# Locomotion

Wednesday May 17th 2017

# Announcements

- Methods draft due tomorrow (Thursday) at 9am
- Email (as usual)
    - Subject: Field Herpetology Results
    - File Name: LastName_Results.docx
- Materials and Methods
    - **Field Methods:** State how you will (or how you are) sampling your study species (different sites? different locations within sites? how many?), what you're measuring (counting? SVL? environmental factors?), etc.
    - **Data Analysis:** Once you've collected your data, you should test it for correlation and/or significance (can I fit a line to my data? can I test for deviation from neutral expectations?)
- A quick word on citations

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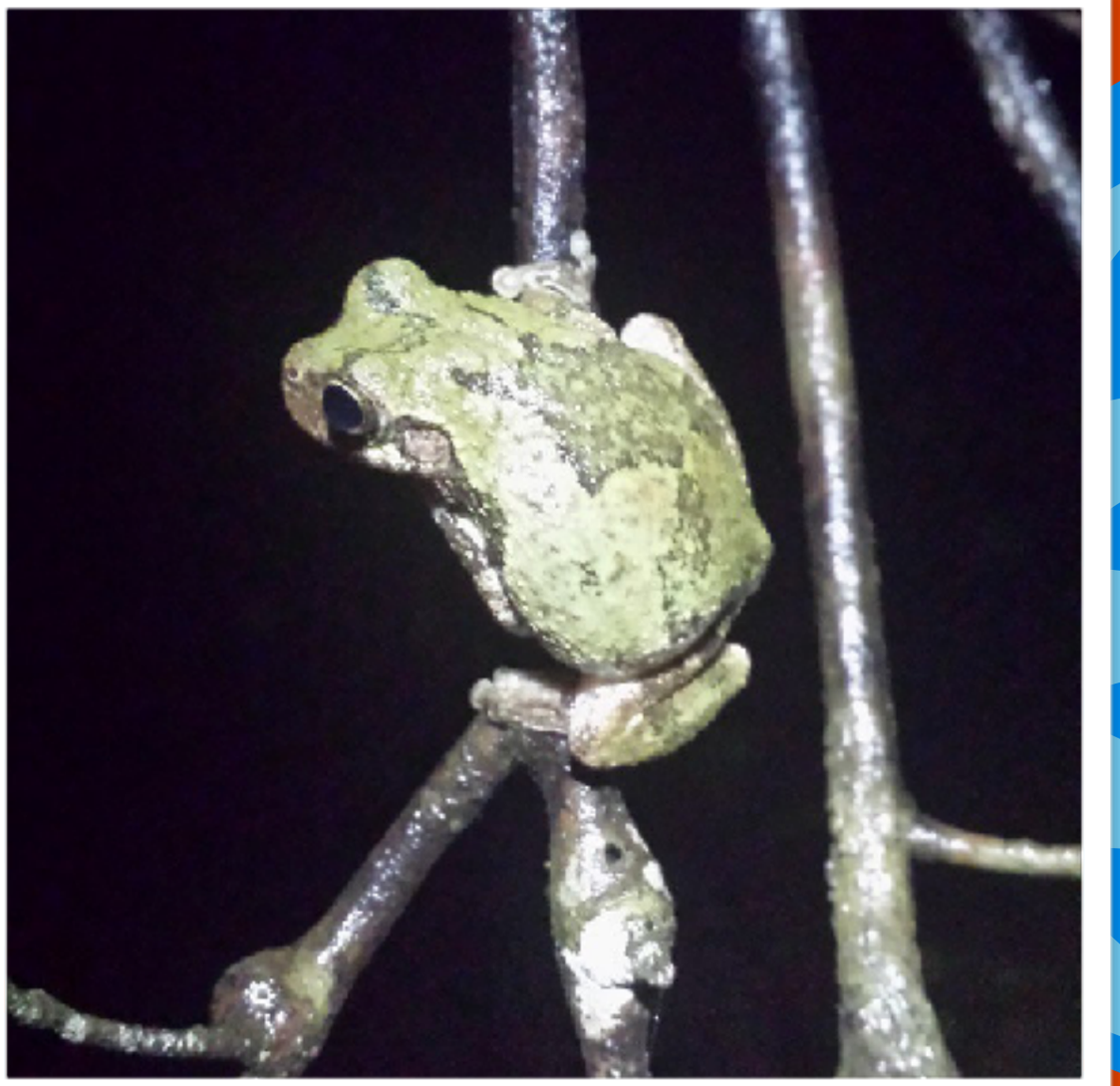
What kind of herp is this?



