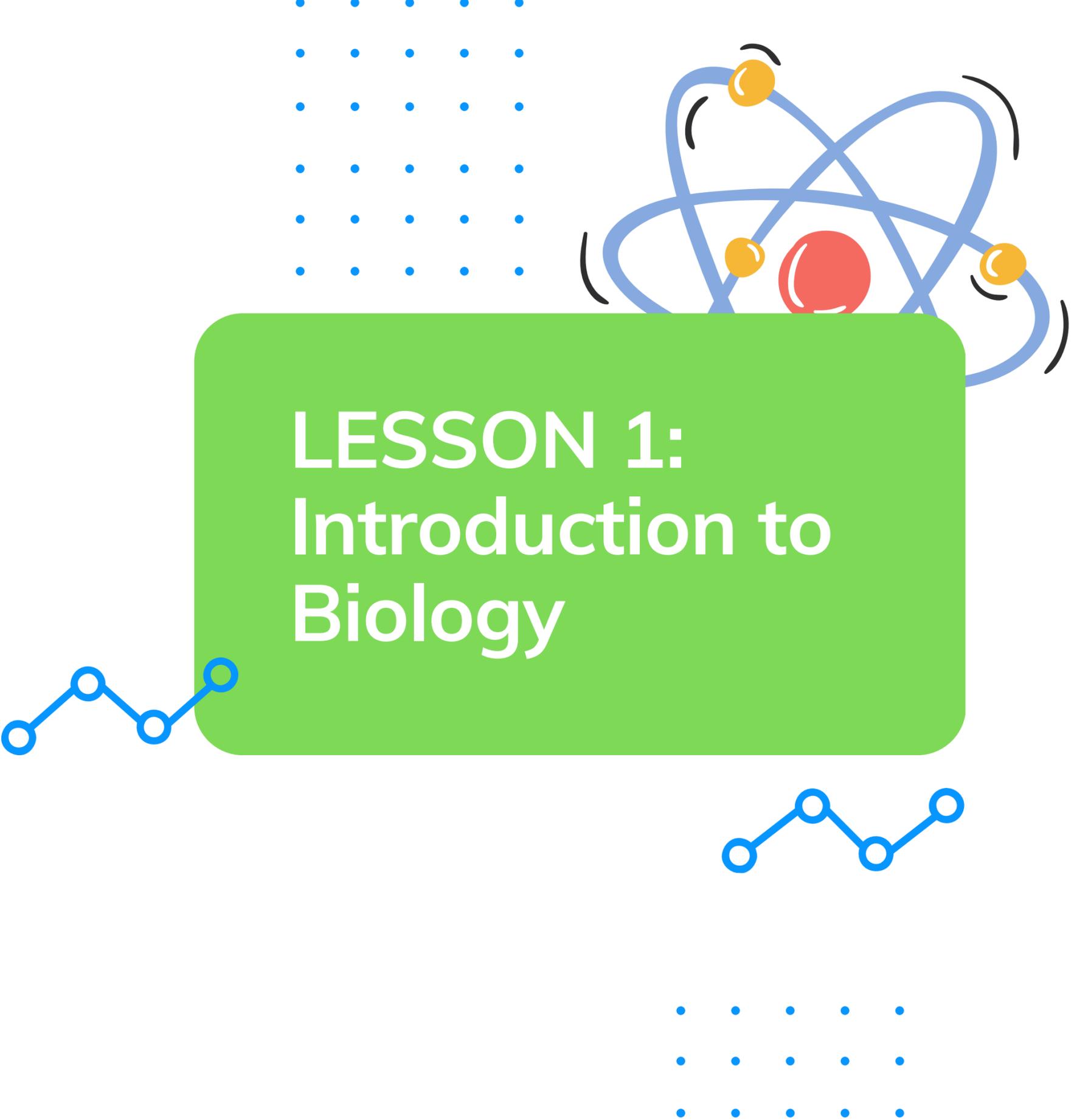


# Biology Prep Course

Course Director: Rachel  
**VMW Edu - 25 Week Series**



## LESSON 1: Introduction to Biology

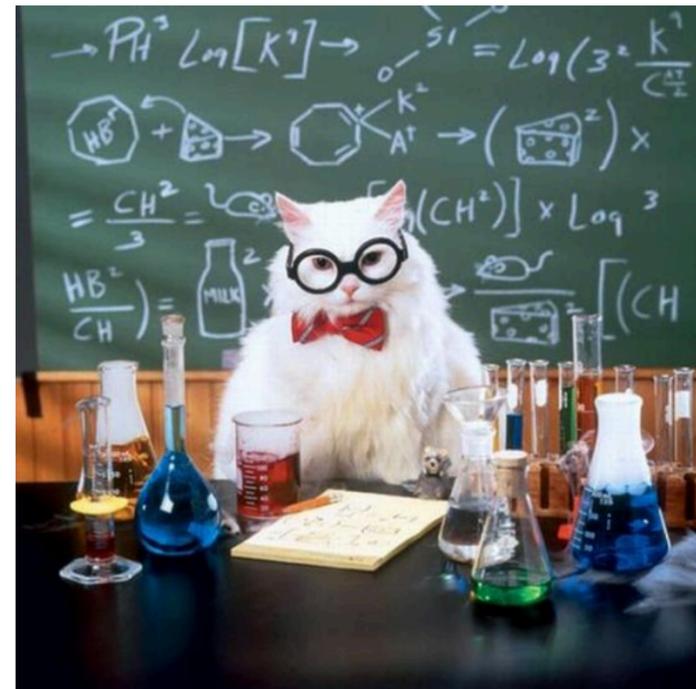
# Introduction

Biology includes the study of plants (botany) animals (zoology), the study of the structure of organisms (morphology) and the function (physiology). All living things share in common certain biological phenomena—for example, various means of reproduction, cell division, and the transmission of genetic material.



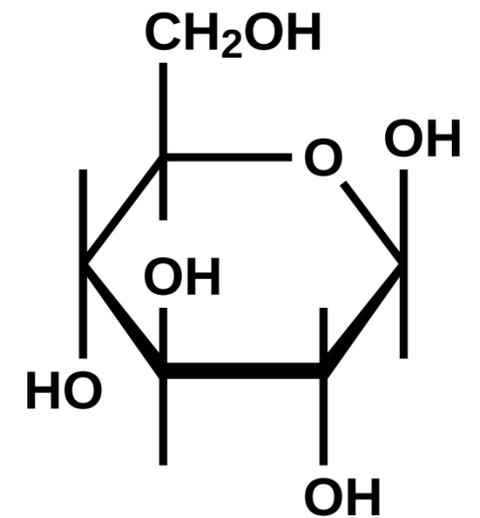
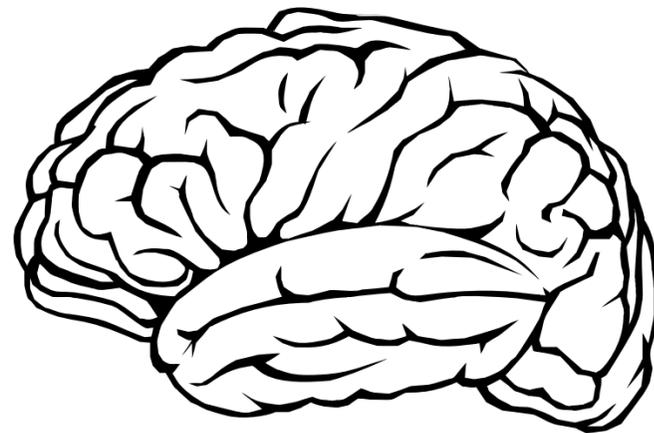
# Introduction

How much Biology do you know? We'll start with 3 challenge problems to see....



# CHALLENGE 1

Rank these in order of size from 1-5, small to large:



# CHALLENGE 1

Rank these in order of size from 1-5, small to large:

3



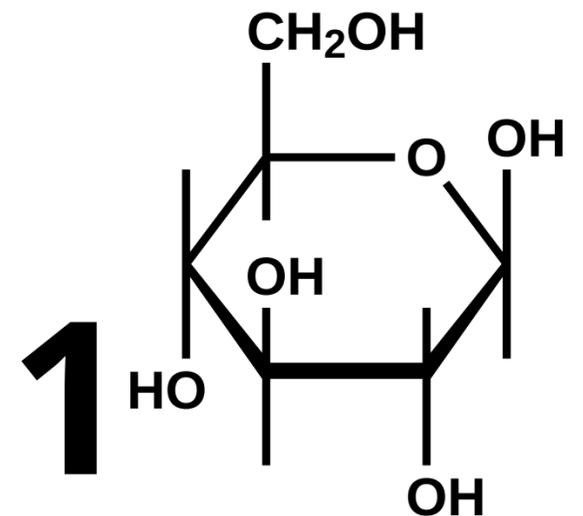
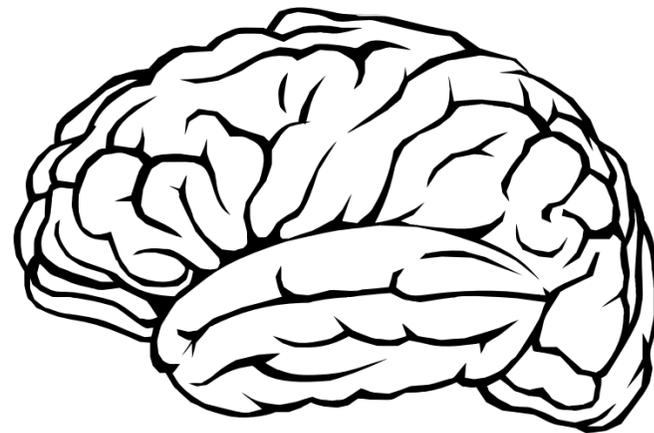
2



4



5



# CHALLENGE 2

**You arrive on an alien planet, where the atmosphere is now 80% carbon dioxide!**

**Can you survive? Why or why not?**

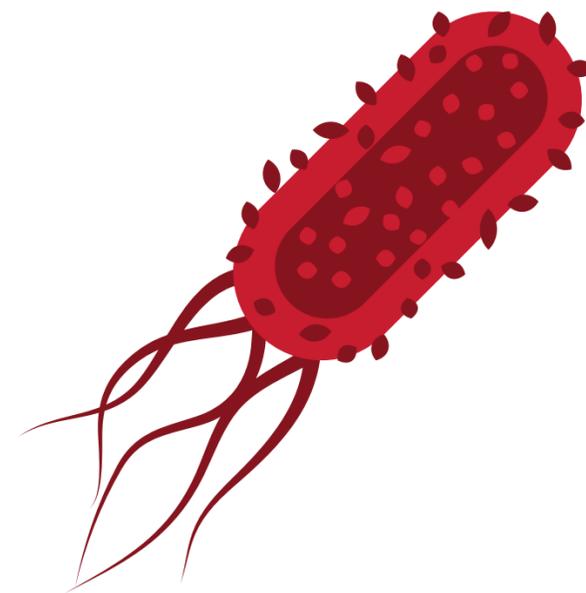
**Can any organism from earth survive?**

# CHALLENGE 2

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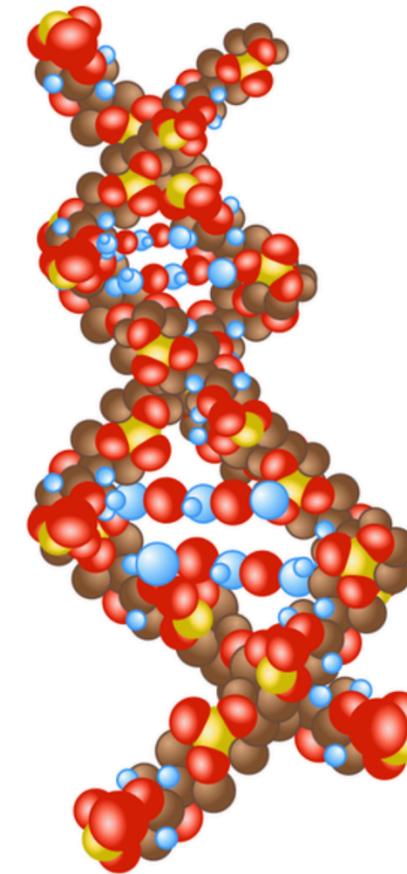
Can any organism from earth survive?



