

Name: \_\_\_\_\_

KEY

## How to Build a Cladogram.

### Background:

Cladograms are diagrams that we use to show phylogenies. A phylogeny is a hypothesized evolutionary history between species that takes into account things such as physical traits, biochemical traits, and fossil records. To build a cladogram one must take into account all of these traits and compare them among organisms.

Building a cladogram can seem challenging at first, but following a few simple steps can be very beneficial.

### Instructions:

There are two steps that will help you build a cladogram.

#### Step One "The Chart":

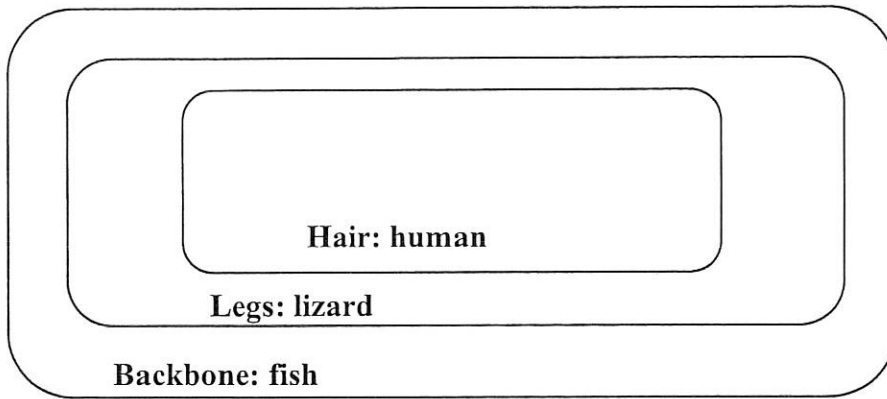
1. First, you need to make a "characteristics chart" that helps you analyze which characteristics each species has. **Fill in a "x" for yes it has the trait and "o" for "no" for each of the organisms below.**
2. Then you **count how many times you wrote yes for each characteristic.** Those characteristics with a large number of "yeses" are more ancestral characteristics because they are shared by many. Those traits with fewer yeses, are shared derived characters, or derived characters and have evolved later.

#### Chart Example:

	Backbone	Legs	Hair
Earthworm	O	O	O
Fish	X	O	O
Lizard	X	X	O
Human	X	X	X
"yes count"	3	2	1

**Step Two "The Venn Diagram":** This step will help you to learn to build Cladograms, but once you figure it out, you may not always need to do this step.

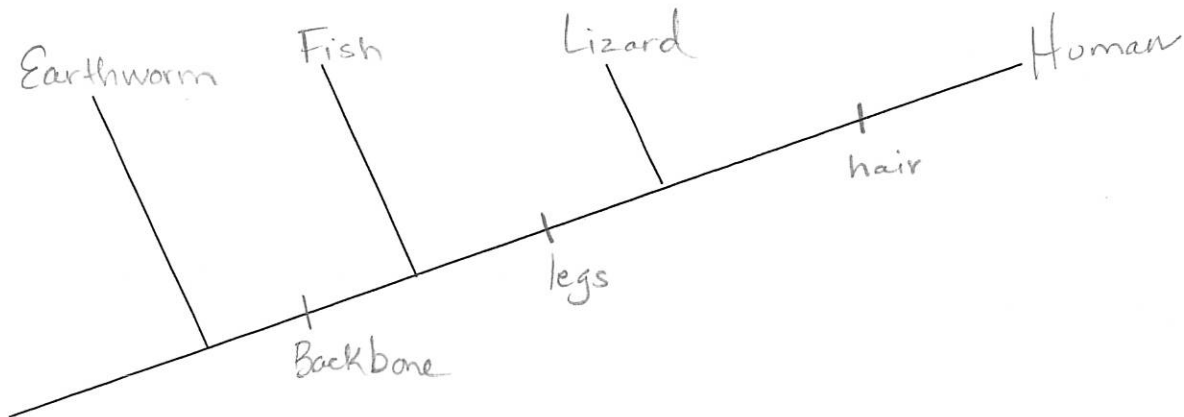
1. **Draw a multi-circular Venn diagram.** You will need as many circles as there are characters.
2. **Start with the character that is shared by all the taxa on the outside.** (you will want to make this a large circle.)
3. Inside each box, write the species that have only that set of characters.
4. On the outside of the Venn Diagram, write the outgroup. This is a group of organisms that do not share any traits and serve as a comparison to the phylogeny you are looking at.