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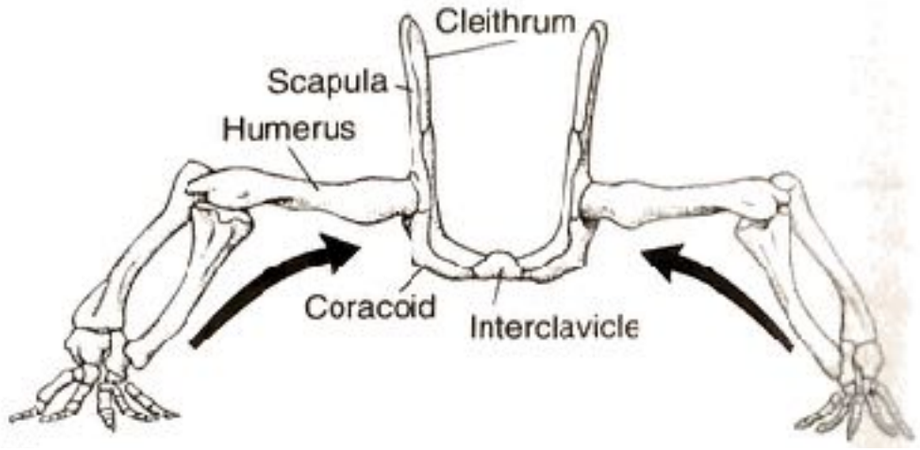
# Locomotion

- **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

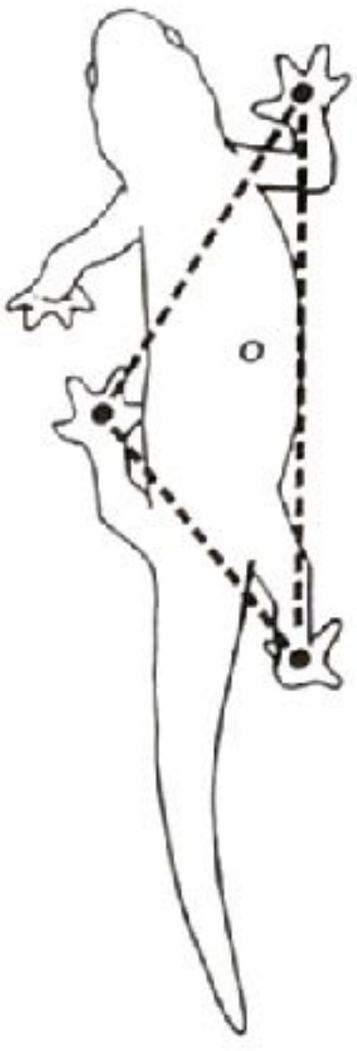
- An animal's **gait** is the pattern of footfalls it makes during locomotion

