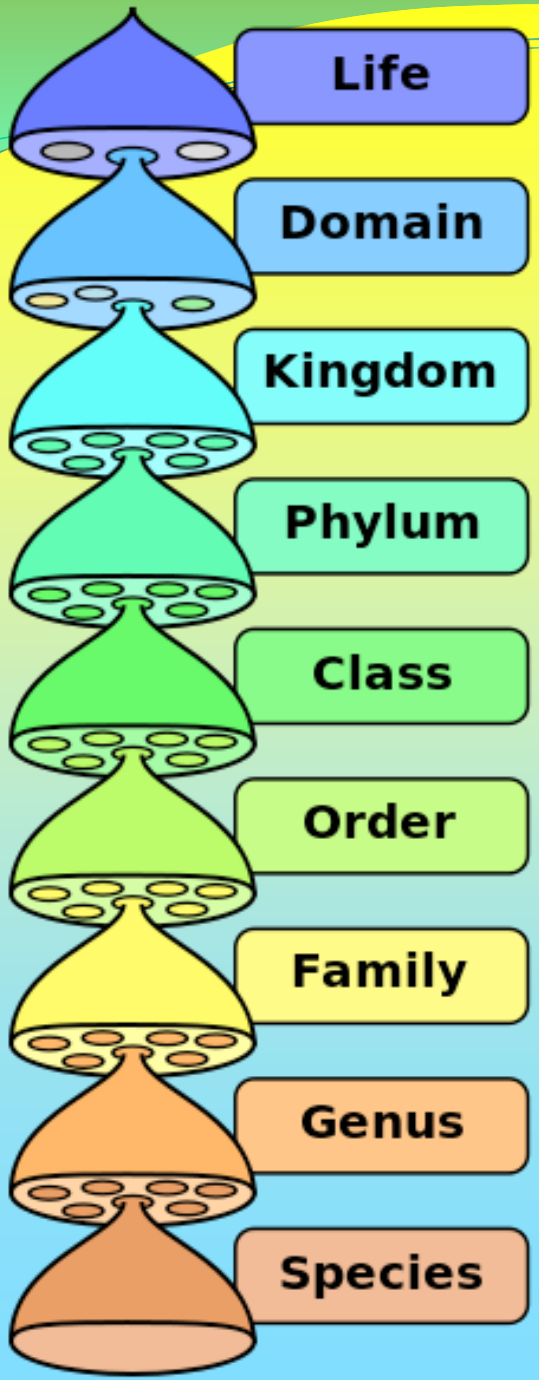


Traditional Classification

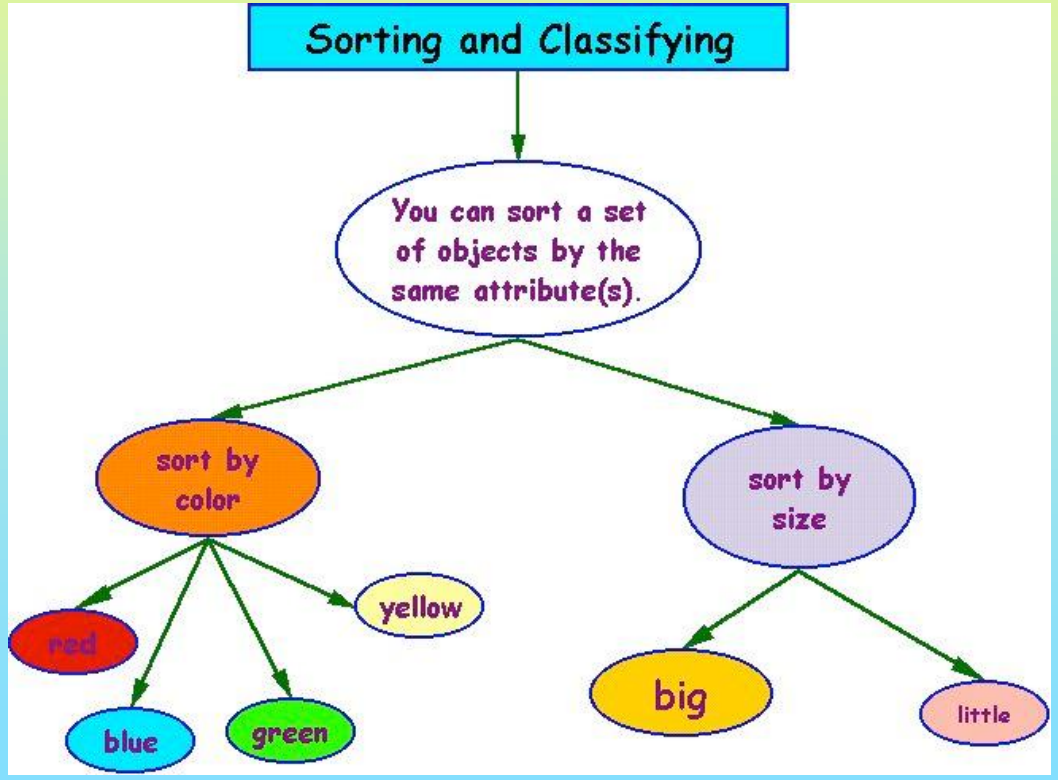
Learning Goals:

1. I can list the traditional classification hierarchy in order.
2. I can explain what binomial nomenclature is, and where an organism gets its first and last name.
3. I can read and create a dichotomous key.

Classifying Species:

"Classify" is to assign groupings to

Taxonomy: is the science of classifying organisms



About three hundred years ago, a Swedish botanist and doctor named Carl Linnaeus realised that:

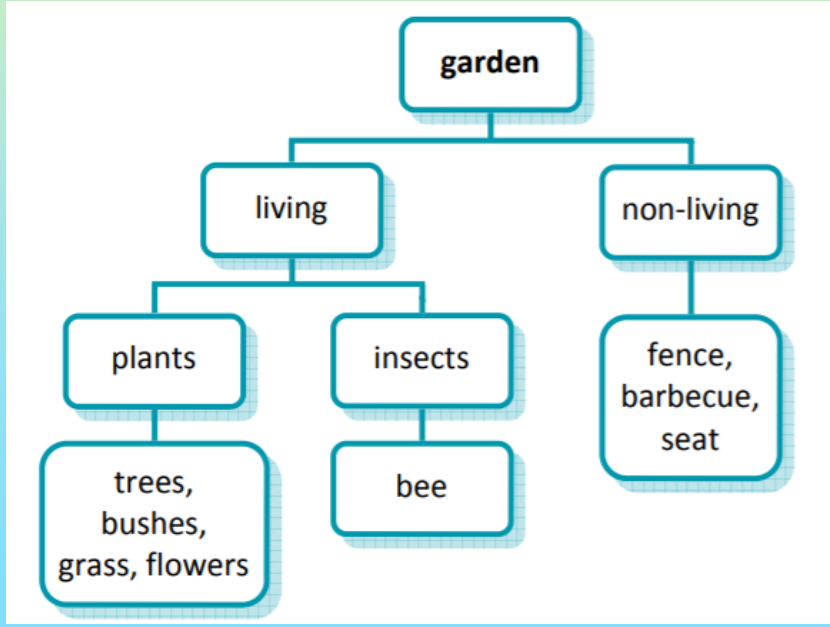
"all the real knowledge we have depends on the METHOD by which we distinguish the similar from the dissimilar. The greater the number of natural distinctions we make, the clearer becomes our idea of things. The more numerous the objects which employ our attention, the more difficult it becomes to form such a method; and the more necessary."

