**Fish Evolution Factsheet**

What did fish evolve from?

* Fish evolved from primitive Chordates (three subphyla in chordate include 1. Urochordata: tunicates; Cephalochordata: lancelets; Craniata: craniates)
  + Characteristics of chordates
  + 1. Dorsal, hollow nerve chord
  + 2. Notochord
    - Flexible dorsal rod for support
    - Present in some stage in all chordates (usually in embryonic development)
    - Remnant present in adults of many primitive fishes: sharks, rays, sturgeons
  + 3. Pharyngeal gill slits
    - Present in embryo of all vertebrates
* Urochordata are a subphyla of chordates, this group is referred to as tunicates
* Tunicates are marine [filter feeders](http://en.wikipedia.org/wiki/Filter_feeder)
* In their [respiration](http://en.wikipedia.org/wiki/Aquatic_respiration) and feeding they take in water through an incurrent [siphon](http://en.wikipedia.org/wiki/Siphon_(biology)) and expel the filtered water through an excurrent [siphon](http://en.wikipedia.org/wiki/Siphon_(biology))
* Most adult tunicates are attached to rocks or similar surfaces on the ocean floor
* Tunicates begin life in a mobile [larval](http://en.wikipedia.org/wiki/Larva) stage that resembles a [tadpole](http://en.wikipedia.org/wiki/Tadpole)
* Neoteny = retention of larval features into the adult stage
* Tunicates gave rise to primitive fishes by neoteny
* The larval stage became more active; more vertebrate-like
* Eventually the larvae became capable of reproduction
* The larvae then evolved into what is known as a lancelet
* Lancelets are in the chordate subphyla cephalochordata
* Lancelets are an important object of study in [zoology](http://en.wikipedia.org/wiki/Zoology) as they provide indications about the origins of the [vertebrates](http://en.wikipedia.org/wiki/Vertebrate)
* Evolution of a proto-vertebrate and development of a cranium lead the lancelets to forming the Craniata
  + Characteristics of Craniata
  + 1. Distinct cranium: skull with brain
  + 2. Notochord does not extend forward of brain
  + 3. Cartilage or bone present
  + 4. Brain well developed
  + 5. Chambered heart
* There are two superclasses within Craniata
  + Agnatha- jawless (=“no jaw”)
  + Gnathostomata – jawed fishes (=“jaw mouth”)
* There are only two living groups of Agnathans
  + Hagfishes
  + Lampreys
* The first jawless fishes were Ostracoderms (“shell skin”)
  + They are now extinct but are ancestors of lamprey and hagfish
    - Characteristics:
* First fossils have well developed external bone, no internal bone
* First fossils were marine; later fossils are marine and freshwater
  + - Features:
* No jaw, muscular feeding pump (filter feeders)
* Body armor – true bone
* Some had paired fin-like appendages, but not true fins with bony support
* Heterocercal tail (having the upper lobe larger than the lower with the vertebral column extending into the upper lobe)
* Charcteristics of both hagfish and lampreys
  + Jawless
  + Single gonad
  + Skeleton cartilaginous or fibrous (no vertebrae)
  + No paired fins
  + No body armor
  + Single median nostril
  + Series of round gill openings, no true gill arches
* Comparison of Agnathan characteristics



* All other Craniates are Gnathostomes
* Gnathostomata: Jawed fishes
* Jaws evolved from modified gill arches (this is an untested hypothesis: no intermediate fossils have been found)
* Gnathostomes diverged from Agnathans soon after fishes first evolved
  + Evolutionary advantages of jaws:
    - Manipulate food (cut, grind, and crush; allows addition of new items to diet)
    - Use for defense
    - Manipulate non-food items (aid in nest building)
* Characteristics all Gnathostomes share
  + Jaws
  + Two sets of paired fins
  + Three semi-circular canals in their inner ears