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Date: _____

Student Exploration: Cladograms

Vocabulary: adaptation, amino acid, amnion, artiodactyls, bipedal, clade, cladistics, cladogram, convergent evolution, evolution, flower, mammary glands, molecular, morphological, multicellular, parsimony, sagittal crest, phloem, selenodont teeth, SNP, xylem

Prior Knowledge Questions (Do these BEFORE using the Gizmo.)

1. Look at the images below. Which two organisms do you think are most closely related?

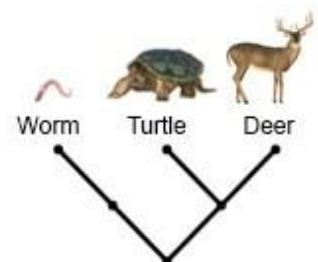
Turtle and Deer



2. Why do you think so? Because they both are vertebrates (have a backbone) but the worm doesn't.

Gizmo Warm-up

Cladistics is a method of hypothesizing the evolutionary relationships between species. A **cladogram** is a branching diagram that illustrates these relationships. For example, the cladogram on the right shows that deer are more closely related to turtles than to worms. In the *Cladograms* Gizmo, you will use **morphological** (physical characteristics) and **molecular** data to create cladograms.




To begin, make sure **Plants** is selected for the **Organism group** and **Morphological** is selected for the **Data** type. Click on one of the characteristics to the left of the table on the **TABLE** tab. Information about the characteristic will be shown on the **ORGANISM** tab.

Using the information on the **ORGANISM** tab, describe each of the characteristics below.

- **Xylem** and **phloem**: Xylem and Phloem are tissues in plants that transport water and solutes up the plant (phloem) and food down the plant (xylem).
- **Flowers**: A flower is a part of a plant containing reproductive organs (stamen and carpel) surrounded by brightly colored petals.
- **Multicellularity**: A multicellular organism is composed of more than one cell.



<p>Activity A: Morphological cladogram</p>	<p><u>Get the Gizmo ready:</u></p> <ul style="list-style-type: none"> Check that Plants and Morphological are still selected for the group and data type. 	
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Question: How do you build a simple cladogram based on physical characteristics? By shared derived characteristics.

- Fill in:** Using what you learned in the warm-up, fill in the table. Clicking one of the boxes of the table will add a check mark to indicate the presence of a characteristic. Then, select **Check table** and adjust any of the boxes you may have filled in incorrectly.

Which organism has the fewest shared characteristics? Flowers

- Organize:** Now you are ready to organize the table.

A. How many characteristics (check marks) does each organism have?

Algae: 0 Arabidopsis: 3 Cycad: 2 Moss: 1

Drag the arrows (↔) below the table to order the organism columns from fewest characteristics on the left to most on the right.

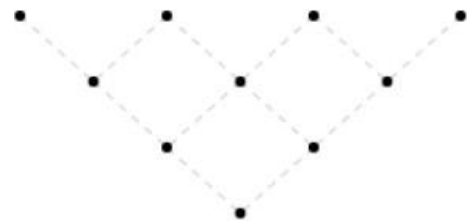
B. How many organisms have each characteristic?

Multicellularity: 3 Xylem and phloem: 2 Flowers: 1

Drag the arrows to the right of the table to order the characteristics from fewest organisms on the top to most on the bottom.

- Build:** Select the CLADOGRAM tab at the top left. The goal of a cladogram is to show the relationships among a group of organisms. Organisms that are most closely related should share the most recent common ancestor (highest branch on the tree). Organisms that are most distantly related should share the oldest common ancestor (lowest branch on the tree).

Click the segments on the cladogram template to build your own cladogram that shows how you think the different plants are related.



Sketch your cladogram in the space to the right.

Answer the following questions based on your cladogram.

A. Which two organisms are most closely related? Algae and Arabidopsis