**Terrestrial Locomotion**

Always start with the physics (as boring as it may be)

•Motion is a result of the environments reactive force (animal exerts a force on environment)

**Quadrapeds** – Salamanders, Lizards, and Turtles (Frogs to some extent)

•Most lizards and Salamanders tend to walk with limbs at sides, not high like crocodilians and most Varanids

Lateral Sequence – B after D (**more stable**) (Northwestern Video as example)

•Increased gait by lateral flexion, however, as a result this does not allow a lizard to breath while running! Can wear them out if you keep chasing them (*Callisaurus* beware!).

Diagonal Sequence – B after C

•Less stable patterns are used by animals using a faster gait

•fewer points of contact with ground at any one time

Ex: Pacific Giant Salamander (*Dicamptodon tenebrosus*) – when trotting it is supported by 2 limbs 92% of the time (a very funny sight, generally witnessed as they scurry across a road trying to avoid death!)

**Lizards**

•Many increase mobility with lateral flexion

•can increase stride length not only through lateral flexion but also through a specialized joint between the pectoral girdle and sternum (found in **all** lepidosaurs)

•Speed generally correlates with hind limb length

Ex: Zebra-tailed Lizard (*Callisaurus draconoides*) – very long hind limbs

•Morphological adaptations such as fringes allow lizards to move quickly and efficiently on surfaces that give way to the forces exerted by the lizard)

•Basilisks have specialized fringes that allow the lizard to trap air under its feet as it moves across the water's surface, the air becomes the resistance that pushes back

•Fringe-toed Lizards (*Uma* sp.) have fringes that create more surface area act as snow shoes on the sand.

•Many lizards can become bipedal at high speeds (in fact, Basilisks are always bipedal when they walk across water – for short distances)

•most lizards that can become bipedal have stout bodies, with long tails and long hind limbs.

Ex: *Dipsosaurus dorsalis, Gambelia, Crotaphytus, Callisaurus*

•When *Callisaurus* go bipedal they increase their stride length substantially!

**Crocodilians**

•Walk more upright

•Also increase their stride length by extending knees and ankle further (maximize energy expendature)

•Can bound! Only reptile known to demonstrate this type of behavior.

**Turtles**

•Vertebrae and ribs are fused to their carapace (makes for limited mobility with pelvic girdle and hips)

•As they fall forward, the lift hind leg before foreleg hits the ground. Sort of a pitch-and-roll. This is due to their center of gravity.

**Frogs**

They jump (saltate), hop, or walk

•Urostyle – fused caudal vertebrae that lies between ilia (**show diagram**)
  - •many muscles pass between these structures and that aid in producing a powerful jump

•Elongate tarsal bones

•As with lizards, hind limb length relates directly to jumping ability
•Both height and distance depends on the initial angle and velocity of the jump

•The morphology of the iliosacral joints is dependent upon whether a frog is a jumper, hopper, or walker (big jumpers like Rana, the ilia are short)

•There are 2 main types of pectoral girdles that frogs have evolved to absorb shock of landing (**show diagram** – page 70 in textbook):

1. Arciferal – epicoracoid cartilage slide past each other when landing. This is considered the ancestral pectoral morphology of frogs. Found in frogs such as Spea, Bufo, Ascaphus.

2. Firmisternal – fused cartilage. More derived (Ranoidea classic example)

**Snakes**

Six types of locomotion:
1. Lateral undulation – non-static
2. Slide-pushing – non-static

3. Concertina – static
4. Sidewinding – static
5. Saltation – static
6. Rectilinear – static

1. Lateral Undulation
    - Most prevalent mode of locomotion in snakes
    - Use fixed points in environment (**show diagram**)
        - Lateral components of reactive forces cancel each other out
        - forward components are additive
    - Body appears fixed in position as the snake moves but it is constantly moving along fixed points in environment
    - Snakes such as the Striped Whipsnake (*Masticophis lateralis*) and other snakes with lateral stripes use this locomotion correlated with pattern to evade predation (creates the optical illusion that the snake is not moving)

2. Slide-pushing
    - Erratic, vigorous form of movement
    - Very similar to lateral undulation
    - ventral friction and migration of contact sites slowly propels the snake forward
    - A type of locomotion if a snake was on a very smooth or wet surface

3. Concertina
    - Anterior end of the snakes becomes fixed in the environment while the posterior end is pulled forward. Then the posterior becomes fixed and the anterior then moves forward. This is repetitive (**show diagram**).
    - Used primarily in tight spaces such as burrows but can also be used to help ascend unusually steep surfaces

4. Sidewinding
    - Comprised of all vertical forces (no horizontal or angular movements)
    - pushes on substrate and then lifts body and pulls and slides forward
    - 2 points of contact at all times (**show video**)

    *Great in low-friction environments, but this is NOT a fixed behavior.

5. Saltation
    - Jumping – anterior to posterior straightening of the body
    - rare and seen in only a few very small vipers

6. Rectilinear
    - Two main sets of muscles PULL the snake along the ground
    - multiple points along the length of the snake can be static with the ground at any given time while other portions of the snake are moving
    - most commonly seen in large-bodied snakes and viperids
    - **Show video of Mojave Rattlesnake**

**At any given time a single snake can be using multiple means of locomotion!**