

Name _____

Date _____

Let's Build a Cladogram!

Introduction: Cladistics is one of the newest trends in the modern classification of organisms. This method shows the relationship between different organisms based on the presence or absence of certain characteristics called “derived characters”. Derived characters are the unique characteristics of a particular group of organisms. These characteristics are “evolutionary innovations” that arose in one group of organisms, but are not found in the older members of the lineage. Based on these derived characters, cladistics is used to determine the sequence in which different groups of organisms evolved. The organisms and their derived characters are then illustrated on a diagram called a cladogram. A cladogram shows the evolutionary relationships among groups of organisms. Organisms that are grouped more closely on a cladogram share a more recent common ancestor than those farther apart.

- Purpose:**
- 1) To make careful observations to determine the derived characters of a group of organisms.
 - 2) To arrange the derived characters into a cladogram showing the relationships between the organisms.

Materials: Pictures of lamprey, trout, caecilian, turtle, cat, gorilla, and human

Procedure:

1. Make careful observations of the animals in the pictures you have been given. As you study each picture, determine if the animal has any of the characteristics that you see in the data table below.
2. If the characteristic is present in the animal, place a “+” in the correct column, indicating that the animal has that particular characteristic.
3. If the characteristic is absent in the animal, place a “-” in the correct column, indicating that the animal does not have that particular characteristic.

Table of Derived Characters:

| Organism | Characteristic | | | | | |
|--------------|----------------|-------|------|-------|-----------------|------------------------|
| | Jaws | Limbs | Hair | Lungs | Opposable thumb | Upright, erect posture |
| Lamprey | | | | | | |
| Trout | | | | | | |
| Caecilian | | | | | | |
| Turtle | | | | | | |
| Cat | | | | | | |
| Gorilla | | | | | | |
| Human | | | | | | |
| Total | | | | | | |

4. Fill in the line of the data table marked “total”. Count how many organisms possess each characteristic. For example: How many organisms have jaws? List this number for the total. Determine the total for each characteristic.

5. Look carefully at your data table. Find the organism that has none of the derived characters shared by the other organisms in the data table. This organism is referred to as the “out-group”. A cladogram deliberately includes an organism that is only distantly related to the other organisms. This organism is called the “out-group”. The purpose of the out-group is to serve as a basis of comparison with the other organisms. The other organisms are called the “in-group”.

6. The out-group in your data table is the: _____.

7. Now let’s draw our cladogram in the space below. (You might want to glance at the small picture at the top of page 1.)

- a) Start by drawing a diagonal line upon which all the derived characters will be placed.
- b) Draw the first branch at the bottom of your diagonal line and place the name of the out-group at this first branch.
- c) Which derived character is the most common? Look at your data table and determine the characteristic that occurs most often.

The most common derived character is: _____.

- d) The most common derived character is placed at the bottom of the diagonal line on the cladogram. Add this characteristic to your cladogram.
- e) Now determine the second most common derived trait. Place it above the most common trait on your cladogram. Continue until all traits have been placed on the cladogram in order from most common to least common.

f) Now let’s add the names of the organisms to the cladogram. Which organism in the data table has only one shared derived character? _____

Draw a branch point for this organism at the bottom of the cladogram, just above the out-group organism.

g) Which organism in the data table has two shared derived characters? _____
Draw a branch point for this organism on the cladogram.

h) Continue until the names of all organisms have been added to the cladogram. Be sure to place the branch points for each animal in the right position depending on its shared derived characters.

Final Observations:

1. What is cladistics?
2. What are “derived characters”?
3. What is a cladogram?
4. What does a cladogram show?
5. In the introduction, the term “evolutionary innovation” was used. What does this mean?
6. How is the out-group determined in a cladogram?
7. Why is the out-group needed on a cladogram?
8. What is the in-group in a cladogram?
9. Which derived character is placed immediately after the out-group on a cladogram?
10. What must be true of organisms that have the most shared derived characters?