- 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

**Trot**



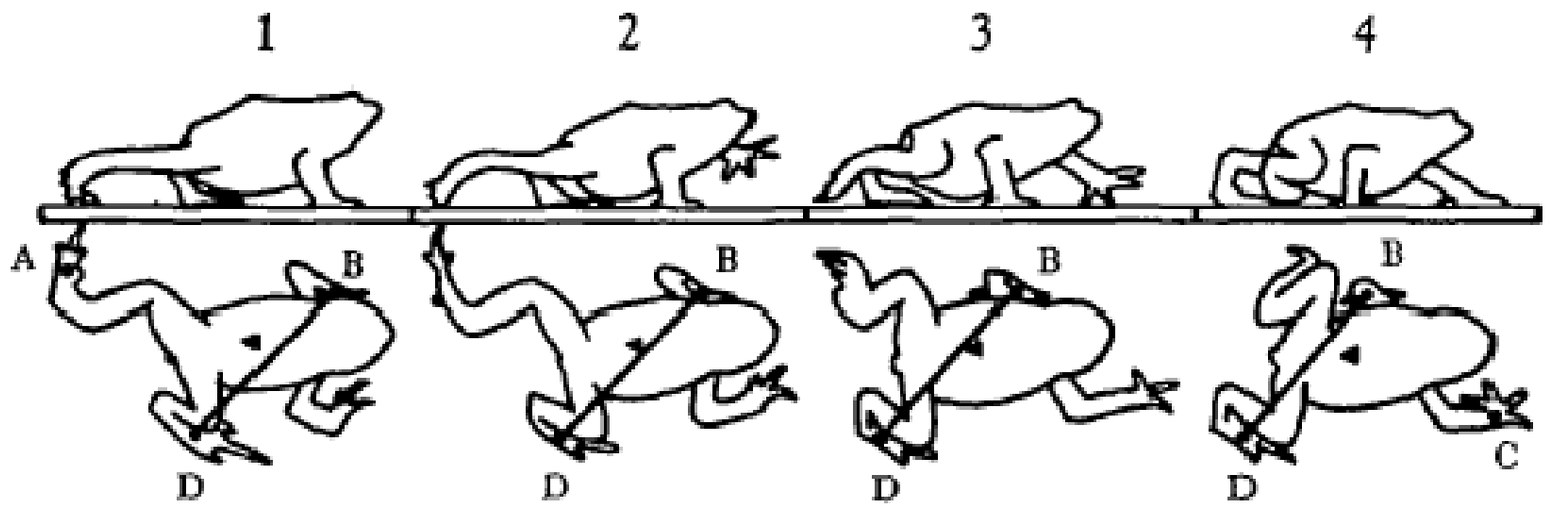
**Lateral Sequence**

# Limbed Locomotion

- **What kind of gait is each animal using?**
  - Salamander
  - Frog
  - Lizard
  - Turtle

# Frog Walking

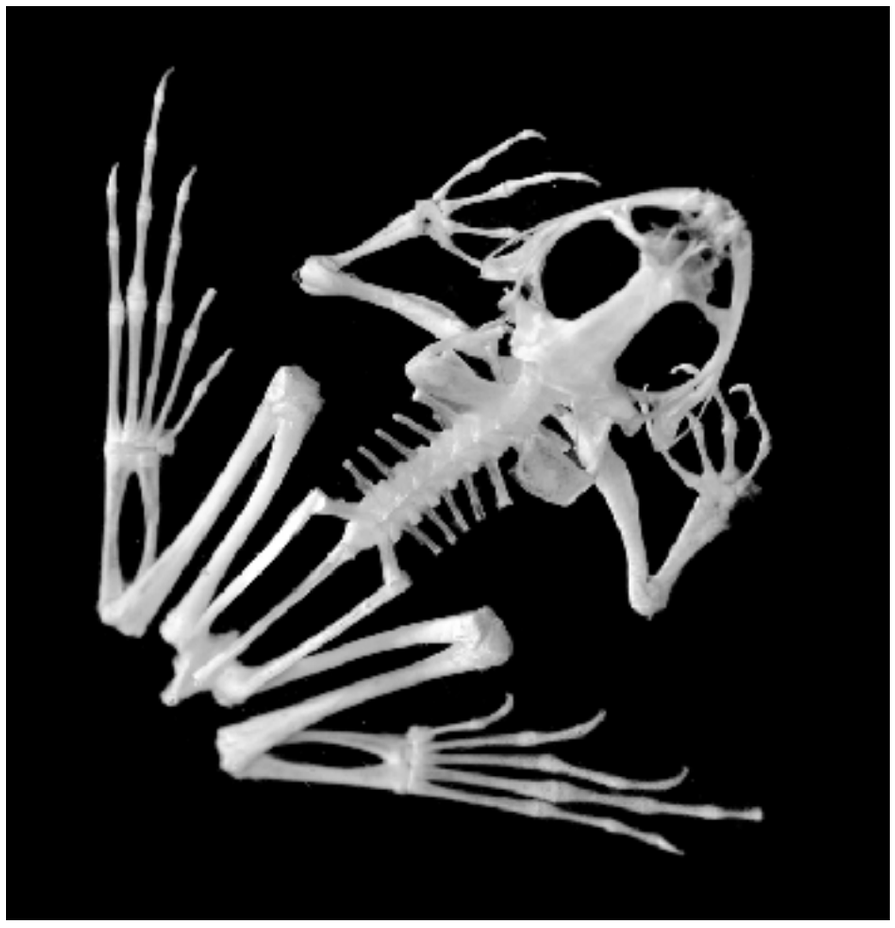
- Ancestral frogs were specialized for jumping
  - Walking frogs and toads reverted back to a lateral sequence gait
- Shorter hind-limbs let toads walk or take small hops