Carl Linnaeus (1707-1778)

Traditional Classification:

Carolus Linnaeaus: early 1700's

- Groups were organized using a **hierarchy**, from largest to smallest in groups called **taxa** (plural) and **taxon** (singular)
- These groups were created using similarities between organisms and the science of naming species was aptly termed **taxonomy**.



Traditional Classification:

***Will need to know in order**

- Kingdom (King)
- Phylum (Philip)
- Class (Came)
- Order (Over)
- Family (For)
- Genus (Good / Great…)
- species (soup / spaghetti / soufflé…)

Taxonomy Example:

Kingdom: Animalia (Animal)

Phylum: Chordata (Backbone)

Class: Mammalia (Mammal)

Order: Cetacea (Porpoise)

Family: Delphinidae (Dolphin)

Genus: *Tursiops (Atlantic bottlenose)*

Species: *truncatus*

Naming Organisms:

Binomial Nomenclature is a system used to name organisms (means two names)

- First name = ***Genus*** and last name = ***species***
  - Genus is CAPITAL and species is lower case
  - Either in *italics* or underlined
  - In Latin: universal language
  - Human = ***Homo sapien***

- Why use scientific name rather than common name? Let's look at the killer whale....
- What about this one?

- The polar bear is called *Ursus maritimus.*
- The first part of the name—*Ursus*—is the genus to which the organism belongs. The genus *Ursus* contains other species of bears (brown, black, panda, koala).

Binomial Nomenclature Example

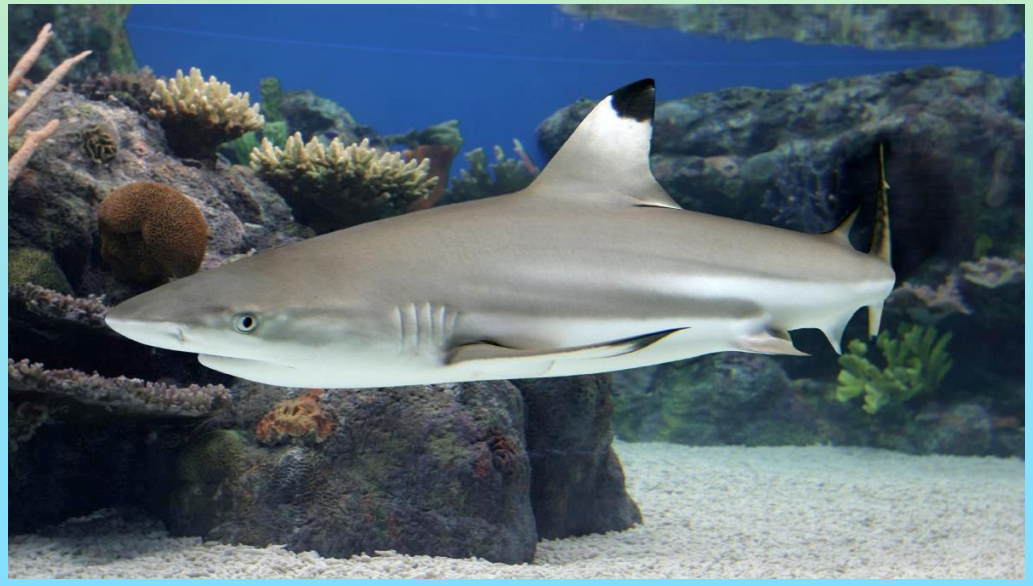
- The second part of a scientific name—*maritimus*—is unique to the species and is often a description of the organism's habitat or of an important trait.
- The Latin word *maritimus* refers to the sea: polar bears often live on pack ice that floats in the sea.

Binomial Nomenclature Example

Blacktip Reef Shark: *Carcharhinus melanopterus*

- *Carcharhinus:* “requiem shark” → (1) requiem ~ funeral, (2) ~ verb *reschignier* ~"to grimace while baring teeth".

  [Live-bearing young, warm waters (includes brackish), round eyes, pectoral fins behind 5 gill slits]
- *melanopterus:* “black-fin”

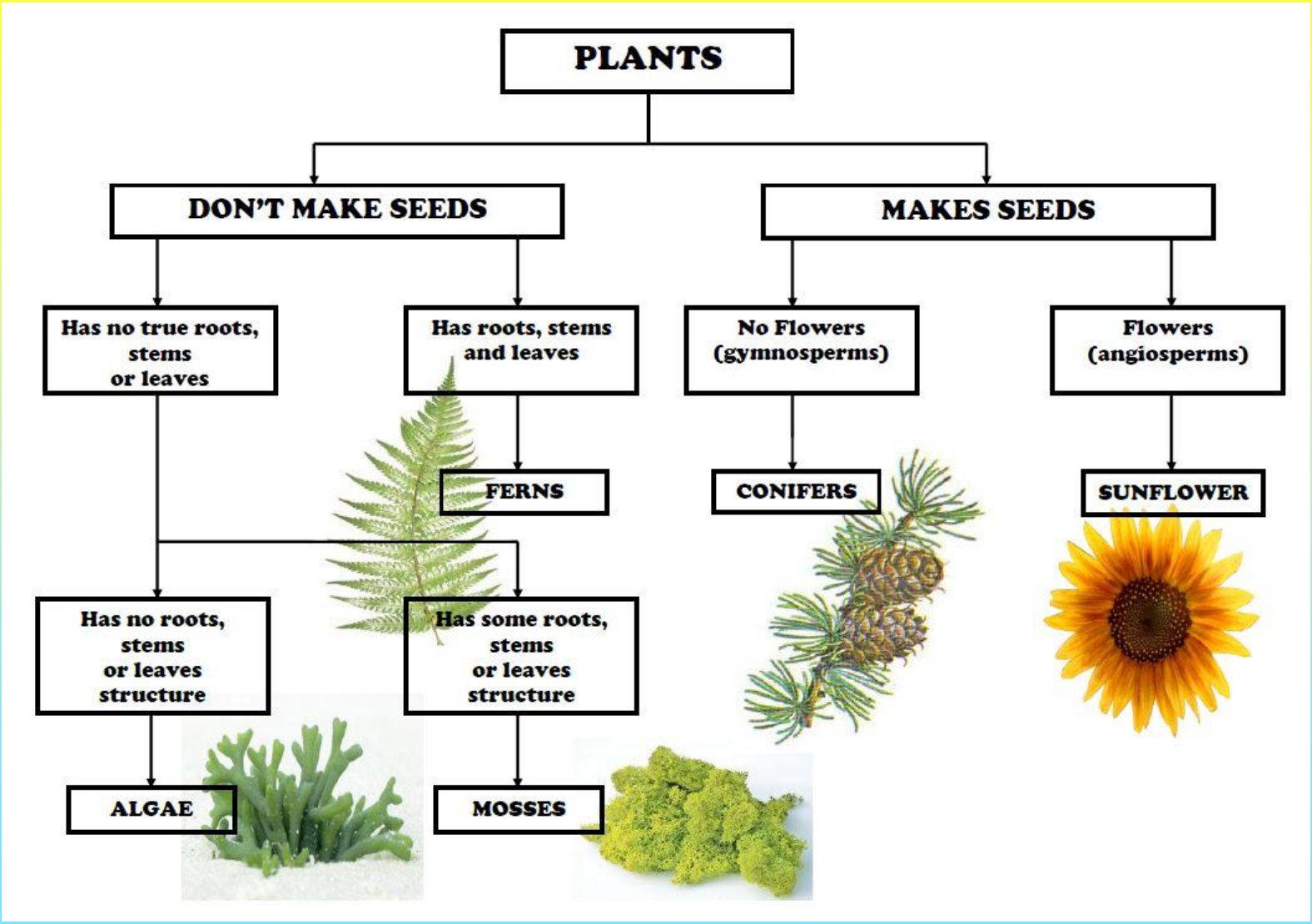


Dichotomous Key:

Dichotomous Keys: are organizational tools that allow you to group and identify organisms based on similar traits

1. The **top word** represents your entire group:
   - Ex: Marine Animals
2. The **branching words** must be traits:
   - Ex: shape of fin, lays eggs, color
3. The **last words** must be your organism name:
   - Sea turtle, blue whale, bottlenose dolphin

Dichotomous Key Example:



Below are pictures of 10 Illinois fish. See if you can identify them using this simple key.