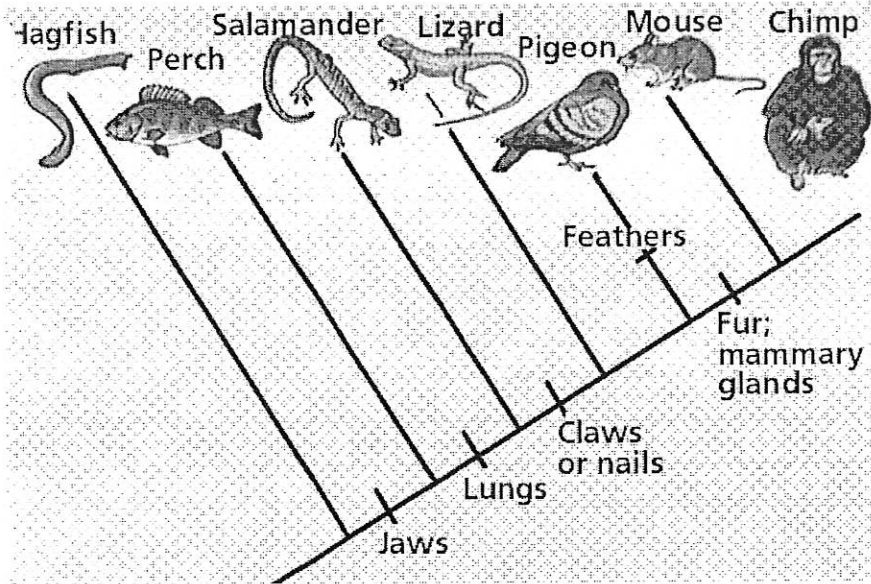
**Outgroup: Earthworm**

**Step Three "The Cladogram":**

This step converts the Venn Diagram into a cladogram. The traits are written on the main line, and species go on the branches. On the cladogram below, try to put all the characters and the species in the correct evolutionary history.



## Interpreting a Cladogram



First, let's practice interpreting some cladograms. Looking at the images, answer the questions below

1. Which species is the outgroup?

Hagfish

2. After which animals did mammary glands develop?

Pigeon

3. What animal does not have jaws?

Hagfish

4. Which animals have lungs?

Salamander, Lizard, Pigeon, Mouse, Chimp

5. What other animals would come after the chimp?

Humans

6. What could the character trait be that would come after the chimp?

bipedal (chimps do have opposable thumbs)

7. What character trait separates salamanders and lizards?

Claws or nails

8. List at least one shared derived character and explain who it is shared by.

Ex. Fur + Mammary glands - shared by mouse and chimp.

\* This question has several possible answers

9. List at least one derived character and explain why.

Lungs - allowed organisms to breathe on land.

10. Based on the cladogram, which shared a common ancestor most recently - a mouse and a lizard, or a mouse and a perch?

Mouse + lizard

11. What evolutionary event occurs when a species branches off from the main line?

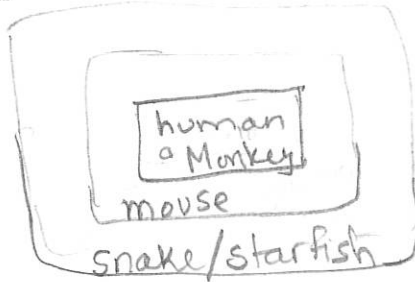
A mutation that helps the organism survive and reproduce + pass on the same mutation to offspring.

