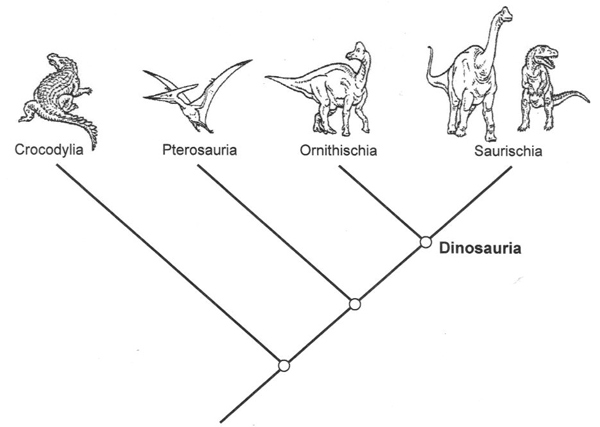
Biology from Hawaii Name

2014

**Cladogram**



**Introduction**

A family tree that shows how species evolved is called a **cladogram**. At the top, various **taxa** (types of organisms) are compared. These taxa could be different species, genera, orders, etc. For example, the dinosaur cladogram on the right compares different orders. The most interesting taxon go on the far right, while their most distant relative (the **outgroup**) goes on the far left. In the dinosaur cladogram, we are interested in *Saurischia*, and the outgroup is *Crocodylia*.

membrane wings

teeth

The **branches** of a cladogram show evolution. Higher branches represent recent evolutionary changes and lower ones more ancient changes. Branches meet at the **common ancestor** that gave rise to subsequent taxa. For example, an early species of *Dinosauria* gave rise to both *Ornithischia* and *Saurischia* but not *Pterosauria*. Common ancestors are not often labeled because no one knows their identity; they are extinct and difficult/impossible to find.

Important **characteristics** are labeled on a cladogram, showing in which branch they evolved and how long ago. For example, membrane-wings only evolved along the *Pterosauria* branch while teeth evolved much longer before, along the branch that gave rise to all these creatures. Scientists place these characteristics using logic, then confirm them with fossils.

**Procedure**

**I**. Record observations in a table of characteristics

**II**. Translate the table of characteristics into a Venn diagram of characteristics

**III**. Translate the Venn diagram into a cladogram

**Hints**: make rough sketches of Venn diagrams and cladograms on scratch paper

use cut-out species names that you can easily move around

start with the most related pair, then work outwards

1. Guided practice. Fill in the table of characteristics. Finish the Venn diagram by circling the amphibious species. Finish the cladogram by adding species and labeling characteristics.

*H. saccophora*

*H. aumakuawai*

1 entrance

*H. papaiili*

**Makes a case**

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | Makes a case | 1 entrance | Amphibious |
| *H. saccophora* |  |  |  |
| *H. aumakuawai* |  |  |  |
| *H. papaiili* |  |  |  |

*H. aumakuawai*

2. Choose only the most important, defining characteristics. Fill in the table of characteristics. Translate the data into a Venn diagram, then a cladogram. Notice any differences from the cladogram above.

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | Makes a case | Eats lichen | Amphibious |
| *H. saccophora* |  |  |  |
| *H. aumakuawai* |  |  |  |
| *H. papaiili* |  |  |  |

3. Adding a few species greatly increases complexity. Make a cladogram of these 5 species. Choose important characteristics. Label characteristics on the cladogram.

You may abbreviate species names.

suggested characteristics

case makes a case

case shape

with pebbles

with sand

with lichen

with algae

with snail shells

has 2 openings

has 1 opening

has hinged door

habitat lives on trees

lives on rocks

lives in streams

island it inhabits

diet eats green plants

eats animals

eats wood

size small (3–5mm)

med (6–12mm)

large (>12mm)

other amphibious

tan wings

gray/black wings

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species** |  |  |  |  |  |
| *H. saccophora* |  |  |  |  |  |
| *H. pupumoehewa* |  |  |  |  |  |
| *H. aumakuawai* |  |  |  |  |  |
| *H. papaiili* |  |  |  |  |  |
| *E. trivitella* |  |  |  |  |  |

4. Final cladogram. Make a cladogram of these 7 species. Choose important characteristics. Translate data into a Venn diagram, then a cladogram.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** |  |  |  |  |  |  |  |
| *H. saccophora* |  |  |  |  |  |  |  |
| *H. kahamanoa* |  |  |  |  |  |  |  |
| *H. pupumoehewa* |  |  |  |  |  |  |  |
| *H. aumakuawai* |  |  |  |  |  |  |  |
| *H. papaiili* |  |  |  |  |  |  |  |
| *H. lignivora* |  |  |  |  |  |  |  |
| *E. trivitella* |  |  |  |  |  |  |  |

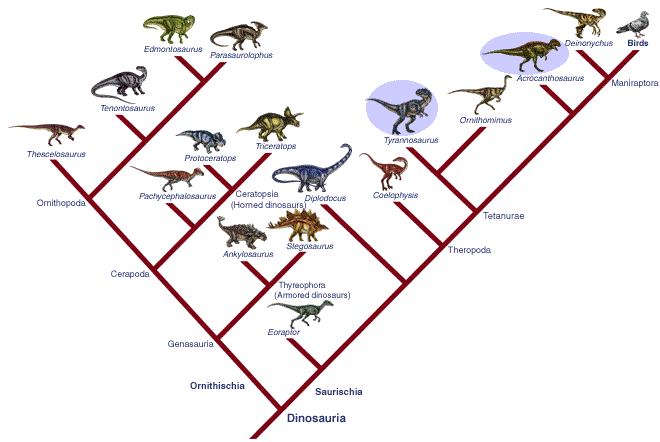
**Discussion**

1. Compare cladogram 1 to cladogram 2 (both should show 3 species). Why are they different?

2. How might different scientists construct different cladograms of the same species? Discuss the roles of observation versus opinion in constructing a cladogram.

3. How did you choose important characteristics?

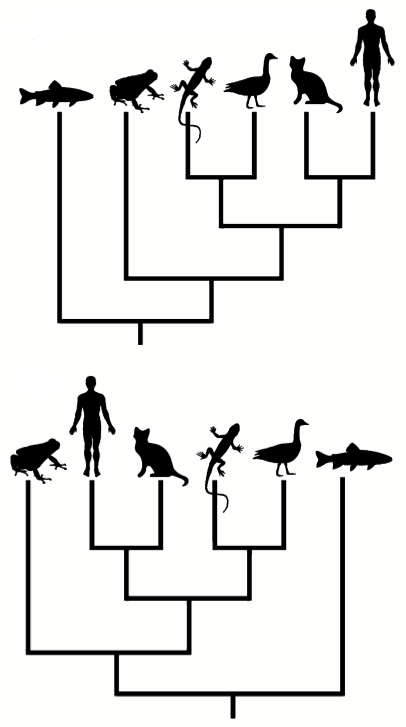
4. Describe your method for translating data tables into Venn diagrams.



5. List 2 interesting facts shown in the

dinosaur cladogram (right).

6. Which cladogram below is correct? Why?



**A**

|  |  |  |
| --- | --- | --- |
| **Grading** | points worth | points earned |
| **Results**  carefully observe species  choose characteristics that distinguish species or groups  accurately translate data tables into Venn diagrams  accurately translate Venn diagrams into cladograms | **14** |  |
| **Discussion**  thoughtful answers use vocabulary from the class/reading | **6** |  |
| **Total** | **20** |  |

**B**