

# Locomotion



# Announcements

- **We did a shitty job of restoring habitat yesterday**
  - Logs and rocks dislodged from their original location
  - At least one salamander left on a log, almost dead
- Here's how to fix it
  - It's **not** enough to place the rock or log back haphazardly, you **must** place it back in its original footprint
  - If there's a gap between the rock/log and the hole under it, brush dirt/leaves over it
  - Animals **must** go back under the rock/log after data collecting
    - Place it in a position to crawl back under, coerce it (gentle prod) if necessary



# Connecticut Amphibian and Reptile Checklist

## Salamanders

*Ambystoma jeffersonianum*  
Jefferson Salamander

*Ambystoma laterale*  
Blue-spotted Salamander

*Ambystoma maculatum*  
Spotted Salamander

*Ambystoma opacum*  
Marbled Salamander

*Desmognathus fuscus*  
Northern Dusky Salamander

*Eurycea bislineata*  
Northern Two-lined Salamander

*Gyrinophilus porphyriticus*  
Spring Salamander

*Hemidactylum scutatum*  
Four-toed Salamander

*Plethodon cinereus*  
Northern Redback Salamander

*Plethodon glutinosus*  
Northern Slimy Salamander

*Necturus maculosus*  
Common Mudpuppy

*Notophthalmus viridescens*  
Red-spotted Newt

## Frogs

*Bufo americanus*  
American Toad

*Bufo fowleri*  
Fowler's Toad

*Hyla versicolor*  
Gray Treefrog

*Pseudacris crucifer*  
Spring Peeper

*Rana catesbeiana*  
Bullfrog

*Rana clamitans*  
Green Frog

*Rana palustris*  
Pickerel Frog

*Rana pipiens*  
Northern Leopard Frog

*Rana sylvatica*  
Wood Frog

*Scaphiopus holbrookii*  
Eastern Spadefoot Toad

## Turtles

*Chelydra serpentina*  
Common Snapping Turtle

*Chrysemys picta*  
Painted Turtle

*Clemmys guttata*  
Spotted Turtle

*Clemmys insculpta*  
Wood Turtle

*Clemmys muhlenbergii*  
Bog Turtle

*Malaclemys terrapin*  
N. Diamondback Terrapin

*Terrapene carolina*  
Eastern Box Turtle

*Sternotherus odoratus*  
Common Musk Turtle

## Snakes

*Carphophis amoenus*  
Eastern Worm Snake

*Coluber constrictor*  
Black Racer

*Diadophis punctatus*  
Ringneck Snake

*Elaphe obsoleta*  
Black Rat Snake

*Heterodon platirhinos*  
Eastern Hognose Snake

*Lampropeltis triangulum*  
Eastern Milk Snake

*Opheodrys vernalis*  
Smooth Green Snake

*Nerodia sipedon*  
Northern Water Snake

*Storeria dekayi*  
Northern Brown Snake

*Storeria occipitomaculata*  
Northern Redbelly Snake

*Thamnophis sauritus*  
Eastern Ribbon Snake

*Thamnophis sirtalis*  
Eastern Garter Snake

*Agkistrodon contortrix\**  
Copperhead

*Crotalus horridus\**  
Timber Rattlesnake  
**\*VENOMOUS**

## Lizards

*Plestiodon (Eumeces) fasciatus*  
Five-lined Skink

16 Caught CT Herps

45 Total CT Herps

Pessimist's estimate: 29 left to go!

20 "Observed" CT Herps

45 Total CT Herps

Conservative estimate: 25 left to go!

16 Caught CT Herps

28 Expected CT Herps

Moderate estimate: 12 left to go!

20 "Observed" CT Herps

28 Expected CT Herps

Liberal estimate: 8 left to go!