# 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

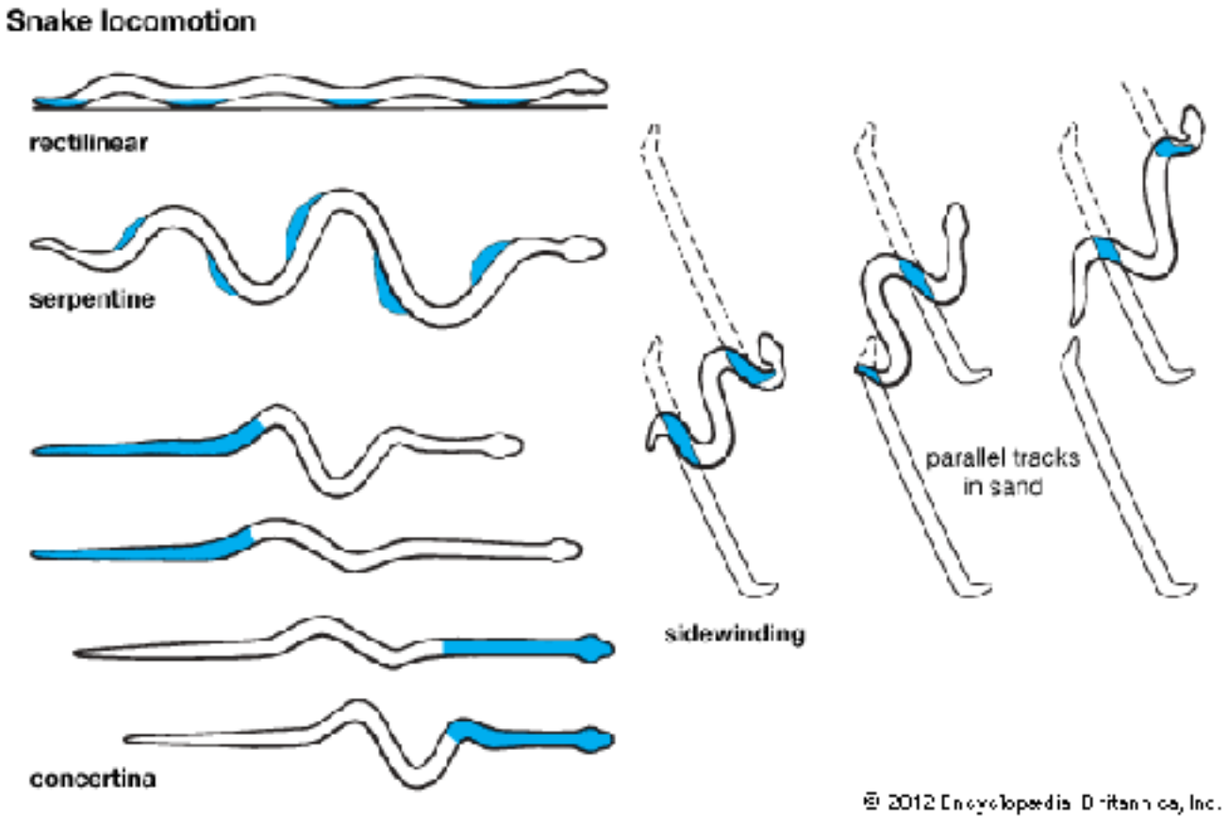
# Saltational Locomotion



- 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!

