1. The **notochord** is an elongate, rod-like, skeletal structure dorsal to the gut tube and ventral to the nerve cord. ... the backbone of adult vertebrates.

The **notochord** appears early in embryogenesis and plays an important role in organizing the embryonic development of nearby structures. **Induction by Sonic Hedgehog**!

*Sonic Hedgehog* expression in the Notocord and Neural Tube floorplate. - Lance Davidson

1st

In most adult chordates (remnants become spongy discs between vertebrae) In some non-vertebrate chordates and fishes the notochord persists as a flexible rod that prevents collapse of the body during swimming. 2. The notochord develops ... as a dorsal hollow tube above the notochord. ... it differentiates into the brain & spinal cord. **(HOX genes induce anterior-posterior segments)**

http://phylogeny.arizona.edu/tree/eukaryotes/animals/chordata/chordata.html

2. The **nerve cord** develops as a dorsal hollow tube above the notochord. ... it differentiates into the brain & spinal cord. **(HOX genes induce anterior-posterior segments)**

In fish and juvenile amphibians the pharyngeal arches develop into **gills** ... organs of gas exchange between the water and blood. { in planktivorous fish 'rakers' are straining devices}

In adult amphibians and the amniote tetrapods **the anteriormost cleft transforms (during ontogeny)** ...

The **visceral clefts** & arches: The visceral clefts ... push outward from the lateral walls of the pharynx ... connecting the pharynx to the exterior. ... tissues between adjacent clefts are the **visceral arches**.
http://phylogeny.arizona.edu/tree/eukaryotes/animals/chordata/chordata.html

3. visceral (pharyngeal or gill) clefts & arches

Visceral clefts & arches evolved & develop from anterior arches.
Visceral clefts & arches evolved from posterior jaw bones.

Segmentation

Muscle somites & nerves

Causes of Zoster/

Recurrence of Varicella from dormant state in the

- Cause is usually unknown
- Linked to periods of stress, old age, immunosuppression
- 10–20% of the infected population will manifest the virus
- Rare in children

Urochordata or Tunicata are commonly known as tunicates, sea squirts, and salps. There are roughly 1,600 species of urochordates; most are small solitary animals but some are colonial organisms. Nearly all are sessile as adults but they have free-swimming larvae. The larva swims until it attaches by its head to a surface and undergoes metamorphosis, during which it becomes sedentary & most of its chordate characteristics disappear. Morphological traits of chordates are clear in the larval "tadpole" stage which shows 3.

- Notochord
- Dorsal hollow nerve cord
- Pharyngeal slits and arches
- Postanal muscular tail

Urochordates are also known as amphioxus and lancelets. The group contains only about 20 species of sand-burrowing marine creatures. Nearly all are sessile as adults but they have free-swimming larvae. The larva swims until it attaches by its head to a surface and undergoes metamorphosis, during which it becomes sedentary & most of its chordate characteristics disappear. Morphological traits of chordates are clear in the larval "tadpole" stage which shows

Cephalochordata

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What is wrong w/ this song? (aside from the obvious!)

(sung to the tune of "It's a Long Way to Tipperary")

chorus:

It's a long way from amphioxus
It's a long way from amphioxus
It's a long way from amphioxus
It's a long way from amphioxus
It's good-bye, fins and gill slits,
Hello, lungs and hair!
It's a long, long way from amphioxus,
But we all came from there!
...
Amphioxus and tunicates as evolutionary model systems • Review article
... all extant chordates, at some stage in their life have:

Vertebrates have acquired several specific characters. 
{not present in Urochordates or Cephalochordates}
The most important ‘invention’ of vertebrates ...

Vertebrates are craniates that have a backbone

Class Cephalaspidomorphi:
There are about 35 species of lampreys inhabiting marine and freshwater environments. The notochord persists as the main axial skeleton in the adult animal, as it does in hagfishes. Also have pairs of cartilaginous projections partially enclosing the nerve cord. (which pass for vertebrae)

Hagfishes and lampreys not only lack skeleton-supported jaws but also lack paired appendages.