1. a) Whiskerlike barbels present on head (catfishes)—Go to 2
   b) No whiskerlike barbels present on head—Go to 3

2. a) Caudal fin forked—channel catfish
   b) Caudal fin rounded—tadpole madtom

3. a) Mouth facing downward (suckers)—Go to 4
   b) Mouth not facing downward—Go to 5

4. a) Front edge of dorsal fin at least 4 times longer than back edge—quillback
   b) Front edge of dorsal fin less than 4 times longer than back edge—black redhorse

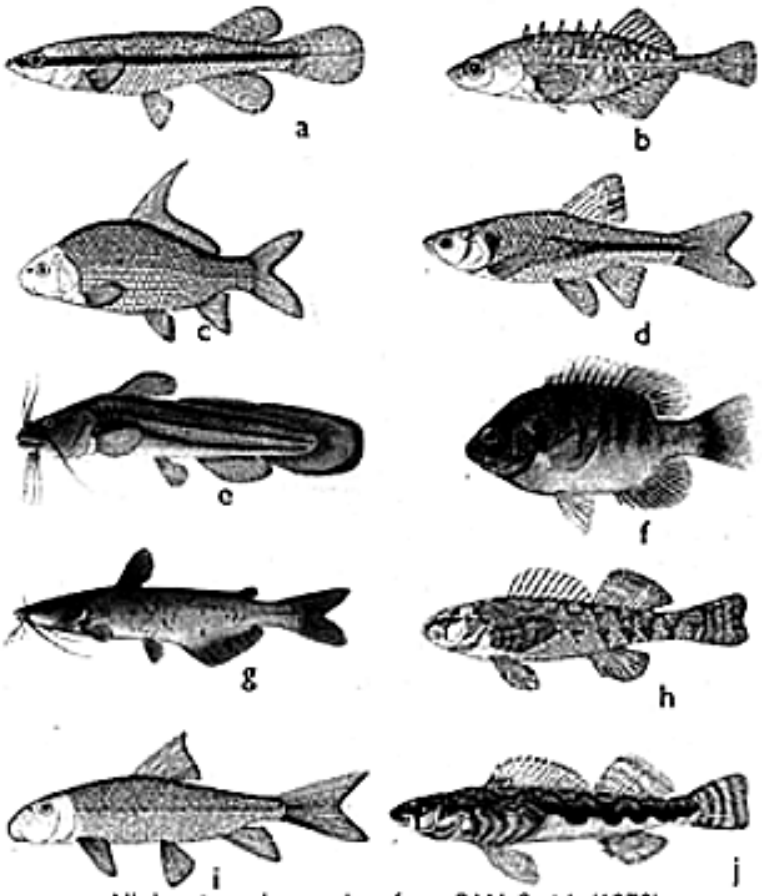
5. a) Body elongate, more than twice as long as tall—Go to 6
   b) Body not elongate, but slab-sided. Not more than twice as long as tall—bluegill

6. a) First five rays of dorsal fin spikelike—brook stickelback
   b) First five rays of dorsal fin not spikelike—Go to 7

7. a) Two dorsal fins. (darters)—Go to 8
   b) Only one dorsal fin—Go to 9

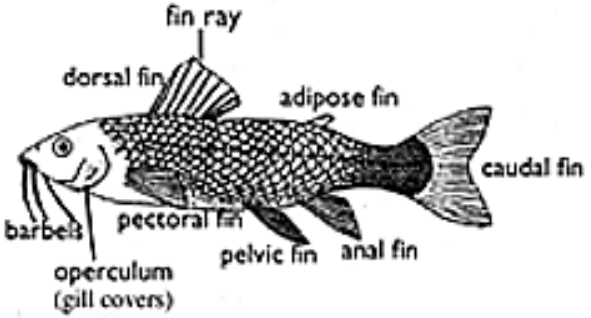
8. a) Bold irregular black stripe on side, like a series of connected blotches—blackside darter
   b) No bold black markings on side. Markings are narrow vertical bars—orangethroat darter

9. a) Caudal fin forked—spotfin shiner
   b) Caudal fin rounded—blackspotted topminnow



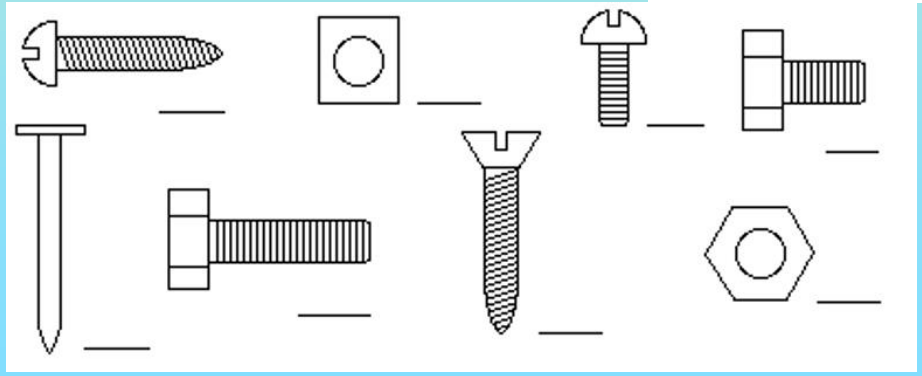
All drawings above taken from P.W. Smith (1979). The Fishes of Illinois.