**What kind of herp is this?**



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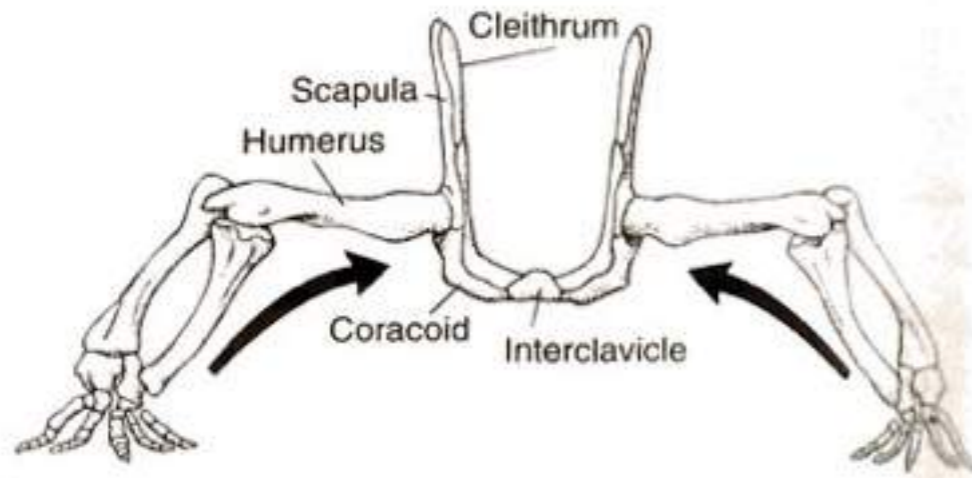
What kind of herp is this?



# Ethology

- **Ethology** is the study of organismal 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**