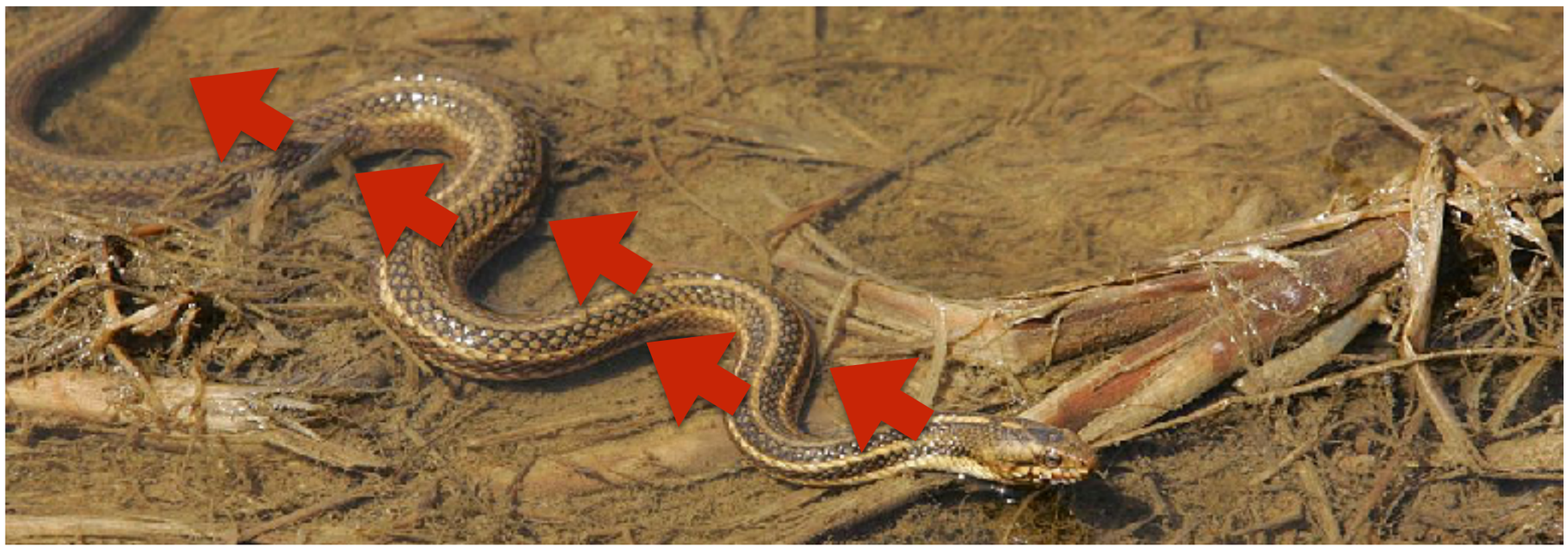
# Limbless Locomotion

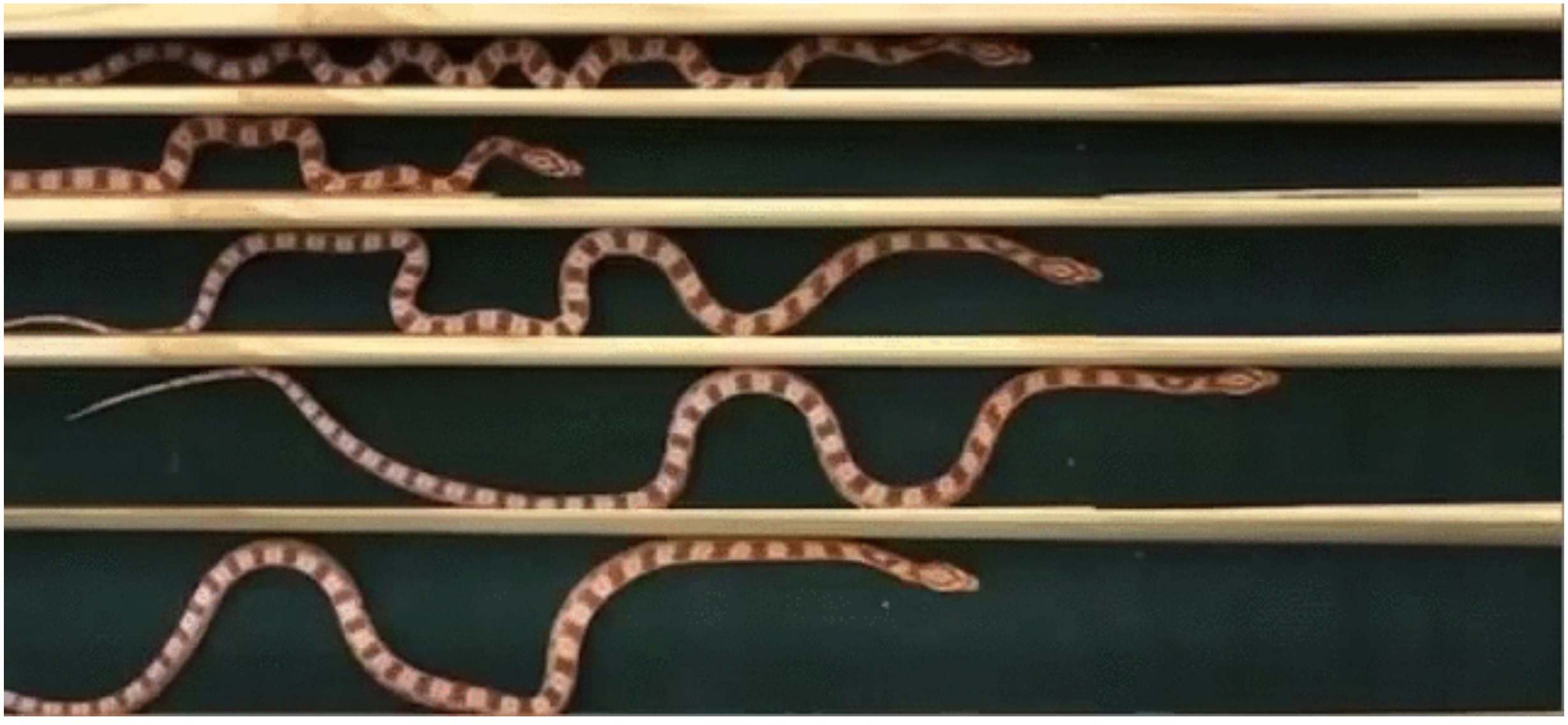
- Four types of limbless locomotion
  - Lateral undulation (serpentine)
  - Rectilinear
  - Concertina
  - Sidewinding



