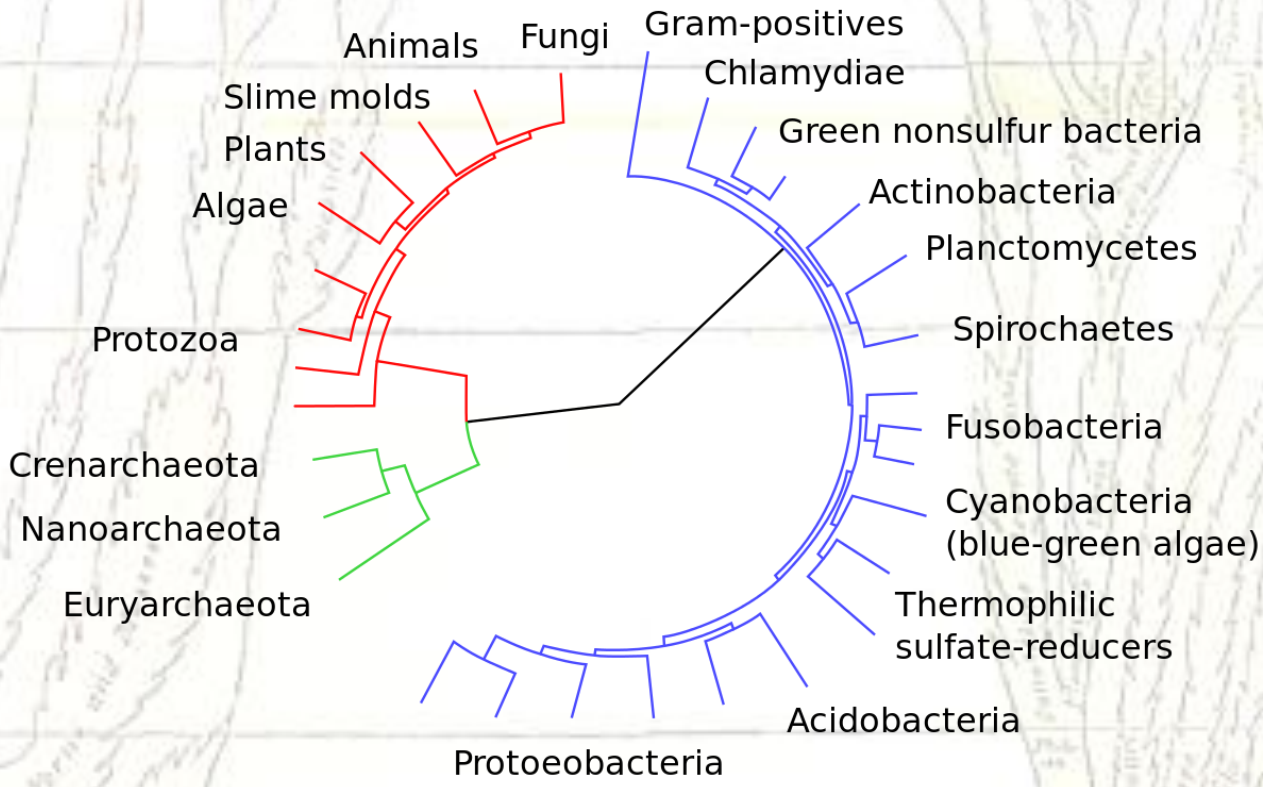
The Villablanca Connection

UNIT 3:

CLASSIFICATION OF THE LIVING BEINGS



“Both biological and cultural diversity are now severely threatened and working for their preservation is a critical task.”
Murray Gell-Mann

Unit 3: Classification of the living beings.
Biology and Geology 1º ESO
Villablanca Connection

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Unit 3: CLASSIFICATION OF THE LIVING BEINGS.

1. What do we do when we 'classify' something?

Sometimes the variety of the things that surround us is so big that it is very difficult to study them. So, one of the best ways to begin to increase the knowledge we have about them is trying to organize the elements into groups. **Classifying** is the process by which we group together the elements taking into account the characteristics they have in common. And the result of this process is a classification. Depending on the particular characteristics that we choose we may have different classifications. We say that the **final classification depends on the criterion**. (The plural of this word is 'criteria').