# CHALLENGE 3

The building blocks of DNA come in 4 flavors - adenine, thymine, cytosine, and guanine.

In a random code of 10 base units, how many different combinations could there be?

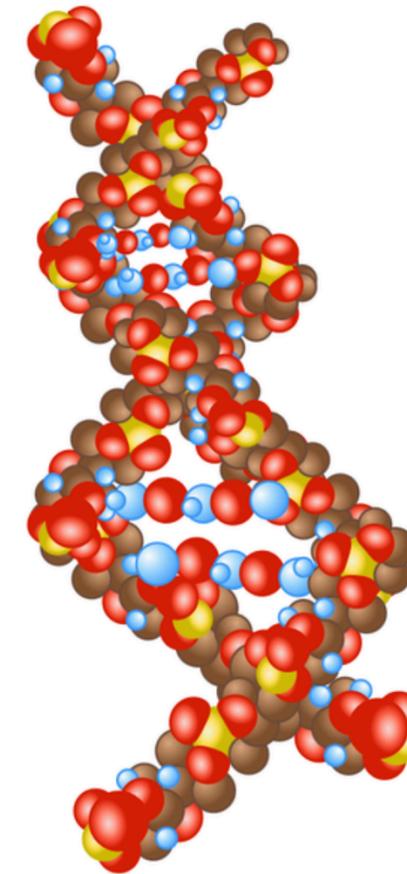


|   |    |
|---|----|
| A | 00 |
| T | 01 |
| C | 10 |
| G | 11 |

# CHALLENGE 3

If the unity of life at the molecular scale is explained by our shared features with an ancient common ancestor, what principle of life could explain all of life's differences today?

- Genetic information changes over time and is selected by competition and its environment.
- Genetic information must be completely randomized.
- There must be many different common ancestors for each existing organism.

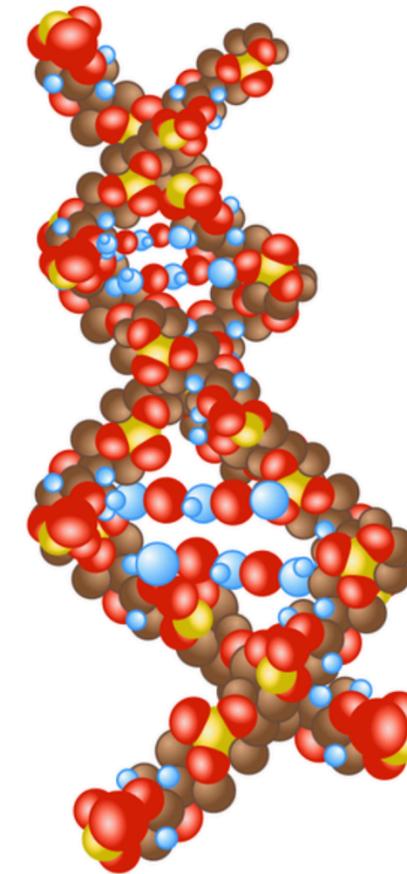


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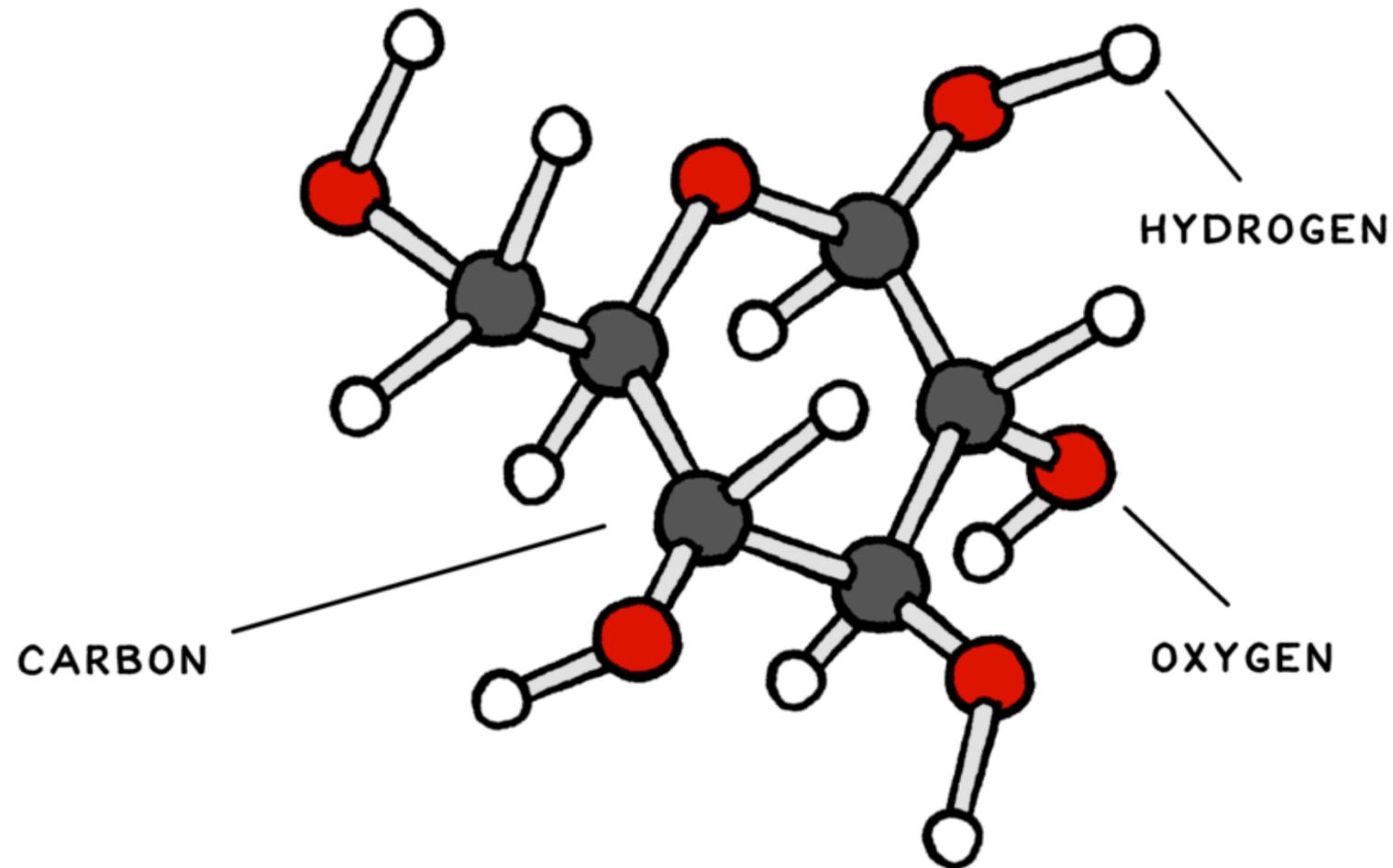
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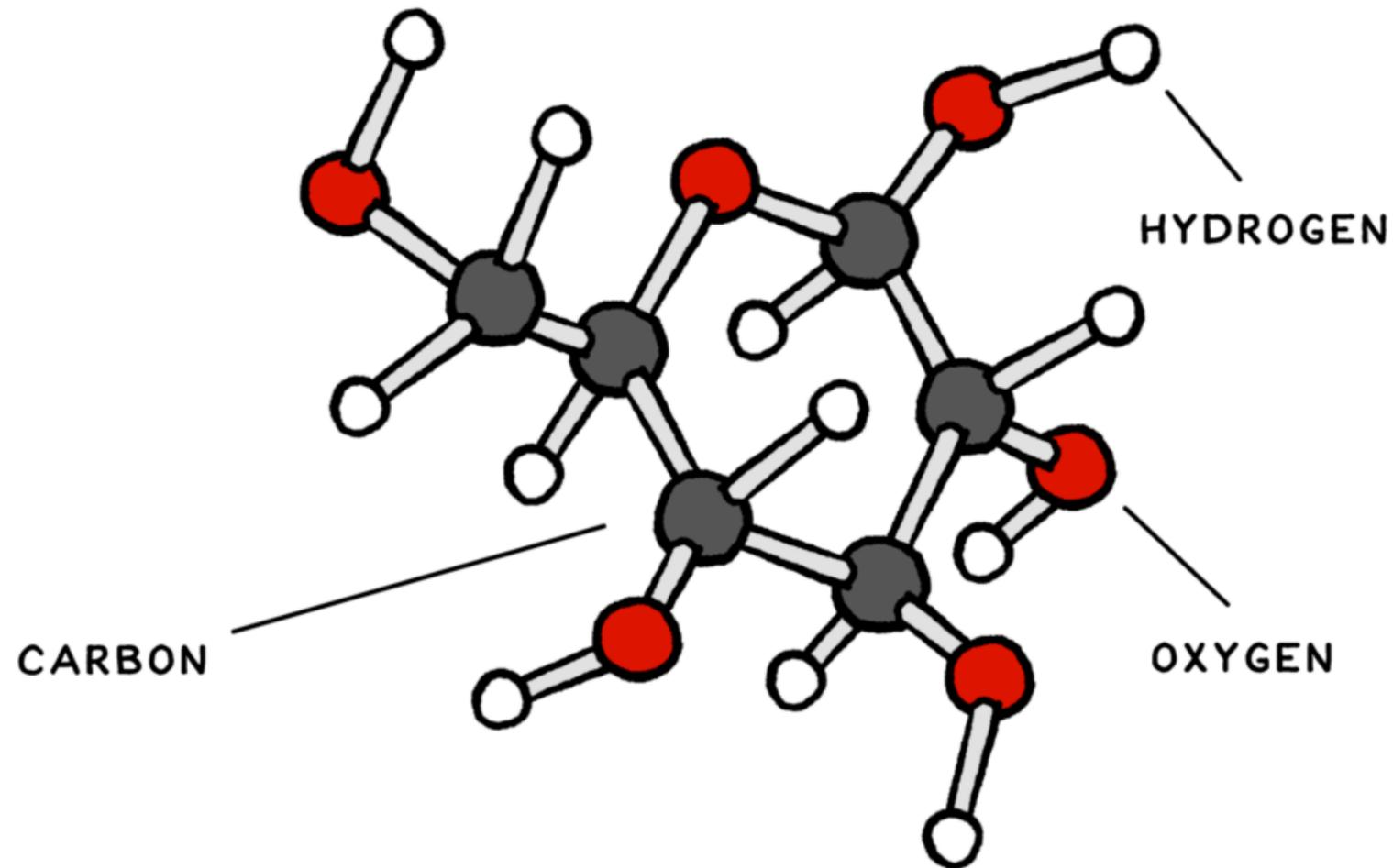
# CHALLENGE - BONUS

What is the chemical formula for a molecule of Glucose (shown below)?

