Slitherin Snakes-All About Snake Locomotion!

There is very little doubt that snakes are among both the most feared and revered groups of animals, at least certainly among vertebrate animals, or those animals with a spinal cord or vertebra. As discussed in previous articles, this is most often due to their vastly different appearances and evolution over thousands, if not millions of years, than what we are much more familiar with, as in humans and other mammals. Their elongated, limbless or legless bodies, lack of eyelids and ability to blink, lack of external ears, and hardened scales covering their bodies instead of hair or feathers all make snakes, as well as other reptiles and amphibians, very unique groups of animals.

All snakes have a well-developed muscular system comprised, or made up of strong muscles, tendons, and ligaments throughout the lengths of their bodies, skull, and jawbones. A snake's vertebrae, ribs, and overall skeletal system are shaped such that their muscles and ligaments are attached and articulated throughout these points. While humans generally have roughly 700 to 800 muscles throughout our bodies, most snakes have as many as 10,000 to 15,000 or more muscles throughout their bodies, allowing them to be much more muscular and flexible than we are! One of the functions of a snake's muscular system are, in the case of all constricting species such as boas, pythons, and even many colubrid species, to subdue and overpower their prey. Contrary to popular belief, constrictors do not actually "crush" their prey, or even "suffocate" it. More recent analysis and scientific studies have found that constriction is actually a surprisingly quick and efficient evolutionary means by which these snakes overpower and dispatch their prey using their muscular system in that this has actually been found to much more efficiently stop or disrupt blood flow to and from the victim's heart, causing cardiovascular collapse instead.

But perhaps the largest and most well-known purpose of a snake's muscular system are that this system assists and enables their movement, locomotion, and overall flexibility. Different species or groups of snakes found throughout the world can have several different forms of locomotion utilizing different muscles throughout their bodies as a result. All snakes use their muscular bodies to grip and push against the surface of the ground and objects around them while exerting force and friction in order for their movement. While much more depth and detail, as well as easily another article on Snake Locomotion could be done, here are the most common forms of their locomotion.

**Figure-Lateral Undulation Form of Locomotion in Snakes. Photo Credit: Guo & Mahadevan 2008.*

Serpentine, or Lateral Undulation is the most common and widely used and familiar form of snake locomotion, in that waves of lateral, or side to side banding are created along their bodies from head to tail in the most familiar "S" shaped pattern of movement forward. The vast majority of snakes are also excellent swimmers, and utilize a similar form of locomotion while swimming. But according to the

Department of Biology at University of Louisiana at Lafayette, lateral undulation is unique in that whenever a bend of coils contacts a surface object, it exerts forces against them, and deforms locally around them. Whenever a snake pushes against multiple objects simultaneously, the lateral force vectors cancel each other out, leaving a resultant vector that propels the snake forward; postural adjustment around each object gives the snake even finer control over the direction of force exertion. In lateral undulation, the large dorsal muscles are activated sequentially along the body. The muscles are active unilaterally in each bend, from the convex part of a bend forward to the straight or concave part of the bend. As the snake progresses, each point along its body follows along the path established by the head and neck, while sliding friction is a critical component of lateral undulation.

