



The Evolution of Shape

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Overview of Lecture

- Why is shape important?
- How has shape evolved across taxa?
- What are some particularly innovative shapes?
- How does shape show up in fossil records?
- What is the evolutionary significance of human shape?
- Fun facts
- Take home message



Why is shape important in the fitness of organisms?



- Shape is one of the biggest contributors to an organism's survival—it helps determine how swiftly it can escape predators or approach prey.
- Shape also determines how organisms interact with one another and with their environment
- Shape is also a direct way of showing that evolution is happening throughout all of life on Earth
 - Shapes that have an advantage will persevere, like the shape of a shark which evolved 400 million years ago and which is still alive today
 - Shapes that are disadvantageous to the organism will most likely die out
- Throughout this presentation, we will show different organisms that shape has showcased its evolutionary characteristics in and how shape have helped these organisms survive.

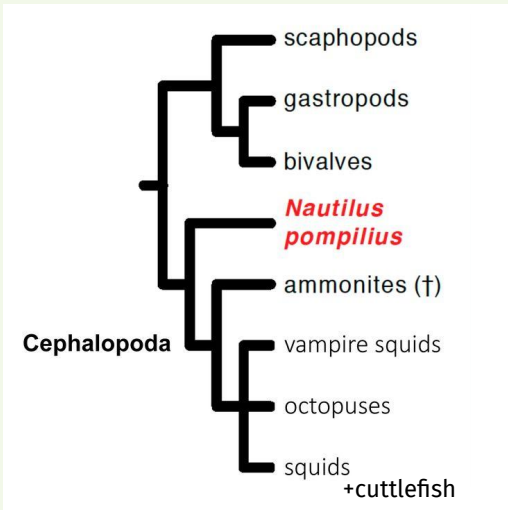
How has shape evolved across taxonomic groups?

Cephalopods

- 400 mya: Cuttlefish, which we can track back to Nautilus, lost a shell but gained a cartilage spine. Additionally gained the ability to hide in plain sight!
- 200 mya: Octopodes, a cousin of the cuttlefish, who also lost its initial shell and all of its bones so that it could be flexible. It also has a similar ability to camouflage like cuttlefish, but this time, with texture!

Sharks

- 400 mya: eventually evolved to one common sleek shape, but then Hammerhead sharks appeared!



Cephalopods

Nautilus



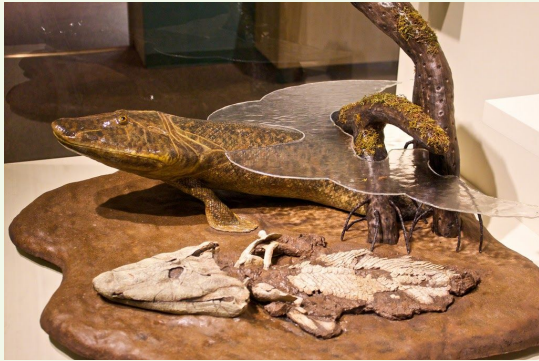
Cuttlefish



Octopus

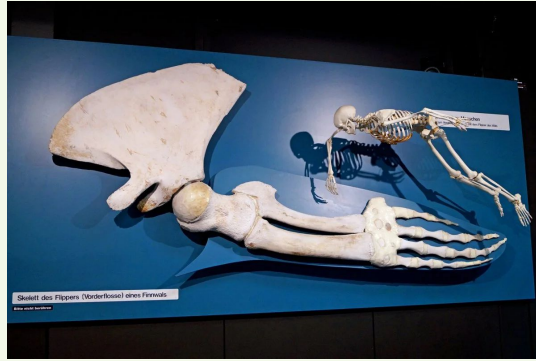


When, where, and how is shape showing in the fossil record?



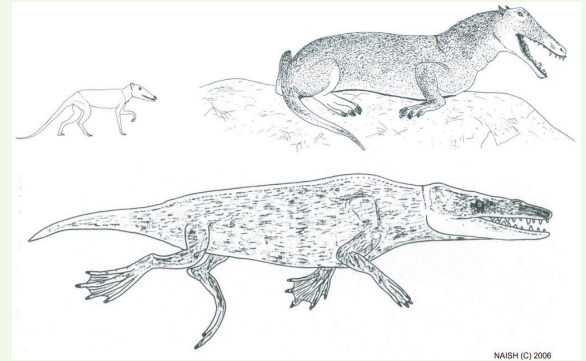
Tiktaalik (400 mya)

- First fossilized example of moving to land
- “Missing Link”



Pakicetus (40 mya)

- Evidence of terrestrial animal returning to the water
- Related to the blue whale





What are some of the evolutionary innovations on shape?