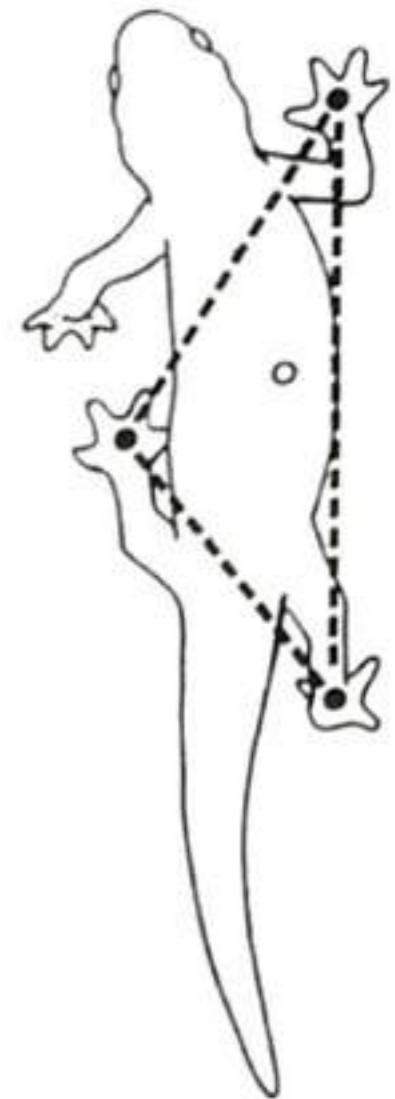


# Limbed Locomotion

- 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**



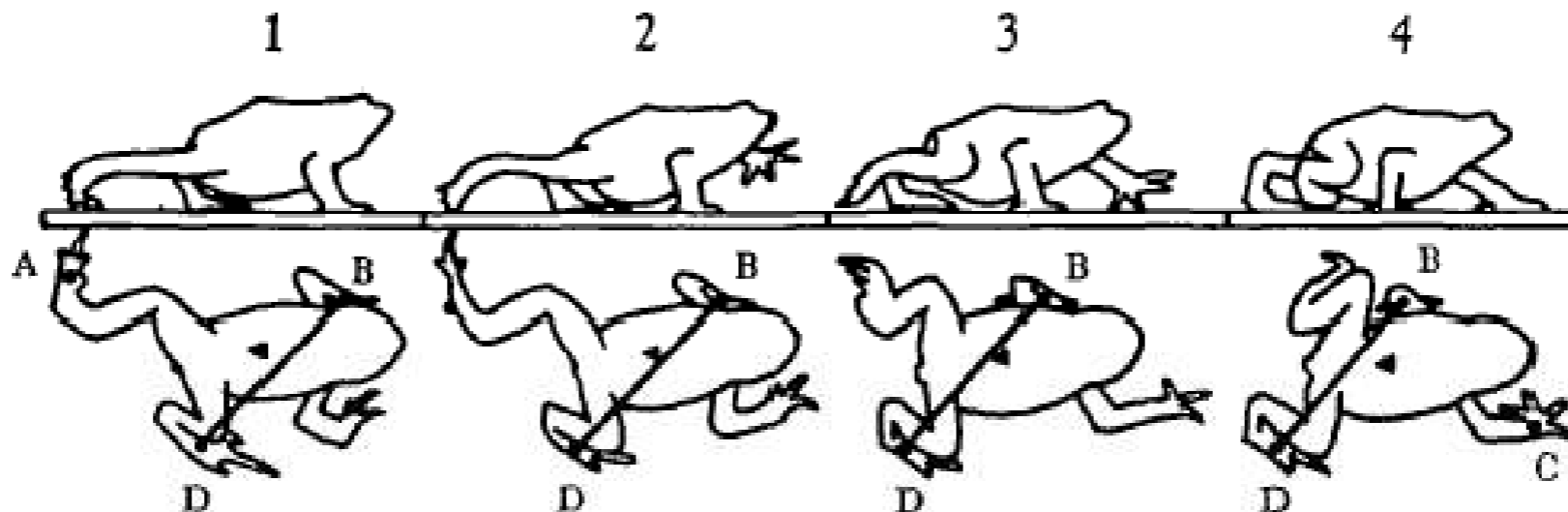
**Lateral  
Sequence**