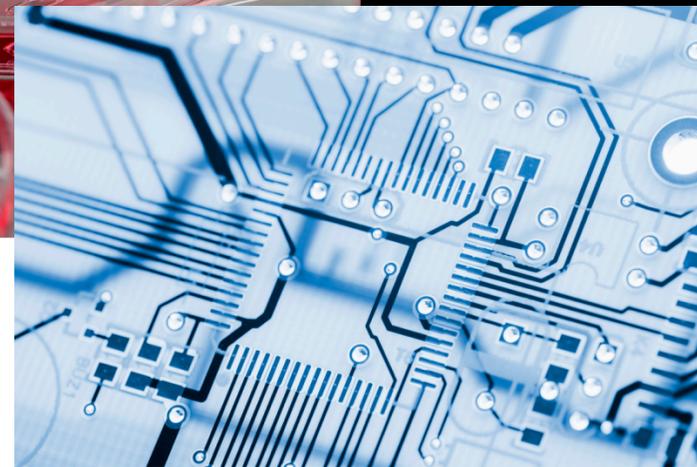
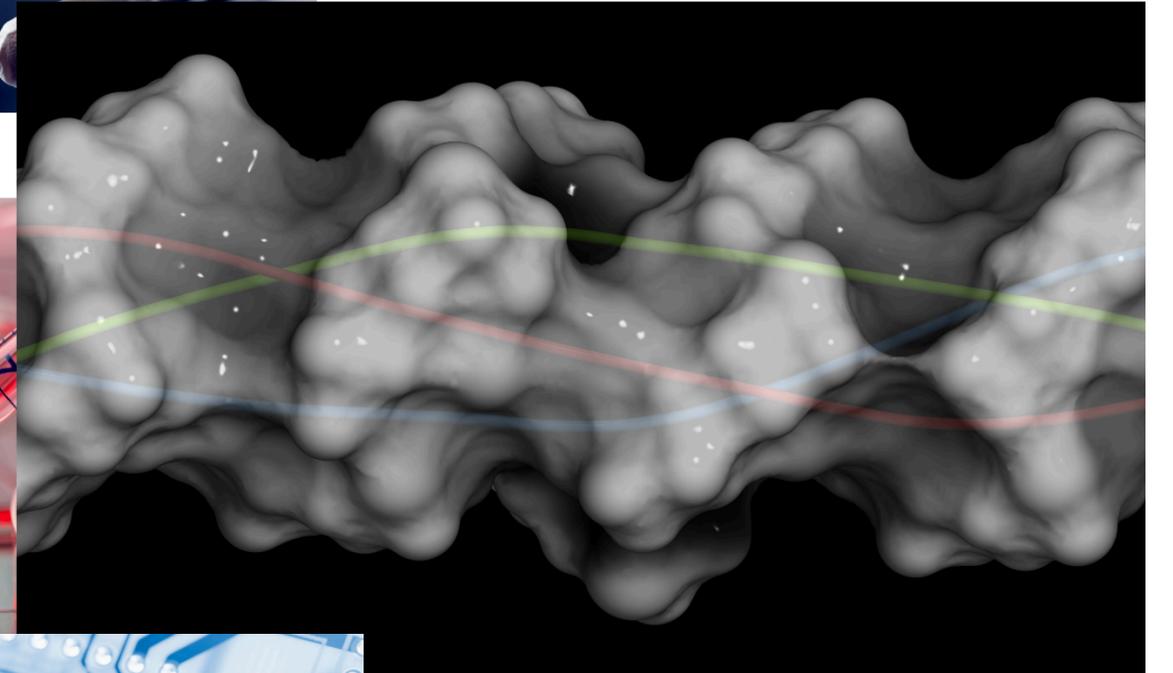


# CHALLENGE - BONUS

What is the chemical formula for a molecule of  
Glucose (shown below)?  $C_6H_{12}O_6$