Activity 23.
Have a look to the followings elements we use very often at the school or at the office.

a) Classify these elements into two groups and write down which have been the criterion that you have used.

b) Classify these elements into three groups and write down the criteria that you have used.

c) Try to classify them now into four or five groups and write down the criteria.

d) In which group would you include a cutter?

2. Biological classification.

We call **biological diversity**, or just **biodiversity**, to the huge amount of different life forms that live or have lived on the Earth. Scientists estimate that there could be between 10 and 100 millions of different species of organisms living today on the Earth and uncountable other species that became extinct during the history of the planet. Most of these species remain unknown nowadays.
Fortunately, living beings are related one another and they are descendant of the same ancestors. This makes easier the work of classifying this astonishing amount of organisms. Biological classification takes into account these relationships between species and individuals as the most important criterion to group the different organisms.

2.1. Unicellular and multicellular organisms.

We already know that most of the organisms in this planet are **unicellular** (=single-celled organisms). They perform the three vital functions with just one cell and they are microscopic living beings. Despite of this small size their shape and ways of living are incredibly different. Some of them are autotrophs and perform photosynthesis; others are predators or parasites with heterotrophic nutrition.
In some cases when the unicellular organisms divide into two, four, eight or more cells, these daughter cells do not separate and remain living together. The result may look like a multicellular organism but it is not a *real* multicellular living being. If we separate them each individual cell will be able to live by their own. We call **colonies** to these groups of unicellular organisms that live together though each of them could live without the others.
Real **multicellular organisms** have many cells that depend on one another; they are bigger and we are used to see them (in fact we *are* one of them). They can have billions of cells and, although every single cell performs the vital functions, some kind of coordination appears to make the organism work as a whole. Sometimes different groups of cells in the organism specialize in different aspects of the functioning of this organism. We call a **tissue** to these groups of cells specialized in one function. Different tissues form an **organ** and different organs form a **system**. So, for instance, in our digestive **system** we have different **organs** like the stomach where we can find different **tissues,** like the muscular tissue, that moves the food inside, or the secretor tissue, that produces the gastric juice, etc.

2.2 Different levels of organization of the living beings.

If we put together what we know about unicellular and multicellular organisms and the possibility of cells forming tissues, tissues forming organs and organ forming systems, we can observe five levels of organization in the living beings that will be very useful later as criteria of classification of the biodiversity. We can summarize those levels as follows:

- Level 1: Unicellular organisms and colonies. We find here bacteria, cyanobacteria and protozoa.
- Level 2: Multicelluar organisms without tissues. The simplest multicellular organisms like fungi, algae and sponges.
- Level 3: Multicellular organisms with tissues but without organs. It's the case of cnidarians and moss.
- Level 4: Multicellular organisms with organs but without systems. As in platyhelminthes worms and plants.
- Level 5: Multicellular with systems. Like arthropods, molluscs, annelids, equinoderms and all the vertebrates.

From level 1 to level 5 the complexity of the living beings increases.

2.3. Taxonomy.

The part of the biology that deals with the groups in which the living beings can be classified is called **taxonomy**. The system used by the scientists to make these groups is **hierarchical** (=hierarchic). This means that every organism belongs to a series of groups that are progressively more general or inclusive, that is, that superior groups contain the inferior groups just like the "matrioshka" or Russian dolls.

In the same way that the bigger dolls contain the smaller dolls the hierarchical classification of the living beings is made of progressively less general or inclusive groups until we get to the individual that we are classifying.

We use the expression "**taxonomic rank**" or just **taxon** to refer to one of the groups in which living beings are classified. when we refer to several of them we use the word "**taxa**".
Well, the 7 main taxa that scientists use to classify the living beings are, from more general to more particular or inclusive:

- Kingdom
- Phylum (plural Phyla) (sometimes, as happens with the plants, the word "Division" is preferred)
- Class
- Order
- Family
- Genus
- Species

("King Phillip Comes Over For Good Spaghetti" or "El Rey es un Filósofo de mucha Clase que Ordena para su Familia Géneros de buena Especie" if you prefer it in Spanish.)
Let's see how it works with an example. Have you ever heard of the panda bear? This is how the panda bear is classified by taxonomists:

- Kingdom: Animalia (this taxon includes all the living beings that are considered animals)
- Phylum: Chordata (all the animals whose nervous system is in a dorsal position)
- Class: Mammalia (all the animals with mammary glands)
- Order: Carnivora (all the mammals with mouth evolved to eat meat)
- Family: Ursidae (all the carnivore mammals with short tail, stout body, big head and small ears)
- Genus: Ailuropoda (it means "feet similar to the ones of the red panda")
- Species: A. melanoleuca (it means "with black and white colors")

Besides the 7 main taxa there can be intermediate groups of living beings among them. In that case the prefixes "super" and "sub" are commonly used. When these intermediate or secondary taxa are needed the hierarchical nature of the classification has to be respected. So, between, for example, the Order and the Family we have the sub-Order and the super-Family. In the example of the classification of the panda bear it is common to include the subphylum Vertebrata that comprises all the animals with a backbone.

2.4. The species. How are they named.

Have you noticed how the names of the taxa are Latin names? Centuries ago the only language that was used by scientists of different countries was Latin. In the 18th century the most famous scientist that had devoted his life to the classification of living beings was a Swedish called Carl Nilsson Linæus but he has passed to the history of science with his Latinized name: **Carolus Linnaeus** (or, in Spanish, Linneo). Linnaeus is considered the father of

the taxonomy and he described and studied a great amount of different organisms. The base of his system of classification is the species.
The species is a group of living beings with similar characteristics that can interbreed and produce a fertile offspring. That means that the offspring can also reproduce again.
Linnaeus adopted a **binomial system** to name each species. The name of each living being is formed by two Latin words. The first one is also the name of the Genus in which that living being is classified. The second one is the specific name that distinguishes that living being from the others in its Genus. Both words form the **scientific name** of the species. There are very strict rules to write the scientific names of the different species:

- Scientific names of the species are **always written in *italics***, if we are using a word processor, or underlined if we are writing by hand. For instance, *Tyrannosaurus rex* and not "~~Tyrannosaurus rex~~".
- The first letter, and only the first letter, of the Genus has to be written in capital letters. The specific name has to be written always in lower-case letters. For instance, *Panthera leo* and never ~~*PANTHERA LEO*~~ or ~~*Panthera Leo*~~ or ~~*panthera leo*~~ or ~~*panthera Leo*~~.
- After the scientific name, using brackets, it is usually added the abbreviation of the name of the scientist who discovered or described the species for the first time. For instance, *Populus alba (L.)*

Activity 24.
a) Define the term "classification criteria".
b) Would two living beings from the same Class have more or less characteristics in common than two living beings from the same Family?
c) Which taxon groups together more living beings the Phylum or the Order?
d) Write down the names of the 7 main taxa, beginning with the inferior one.
e) Which is the correct order from more general to more particular of these taxa: super-Class, Class, Phylum, sub-Phylum?

Activity 25.
Choose the correct scientific name of the human being:
a) HOMO sapiens b) homo SAPIENS c) Homo sapiens (L.) d) *Homo sapiens (L.)*

Activity 26.
Look up in a guide or in the Internet the scientific names of the following living beings:
a) One of the bacteria that is used to produce yogurt
b) the cat
c) the lion
d) the tiger
e) the rose
f) the polar bear
g) the oak
h) the daffodil
i) the African elephant
j) the Asian elephant
k) One poisonous mushroom

3. Dichotomous keys

Scientists always try to make things easier for the students while they are still in training. This is why they design guides or keys that let other inexpert people to learn how to distinguish between sometimes very similar living beings. Dichotomous keys are very effective tools to learn about living beings because they are very easy to use. All we have to do is to answer to questions with just two alternatives. The answer to the first question leads us to a second question and then to a third question and so on until we find the name of the species we are looking for.
Let's have a look to this example. Imagine that in our neighbourhood we can find very different types of vehicles. How could we organize them to help a non-expert person to determinate if a given vehicle is one of these?









We could organize these elements in a dichotomous key like this:

1. a) Vehicles with wheels → Go to number 3. 1. b) Vehicles without wheels →Go to number 2.
2. a) Vehicles that fly → Helicopter. 2. b) Vehicles used in the snow →Sled.
3. a) Vehicles with two wheels → Bicycle. 3. b) Vehicles with more than two wheels →Go to number 4.
4. a) Vehicles with a steering-wheel → Go to number 5. 4. b) Vehicles without a steering wheel → Skateboard.
5. a) Vehicles normally used to transport people → Go to number 6. 5. b) Vehicles normally used to transport goods → Go to number 7.
6. a) Vehicles that can transport more than 5 passengers → Bus. 6. b) Vehicles that can transport less than 5 passengers → Go to number 8.
7. a) Very heavy vehicles with more than 4 wheels and articulated structure → Truck. 7. b) Not so heavy vehicles with usually 4 wheels → Van.
8. a) Public transportation vehicles → Taxi. 8. b) Vehicle for private use → Private car.