# 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



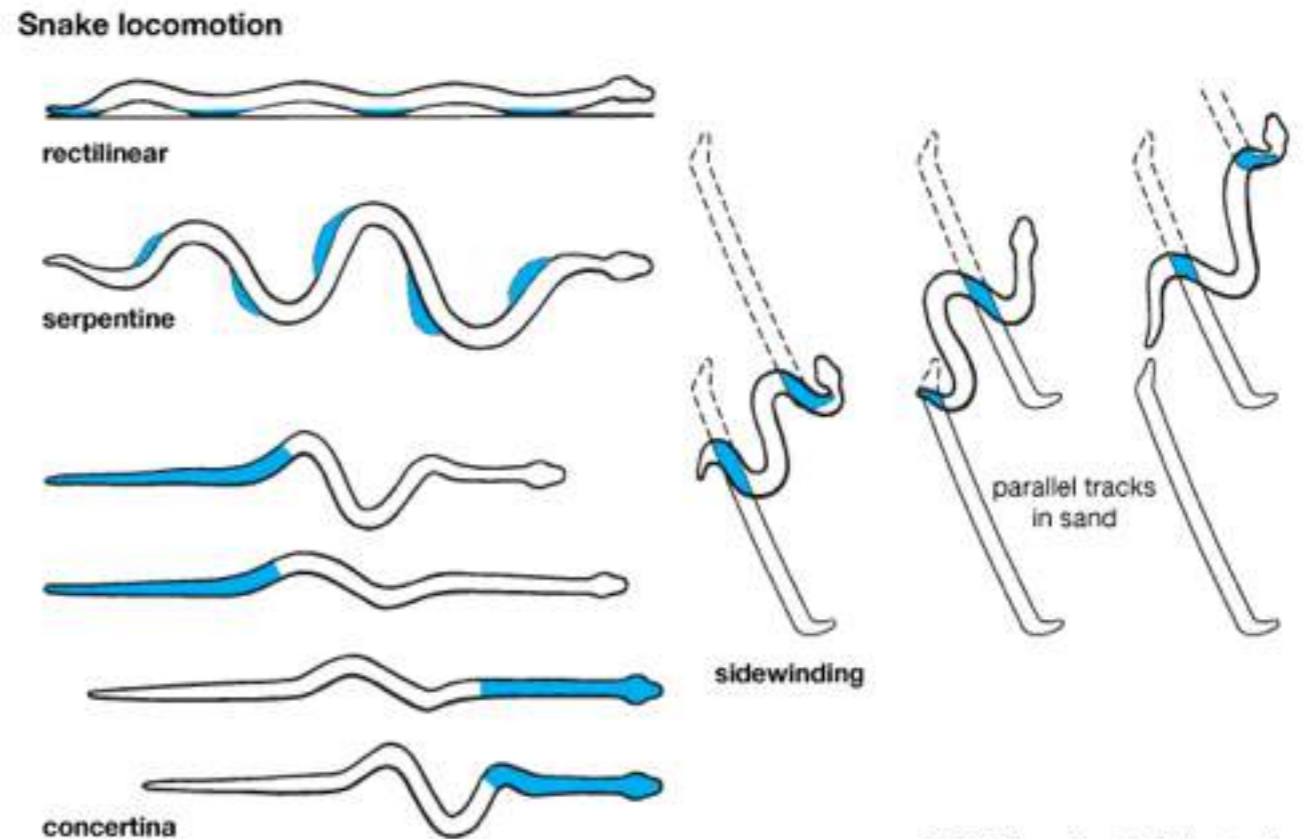
# Saltational Locomotion



- 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!

