

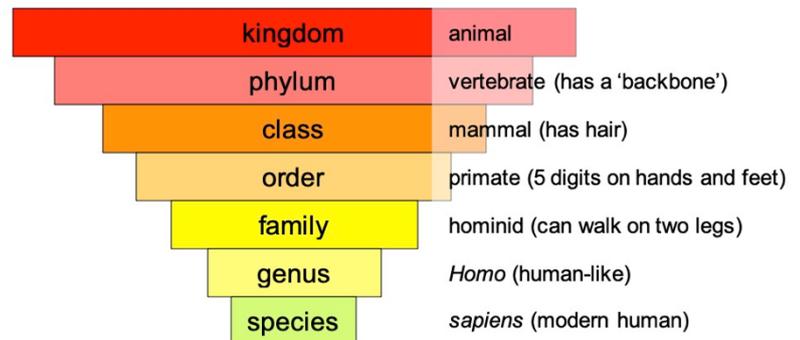
Kingdoms

Living things can be classified in one of five **kingdoms**, based on what their cells are like and whether they have just one cell (**unicellular**) or many.

Each kingdom is divided into smaller groups, each of which is further divided. The diagram shows the groups ('taxonomic ranks') for humans. Going down the diagram, the groups get smaller and the organisms in a group become more similar.

often called 'protists'

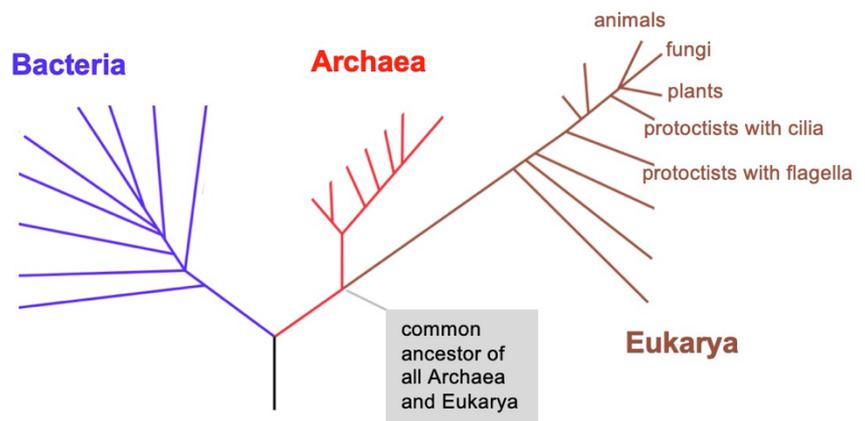
| | kingdom | | | | |
|---------------|-------------|-------------|-------|--------|---------|
| | prokaryotes | protists | fungi | plants | animals |
| nucleus | X | ✓ | ✓ | ✓ | ✓ |
| mitochondria | X | ✓ | ✓ | ✓ | ✓ |
| cell wall | ✓ | (only some) | ✓ | ✓ | X |
| chloroplasts | X | (only some) | X | ✓ | X |
| multicellular | | ✓ | ✓ | ✓ | ✓ |
| unicellular | ✓ | ✓ | ✓ | | |



The names of the last two groups are used to give a **species** its scientific name. So humans are *Homo sapiens*. Scientific names are written in italics (or underlined).

As our understanding of genes increased, scientists found one group of prokaryotes with genes that are more similar to animals and plants than to bacteria. So, biologists now also classify living things in **domains**: Bacteria, Archaea and Eukarya (or Eukaryota). Domains divide into kingdoms.

This 'phylogenetic tree' shows how domains may have evolved. Each branch point shows where scientists think groups of the same organism evolved in different ways and changed into new types of organism.



Viruses

Viruses do not fit into the **classification** system for living things because they cannot carry out **life processes**. The **International Committee on Taxonomy of Viruses (ICTV)** is a group of scientists who classify viruses using the same taxonomic ranks as living things. They invented the name SARS-CoV-2 and classified this virus in the same genus as the SARS virus (from 2002) and the MERS virus (from 2012). This genus is in the coronavirus family. All members of this family have RNA genomes and spiky surfaces that look like crowns when viewed with high power microscopes.