Hammerhead shark



Evolved 20 mya, make up 5% of the evolutionary history of sharks
Hypotheses for this evolution?
Allows sharks to pin down manta rays more easily, bite/prey on them; maneuverability/tight turns needed for elusive prey; could offer a larger surface area for electrosensory use of the head



Star-nosed mole

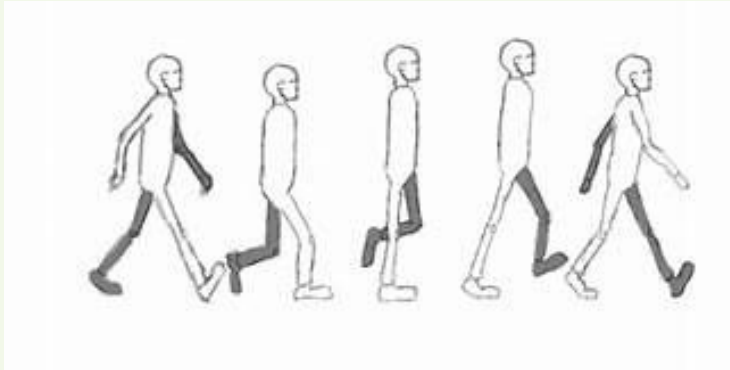
“Star nose” forms in embryonic development and peels forward after birth
Hypothesis for this evolution?
Star is a skin surface with thousands of touch receptors used to locate small food sources; only takes $\frac{1}{5}$ of a second for them to first detect and then eat food they find

Stalk-eyed fly



Antennae-like heads with their brains filling out the stalks and their eyes resting on top
Hypothesis for this evolution?
Females choose to mate with longer stalked male flies even though longer stalks tend to hurt an individual's ability to survive

Humans and their shape



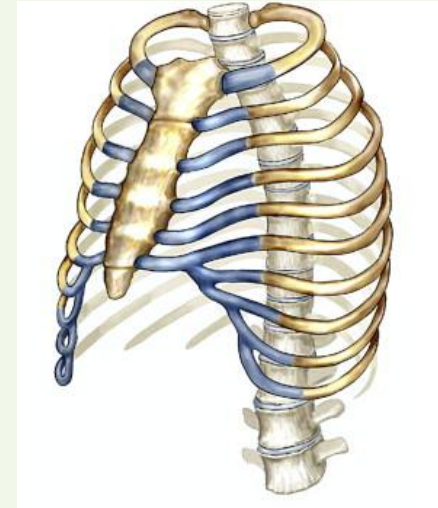
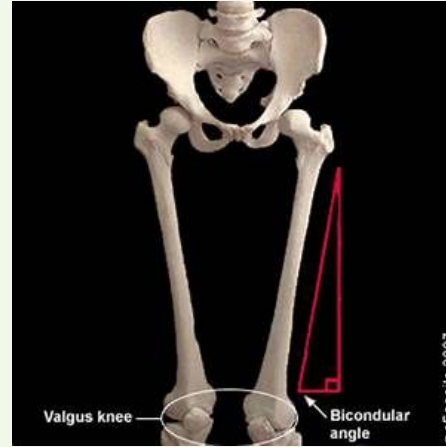
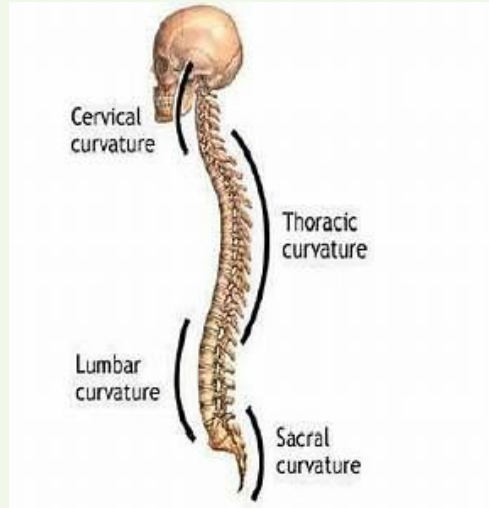
- Began walking upright ~4.5-5 mya, directly influenced our shape
- Standing made it so we can have our hands free for carrying things and nurturing young
 - considered a learned behavior, especially in blind children
- Striding biped: when we walk, we do so one foot at a time



