1. Examine the phylogenetic tree in Figure 1 to answer the following questions.
   a. Which species is/are most closely related to species V? U
   b. Which species is/are most closely related to species T? S and R
   c. Which species is/are most closely related to species Q? R, S, and T
   d. Which 2 species are least related? Explain why. Q and V since they share the oldest common ancestor
   e. If a new trait evolved at position 4, which species would NOT have the new trait? Explain. Q, R, S, and T, since they branched off previous to position 4
   f. Would you expect the species at position 5 to resemble S or T more closely? Explain. If there are no other traits it would resemble both the same, but if there are due to the branching then T resembles 5 more closely since it directly descends from that species
   g. Along which path could a derived trait evolve that would eventually be inherited by S? at location 5, 3, or 1, or anywhere along those paths
   h. Which species would you expect to be most ancient in appearance? Q since it has the least derived traits
   i. Identify the trait that species U has, but V does not. 7
   j. Is there a trait shared by all species on the phylogenetic tree? If so, identify which trait. If not, explain why. trait 1, as it is at the node the precedes all species
   k. Identify the traits that species R, S and T share, but are not shared with species U and V. trait 5
   l. Is there trait shared by species R and S but not by T? Explain why or why not. No, trait 5 is shared by all species, no other traits were evolved

2. Use the cladogram to answer the following questions.
   a. Which organisms have fur and mammary glands? mouse, chimp
   b. Which organisms have jaws? all but hagfish (perch, salamander, lizard, pigeon, mouse, chimp)
   c. Which organisms shared a common ancestor most recently – a mouse and lizard or a mouse and perch? mouse and lizard
   d. Which 2 organisms would you expect to have closer matching DNA for a gene that is not under selective pressure in nature – hagfish and pigeon or hagfish and salamander? hagfish and salamander

3. Use the table provided to answer the following questions.
   a. Construct a cladogram from the derived traits in the table.
   b. Which 2 species are most closely related? pike and lamprey, and wolf and human

<table>
<thead>
<tr>
<th>Table 2 Selected Derived Traits for Ingroup and Outgroup</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td>hair</td>
</tr>
<tr>
<td>lamprey</td>
</tr>
<tr>
<td>turtle</td>
</tr>
<tr>
<td>gorilla</td>
</tr>
<tr>
<td>lungfish</td>
</tr>
<tr>
<td>pike</td>
</tr>
<tr>
<td>wolf</td>
</tr>
<tr>
<td>human</td>
</tr>
</tbody>
</table>

-- indicates absence of the trait + indicates the presence of the trait
c. Are pike more closely related to lungfish or to gorillas? *lungfish, as they only have 1 different trait as opposed to 3*

d. Which of the derived traits came into existence before the bony shell? *Jaws and lungs*

e. List all the derived characters in the table that would have been present in the ancestor to gorillas, wolves, and humans. *Jaws, lungs, hair*

4. Construct a cladogram for the organisms in each table. First, choose an organism that has the fewest of the derived traits, it is the first to split from the group. For example for Table 1, it is the lamprey. Draw a large V, the base of the V represents your first node and is the common ancestor that split into 2 lineages. Write “lamprey” at the top of the line on the left as shown. Next, determine which organism(s) have the next fewest derived characters that are shared with all remaining group members. Continue until all organisms are placed.

```
  lamprey  shark  frog  dog  chimp  humans

  small canines
  enlarged cranium
  mammary glands
  bony skeleton
  paired appendages
```

a. For Table 1: which animals are most similar to each other? *Humans and chimps, lamprey and shark*

b. For Table 1: which animals share the most recent common ancestor? *Humans and chimps*

c. For Table 1: which animals are least similar to each other? *Lamprey and humans*

d. For Table 2: which animals are most similar to each other? *Lion and lynx*

e. For Table 2: which animals share the most recent common ancestor? *Lion and lynx*

f. For Table 2: which animals are least similar to each other? *Perch and lion/lynx*