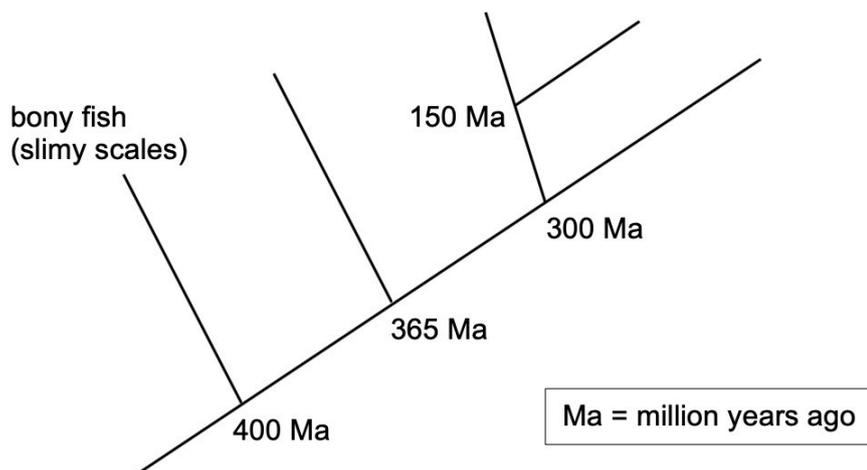
Find out

1. Find the full name of SARS-CoV-2. _____
2. Name one cell part that all Eukarya have that other domains do not. _____

3. Go to <https://bit.ly/3bdK3ip> which shows an interactive phylogenetic tree. Use it to find:
- how long ago the common ancestor of all of today's Eukarya lived _____
 - how long ago the common ancestor of birds and mammals lived _____
 - which of the following are most closely related to chimpanzees (tick one)

| | | | |
|----------------------------------|-----------------------------------|----------------------------------|-------------------------------------|
| <input type="checkbox"/> gibbons | <input type="checkbox"/> gorillas | <input type="checkbox"/> monkeys | <input type="checkbox"/> orangutans |
|----------------------------------|-----------------------------------|----------------------------------|-------------------------------------|
 - which of the following are most closely related to squirrels (tick one).

| | | | |
|----------------------------------|----------------------------------|----------------------------------|-------------------------------|
| <input type="checkbox"/> beavers | <input type="checkbox"/> dormice | <input type="checkbox"/> rabbits | <input type="checkbox"/> rats |
|----------------------------------|----------------------------------|----------------------------------|-------------------------------|
4. Find the names of the other classes of vertebrate. Add their names and one of their characteristics to complete the phylogenetic tree.



Test yourself

5. Organisms in which kingdom:
- never have cell walls _____
 - are always single-celled? _____
6. Ladybirds are part of the large **coccinellid** family of beetles. All beetles belong to a class in the **arthropods** phylum, called **insects**. Most ladybird species (e.g. **septempunctata** – the seven-spot ladybird) belong to the **Coccinella** genus.
- Which group in **bold** contains the greatest number of different species? _____
 - Write the scientific name for the seven-spot ladybird. _____
7. a. Give the two domains that prokaryotes were split into. _____
- b. State why they were split like this. _____

Check-up

- Check your answers.
- Find the taxonomic ranks of a favourite organism or pet. Present your work as a chart and add pictures if you can (showing other members in each group of taxonomic ranking).

Answers

Note to home educators

This worksheet is designed to support understanding of classification. You may wish to share these objectives with students:

- Describe the key characteristics of the five kingdoms of organisms and use this to assign organisms to their kingdoms.
- Describe how organisms are classified into smaller and smaller groups based on their characteristics.
- Identify the genus and species names from a scientific name.
- Explain why biologists often now also classify organisms into three domains. (GCSE)

Other sheets in the series in which phylogenetic trees are met include Worksheet 14. All the sheets in the series are available at: <https://shwca.se/covid19science>

It is suggested that students complete the worksheet independently, using the internet for questions 1 - 4. Questions 5 - 7 should be completed without help from additional sources.

This sheet is designed for students in Years 7 – 11. The material is drawn from the National Curriculum for Science for Key Stage 3 and the GCSE 9-1 Science specifications.

If you wish to check the answers, keep this part of the sheet away from the questions!

- I.
 1. Severe acute respiratory syndrome coronavirus 2
 2. nucleus or mitochondria
 3. a. 1500 million years ago / Ma
b. 320 million years ago / Ma (the amniotes)
c. gorillas
d. dormice
 4. From left: amphibians (moist skin or lay jelly-coated eggs), reptiles (dry scales or lay leathery shelled eggs), birds (feathers or lay hard-shelled eggs), mammals (hair or give birth to live young or produce milk).
 5. a. animals
b. prokaryotes
 6. a. arthropods (phylum is above the others in the taxonomic ranking)
b. *Coccinella septempunctata*
 7. a. Archaea, Eukarya (or Eukaryota)
b. Archaea have genes that are more similar to Eukarya than other prokaryotes.

- II. The diagram could be based on the middle diagram on page 1.