# 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

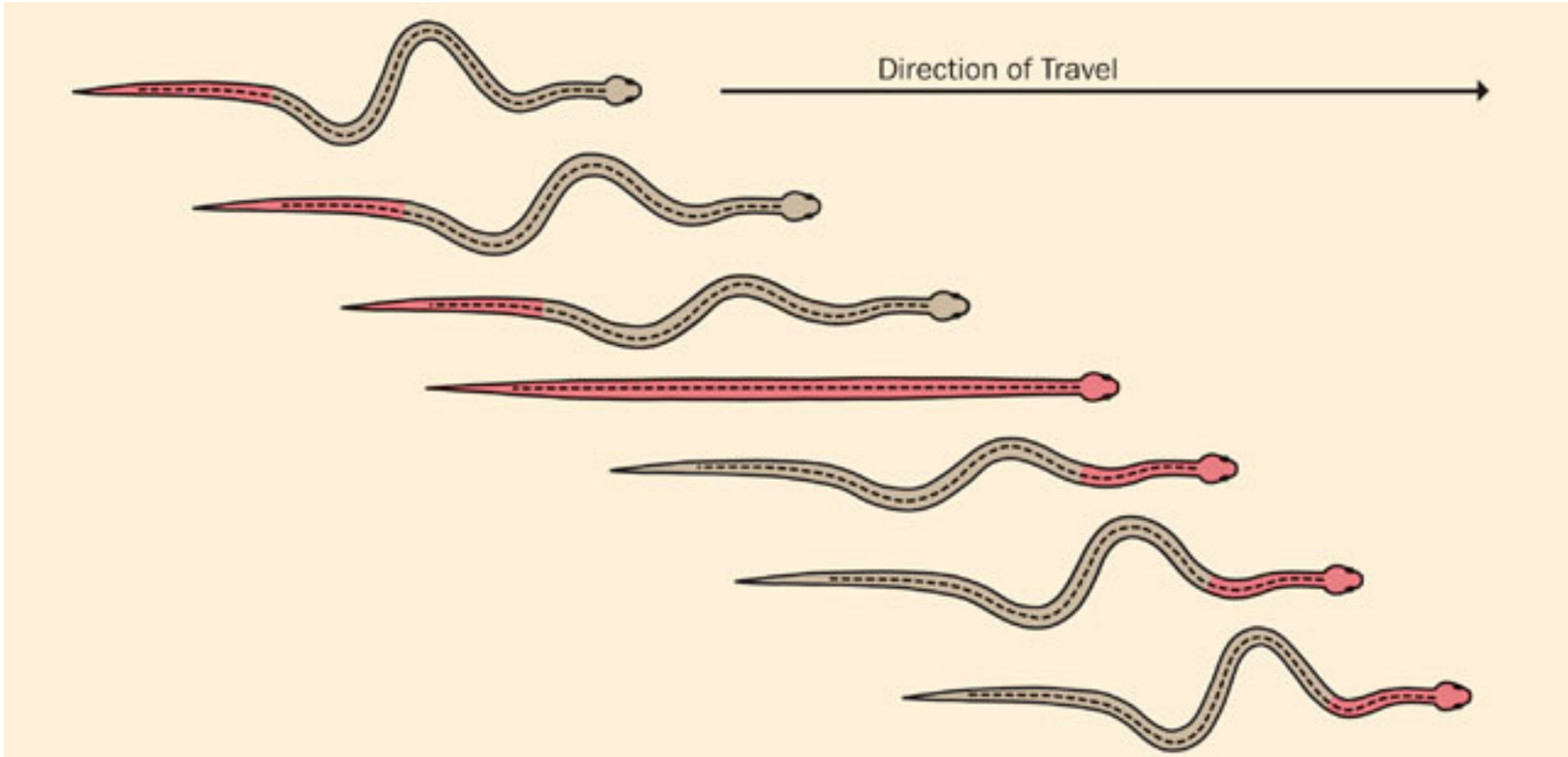
- Snake uses **gastrosteges** scales (belly scales) to inch forward (like a worm)