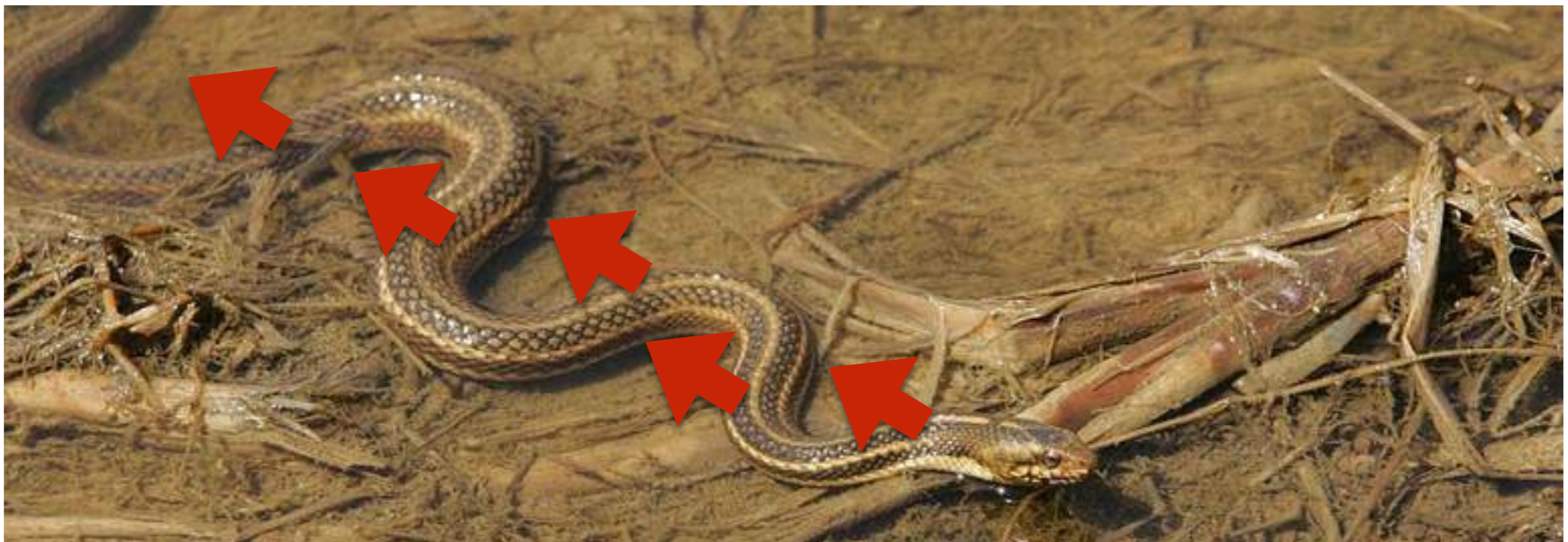
# Limbleless Locomotion

- Four types of limbleless 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

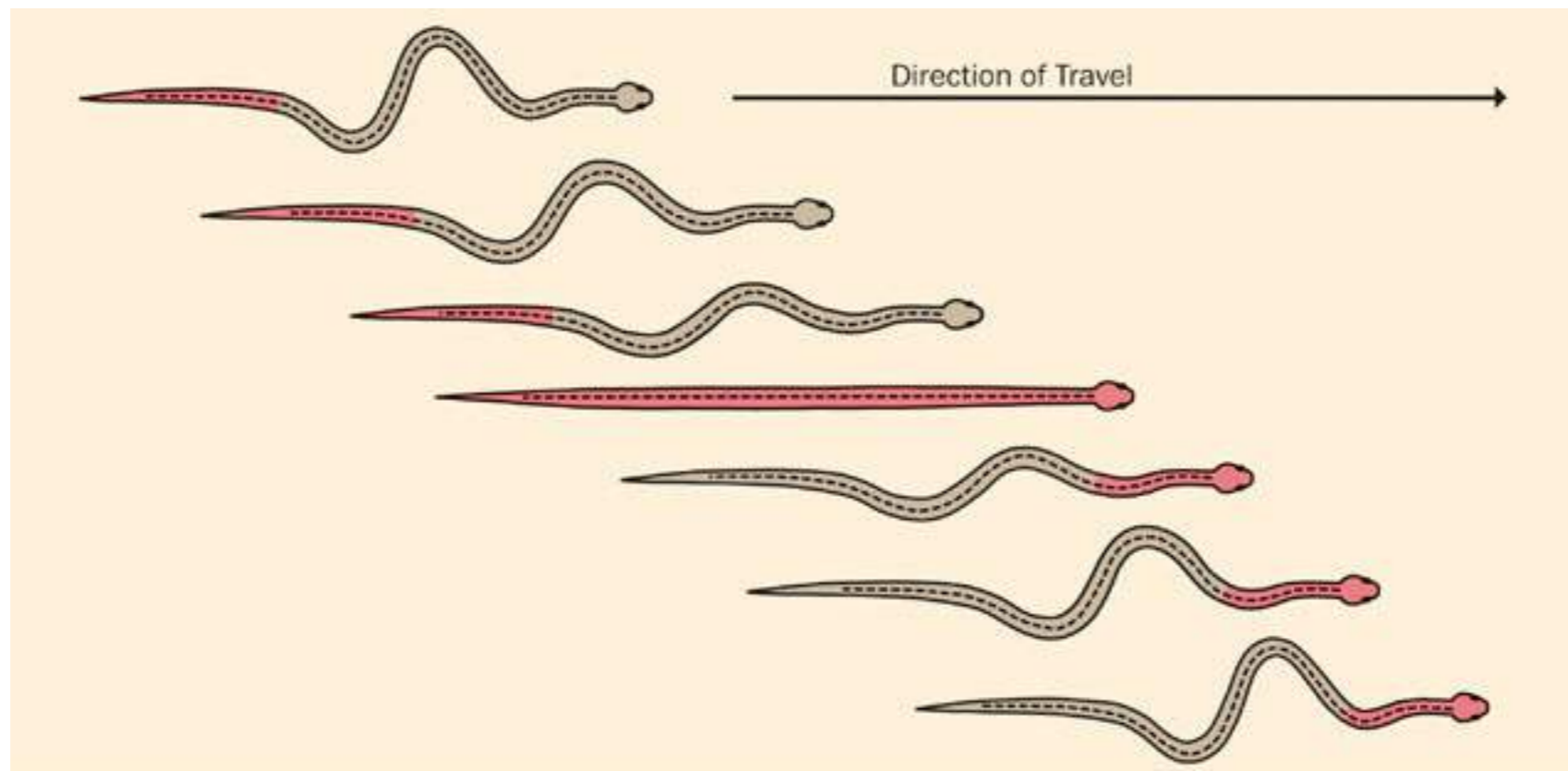
- Snake uses **gastrosteges** scales (belly scales) to inch forward (like a worm)
- [Video](#)