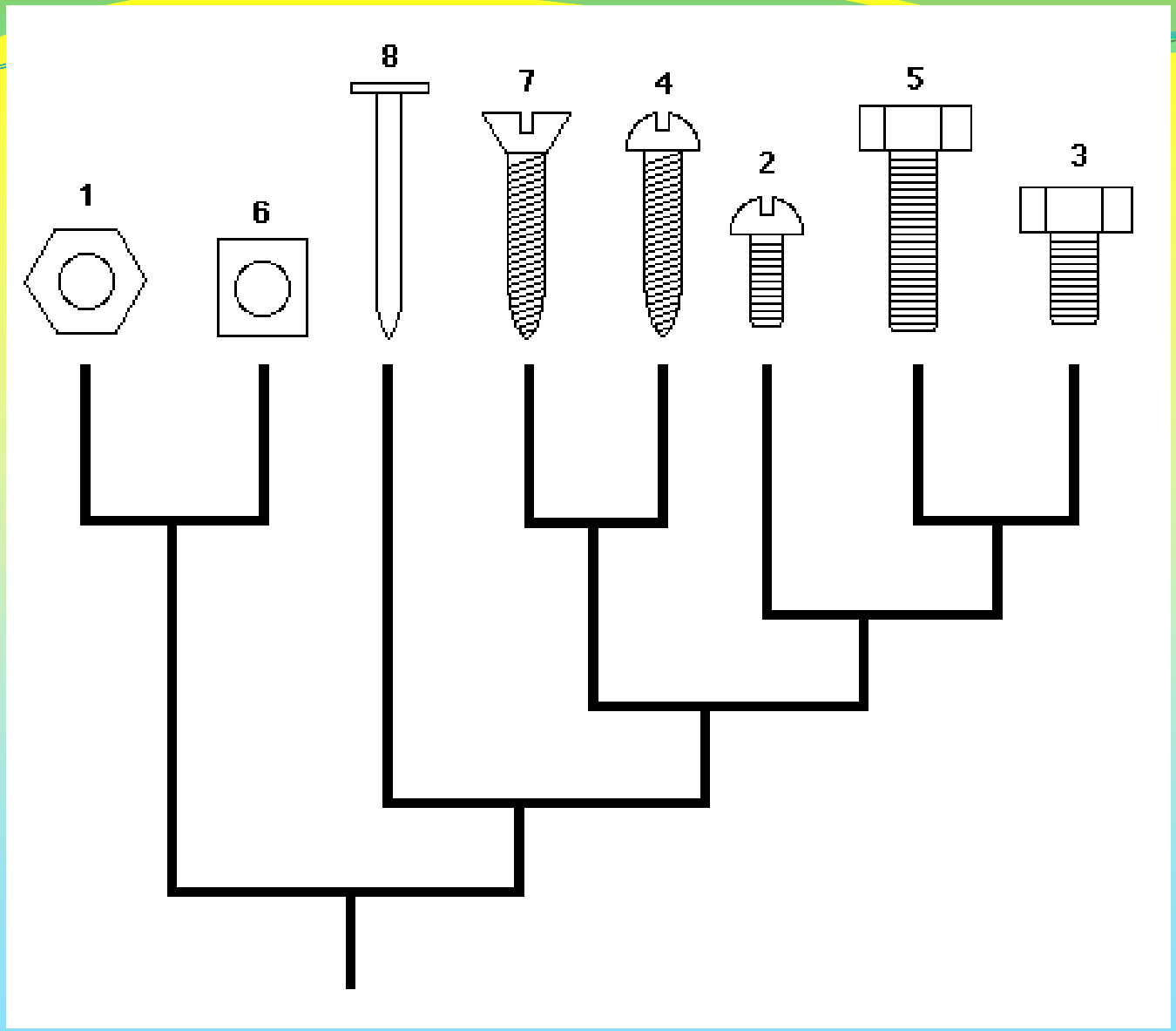
Fish Anatomy

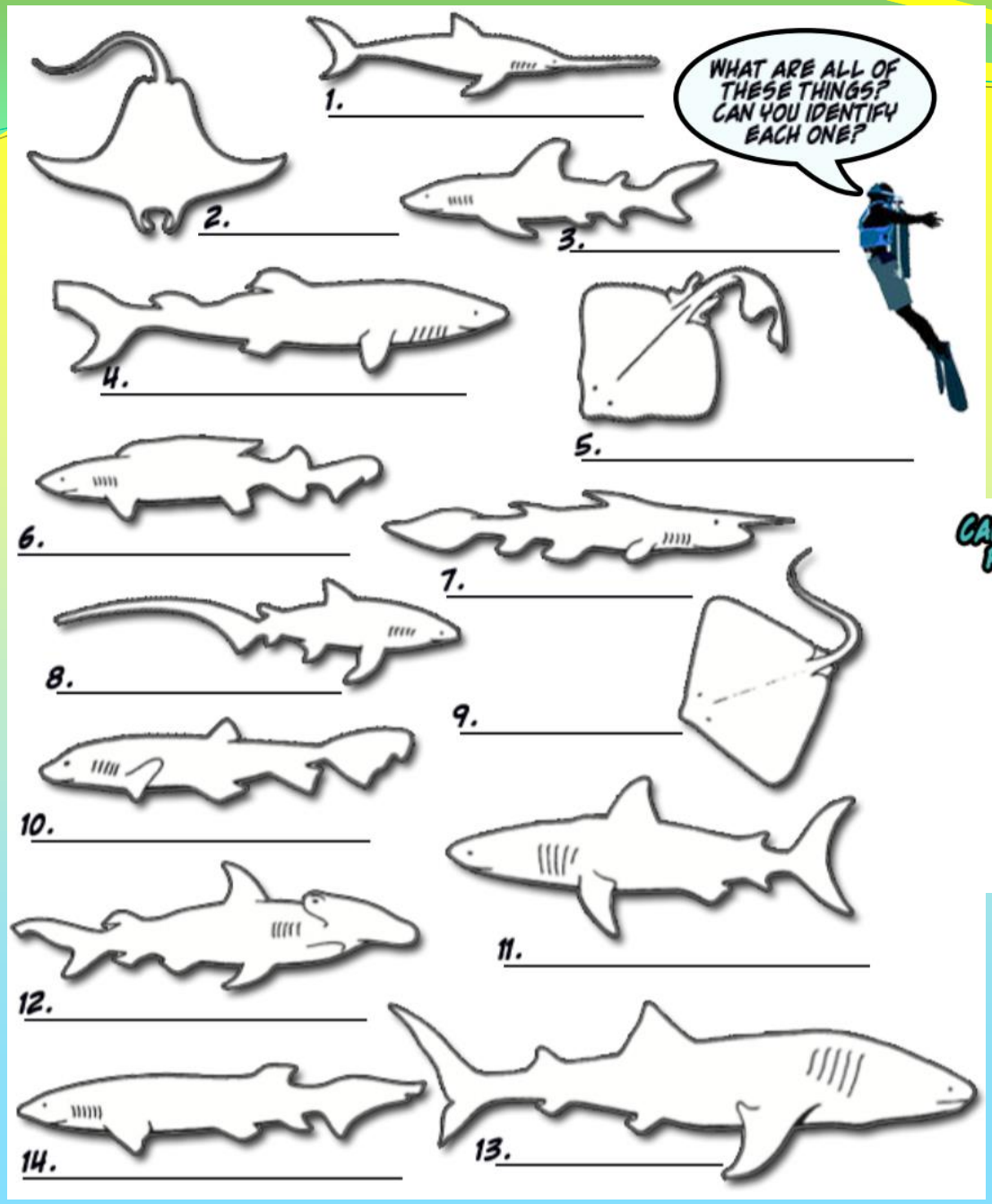


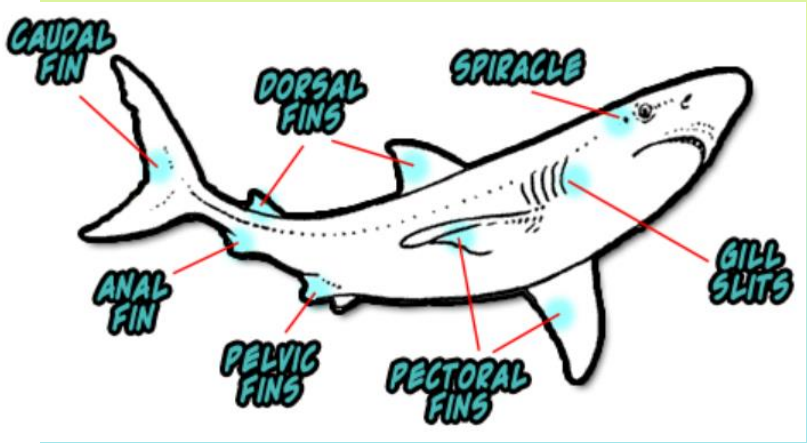
Practica

1a. With a hole	Go to Question 2
1b. Without a hole	Go to Question 3
2a. Six sided	**It is Species #1**
2b. Four sided	**It is Species #6**
3a. With threading	Go to Question 4
3b. Without threading	**It is Species #8**
4a. Pointy tip	Go to Question 5
4b. No pointy tip	Go to Question 6
5a. Rounded head	**It is Species #4**
5b. Not rounded head	**It is Species #7**
6a. Flat head	Go to Question 7
6b. Not flat head	**It is Species #2**
7a. Body length twice the width of head	**It is Species #5**
7b. Body length not twice the width of head	**It is Species #3**




1
6
8
7
4
2
5
3


WHAT ARE ALL OF THESE THINGS? CAN YOU IDENTIFY EACH ONE?
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.

