Intro to Phylogeny/Cladograms **Name** _____

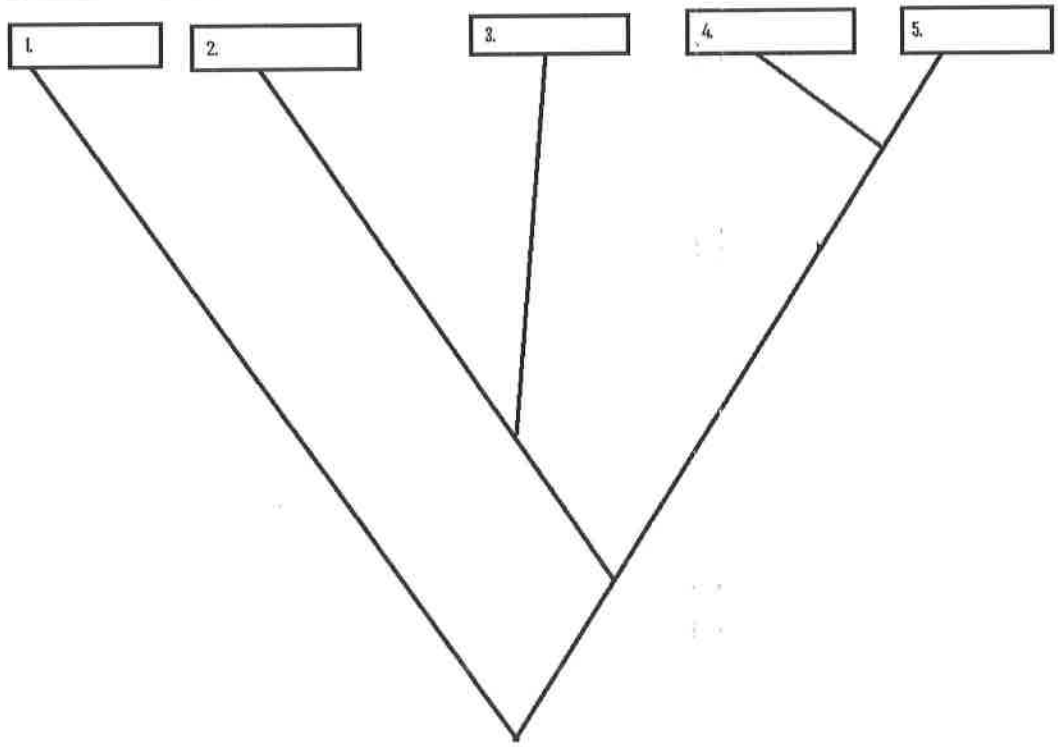
Constructing Phylogenetic Trees: Using Table A, count the number of differences in a section of DNA from the same gene for the horse, rat, deer, moose, and donkey. Use this information to fill in Table B and to complete the given phylogenetic tree by printing the names of the organisms in the boxes #1-5.

Table A: a section of DNA

horse	deer	donkey	rat	moose
A	C	A	C	C
A	T	A	C	T
T	G	C	A	G
T	T	T	T	T
G	T	G	C	A
A	T	A	C	G
C	C	C	C	C
T	T	T	T	T
G	G	G	C	G
G	A	G	T	G
G	G	G	A	G

Table B: Number of Differences in DNA

	horse	deer	donkey	rat	moose
horse					
deer					
donkey					
rat					
moose					



1. Which two species have the fewest number of differences in their DNA? Explain how you knew this.

2. What does the above phylogenetic tree suggest about the horse's evolutionary history? Explain.

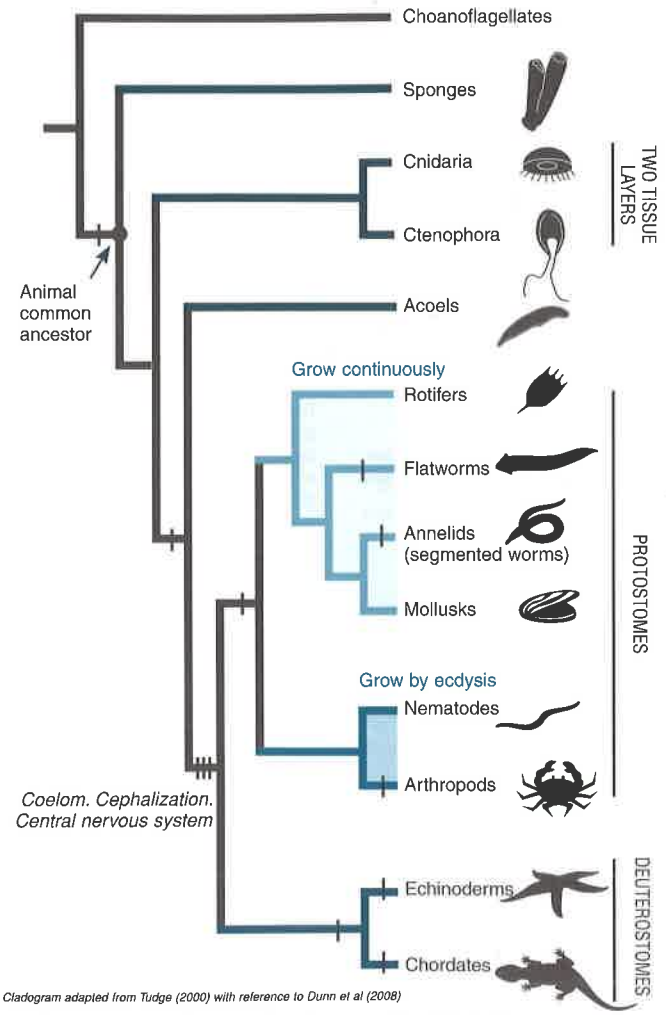
3. Identify two other kinds of evidence that could be used to build a phylogenetic tree.

