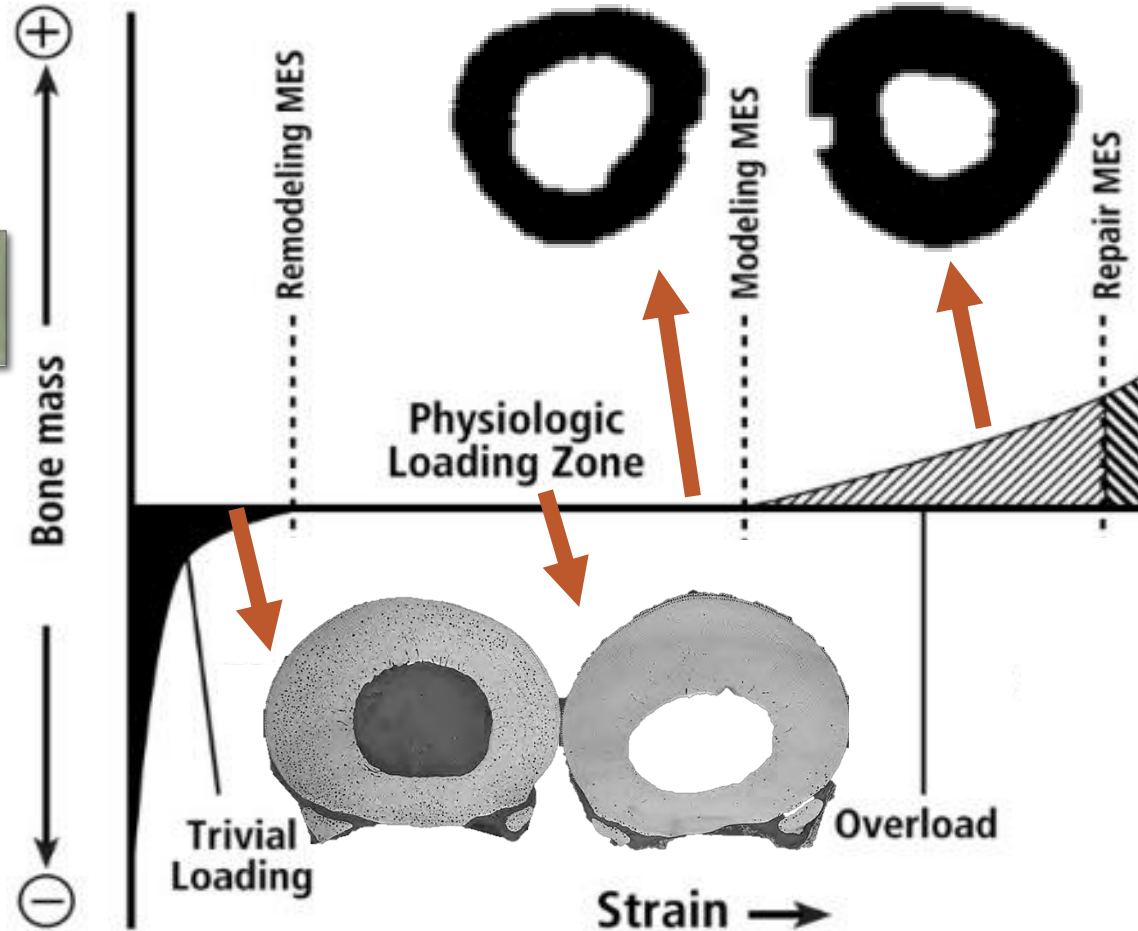
Maynard Smith and Savage,  
1956. Zool J Linnean Soc