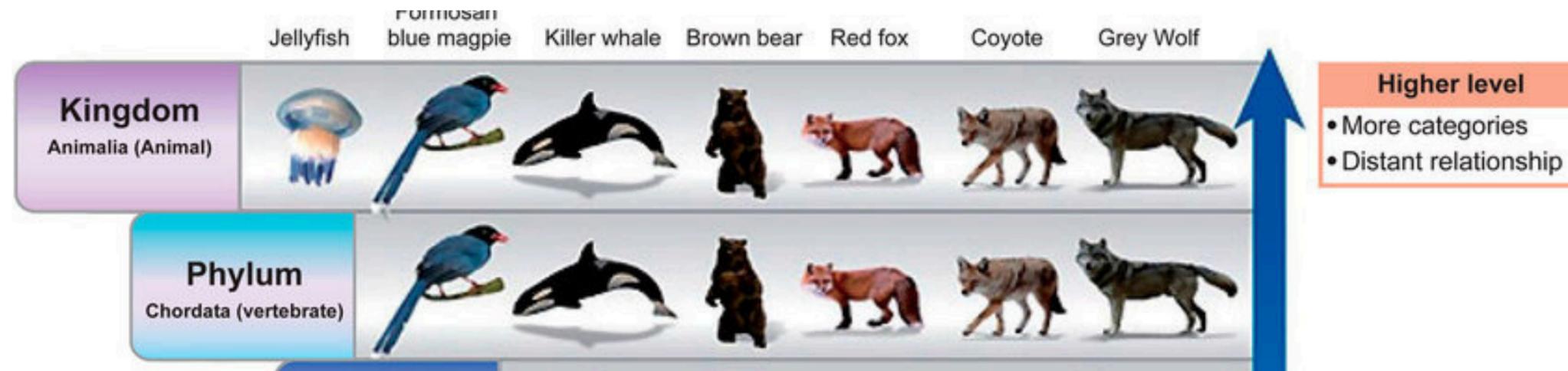
# Introduction



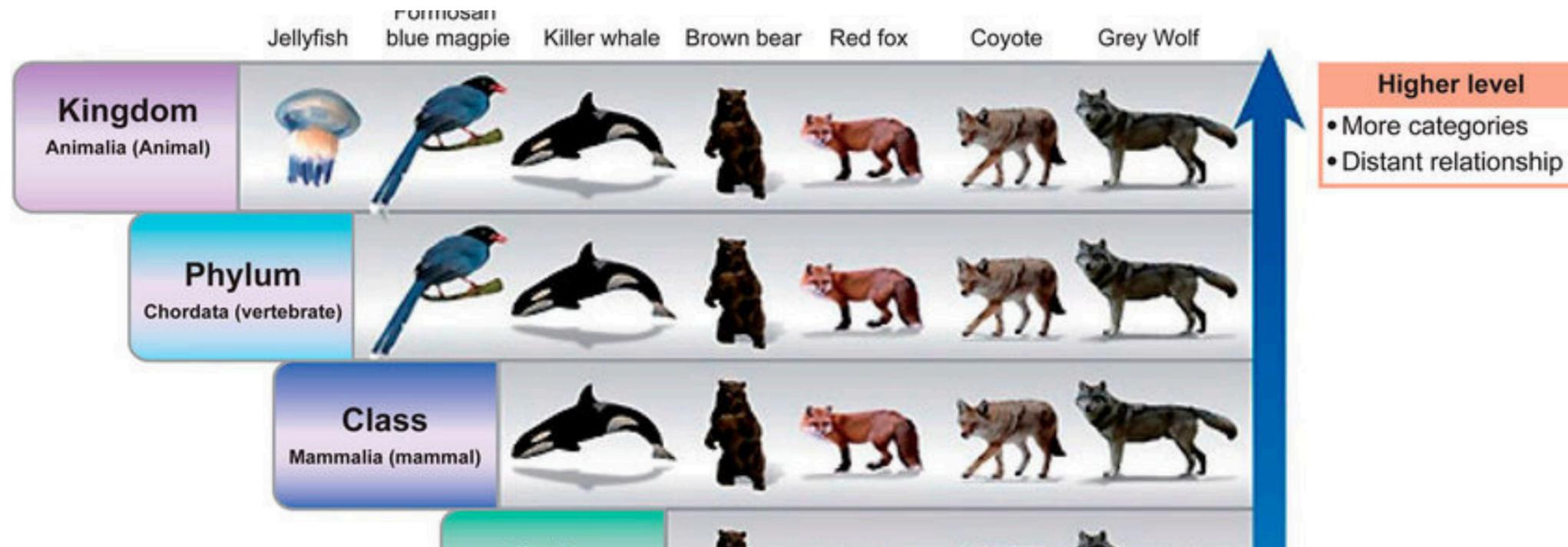
# 1. Tree of Life



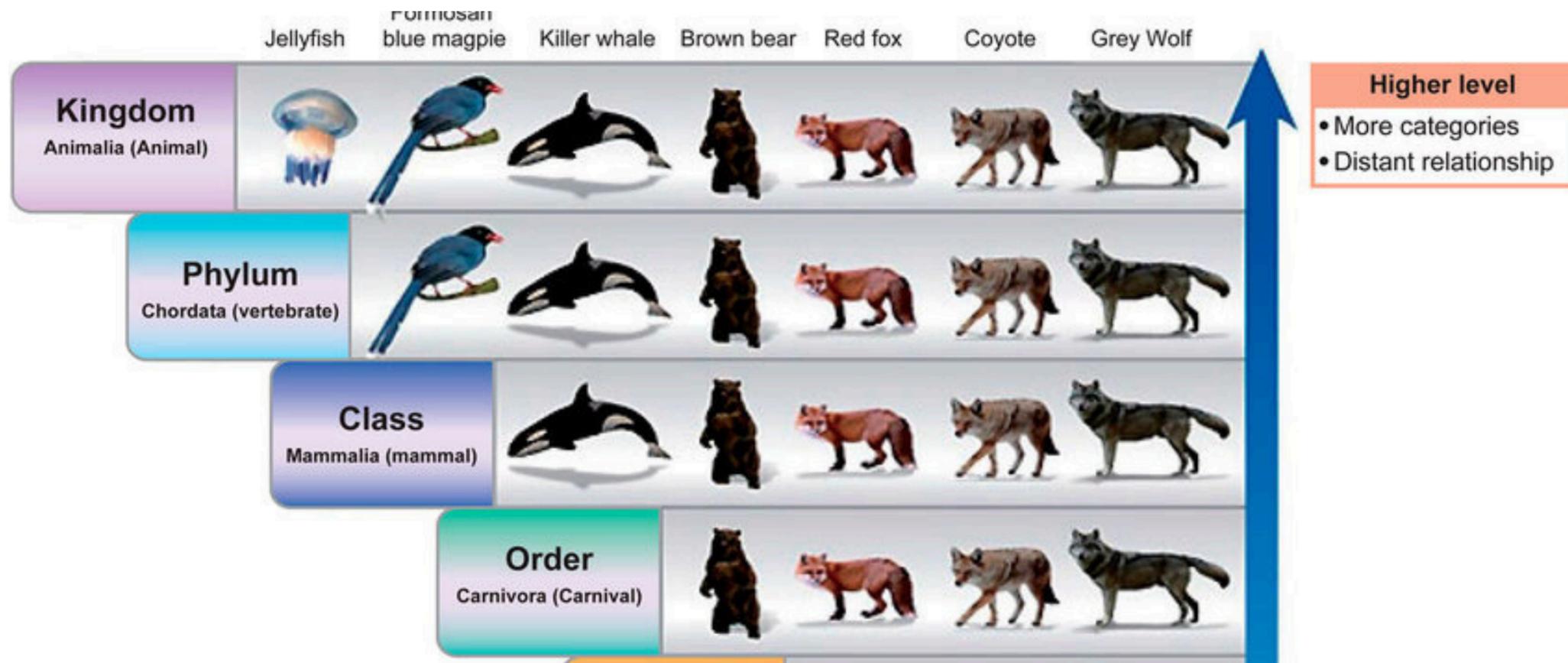
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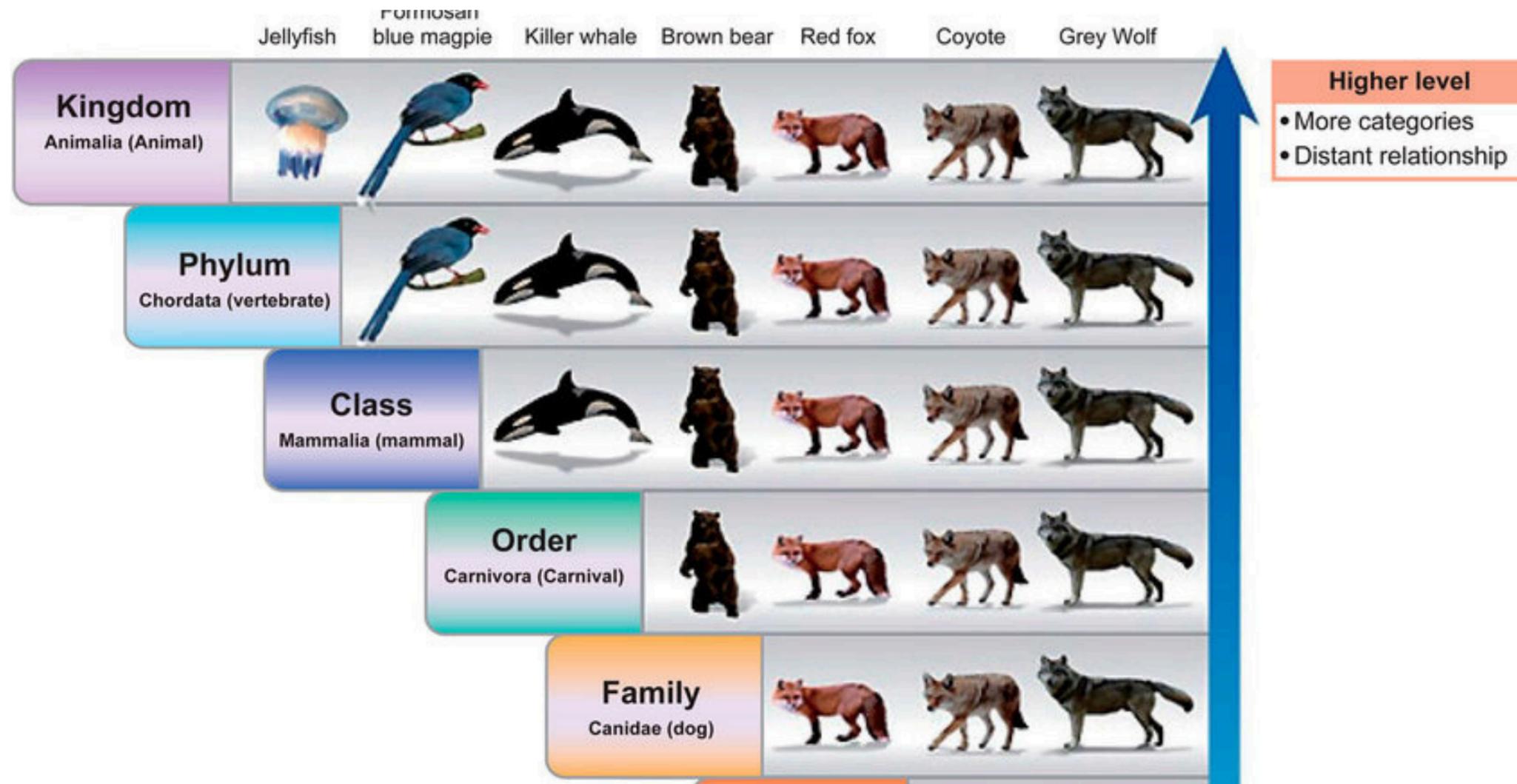
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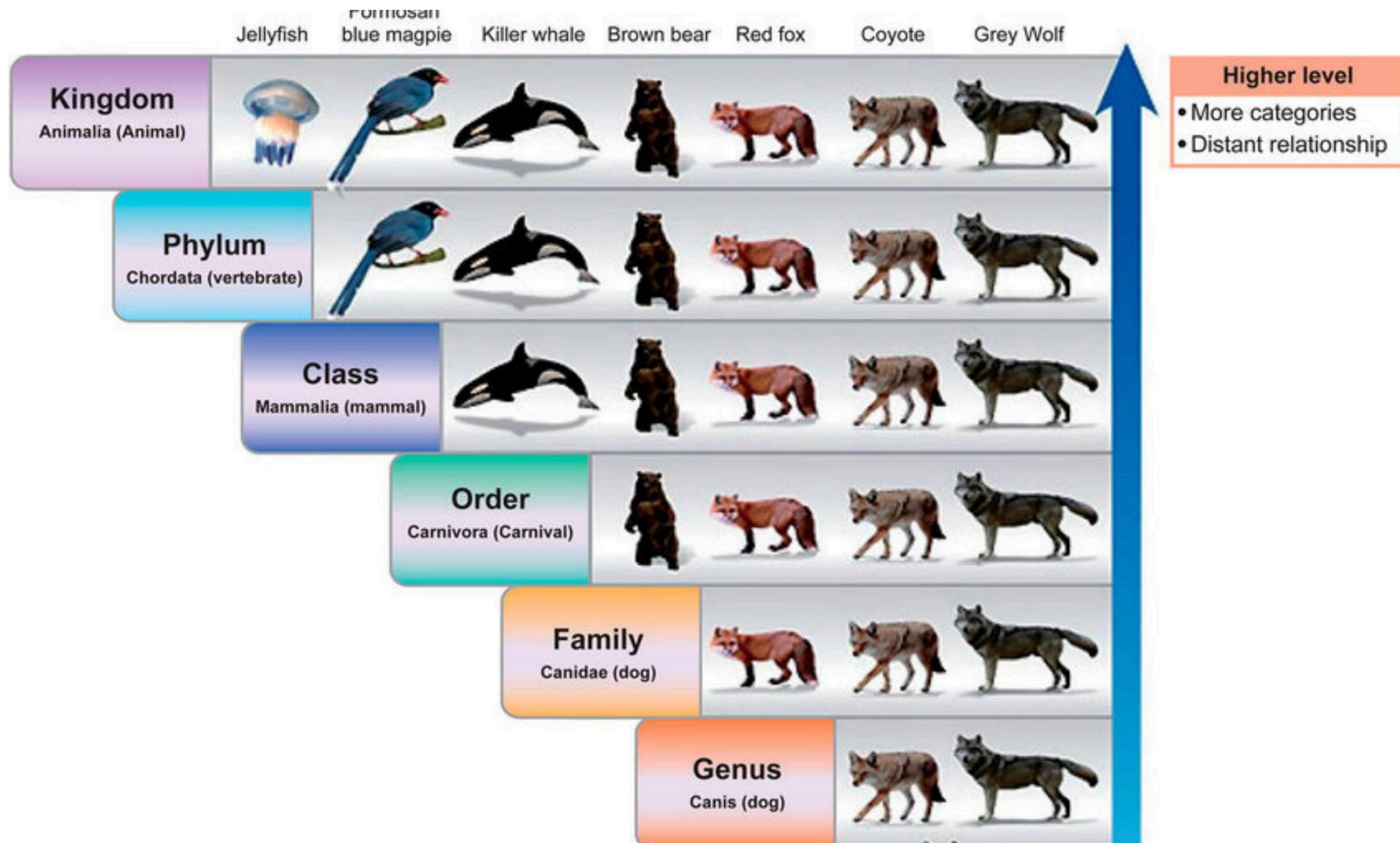
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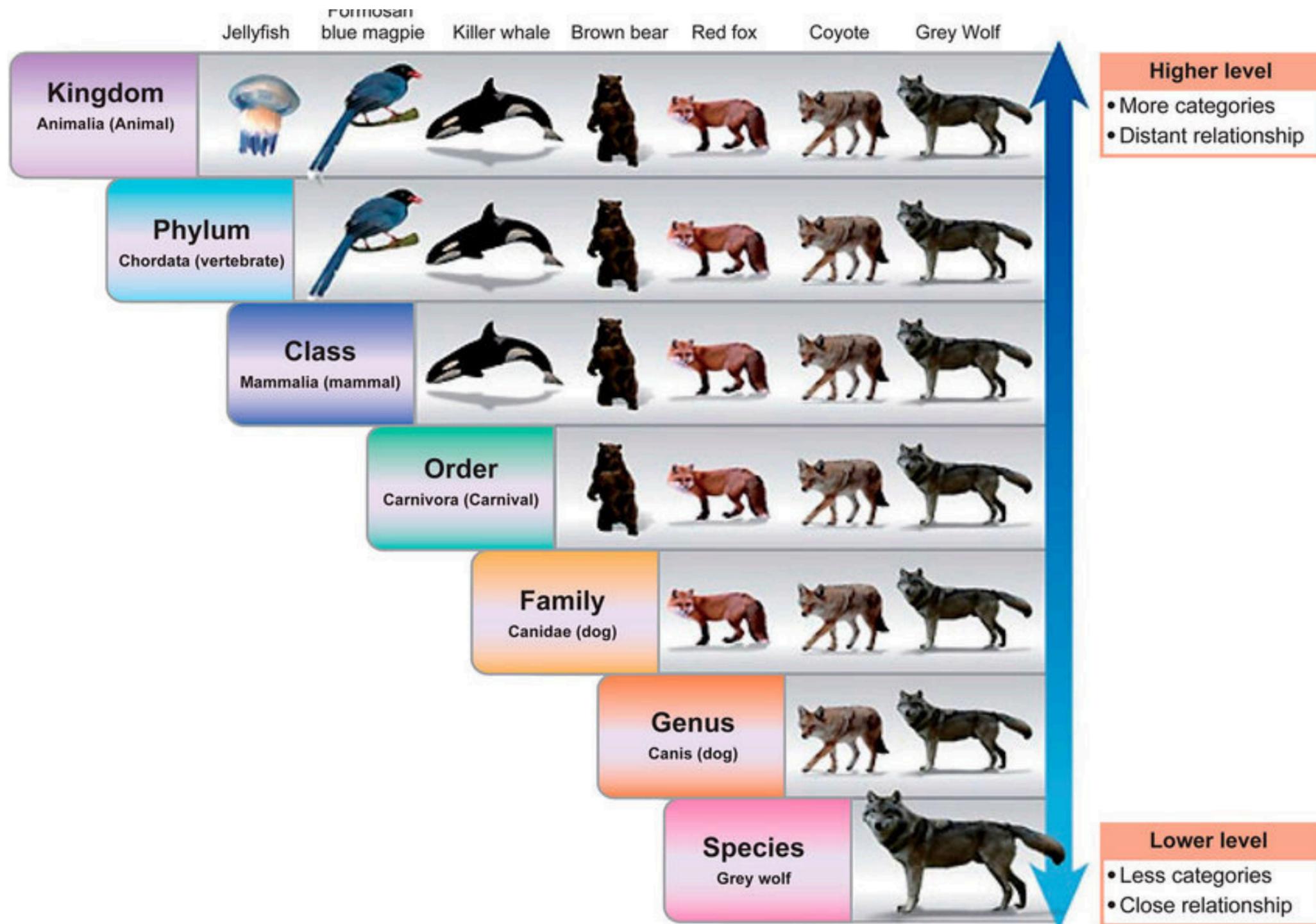
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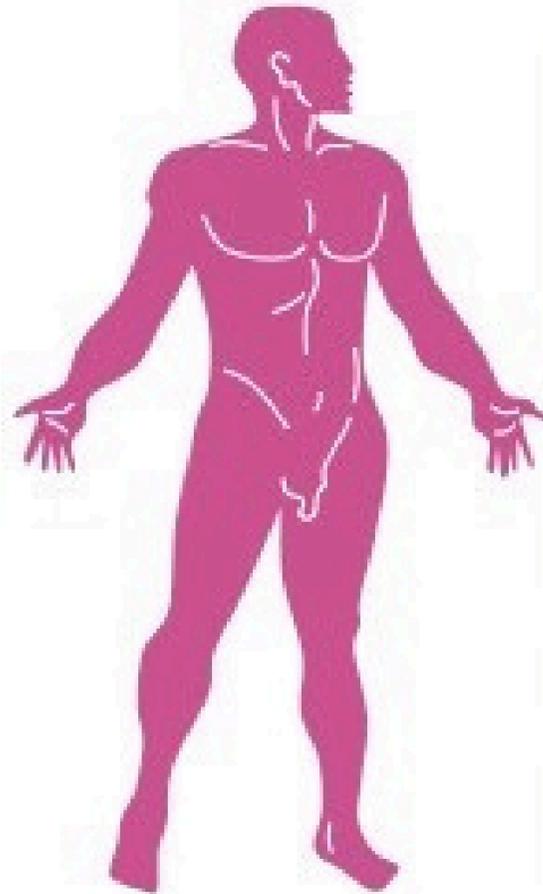
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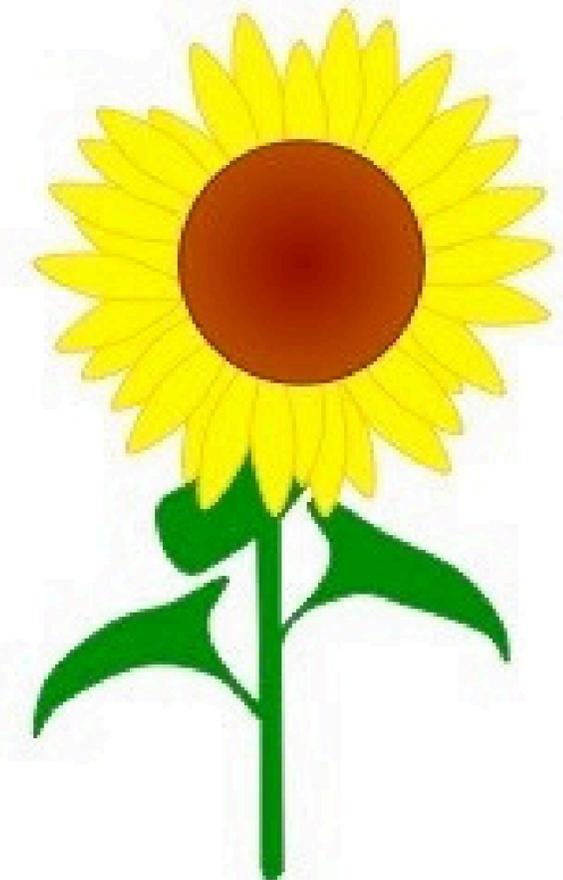
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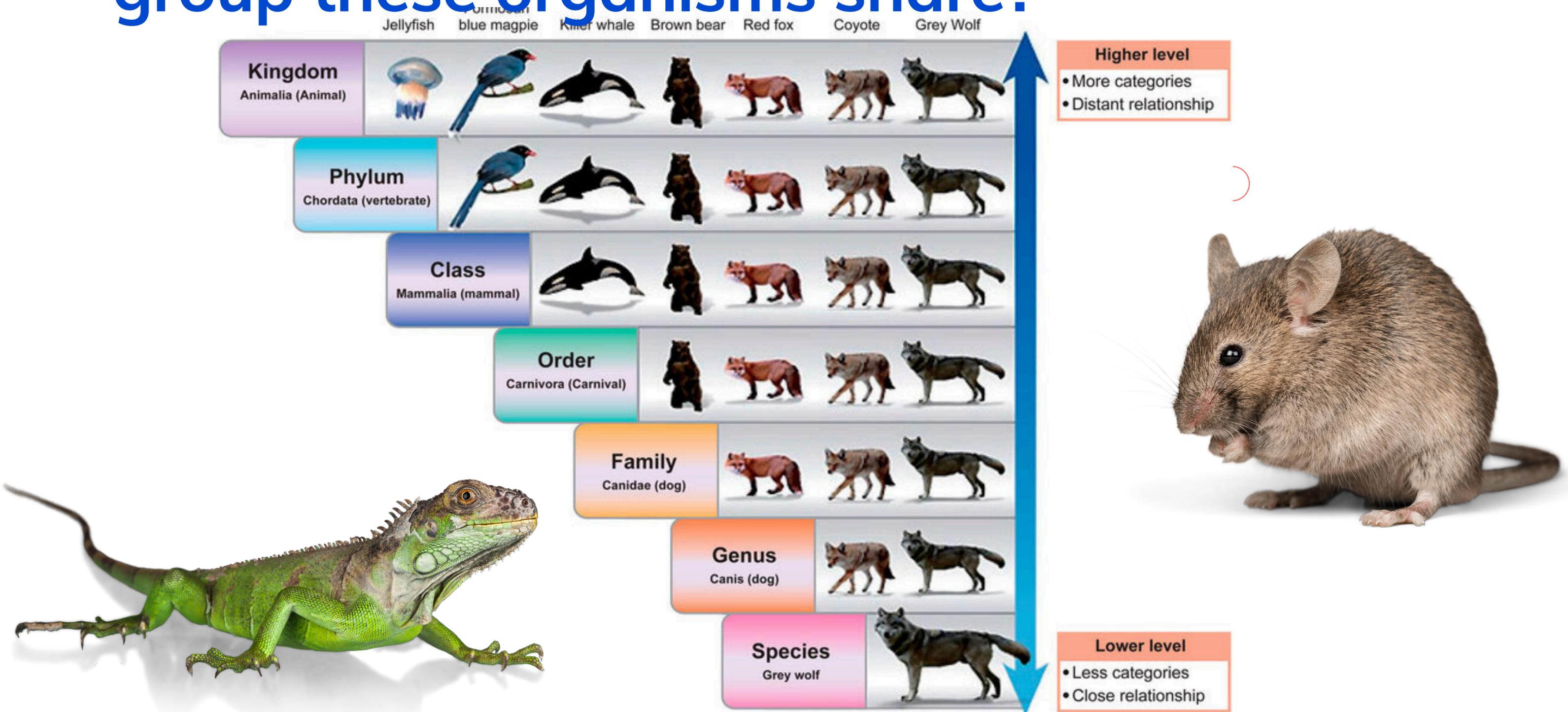
# 1. Tree of Life