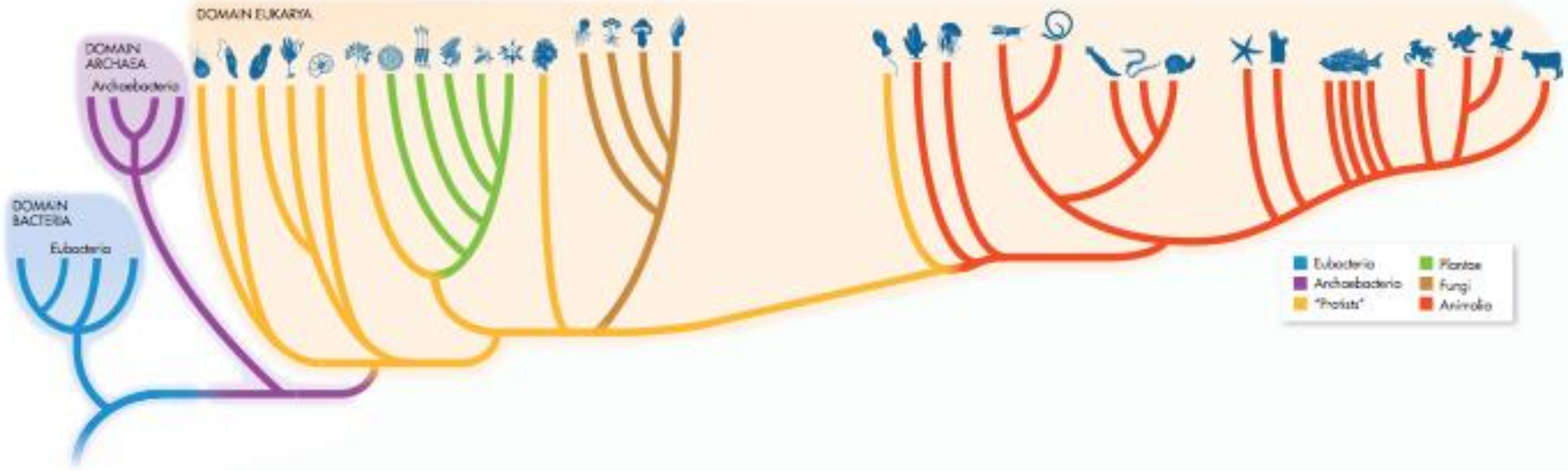

CAUDAL FIN
DORSAL FINS
SPIRACLE
GILL SLITS
ANAL FIN
PELVIC FINS
PECTORAL FINS

Shark Dichotomous Key

1	A	Body kite like in shape (if viewed from above)	Go to statement 12
	B	Body not kite like in shape (if viewed from above)	Go to statement 2
2	A	Pelvic fin absent and nose sawlike	Family **Pristiophoridae**
	B	Pelvic fin present	Go to statement 3
3	A	Six gill slits present	Family **Hexanchidae**
	B	Five gills present	Go to statement 4
4	A	Only one dorsal fin present	Family **Scyliorhinidae**
	B	Two dorsal fins present	Go to statement 5
5	A	Mouth at the front of the head rather than back along underside of head	Family **Rhinocodontidae**
	B	Mouth back along underside of head	Go to statement 6
6	A	Head expanded on the side with eyes at the end of expansion	Family **Sphyrnidae**
	B	Head not expanded	Go to statement 7
7	A	Top half of caudal fin exactly same size and shape as bottom half	Family Isuridae
	B	Top half of caudal different in size and shape from the bottom half	Go to statement 8
8	A	First dorsal fin very long, almost half the length of the total body	Family **Pseudotriakidae**
	B	First dorsal fin length much less than the half the total length of body	Go to statement 9
9	A	A. Caudal fin very long, almost as long as the entire body	Family **Alopiidae**
	B	Caudal fin length much less than length of entire body	Go to statement 10
10	A	Nose with long needlelike point on end	Family Scapanorhynchidae
	B	A light stripe extending the length of the body, a marked constriction at the base of the tail	Go to statement 11
11	A	Anal fin absent	Family **Squalidae**
	B	Anal fin present	Family **Carcharhinidae**
12	A	Small dorsal fin present near tip of tail	Family **Rajidae**
	B	Small dorsal fin absent near tip of tail	Go to statement 13
13	A	Hornlike appendages at front of shark	Family **Mobulidae**
	B	Hornlike appendages not present at front of shark	Family **Dasyatidae**

https://students.ga.desire2learn.com/d2l/lor/viewer/viewfile.d2lfile/1798/12579/taxonomy10.html

Modern Classification



Learning Goals:

1. I can compare and contrast traditional and modern classification methods.
2. I can explain how different organisms are related by using a cladogram.
3. I can read and construct a cladogram.

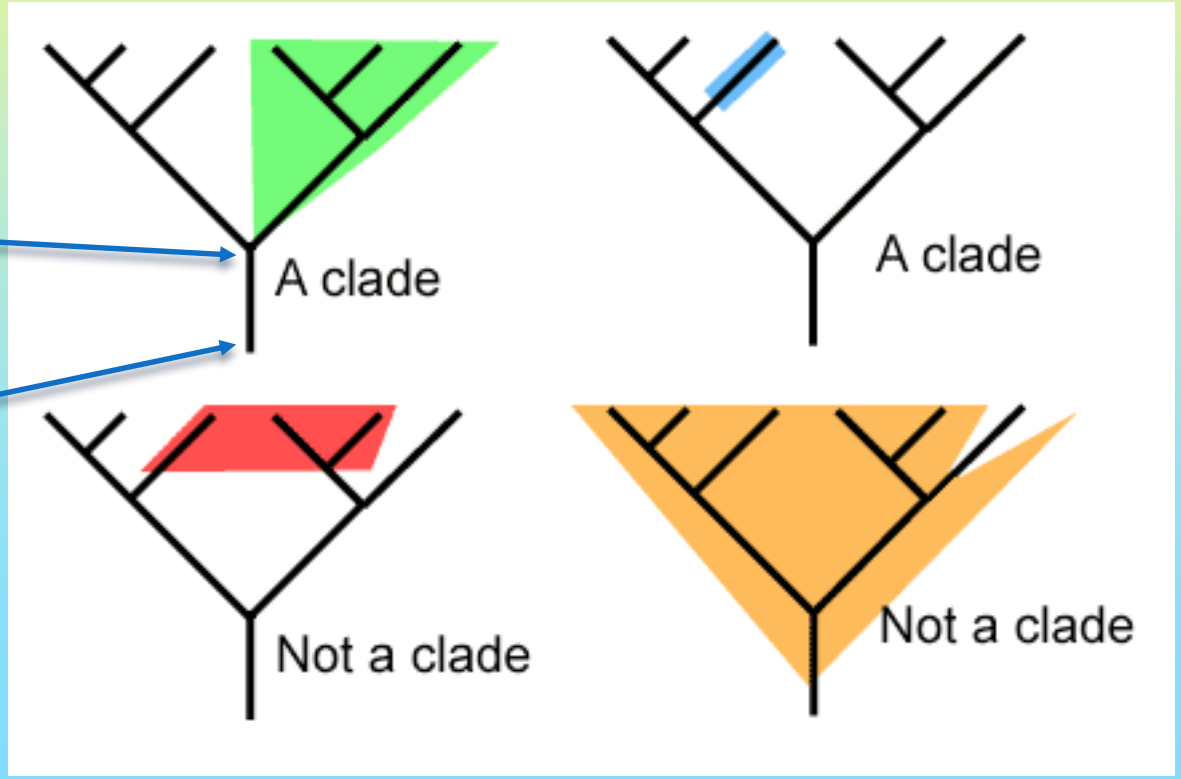
Problems With Traditional Classification