# Bones are Mechanically Sensitive

Bones can sense and adapt to physical forces placed on them



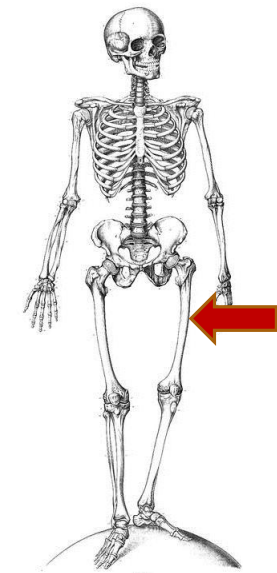
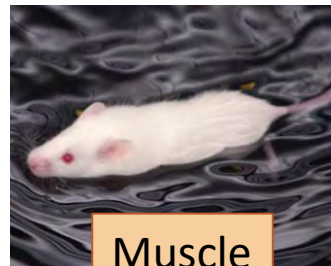
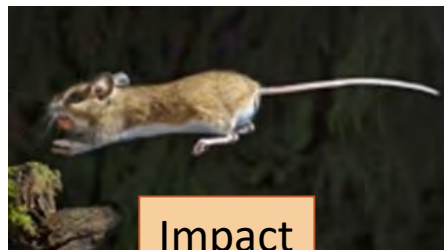
# Which Exercise Grows the Strongest Bones?

**Observation:** Bone changes in response to locomotion/ exercise

**Hypothesis:** High-impact exercise will cause bones to grow stronger than muscle-driven exercise

**Experiment:** Using mice, observe the effects of type of exercise on bone shape and density

**Control Group:** Bone shape in mice with no exercise

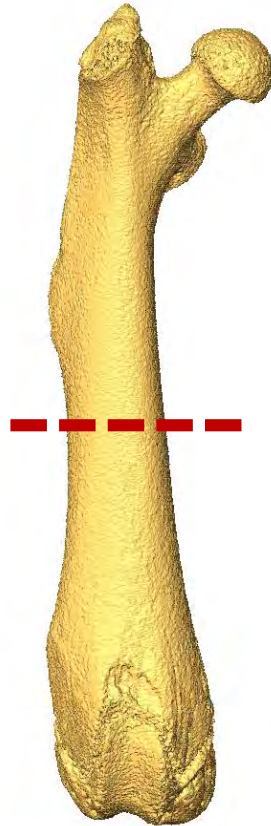


# Project Methodology

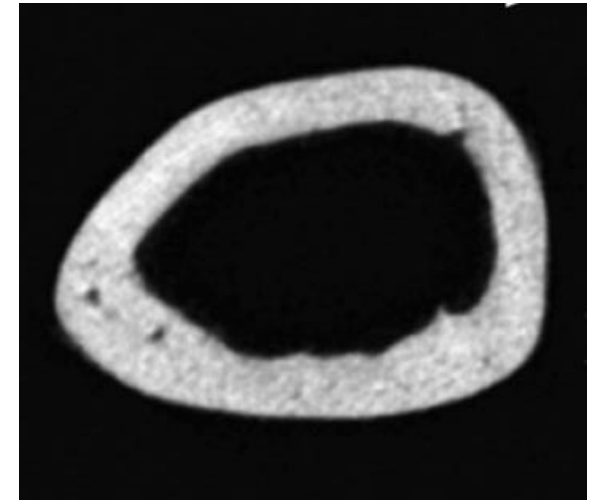
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micro-CT  
scan