| Animal Example | Taxonomic Rank | Plant Example     |
|----------------|----------------|-------------------|
| Animalia       | <b>Kingdom</b> | Plantae           |
| Chordata       | <b>Phylum</b>  | Angiospermophyta  |
| Mammalia       | <b>Class</b>   | Eudicotidae       |
| Primate        | <b>Order</b>   | Ranunculales      |
| Hominidae      | <b>Family</b>  | Ranunculaceae     |
| <i>Homo</i>    | <b>Genus</b>   | <i>Ranunculus</i> |
| <i>sapiens</i> | <b>Species</b> | <i>acris</i>      |
| Human          | Common Name    | Buttercup         |



# 1. CHALLENGE - what is the highest group these organisms share?



**Higher level**

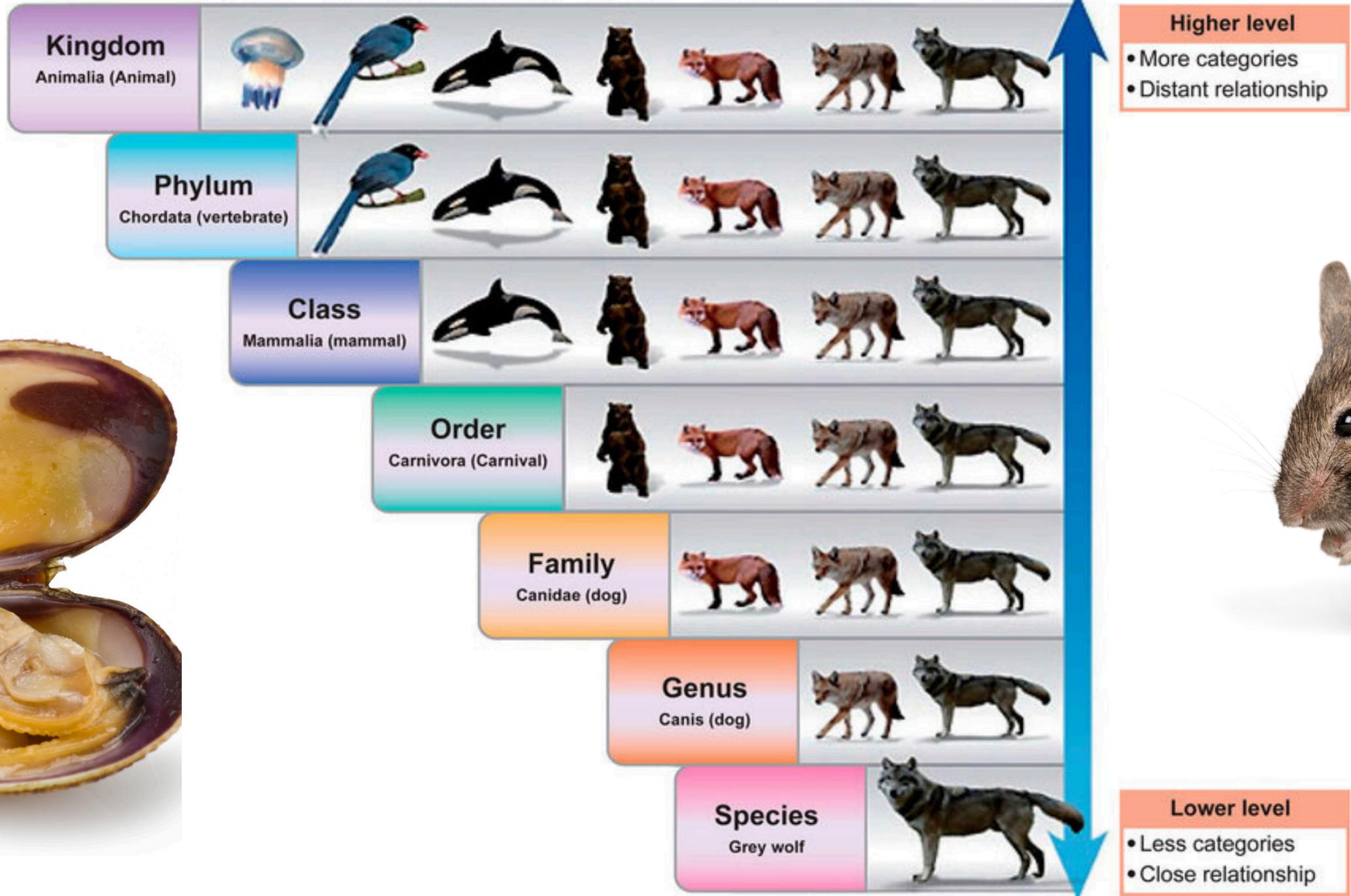
- More categories
- Distant relationship

**Lower level**

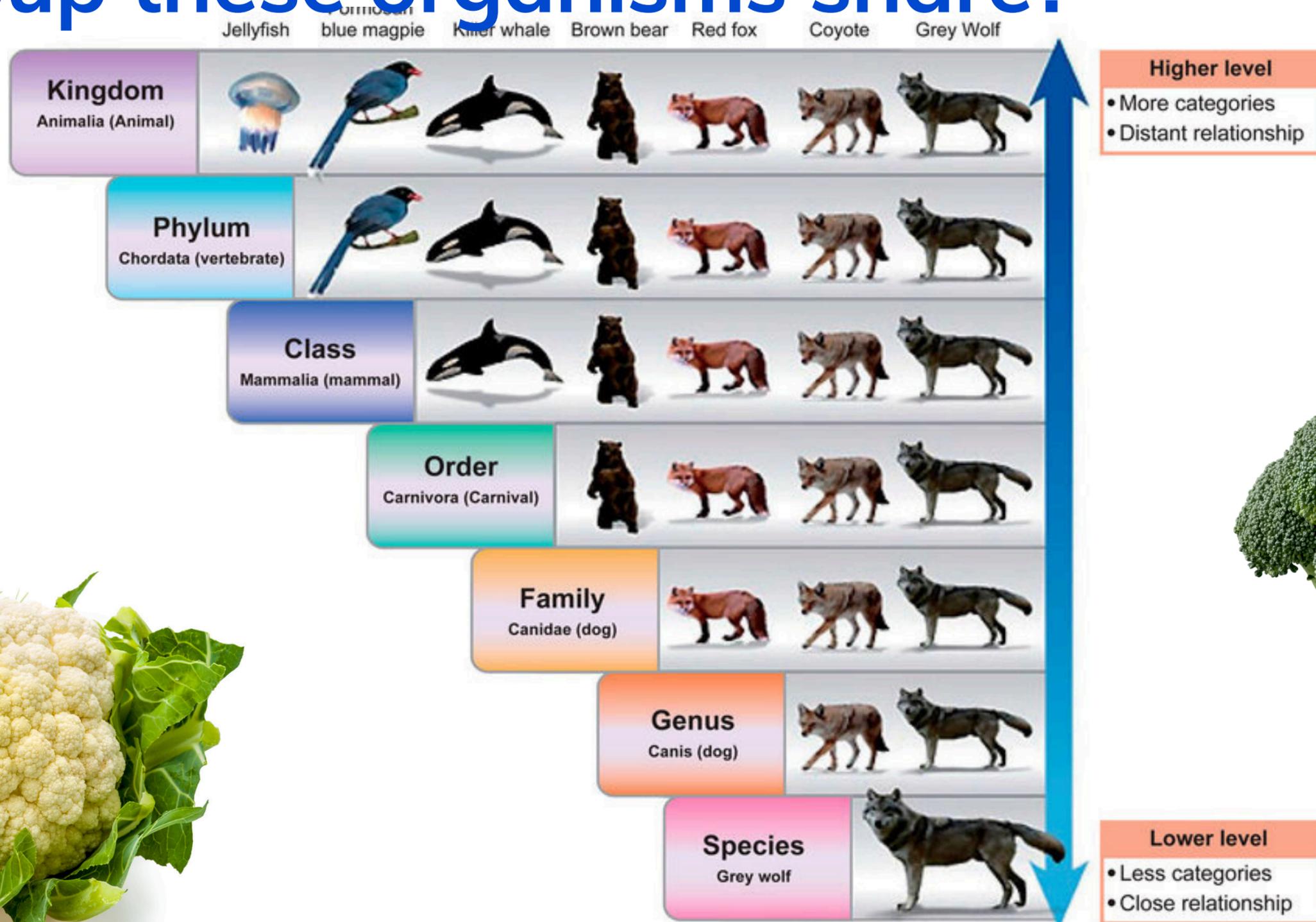
- Less categories
- Close relationship

# 1. CHALLENGE - what is the highest group these organisms share?

Jellyfish   blue magpie   Killer whale   Brown bear   Red fox   Coyote   Grey Wolf