Can you see how a dichotomous key works?

Activity 27.
Try to make a different dichotomous key to organize the nine types of vehicles.

4. The 5 kingdoms.

All the living beings in this planet can be grouped in five kingdoms (remember: the more general or inclusive of the taxa).

- **Monera kingdom**. We find here all the unicellular organisms with prokaryotic cells that live independent or, only in certain cases, can form colonies. Bacteria and cyanobacteria belong to this kingdom.
- **Protista kingdom** (some biologists prefer “protoctista kingdom”). The organisms in this kingdom are in some cases unicellular and multicellular in others, but all of them are eukaryotic and never develop real tissues if they are multicellular. Protozoa and algae belong to this kingdom.
- **Fungi kingdom**. Unicellular or, more often, multicellular eukaryotic organisms without real tissues and with heterotrophic nutrition. Most of them are decomposers. Yeasts, moulds and mushrooms belong to this kingdom.
- **Plant Kingdom**. Groups multicellular eukaryotic autotroph organisms. They have real tissues and sometimes they have organs. Examples: ferns, cactuses, oaks, mosses…
- **Animal kingdom**. Multicellular eukaryotic heterotroph organisms. They have real tissues and most of them organs and systems. Examples: rabbits, flies, sardines, ostriches, kangaroos…

Let’s try to summarize this information in a simple chart:

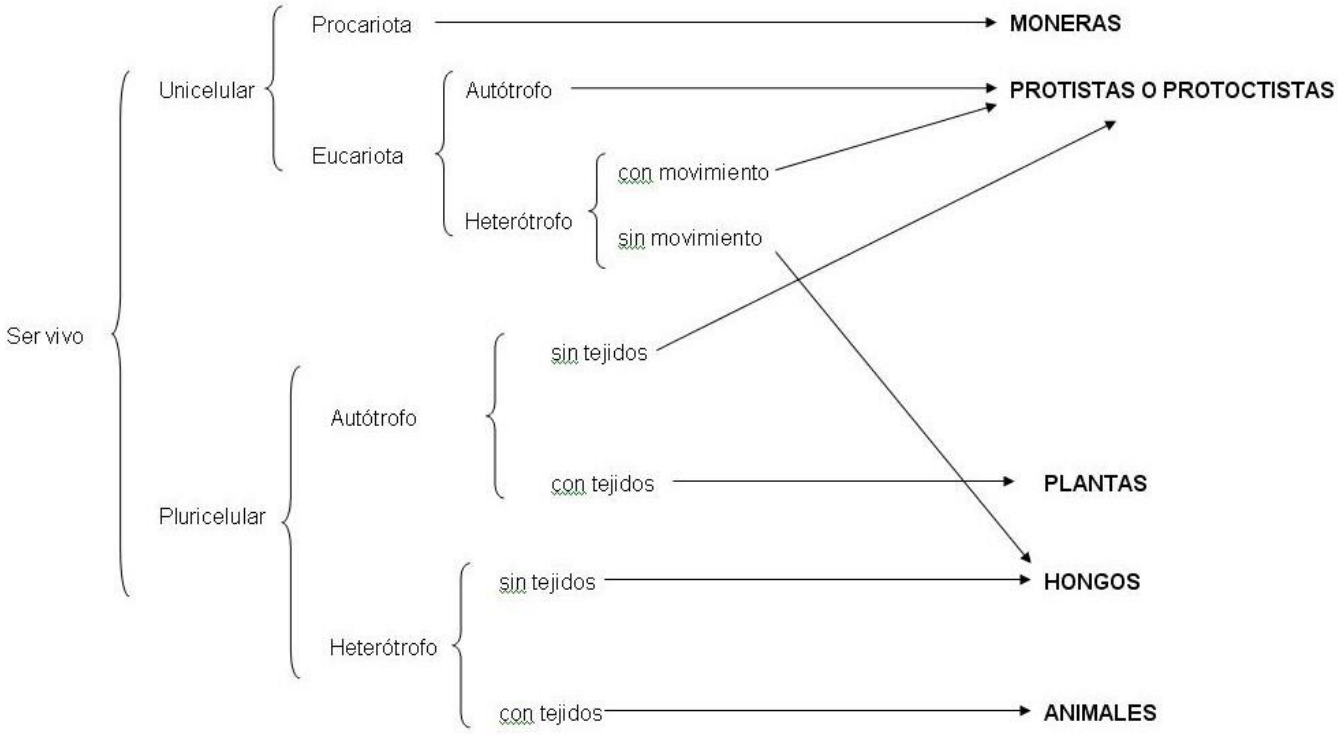
Kingdom	Number of cells	Type of cell	Type of nutrition
Monera	unicellular	prokaryotic	autotrophic/heterotrophic
Protista	unicellular/multicellular	eukaryotic	autotrophic/heterotrophic
Fungi	unicellular/multicellular	eukaryotic	heterotrophic
Plant	multicellular	eukaryotic	autotrophic
Animal	multicellular	eukaryotic	heterotrophic