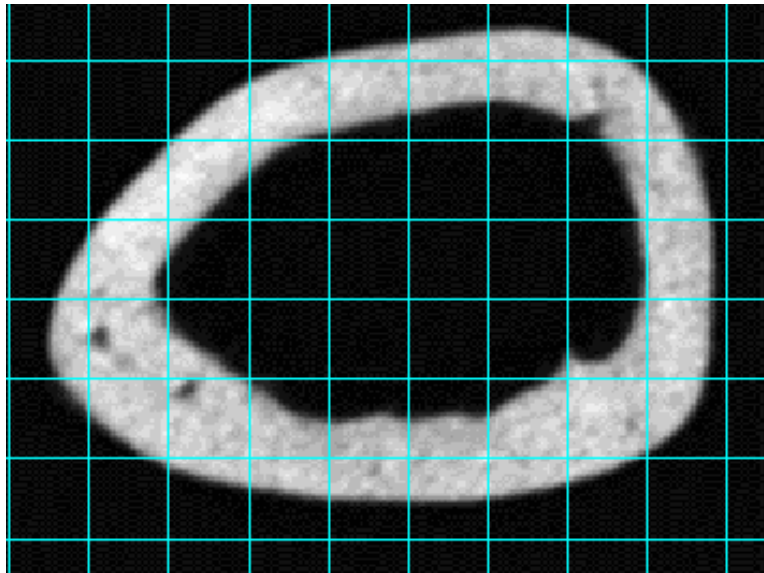
Extract  
cross  
sections



# Measurements

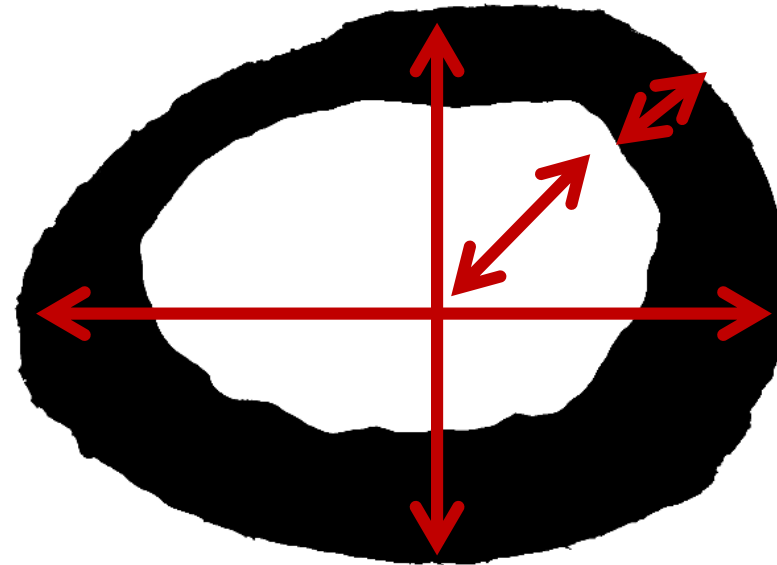
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CT Slices