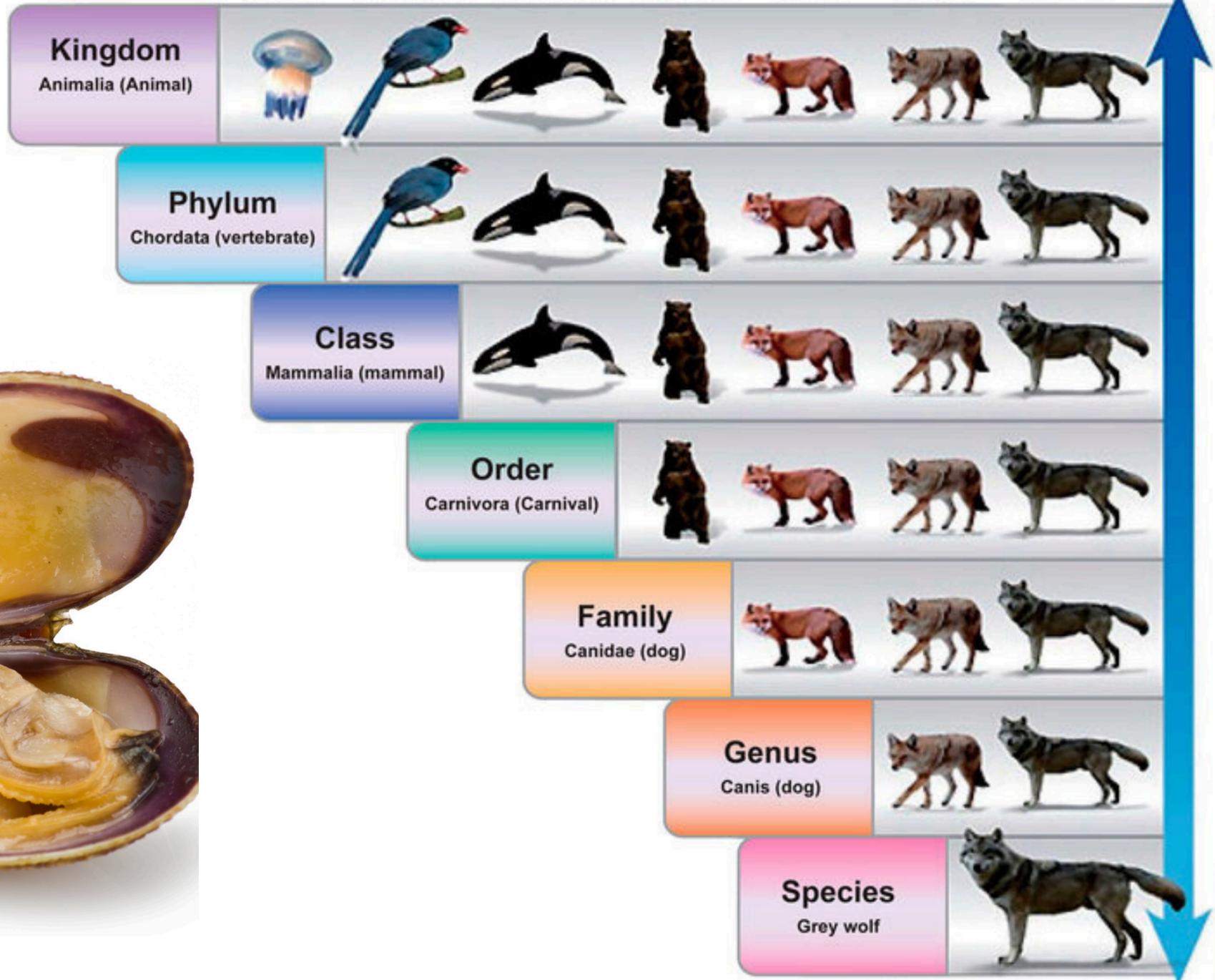


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Jellyfish   blue magpie   Killer whale   Brown bear   Red fox   Coyote   Grey Wolf



**Higher level**

- More categories
- Distant relationship



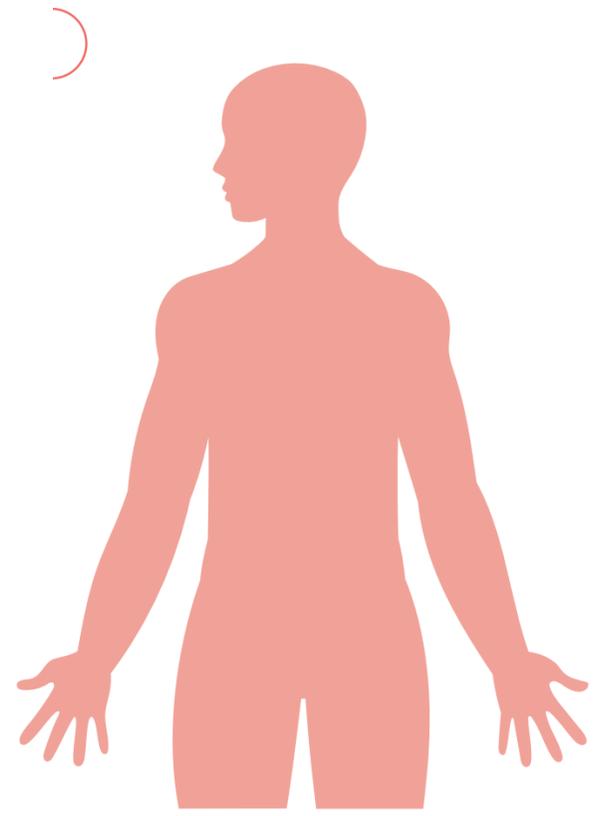
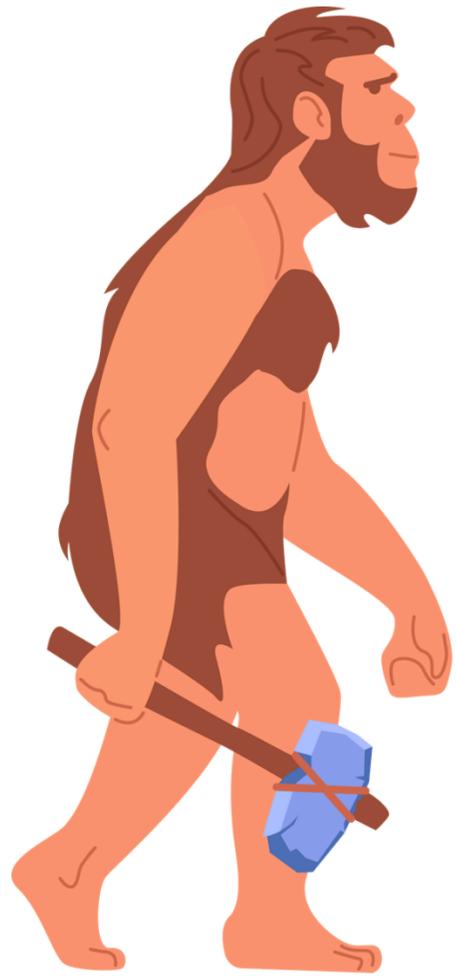
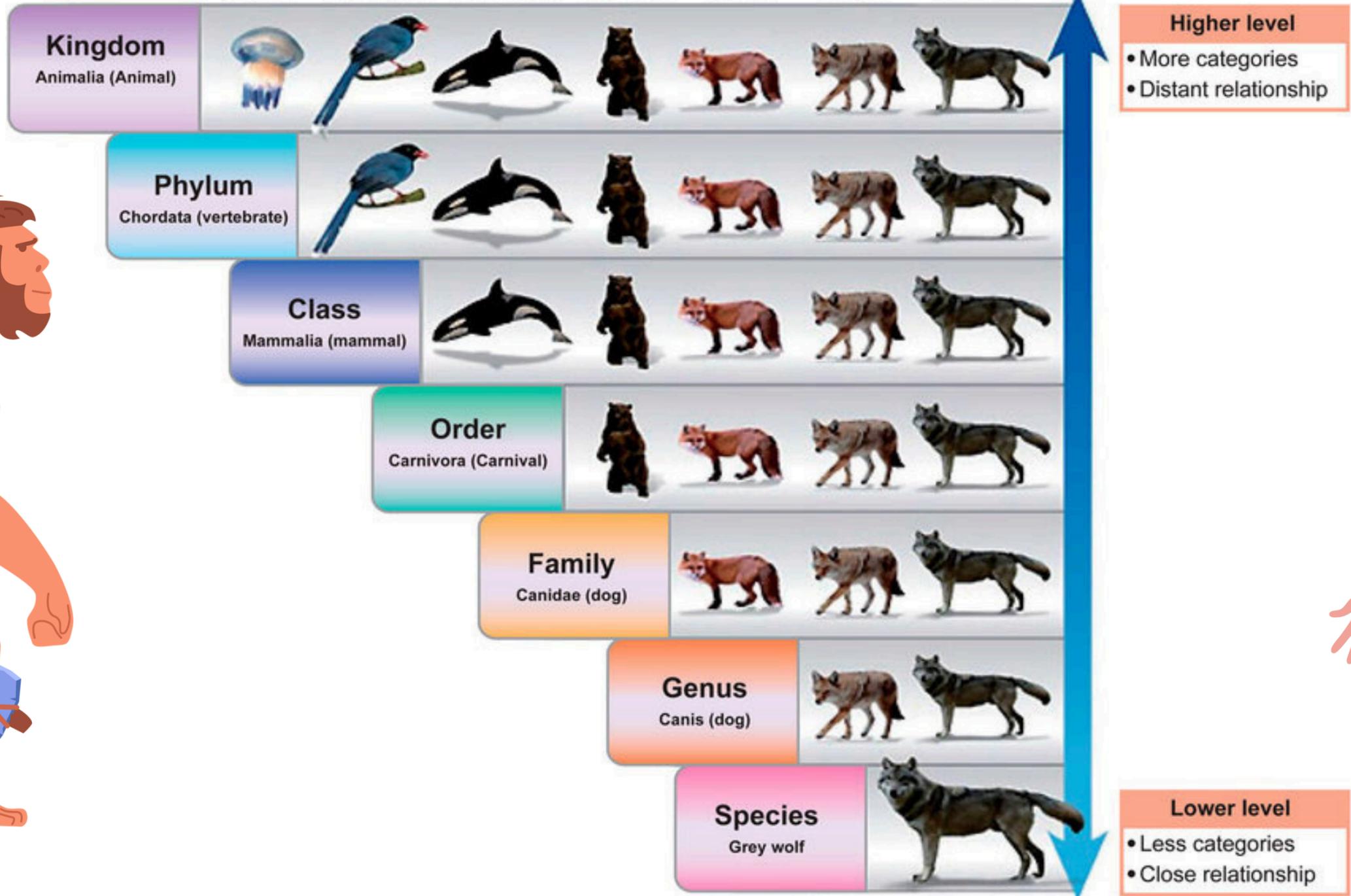
**Lower level**