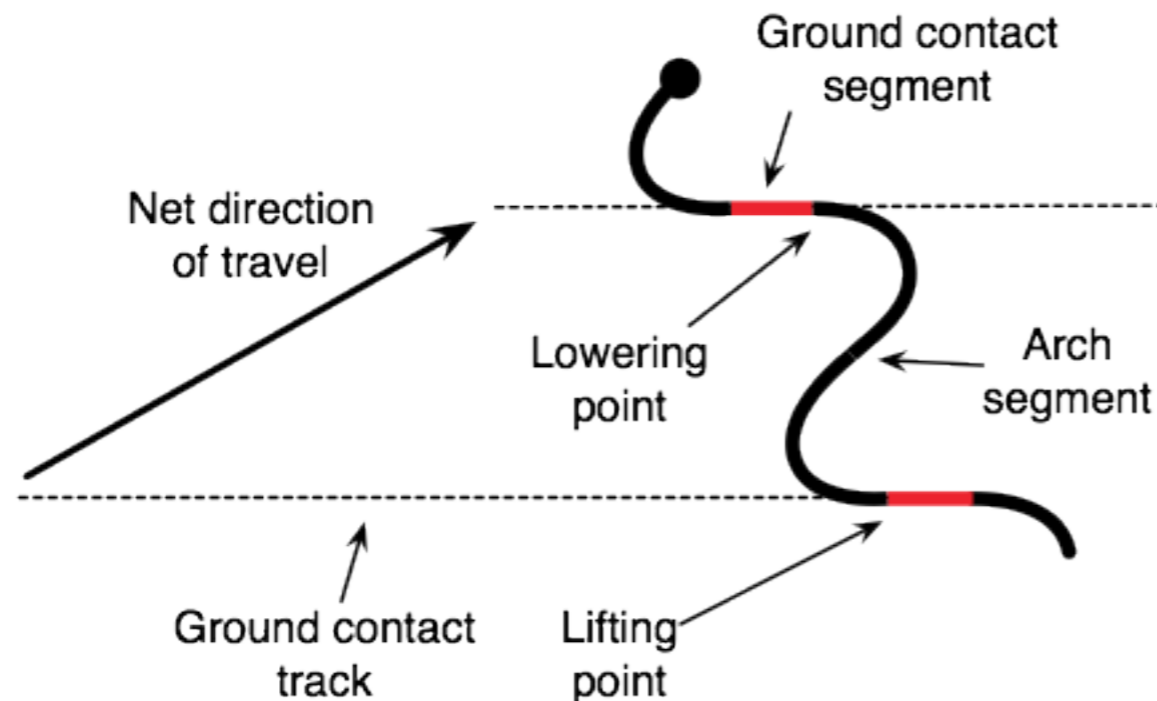
# Limbless Locomotion: Concertina

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



# Limbless Locomotion: Sidewinding

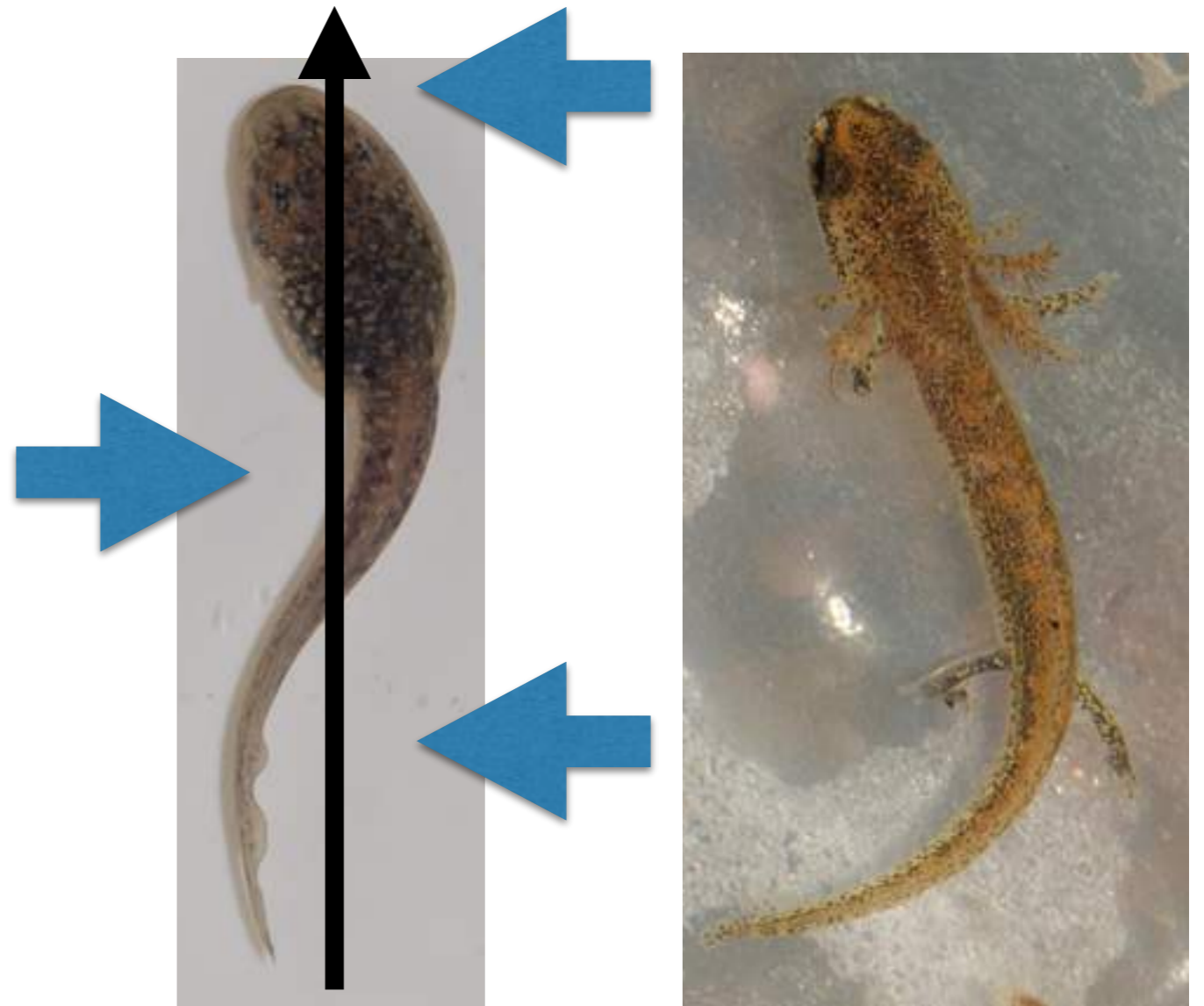
- Snake travels at an angle going “backwards”
- Sections of the snake are lifted and moved over to a new segment parallel to the original segment



[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 tetrapods
    - The basis of many other amphibian and reptile modes of locomotion



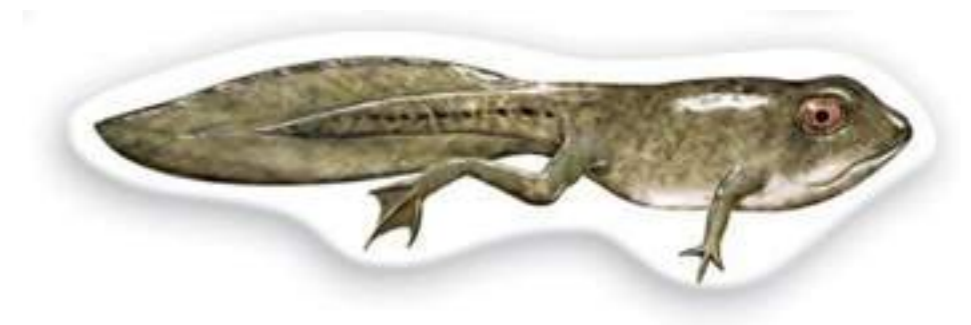
# Aquatic Locomotion: Lateral Undulation

- 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