11. What trait on your cladogram separates the least closely related organism from the other organisms?

12. What is a “branch point” on a cladogram?

13. According to your cladogram, the cat most recently shared a common ancestor with what organism?

14. What are the derived characters of a turtle?

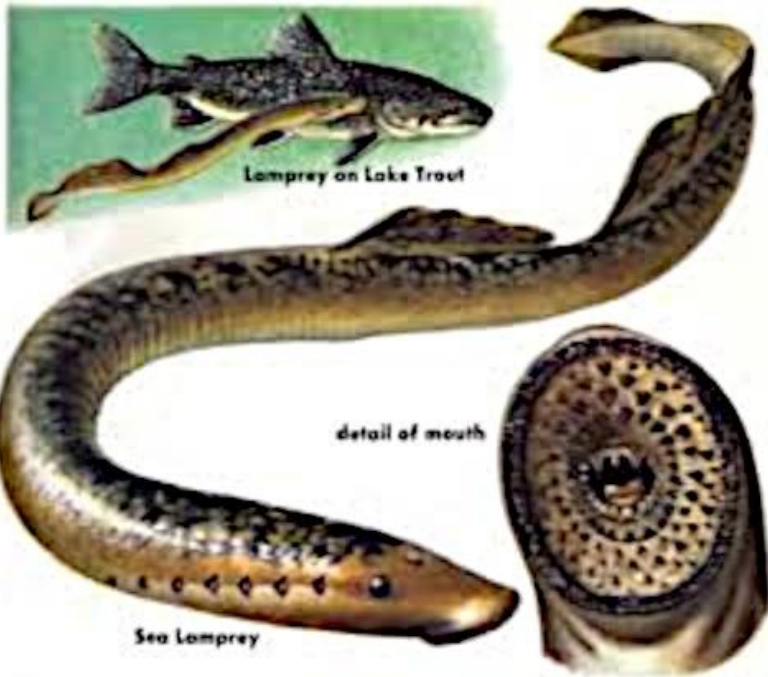
15. A derived character found in birds is feathers. Where would this be placed in the cladogram that you drew? Explain your answer.

16. Which organism on your cladogram was the first to evolve?

17. Which organism on your cladogram is the most recently evolved?

18. Which derived character is unique to gorillas and humans?

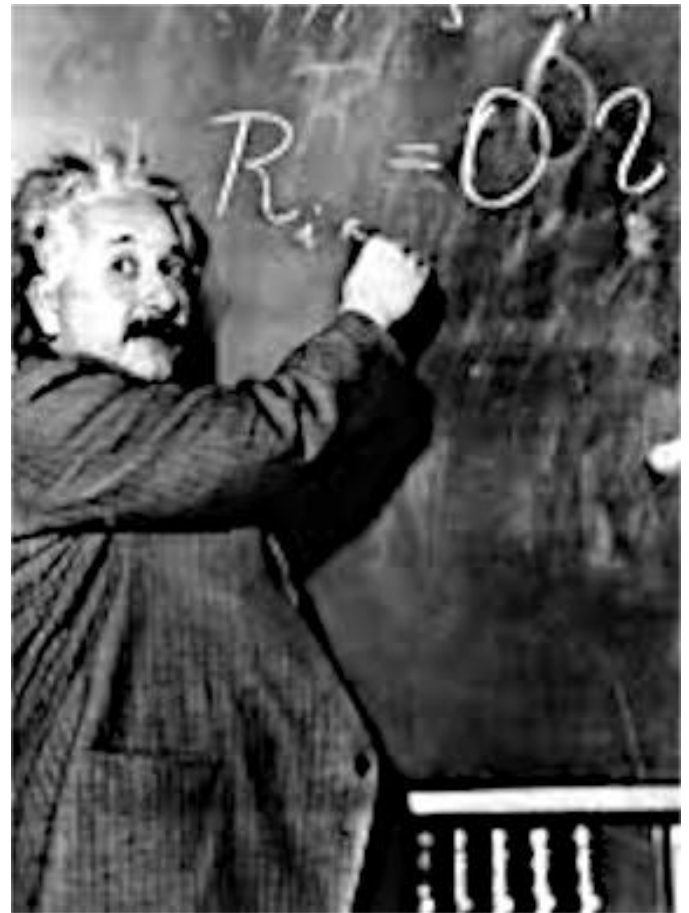
19. Which two organisms on the cladogram are the most closely related? Why are they the most closely related?



Lamprey



Gorilla



Human



Trout



Turtle



Cat



Caecilian