- Less categories
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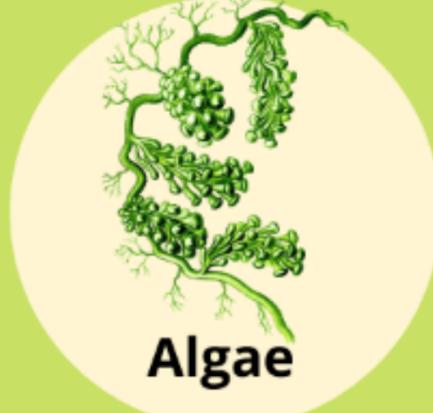
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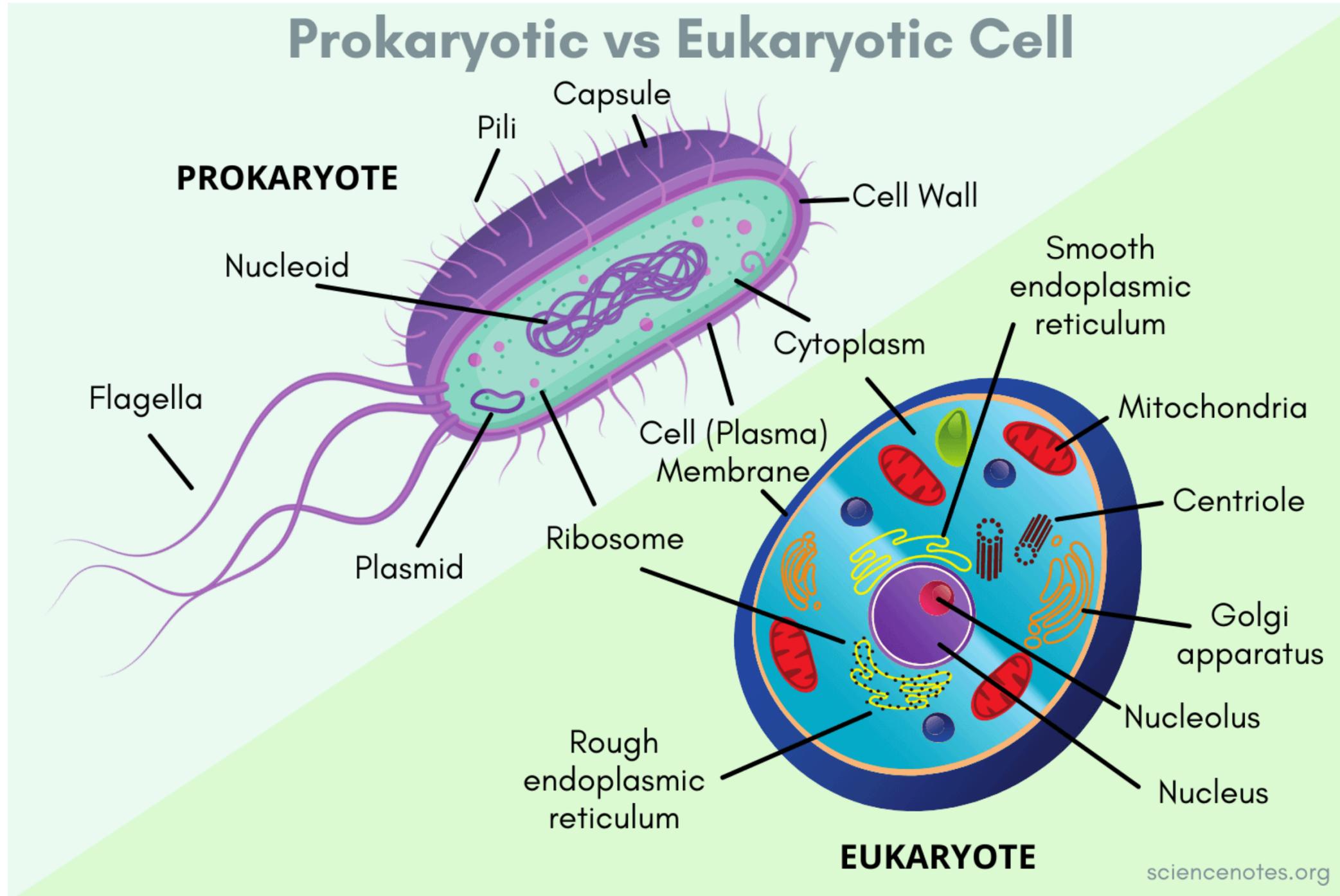
# 1. Tree of life

## Autotroph vs Heterotroph

| AUTOTROPH<br>Producers   | HETEROTROPH<br>Consumers  |
|--|---|
| An autotroph is an organism that produces its own food.  | A heterotroph is an organism that does not make its own food.   |
|  <p>Plants</p>  <p>Algae</p>                  |  <p>Animals</p>  <p>Fungi</p>                 |
|  <p>Some Bacteria</p>  <p>Phytoplankton</p> |  <p>Most Protozoa</p>  <p>Most Bacteria</p> |

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# 1. Tree of life



# 1. Tree of life

## Unicellular Organisms

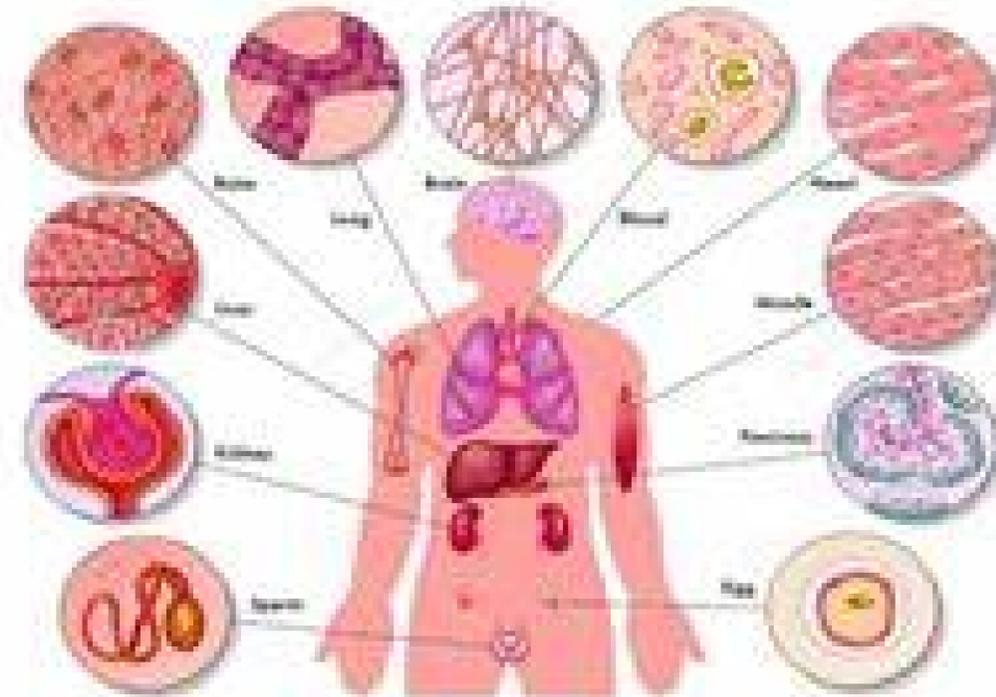


Amoeba



Paramecium

## Multicellular Organisms

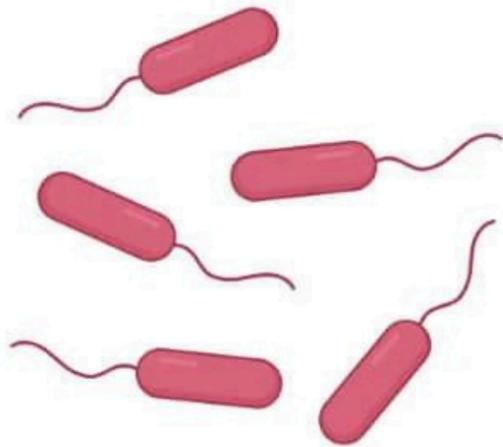


Humans

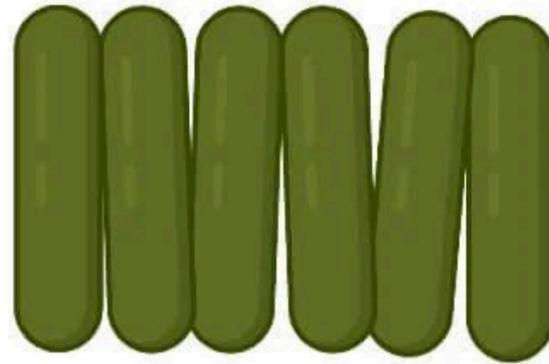
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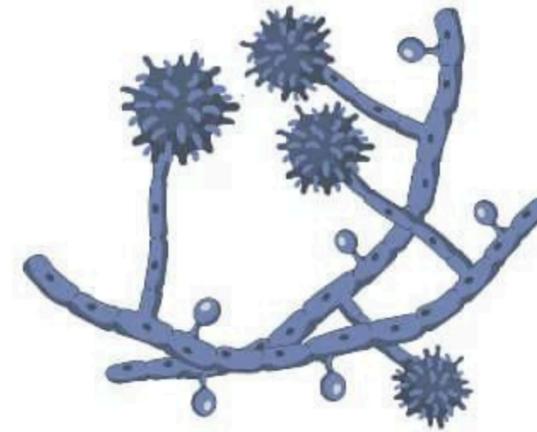
## 3 Domains of Life (Bacteria, Archaea, Eukarya)



Domain Bacteria



Domain Archaea

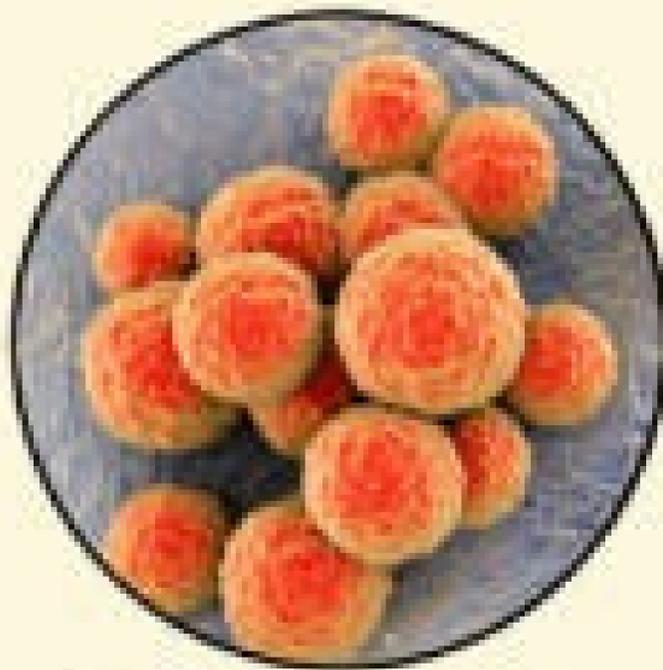


Domain Eukarya

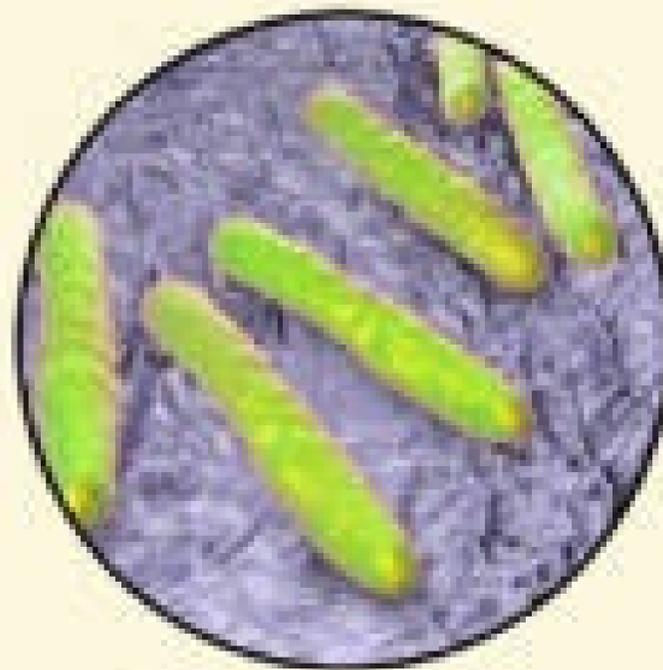
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# 1. Tree of life