- Sometimes organisms that are quite different from each other evolve similar structural characteristics.
  - These similarities make it difficult for taxonomists to decide how organisms should be classified.
- Organisms share certain traits because they share evolutionary history.
- Biologists today group organisms into categories that represent lines of evolutionary descent, not just physical similarities.

- For example, adult barnacles and limpets live attached to rocks and have similar looking shells. Adult crabs don't look anything like barnacles and limpets.
- Based on these features, one would likely classify limpets and barnacles together and crabs in a different group. However, this would be wrong.

Modern Classification:

- A **clade** is a group of species that have a single common ancestor (same branch!)
- **Cladogram:** a visual organization linking organisms by their common ancestors

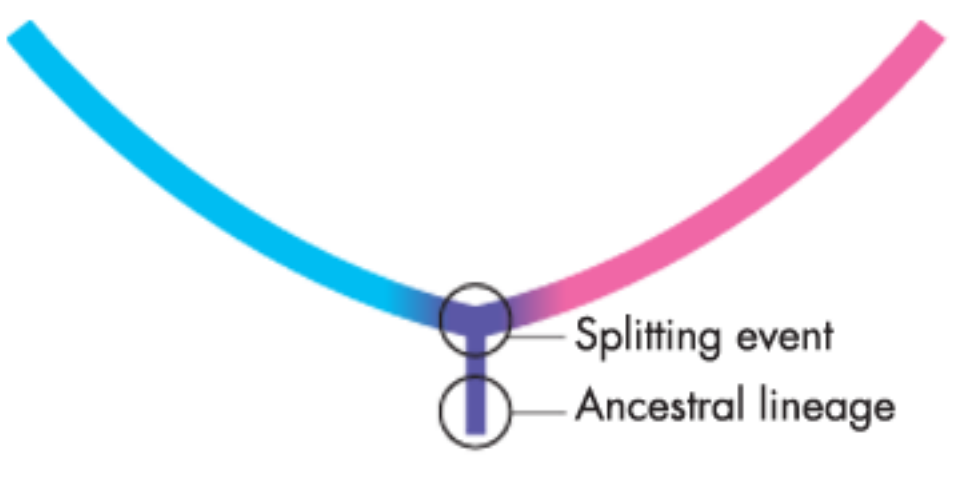


Traditional VS Modern Classification:

- **BOTH** systems are still used today:
  - **Traditional** is used to name organisms and group them based on similar traits
    - Uses a **dichotomous key** to sort traits
  - **Modern** is used to determine evolutionary relationships and who you are most closely related to
    - Uses a **cladogram** to sort clades

Building a Cladogram:

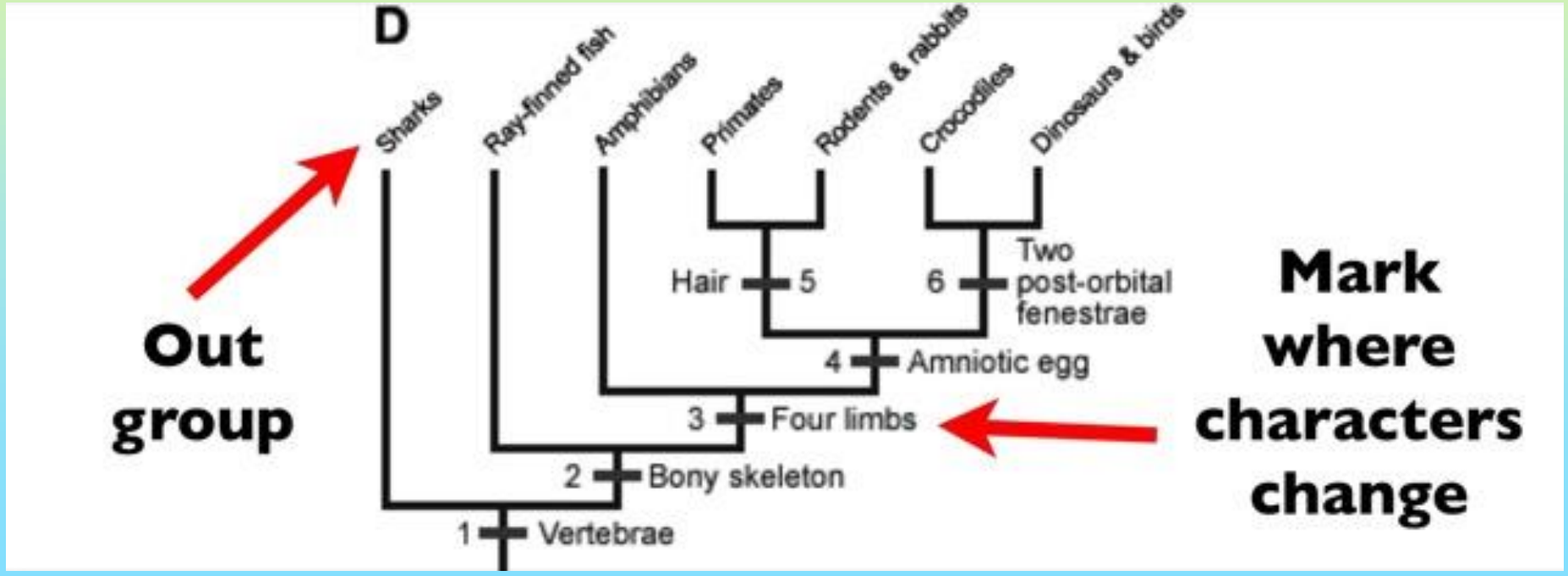
- Cladograms begin with a **common ancestor**
- Each splitting event or branch is called a **node**
  - Each node represents a **derived character**, a trait that developed in the common ancestor and was passed to all offspring



	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Outgroup	0	0	0	0	0	0	0	0	0	0	0	0
Hagfish	1	1	0	0	0	0	1	1	0	0	0	1
Bass	1	0	1	1	1	1	1	0	1	0	0	0
Trout	1	0	1	1	1	1	0	0	0	1	0	1
Lamprey	1	0	0	0	0	0	1	1	0	0	1	1
Shark	1	0	1	0	1	0	0	0	0	0	0	0