## Building a Cladograms

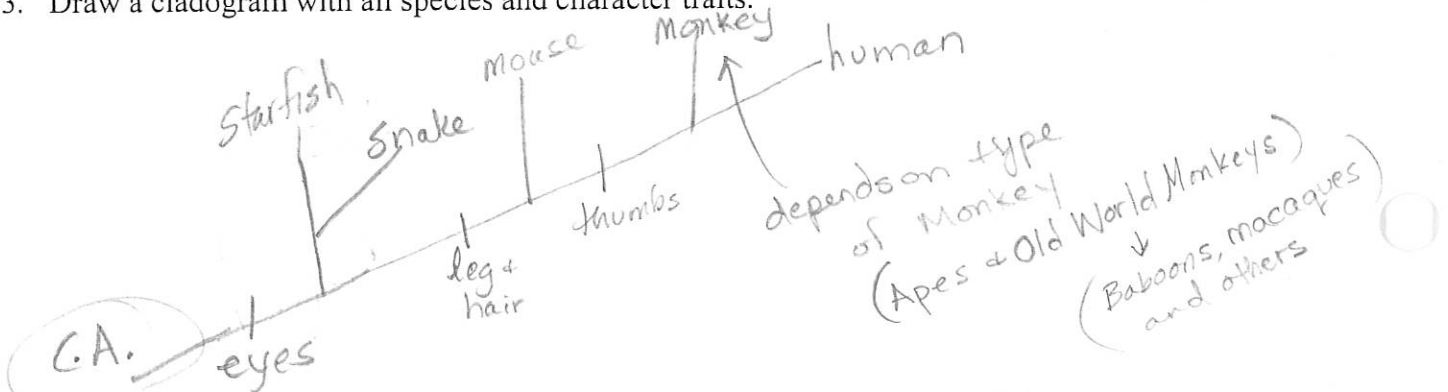
1. Fill in the following table. Mark an X if the species has the trait and O if they do not

	Hair	Legs	Thumbs	eyes
Human	X	X	X	X
Snake	O	O	O	X
Monkey	X	X	O	X
Mouse	X	X	O	X
Starfish	O	O	O	X

2. Draw a Venn diagram



3. Draw a cladogram with all species and character traits.



4. Using complete sentences, explain why you put each species where you did.

Organized by trait all organisms shared to the trait (thumbs) that only monkeys and humans share.

5. According to your cladogram, which two species are more closely related: humans and snakes or humans and mice? How do you know?

Humans and mice are more closely related, because they are closer on cladogram and share more traits.

6. According to your Diagram, what species are humans most closely related to? How do you know?

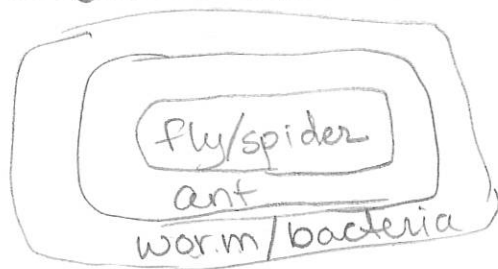
Humans are most closely related to monkeys as we share all of the same traits.

1. Fill in the following table. Mark an X if the species has the trait and O if they do not

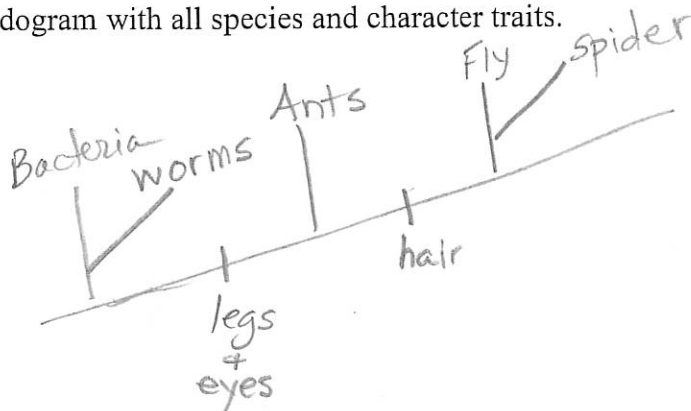
no eyes but receptor organs.

	Hair	Legs	Thumbs	eyes
Worm	O	O	O	O
Spider	X	X	O	X
Ant	O	X	O	X
Fly (on legs)	X	X	O	X
bacteria	O	O	O	O

2. Draw a Venn diagram



3. Draw a cladogram with all species and character traits.



"Flies are one of the few insects that have hair. (Hair is on its legs)"

4. Using complete sentences, explain why you put each species where you did.

Organized from organisms that share fewest/no. traits, to organisms that share the most traits

5. According to your cladogram, which two species are more closely related: worms and spiders or worms and ants? How do you know?

Worms and ants are more closely related, because they are closer on cladogram than worms and spiders.

6. According to your cladogram, what species are flies most closely related to? How do you know?

Flies are most closely related to spiders, as they share all of the same traits.

