Locomotion
Paper Guidelines

• Entire paper will be 5-7 double spaced pages (12 pt font, Times New Roman, 1 inch margins) without figures (but I still want you to include them, they just don’t count towards page count)

• Include a title

• Introduction and methods will follow the same guidelines as for the draft
  • Methods and all sections following will be in the past tense (because when you hand in your paper, you already did your collecting and analysis!)

• Results
  • One subsection per experiment and/or analysis. It really helps to reference figures in this section (graphs, maps, etc.)
  • For complex data sets, highlight the data that agrees with and disagrees with your hypothesis

• Discussion
  • It helps to have a subsection per experiment and/or analysis, not but required
  • Here you must discuss the implications of your results on your hypothesis, and put forth new ideas as to what may explain your results

• Literature cited section at the bottom should be in APA format for the final paper
Presentation Guidelines

• 12 minute PowerPoint, leaving 3 minutes to answer questions

• Between 8-15 slides, but there is no slide requirement

• Presentations will be graded by….

  • Content
    • Follow the format: introduction, methods, results, discussion
    • Did you ensure to include all the important results from your research paper?

  • Quality
    • Did you clearly spend time formatting your presentation in a compelling way?
      • No “walls of text”
      • Abundance of visual aides
      • Effective use of pictures

  • Clarity
    • Did you present your project in a way that was easy to follow and compelling?
    • Did you (and your partner) speak clearly and communicate effectively?
Locomotion

- **Locomotion** is movement that results in the organism changing place in 3-dimensional space

- Amphibians and reptiles have a wide variety of locomotion modes
  - Limbed locomotion (walking)
  - Saltatorial locomotion (hopping in frogs)
  - Limbless locomotion (many types in snakes)
  - Aquatic locomotion (swimming)
Limbed Locomotion

- Locomotion in salamanders, crocodiles, and lizards hasn’t changed much since the Devonian period (before dinosaurs evolved)

- Limbs are short and sprawled out, bodies are pressed to the ground and lifted to walk

- Movements are like undulations
Limbed Locomotion

• An animal’s **gait** is the pattern of footfalls it makes during locomotion.

• Most amphibians and reptiles use a **trot** or **lateral-sequence** gait to walk.
  
  • Trot: 2 points of contact with the ground.

  • Lateral sequence: 3 points of contact with the ground.
Limbed Locomotion

• What kind of gait is each animal using?

• Salamander

• Frog

• Lizard

• Turtle
Frog Walking

- Ancestral frogs were specialized for jumping

- Walking frogs and toads reverted back to a lateral sequence gait

- Shorter hind-limbs let toads walk or take small hops
Turtle Walking

• Turtles have problems with inflexibility
  • Ribs and vertebrae are attached to the shell
  • Limb movements are confined by small shell openings
• Steps in turtle walking (a modified lateral sequence gait)
  1. Lift shell vertically off the ground
  2. Move one limb at a time (lateral sequence gait)
  3. Slowly pitch and roll the body forward with each step
Saltational Locomotion

• Frog skeleton is specialized for jumping
  • Launching evolved before landing

• Skeletal Adaptations:
  • Launching:
    • Massive bones in the hind limbs, with massive muscles attached
    • Flexible hip bones for spring-like launch
  • Landing:
    • Head and spinal column are fused (no neck)
    • Thick bones in the pectoral girdle function
    • Shock absorption!
Limbless Locomotion

- Four types of limbless locomotion
  - Lateral undulation (serpentine)
  - Rectilinear
  - Concertina
  - Sidewinding
Limbless Locomotion: Lateral Undulation

- Each curve of the snake pushes against and away from the ground
- Requires rough ground or objects to push against (does not work on smooth surfaces)
Limbless Locomotion: Rectilinear

- Snake uses *gastrosteges* scales (belly scales) to inch forward (like a worm)

- [Video](#)
Limbless Locomotion: Concertina

- The snake “piles-up” in one spot, then shoots its head forward, then “piles-up” in the new spot
Limbless Locomotion: Sidewinding

- Snake travels at an angle going “backwards”
- Sections of the snake are lifted and moved over to a new segment parallel to the original segment
Aquatic Locomotion: Lateral Undulation

• Frog and salamander larvae use **lateral undulation** to propel themselves through the water

  • Provides thrust by pushing body against the water

  • The most primitive form of locomotion found in tetrapods

  • The basis of many other amphibian and reptile modes of locomotion
Aquatic Locomotion: Lateral Undulation

- Salamander larvae (and *Necturus maculosus* and adult *Notophthalmus viridescens*) quickly augment lateral undulation with walking-like motion
Aquatic Locomotion: Lateral Undulation

- Tadpoles are especially adept at lateral undulation
  - They lack vertebrae (they only possess a flexible notochord until metamorphosis)
  - Can quickly maneuver, but lack of fins severely reduces speed

- Frogs are most often preyed upon while in intermediate stages of metamorphosis
  - Unable to effectively swim away
  - Strong selection for extremely brief metamorphosis
Aquatic Locomotion: “Frog-kicking” and “Turtle paddling”

• “Frog-kicking” is a modification of the jumping movement, where webbed hind-limbs provide the majority of the thrust.

• “Turtle paddling” is a modification of the walking movement, where webbed fore-limbs and hind-limbs provide thrust using a lateral sequence gait.