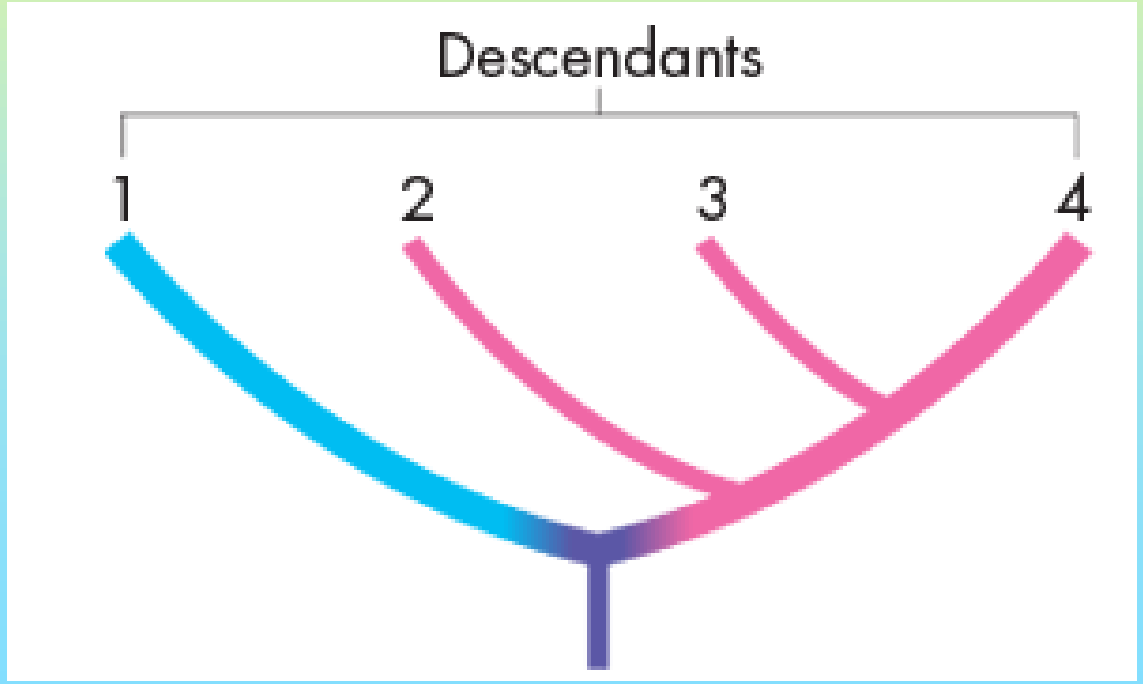
Building a Cladogram:

- **Derived characters** go at the **bottom** of the cladogram
- **Clades/species** go at the **top** of each branch
- If the derived character comes **before** the clade/organism, they **have evolved** that trait
- If the derived character comes **after** the clade/organism, they **did NOT evolve** that trait

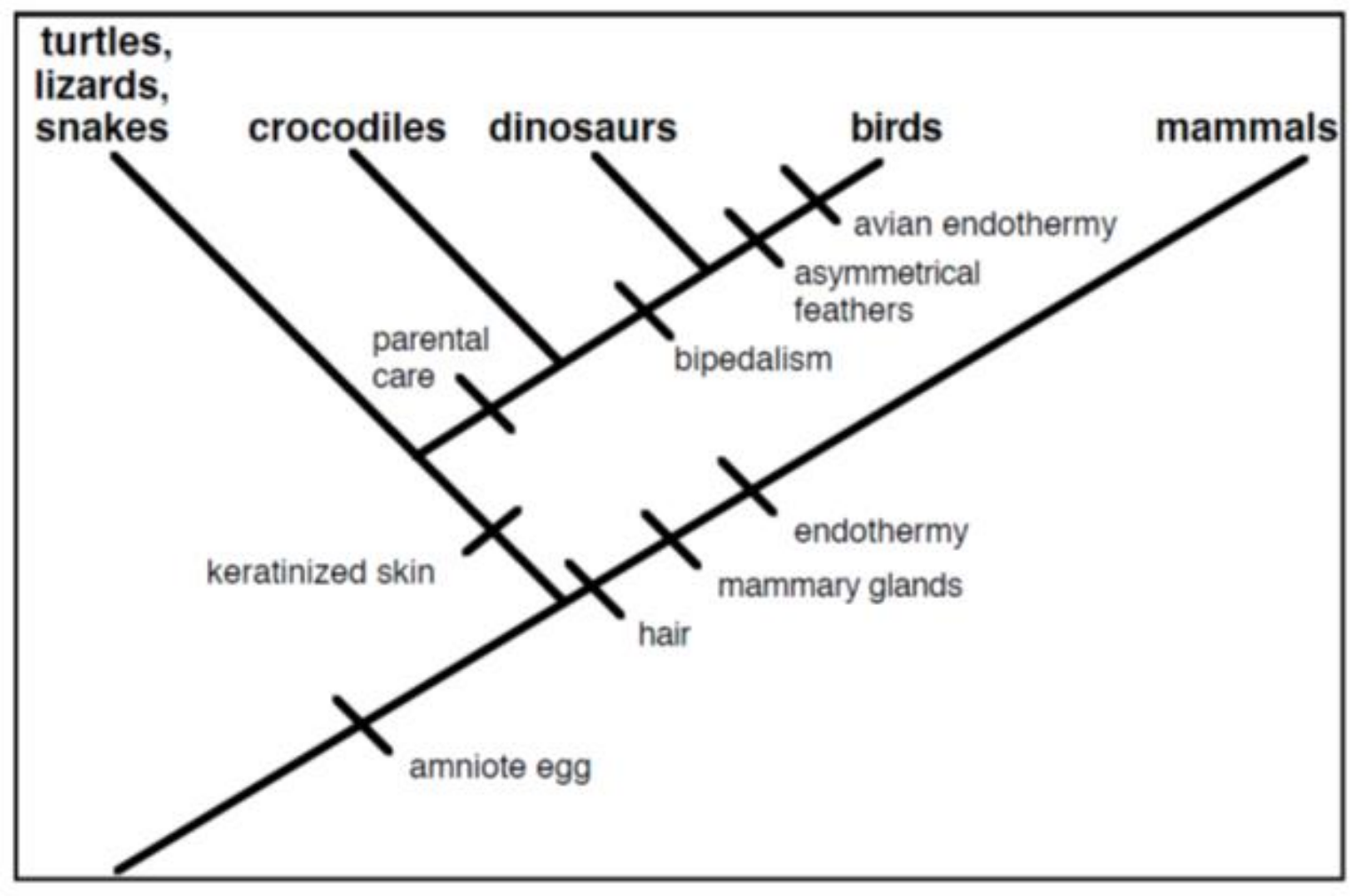


Building a Cladogram:

- A cladogram's branching patterns indicates how closely related you are to the clade/organism next to you (Ex. Organism 4 is most closely related to organism 3)
- The Tree of Life is actually a large cladogram of how we are all related!