The Phylogeny of Animals

The animals are a monophyletic group of multicellular eukaryotes that arose early in evolution from a group of protists called choanoflagellates. Sponges are the simplest animals, being sessile and without any body symmetry. They form a lineage separate to all other animal groups, and split off very early in animal evolution. The ctenophores and cnidarians form another lineage on the basis of having two (not three) tissue layers and radial symmetry. Bilateral symmetry, in which there are mirror-image left-right sides and an anterior and posterior end, is characteristic of all other animals (at least in embryonic stages). It arose later in animal evolution and is associated with the development of a head region and a coelom (an internal body cavity lined with mesoderm). Bilateral symmetry is considered to be an adaptation to the motile lifestyle of most animals.

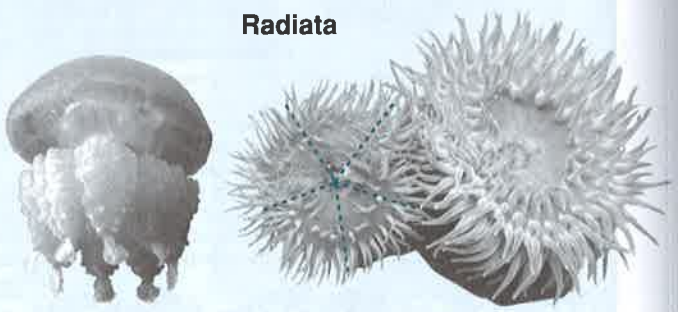
Phylogeny of Animals

This phylogeny is based on DNA sequence data of a number of genes from various phyla. The short vertical bars indicate when novel traits arose. All animals more derived than the cnidarians and ctenophores are triploblastic.



Cladogram adapted from Tudge (2000) with reference to Dunn et al (2008)

Radiata

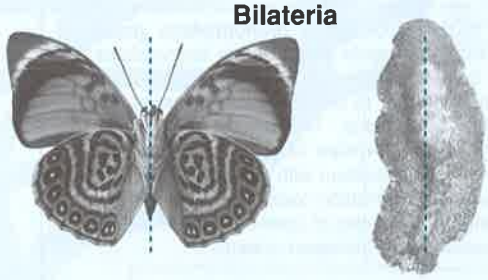


Cnidarians and ctenophores show **radial symmetry**, with similar body parts are arranged symmetrically around a central body axis. Adult echinoderms (e.g. sand dollar) are also radially symmetrical, but this is secondary as their larvae show bilateral symmetry.

Protostomes vs Deuterostomes

Protostomes and deuterostomes are divisions of the coelomate animals according to how the coelom develops and how the gut and embryonic germ layers form. Evolution has resulted in two ways to produce a bilateral, coelomate body plan. The origin of the coelom is uncertain, but probably arose in a Precambrian ancestor that gave rise to both deuterostome and protostome lineages.

Bilateria



Most animals show **bilateral symmetry**, where the body can be divided evenly through only one plane. The division produces roughly equivalent, mirror-image halves. Bilateral animals also show triploblastic development (three tissue layers).

1. Suggest why the origin of **bilateral symmetry** is considered to be a great milestone in animal evolution.

2. (a) In the phylogenetic tree above, short vertical bars indicate when certain traits originated. Identify when each of the following traits arose by assigning each bar its corresponding letter, as follows (one is completed for you). Note that segmentation arises independently three times in three lineages. Radial symmetry in adults (**R**). Secondary loss of coelom (**L**). Segmentation (**S**). Multicellularity (**M**). Bilateral symmetry (**B**). Protostomy (**P**). Deuterostomy (**D**).

   (b) Place a vertical bar where you think ecdysis (molting of the cuticle or exoskeleton) arose in animal evolution.

3. (a) The free-swimming larvae of cnidarians are bilaterally symmetric. Also, new research shows that a few primitive cnidarians show bilateral symmetry. Where would you place the origin of bilateral symmetry based on this information?

   (b) If the cnidarians were reclassified, on what basis would they remain distinct from other bilateral organisms?