And here you have a dichotomous key to find out to which kingdom a living being belongs:

1. a) Unicellular organisms → Go to number 2. 1. b) Multicellular organisms →Go to number 4.
2. a) With prokaryotic cells → **Monera kingdom**. 2. b) With eukaryotic cells →Go to number 3.
3. a) Autotrophic organisms or heterotrophic with cilia or flagella→ **Protista kingdom**. 3. b) Heterotrophic decomposer organisms →**Fungi kingdom**.
4. a) Heterotrophic without tissues → **Fungi kingdom**. 4. b) Heterotrophic with tissues or autotrophic → Go to number 5.
5. a) Autotrophic with tissues → **Plant kingdom**. 5. b) Heterotrophic with tissues → **Animal kingdom**.

A different way to represent dichotomous keys is using curly brackets like here (in Spanish):

CLAVE SIMPLIFICADA DE REINOS PARA 1º ESO



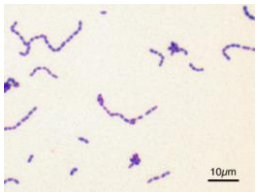
Activity 28.
Which Kingdom do these living beings belong to?


Fucus vesiculosus


Pinnularia sp.


Rosa sp.


Yellow jacket wasp



Bacteria

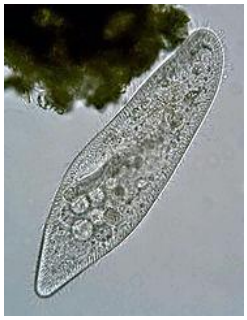

Moss

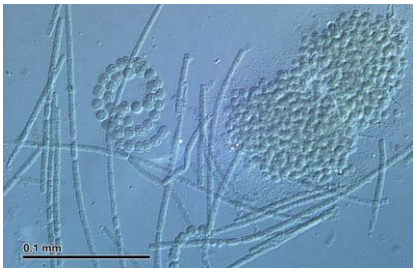

Mould on an orange


Lizard


Marine Sponge


Morchella sp.


Paramecium sp.