- More common in very heavy bodied snakes
    - Large boas, pythons, vipers

- Video

# Limbless Locomotion: Concertina

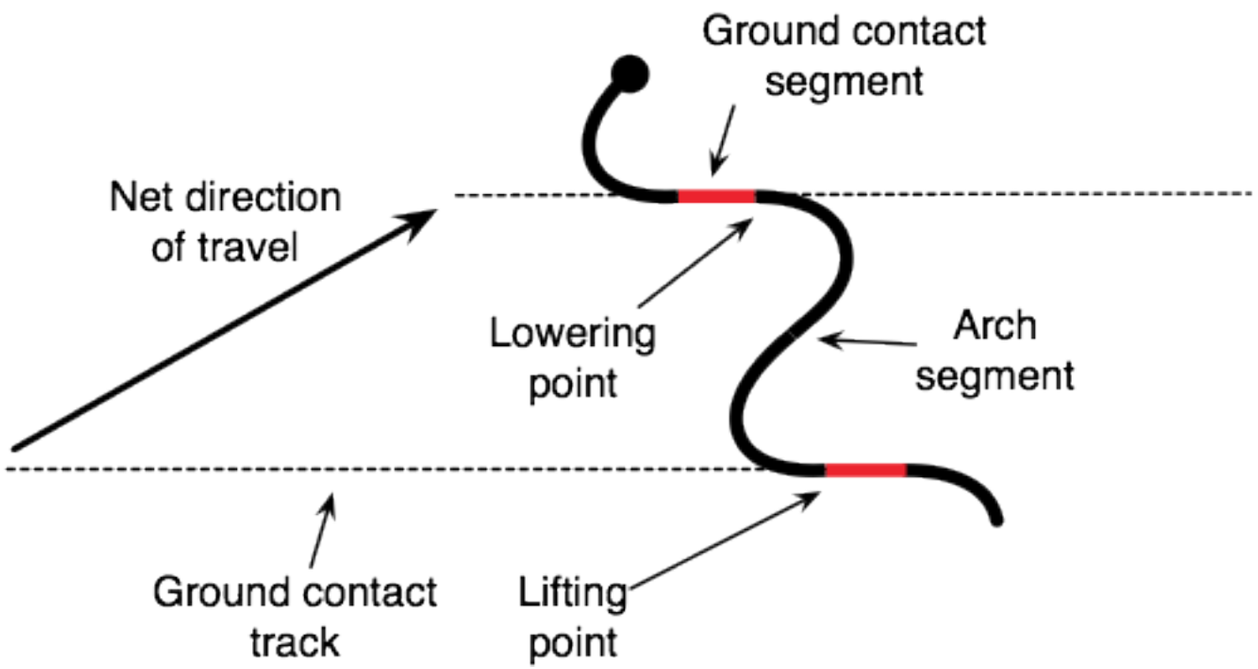
- The snake “piles-up” in one spot, then shoots its head forward, then “piles-up” in the new spot