Other organisms that can stand on two legs:

- Dinosaurs
- Land-based birds
- Kangaroos

Humans and their shape



Spine evolved over millions of years to have four sets of curves:

- Keep birth canal open
- Keep torso over hips
- Keep our head level

Knees closer together than hips

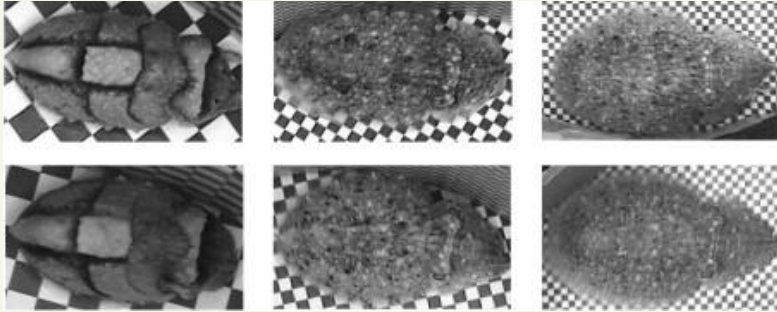
Barreled chest



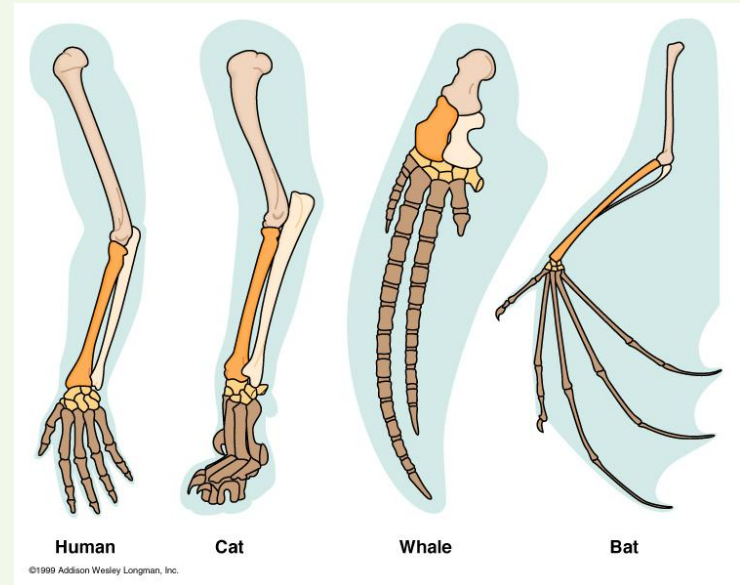


Fun facts

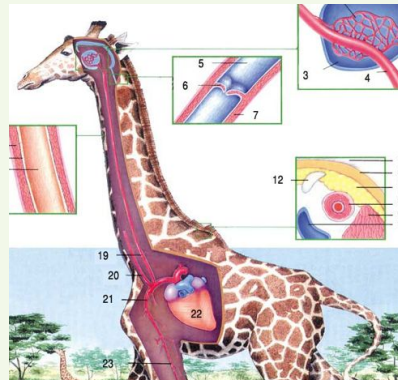
Study by Dr. Hanlon found that cuttlefish can mimic a checkerboard pattern



Whales still have five “fingers” encased within their flippers. They also have hyperphalangy meaning that each “finger” is made up of an increased number of bones



A giraffe’s heart is 25x larger than human’s in order for it to pump blood all the way up to the brain





What's to be learned + Take home message

- Variations in shape across taxa are just as much of a result of genetic coding as they are a result of environmental trends
- Aquatic and terrestrial taxa are more interrelated than one may realize (best shown by fossilized evidence of past species)
- The evolution of shape has proved beneficial for both predator species (i.e. hammerhead shark) and prey species (i.e. cuttlefish)
- While some evolutions of shape adhere to survivability (i.e. star-nosed mole), others adhere to sexual selection (i.e. stalk-eyed fly)
- Shape has always been evolving and will continue to evolve until the end of time