Cyanobacteria

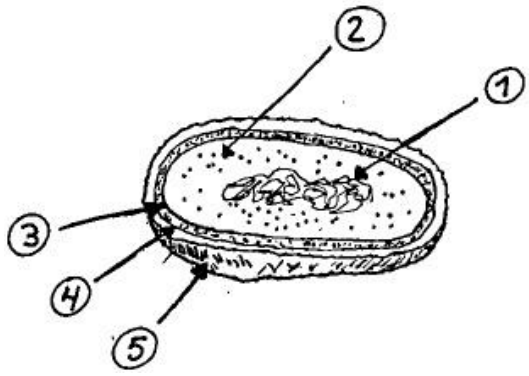

Starfish

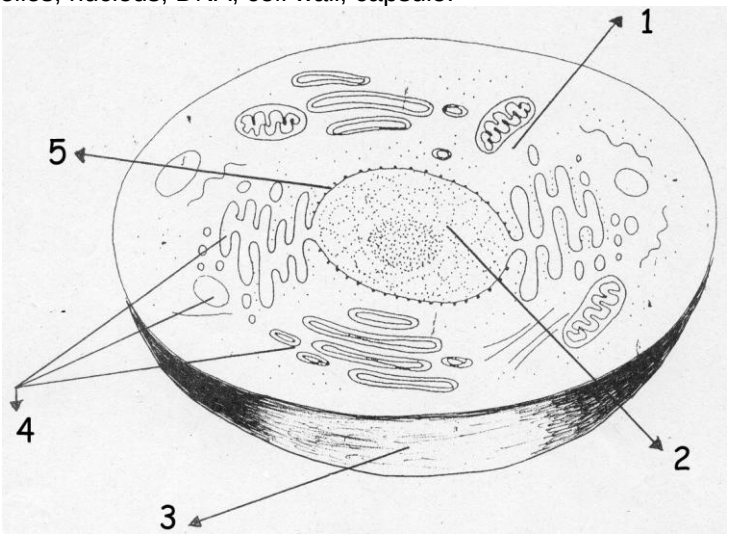

lettuce

Activity 29.
Fill this table with “yes” or “no” and write the Kingdom of these living beings.

	Autotrophic nutrition	Heterotrophic nutrition	It performs photosynthesis	It does not perform photosynthesis	Unicellular	Multicellular	Prokaryotic cells	Eukaryotic cells	With tissues	Without tissues	Kingdom
spider											
oak											
mushroom											
bacteria of the yogurt											
medusae											
unicellular algae											
yeast											
lettuce											
ameba											
frog											
intestinal bacteria											
paramecium											
coral											
multicellular algae											
bacteria of the meningitis											
sponge											
moss											

Activity 30.
Distinguish between the prokaryotic and eukaryotic cells and match the numbers in the drawings with the following words: plasmatic membrane, cytoplasm, organelles, nucleus, DNA, cell wall, capsule.





Activity 31.
Write in this table "eukaryotic cell", "prokaryotic cell", "both types of cell" or "neither of the types of cell"

a) they appeared first in evolution	
b) their DNA is enclosed in an envelope	
c) they are the bigger cells	
d) they have DNA	
e) they form multicellular organisms	
f) they have organelles	
g) they have plasmatic membrane	
h) they are microscopic	
i) they have many different organelles	
j) they perform nutrition, interaction and reproduction	

Activity 32.
In this table write how prokaryotic and eukaryotic cells are alike and how they are different.

They are alike in	They are different in

Activity 33.
a) Name the vital functions
b) Distinguish between the nutrition of plants and the nutrition of animals.
c) Explain the difference between sexual and asexual reproduction. Name one example of each one.
d) Write the name of the organic and inorganic principles that form the living beings
e) Write an example of stimulus and describe the reaction of the living being.
f) What is the difference between a colony and a multicellular organism?
g) Reorder these taxa from the most general to the most particular: Family, Species, Genus, Class, Kingdom, Order and Phylum.
h) Which of these scientific names are correct?
1. Pinus halepensis 2. PINUS halepensis 3. *Pinus Halepensis* 4. *Pinus halepensis*
i) Where do we find a "revolving nosepiece"?

Activity 34.
What is a dichotomous key? What are they used for?

Activity 35.
Fill the table with the words “system”, “cell”, “tissue” or “organ” according the following definitions:

a) Part of the body with a specific function whose structure is made of different tissues.	
b) The unit of life. Living beings have at least one of these.	
c) Several organs cooperating in a general activity in an organism.	
d) A group of cells coordinated to perform the same function	

Activity 36.
Write down the characteristics of the organisms in the Monera Kingdom.

Activity 37.
What do we mean when we say that the Earth is in the “habitable zone”?

Activity 38.
Describe the main characteristics of the aquatic and terrestrial environments.

Activity 39.
What is the “habitat”?

Activity 40.
What is “biodiversity”?

Activity 41.
A male lion and a female tiger can be crossed in captivity and the result is a hybrid animal called “liger”. Ligers are said to be the largest cats of the world. As they are descendant of two different species their fertility is reduced and seldom reproduce. Write down the definition of “species”.

Activity 42.
Look at the organisms and answer the following questions:
a) How many species of plants are in the picture? How many species of animals?
b) Which ones belong to the same genus?
c) Which ones belong to the same family?
d) Which ones belong to the same class?
e) Which ones belong to the same Phylum?

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