Vertebrates are craniates that have a backbone.

Class Myxini:
Hagfishes
There are ~30 species of hagfishes, all marine. They are mainly bottom-dwelling scavengers. The skeleton of a hagfish is entirely cartilage: - cartilaginous cranium (skull) - a cartilaginous notochord

Hagfishes (“degenerate” sister group to vertebrates)

Hagfish embryology with reference to the evolution of the neural crest.
K.G. Ota et al. 2007 Nature 446, 672-675 ... hagfish neural crest is specified by molecular mechanisms that are general to vertebrates.

During the late Silurian & early Devonian period, gnathostomes largely replaced the agnathans.

The common ancestors of all gnathostomes ... an additional duplication of Hox genes. ... the single cluster in early chordates → four. Running the length of each side of the body in aquatic gnathostomes is the lateral line system, a row of microscopic organs sensitive to vibrations ...

Fishes & vert. descendants cannot synthesize ‘essential’ aromatic Amino Acids (ch 41)
Sharks and their relatives, are called cartilaginous fishes because they have relatively flexible endoskeletons made of cartilage rather than bone. In most species, parts of the skeleton are strengthened by mineralized granules, and the teeth are bony. The cartilaginous skeleton of these fishes is a derived characteristic, not a primitive one; the ancestors of Chondrichthyes had bony skeletons.

They have a lateral line (pressure sensor) but no operculum (boney gill cover, helps pump water); & no swim bladder to maintain neutral buoyancy.

Unlike most bony fish, sharks have internal fertilization.

The Shark Research Institute (SRI) is engaged in a worldwide study to locate, tag and document the behavior of whale sharks, Rhincodon typus, the largest fish in the sea.

Nearly all the families of fishes familiar to us are ray--finned fishes (class Actinopterygii): bass, trout, perch, tuna, herring etc.

Lobe-finned fishes (Sarcopterygii) have muscular pectoral and pelvic fins supported by extensions of the bony skeleton - the coelacanth (Latimeria) (+ Dipnoi lungfishes)

Zoology: Record-breaking fish

Zoologists have unveiled the smallest free-living vertebrate ever found. Mature females of the fish Paedocypris progenetica (pictured right), which lives in highly acidic blackwater peat swamps in southeast Asia, average just 7.9 millimetres in length.

Described by Ralf Britz, of London's Natural History Museum, and his colleagues, the miniature species has a larva-like appearance, with a skull that does not form properly, leaving it with a hole in the top. But the specimens' gonadal development shows them to be mature adults - and males possess a unique specialized structure near their genitals thought to be used for clasping the female during mating.

Amphibians lack the amniotic egg. Tetrapods are gnathostomes that have four legs & feet. The bones of the pelvic girdle are fused to the backbone, permitting forces generated by the hind legs to be transferred to the rest of the body.

... on the origin and phylogeny of living amphibians
The amniotic egg possesses a unique set of membranes: the amnion, chorion, and allantois. The chorion forms a protective membrane around the egg. The allantois performs gas exchange and stores metabolic wastes (and becomes the urinary bladder in the adult). As in other vertebrates, nutrients are stored in the yolk sac, which is much larger in amniotes than in vertebrates generally.

Placental mammals have suppressed the egg shell & yolk sac, and elaborated the amniotic membranes to enable nutrients and wastes to pass between mother and embryo. The chorion & allantois fuse, forming the placenta.

The amnion surrounds the embryo and creates a fluid-filled cavity in which the embryo develops.


Almost every part of a bird’s anatomy is modified to enhance flight. The bones are honeycombed – strong but light. The skeleton of a frigate bird has a wingspan of more than 2 m but weighs only about 113 g (4 oz) (≈ a Quarterpounder!)


Birds have the smallest genomes of all amniotes. Bats possess smaller genomes than do mammalian sister groups. There is a well-known positive relationship between cell size and genome size; it is possible to approximate osteocyte (bone-cell) size from fossilized bones and/or estimate osteocyte size from fossilized bones.

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*Note: phylogeny of turtles is still unresolved, rel to other 'reptiles.'*

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