Why is Linnaeus famous?

Systema Naturae (1758)
Linnaean classification.....
...has a hard time with evolving organisms. Transitional forms from the fossil record spawned the theory of evolution, and now an evolutionary system of classification.

Archaeopteryx – a Jurassic fossil with feathers and teeth....
Phylogenetic nomenclature is hierarchical....
Cladogram: evolutionary map of relationships, or phylogeny
Monophyletic group: an ancestor and ALL of its descendants
Figure 23.1. Chordate phylogeny, showing the relationships of extant lineages and the oldest fossils, superimposed on a geological time column. Nodal numbers are keyed to text headings.
Lampreys - Petromyzontida

43 living species
2 extinct species

Vertebrata

Gnathostomata

Paleozoic

Permian
Carboniferous
Devonian
Silurian
Ordovician
Cambrian
The vertebral column is a synapomorphy of Vertebrata – it arose in the ancestral vertebrate.
Neurocranium

- ectoderm
- olfactory epithelium
- retina
- pituitary foramen
- otic epithelium
- notochord
- olfactory capsule
- prechordal cartilage
- lens
- optic capsule
- otic capsule
- parachordal cartilage
- ethmoid plate
- basal plate
The lateral line system

Fig. 11. — Schéma de la distribution des organes de la ligne latérale chez les Poissons (d’après Goodrich).

io, canal infraorbitaire; jl, canal jugal; la, lignes antérieures des organes en fossettes; ld, lignes dorsales des organes en fossettes; md, canal mandibulaire; oc, canal occipital transverse; or, canal oral; po, canal postorbitaire; pro, canal préoperculaire ou hyomandibulaire; pt, canal principal du tronc; so, canal supraorbitaire; spo, neuromaste spiraculaire; tp, canal temporal.
The ancestral vertebrate had a head organized like this.

The ancestral gnathostome had a head organized like this, with jaws.
Fishes breathe by taking in water through the mouth and forcing it out through the gill slits. Gills form a curtain that separates the mouth cavity from the gill cavities, so the water must pass through the gill curtain. During this process, up to 95 percent of the oxygen in the water taken in is extracted, making the respiratory efficiency of fish gills the highest among water-breathing organisms. Indeed, such a high efficiency in capturing oxygen is needed because water is so dense and contains only $\frac{1}{50}$ of the oxygen in air.
Chondrichthyes...the jaws and branchial arches are held together with ligaments.
Chondrichthyes...the jaws and branchial arches are held together with ligaments; jaws can swing forward on their suspensory ligaments.
Chondrichthyes
Prey capture in the bowfin *Amia calva*. The frames (left) are from a high-speed (200 frames/sec) film that is synchronized with electromyographic recordings of cranial muscles (right). The recordings are a summary of 45 feeding events. The wire leading from the head muscles to the recording apparatus can be seen in the photographs. Note that the maxilla swings anteriorly to produce a nearly circular mouth opening at peak gape (frame 4) as the prey enters the mouth. Both the levator operculi and sternohyoideus muscles are active at the start of the expansive phase and activate couplings 2 and 3 (Fig. 12-2) to cause mouth opening. Muscles: $SH_l$, $SH_r$ = left and right sternohyoideus muscles; $LOP$ = levator operculi; $DO$ = dilator operculi; $LAP$ = levator arcus palatini; $AOP$ = adductor operculi; $AM_2$, $AM_1$, and $PO_4$ = divisions of the adductor mandibulae; $BM$ = branchiomanibulafis; $Imp$ = intermandibularis posterior; $Ih$ = interhyoideus. (From Lauder, 1980d.)
Petromyzontida
The ancestral vertebrate had a head organized like this.

The ancestral gnathostome had a head organized like this, with jaws.
Chondrichthyes...the jaws and branchial arches are held together with ligaments.
sharks and rays - Chondrichthyes

6. 960 living species
hundreds of extinct species

7. Lampreys

Osteichthyes

Vertebrates with jaws - Gnathostomata

Paleozoic

Cambrian
Ordovician
Silurian
Devonian
Carboniferous
Permian

245
290
360
410
440
510
570
Gnathostomata synapomorphy: paired appendages
A generalized bony fish showing major morphological features. Fishes vary widely in size, position, and arrangement of fins and other appendages, and no single species has all the features shown.

Sharks differ most obviously from bony fishes in their multiple gill slits and in the outstretched set of their pectoral fins, used as hydroplanes rather than oars.
Paired appendages in a shark
Expanded pectoral appendages in a shark
Huge pectoral fins in a ray (a kind of shark)
Huge pectoral fins in a ray (a kind of shark)
Amniota (almost)
Permian of Texas