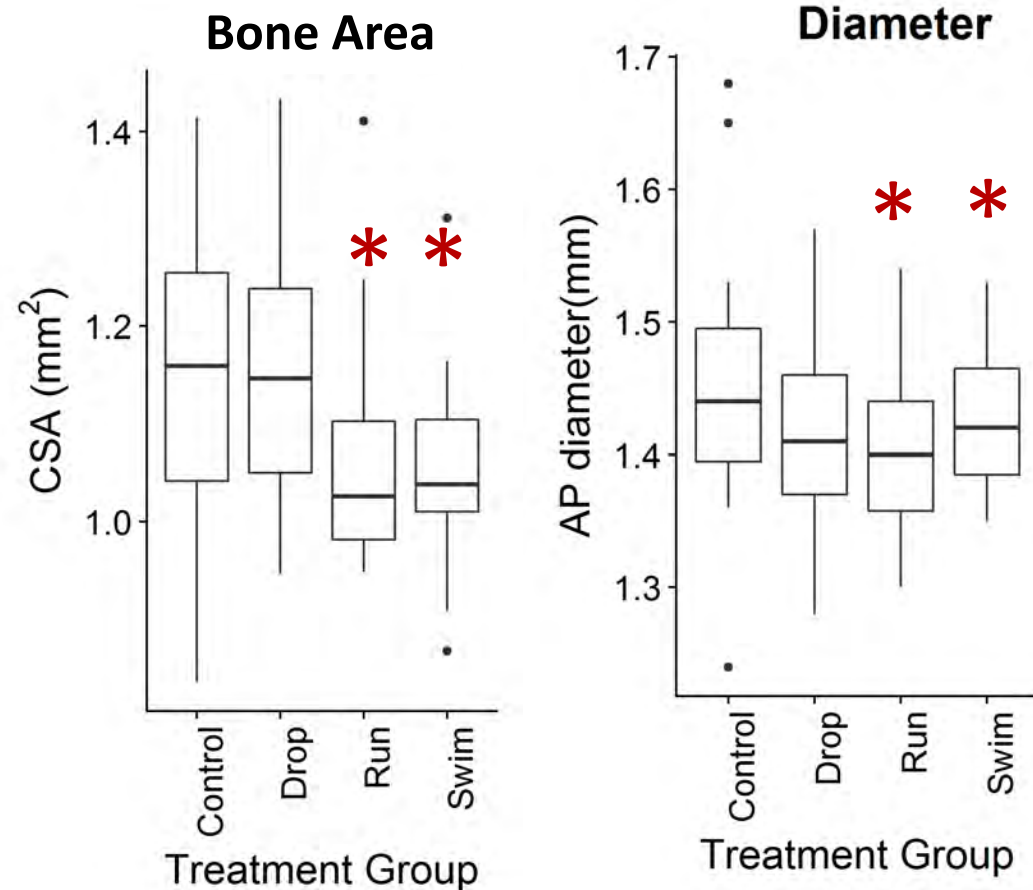
- Bone mineral density

Image Silhouettes

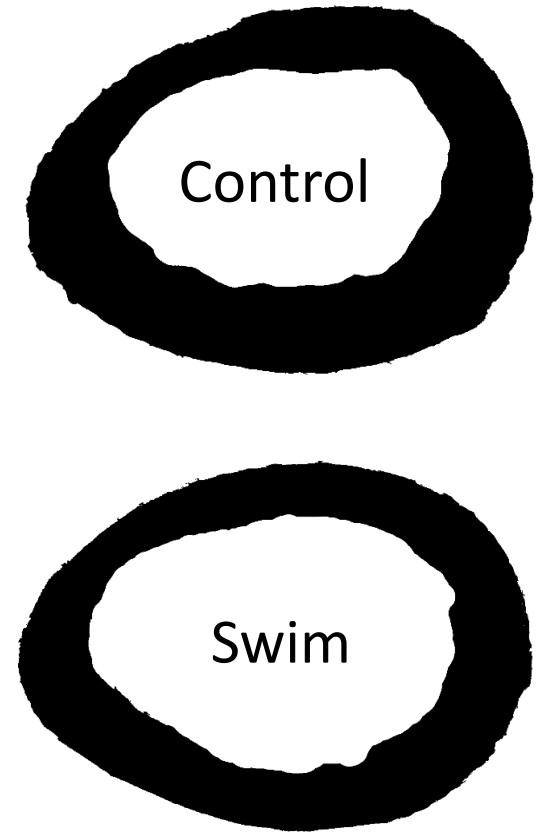


- Structural strength

# Geometry Results

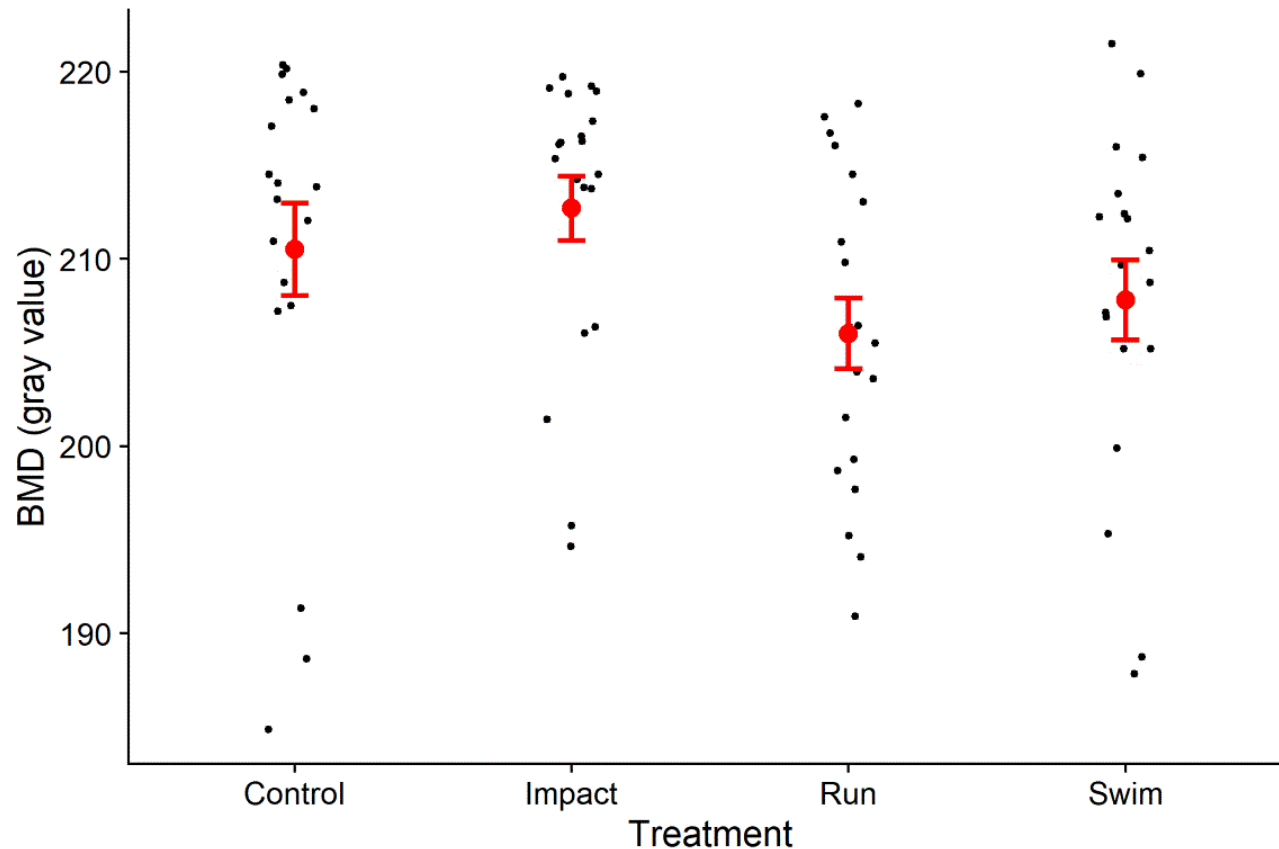


Running & swimming led to smaller, thinner, bones



# Bone Density Results

**Bone Mineral Density After Exercise**

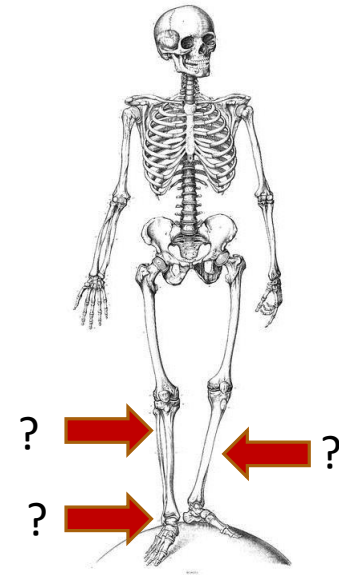
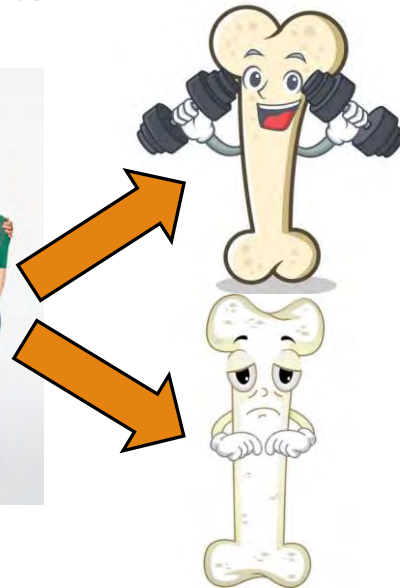


No significant changes  
in bone density

↓ Structural Strength  
= Mineral Density  
→ Weaker Bones

# Interpretations and Future Directions

- Our study found weaker bones after exercise, but others have found that exercise can increase bone strength. Genetics must be playing a role in how bone responds to exercise.
- Maybe the femur isn't a good place to look for these changes. Checking other limb bones may yield different results.



# STEM Skills in Anatomy and Research

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## “Science” Skills

- Creative and critical thinking
- Experimental design
- Using logic to troubleshoot problems
- Making and interpreting graphs
- Drawing conclusions from data
- Constructing an argument supported by evidence
- Thinking in 3D using 2D images

## Non-technical Skills

- Time management
- Organization
- Study skills
- Efficient use of references

## Knowledge

- Chemistry, math, physics, writing
- Big picture biology principles
- Spreadsheet & word processor software



# Experiences for Future Biologists

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- Volunteer opportunities
  - Museum collections preparation or Fossil digs
- Science- or health-themed community or after school programs
- Classroom outreach, e.g. Skype a Scientist (<https://www.skypeascientist.com/>)
- Encourage students to consider colleges with undergraduate research experiences
  - Look for “UROP” on the school website
  - Explore faculty webpages to learn what projects are available
- Roanoke College Research Fellows Program: <https://www.roanoke.edu/researchfellows>
  - Apply as a HS Senior, join as a College Freshman, receive a small scholarship & \$\$\$ to do research

# Thank You For Your Time!

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Roanoke College

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