# Limbless Locomotion: Sidewinding

- Snake travels at an angle going “backwards”

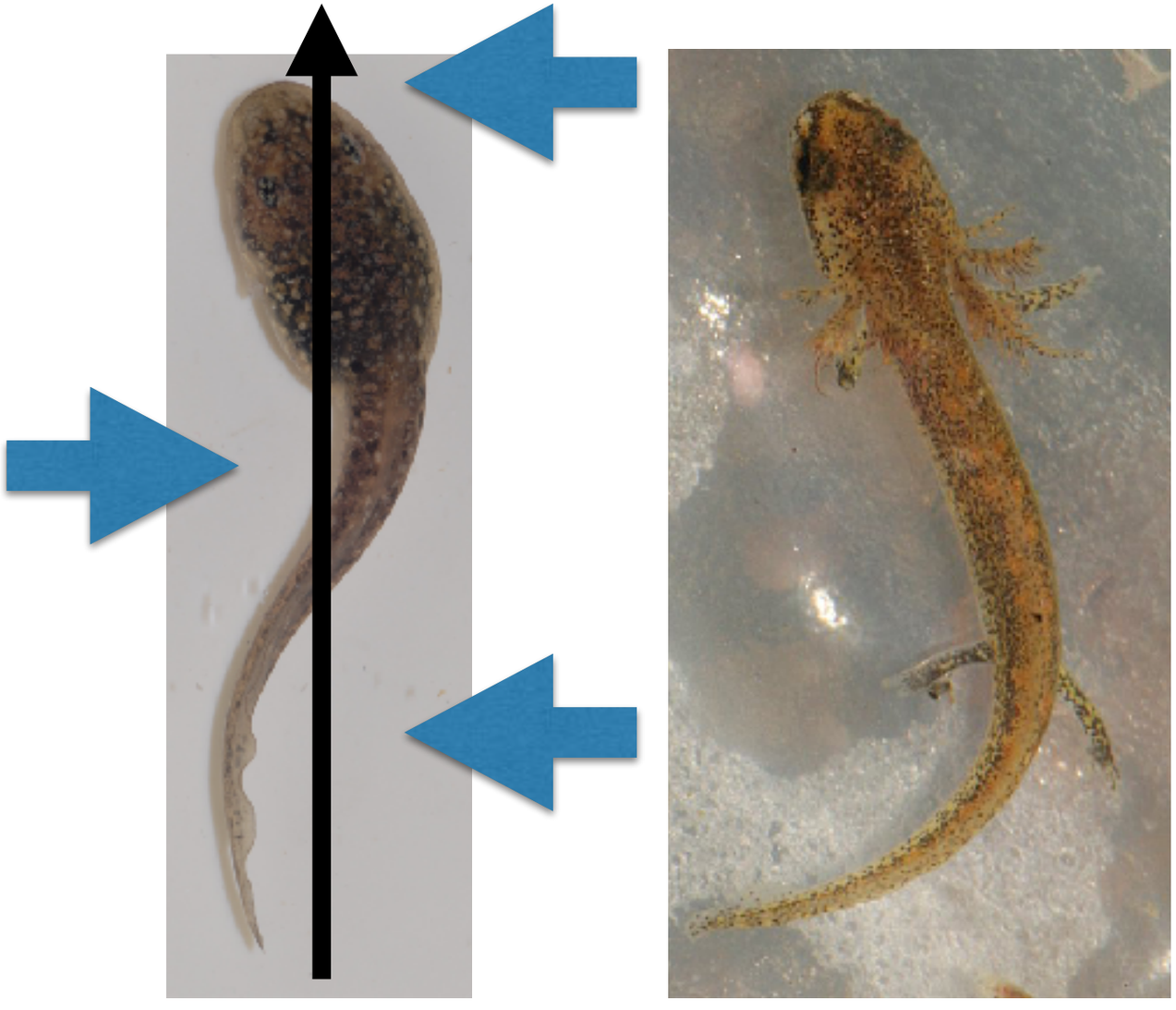
- Sections of the snake are lifted and moved over to a new segment parallel to the original segment




Video

# 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 vertebrates

    - 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