I. Analyze a cladogram



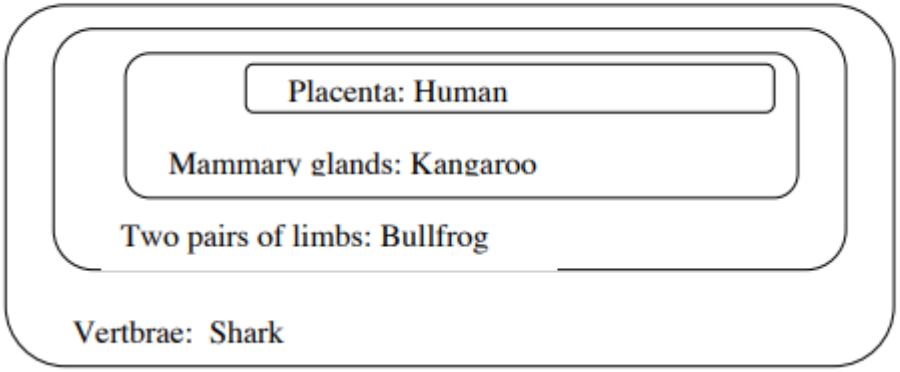
Example

1. Given these characters and taxa:

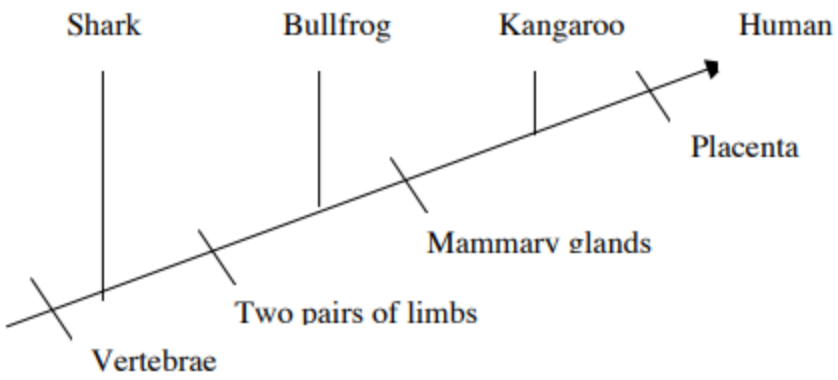
Taxa

Characters	Shark	Bullfrog	Kangaroo	Human
Vertebrae	X	X	X	X
Two pairs of limbs		X	X	X
Mammary glands			X	X
Placenta				X

2. Draw a Venn diagram. Start with the character that is shared by all the taxa on the outside. Inside each box, write the taxa that have only that set of characters.



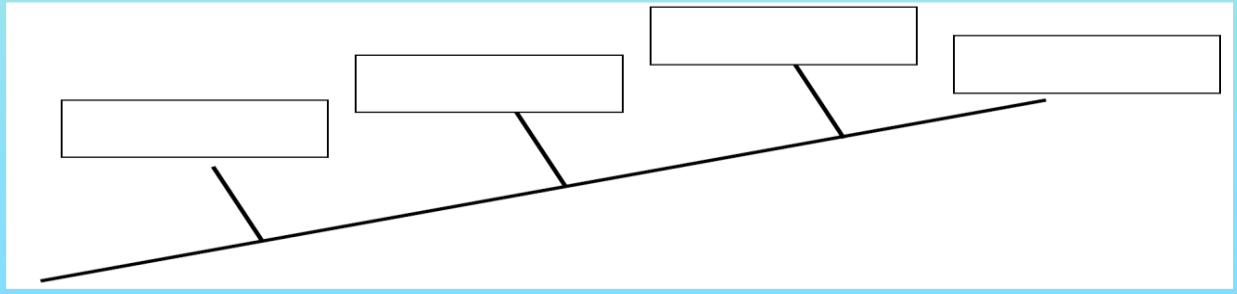
3. Convert the Venn diagram into a cladogram like so:

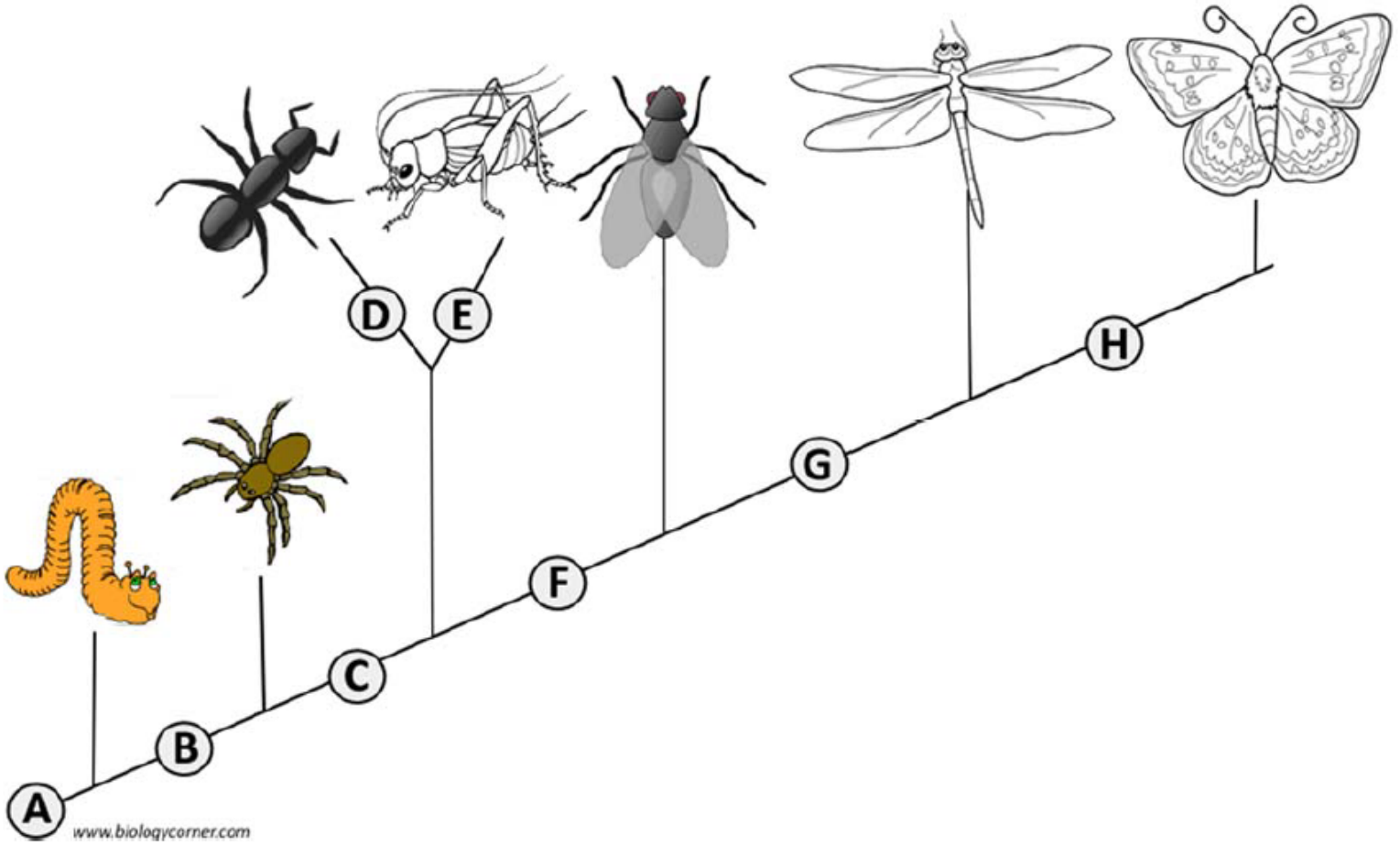


II. Construct a Character Matrix → Venn diagram. *1 = trait present, 0 = trait absent*

	hair	legs	thumbs	eyes
Human				
Snake				
Monkey				
Mouse				

III. Create your Cladogram





1. _____ Wings

2. _____ 6 Legs

3. _____ Organs

4. _____ Double set of wings

5. _____ Jumping Legs

6. _____ Has a queen who reproduces

7. _____ Legs

8. _____ Curly Antennae