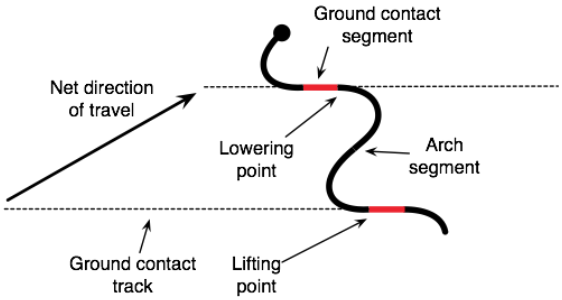

**Figure-Sidewinding Form of Locomotion in Snakes. Photo Credit: Ross L. Hatton.*

Sidewinding is another commonly known method of locomotion, particularly among sidewinder rattlesnakes (*Crotalus cerastes*), as well as a few species of African and Asian desert vipers. This form of locomotion may also be used by snakes on more slippery or smooth surfaces as well. Similar to lateral undulation, sidewinding differs in three ways. First, in that each point along the body is placed sequentially in static (rather than sliding) friction with the ground or substrate. Secondly, segments of the body are lifted off of the ground in between regions of static contact with the ground, thus allowing their bodies to roll along the ground from head to tail, thereby leaving the characteristic tracks. After anterior, or front portions of the body are lifted and set down again forming a new track, the anterior or tail regions of the body complete the older, previous track. Third, due to the static contact and lifting of the body, the snake travels relatively diagonally relative to the tracks formed on the ground. Muscle activity during sidewinding is mostly similar to that of lateral undulation except that some muscles are also active bilaterally during trunk lifting.

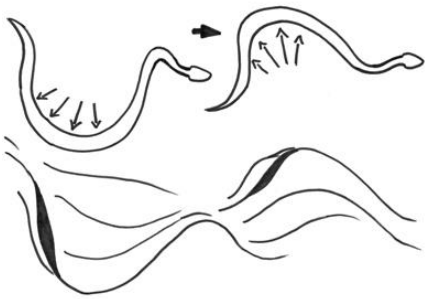

**Figure-Slide Pushing Form of Locomotion in Snakes. Photo Credit: Alderleaf Wildnerness College.*

Slide Pushing is a third form of snake locomotion. This method involves vigorous movements of the

body which slide widely over a surface, and is used when a snake becomes startled on a smooth or slippery surface and attempts to escape quickly. In slide pushing, irregular bends of the body and tail press vertically on the surface at different points although the body often slips while pushing down enough force to move the center of the mass in a semi-regular pattern. Sliding friction is most important in slide pushing, although there may be occasional moments of static contact. The patterns of muscle activity used during slide pushing are currently unknown.

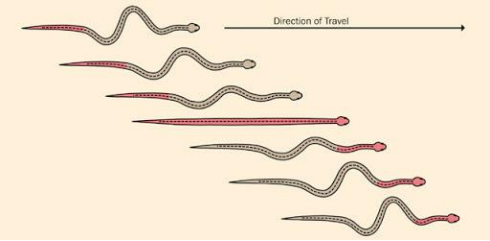

**Figure-Concertina Form of Locomotion in Snakes. Photo Credit: BioKids: Kids' Inquiry of Diverse Species*

Concertina is a fourth form of snake locomotion. In concertina, the body is alternately pulled into bending and straightening of the body forward from the bends, somewhat like an accordion. The front, or anterior part of the body comes into rest on the surface while the anterior or back half of the body is pulled again into bends, and so forth. These bends may push laterally against the sides of tighter, or more confined spaces, when climbing, or vertically against the ground to keep the body from slipping. Thus, static friction is very important during concertina. In concertina motion, blocks of muscles are activated simultaneously and unilaterally during regions of bending and with static contact with the sides of the surfaces.

**Figure-Rectilinear Form of Locomotion in Snakes. Photo Credit: George Maestri.*

Rectilinear locomotion is a fifth form of locomotion which some snakes, particularly larger and heavier bodied species, such as boas, pythons, and some vipers use. This form of locomotion propels the snake slowly forward in a straight line. In rectilinear locomotion, the belly or ventral scales are alternately slightly lifted from the ground and pulled forward, somewhat similar to a caterpillar-fashion. This cycle of movement occurs simultaneously over several points on the snake's body, and static friction is the main form of friction involved in rectilinear locomotion. Unlike sidewinding and lateral undulation, which utilize alternating unilateral muscle activity from side to side, this form of locomotion utilizes bilateral activity of the muscles. One set of muscles lifts the belly scales up and pulls them forward, while another set pulls them downward and backwards.