Humans are only one animal

Much of our knowledge of the development of the brain comes from study of other animals:
- Caenorhabditis elegans for cell lineages and genetics
- Drosophila for genetics
- Xenopus laevis for vertebrate embryology
- Zebra fish for vertebrate lineages
- Chick and quail for transplants/lineages
- Mouse and rat for mammalian development
- Fish and marsupials for regeneration of the CNS

We need to know their taxonomic relationships:
- How closely related are their nervous systems?
- What characteristics are derived?
- What characteristics are convergent?
- What pre-adaptations are required?
- What restricts nervous system development in different phyla?
- Only evolution can make sense of taxonomic relationships
- Taxonomy is based on presumed evolution
Nerve Nets

Even primitive animals can have complex behavior.

Hirudinea (Leeches)

With the addition of a gut, cephalization and segmentation a segmental nerve pattern arises.

Interneurons & Sensory Cells Added
Segmentation Common in Invertebrates

Human Neurobiology 217
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Invertebrate Embryology is Determinate

Individual cells can be identified
Cells have specific lineages
Destroy cells, specific parts of the embryo are missing
Vertebrates are regulative (otherwise in vitro fertilization would be impossible)
Invertebrate embryology is variable and quite unlike that of vertebrates.

Cephalopods have the most complex nervous systems.

Invertebrate nervous systems are ventral.
Vertebrate nervous systems are dorsal.

Amphioxus

Annelids
Vertebrate Nervous Systems are Dorsal

The inverted lobster!

Hemichordates are a side issue?

We most likely evolved from tunicates

- Only echinoderms and vertebrates share caudal gastrulation
- Tunicates are sessile filter feeders
- Their larvae are mobile
- Some salps are permanently mobile
- Their tails have somites and a notocord
- Add a basic neural tube and you end up with Amphioxus.
All vertebrate embryos look very similar

Primate evolution has been marked by an increase in cerebral volume by a rotation of the foramen magnum

Are Humans “Different”?  
• Development of language needs many preadaptations?  
• Use of hands and tools precede brain development  
• Neanderthals had larger cranial capacity than Homo sapiens  
• When did consciousness evolve?  
• Is the brain more than just cells?