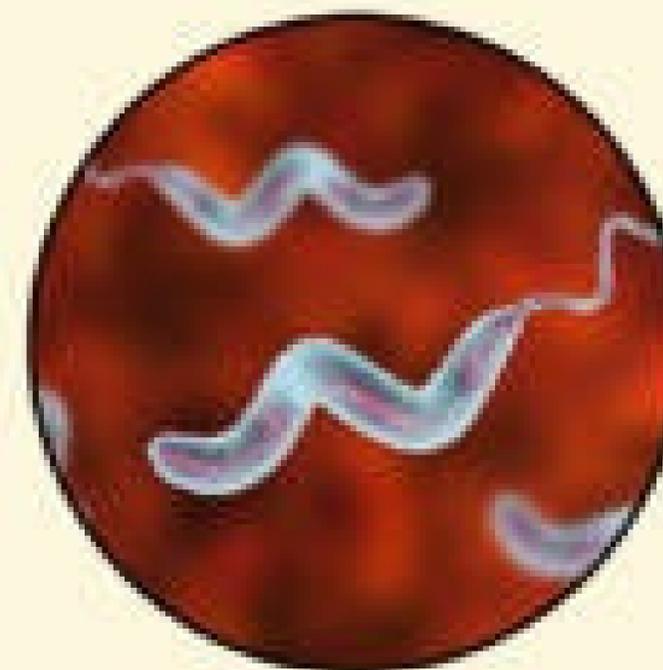
## EXAMPLES OF BACTERIA



**Spherical**



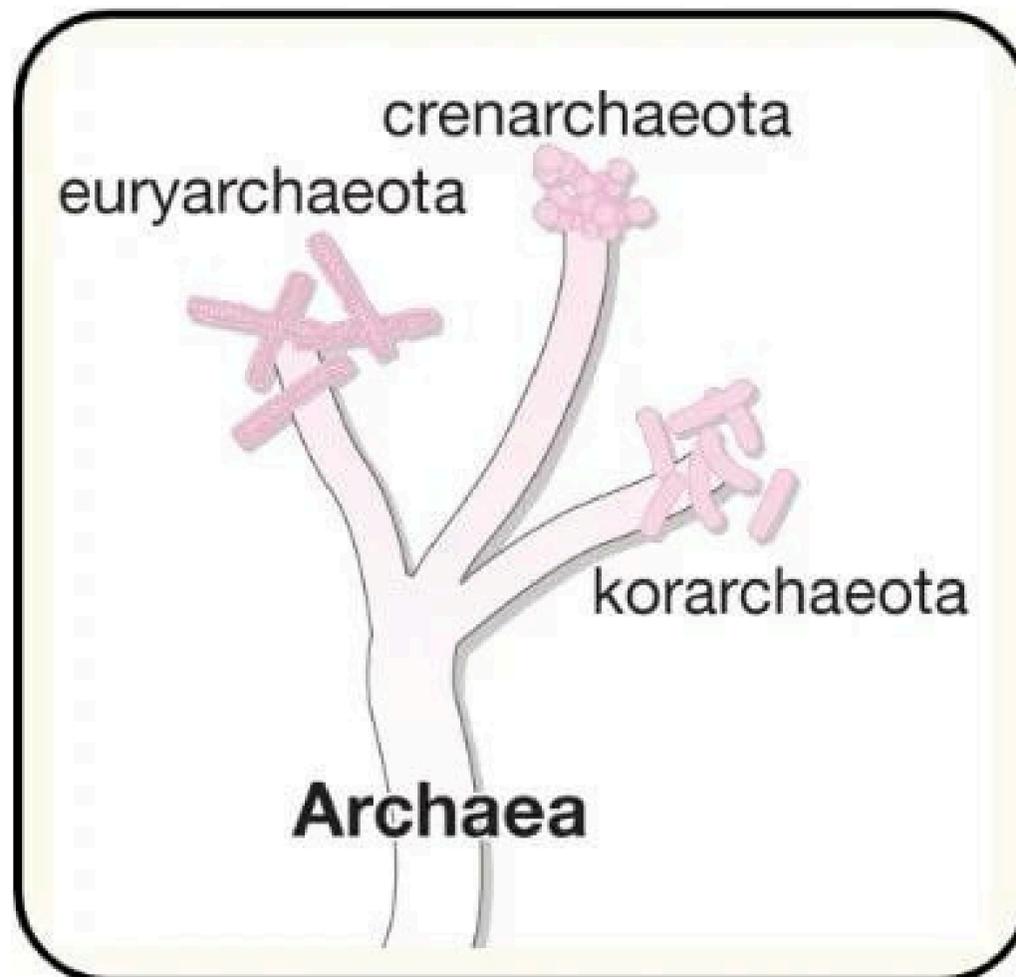
**Rod-like**



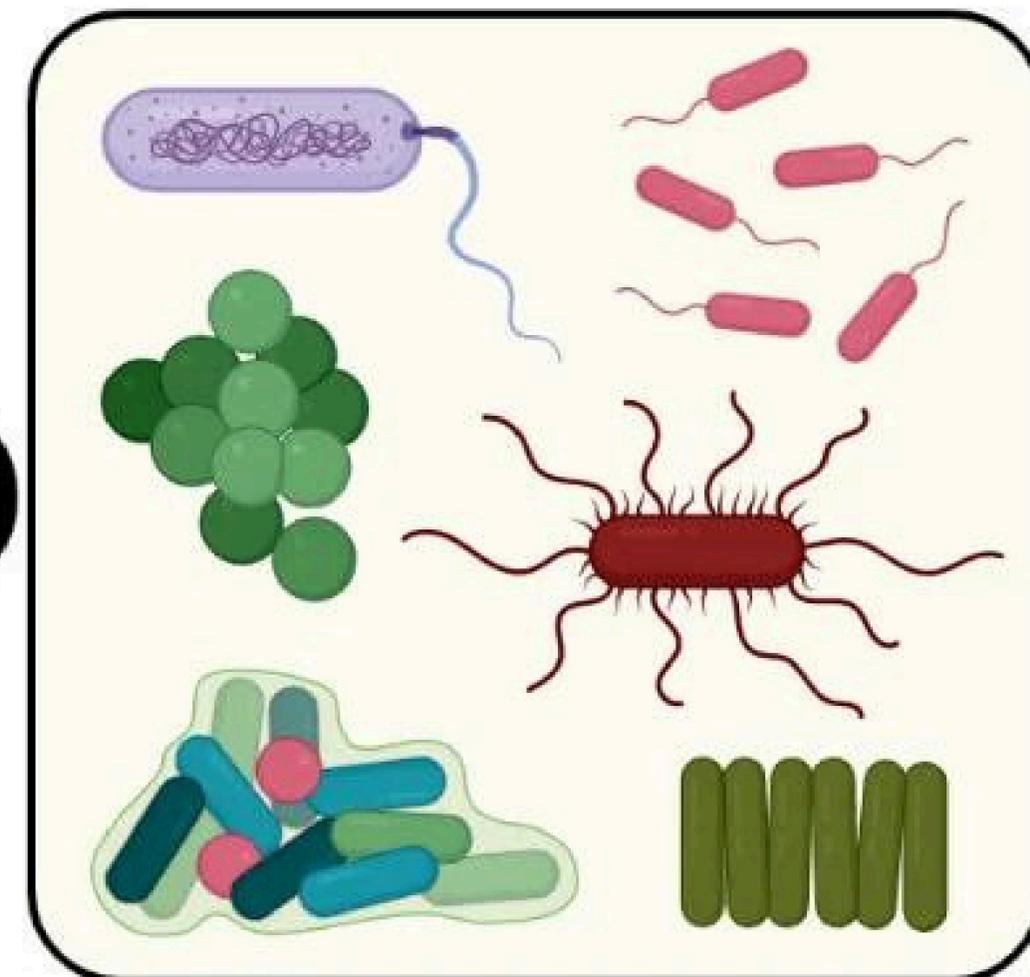
**Spiral**

# 1. Tree of life

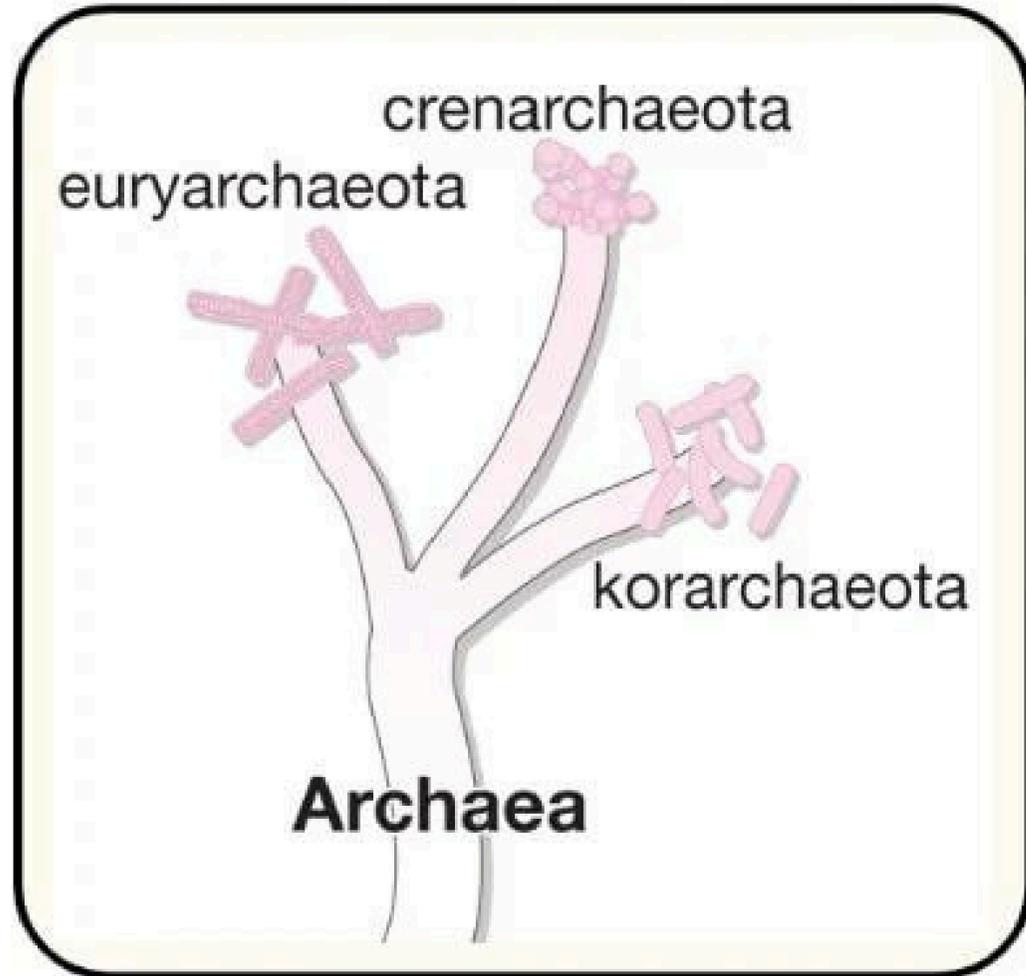
## Differences between Archaea and Bacteria



VS



# 1. Tree of life



## Archaea Are Extremophiles

Perhaps the most fascinating aspect of Archaea is their ability to live in incredibly extreme environments. They are capable of thriving where no other organism can survive.

For example, according to one study, the archaeal *Methanopyrus kandleri* strain can grow at 252 degrees F, while *Picrophilus torridus* can thrive at the incredibly acidic PH of 0.06. These are both records for extremophile environments. <sup>3</sup>

Other examples of Archaea in extremophile environments include:

- The hot springs in Yellowstone National Park, in boiling hot water
- Near hydrothermal vents at the bottom of the ocean where temperatures are above 100 degrees Centigrade
- In the world's most alkaline and acid water
- In the digestive tracts of termites and many other animals where they produce methane
- Deep underground in petroleum deposits

## 2. What is life?

**life, living matter and, as such, matter that shows certain attributes that include responsiveness, growth, metabolism, energy transformation, and reproduction.**

## 2. What is life?

**You arrive on your deep sea expedition and find the following:**

- **a large sheet of rubbery strands**
- **it flows around the ocean emitting light**
- **when you shine a light on it, it pulls away**
- **when you touch it, it retracts**
- **you take one branch of it home with you. After a week, it has doubled in size.**

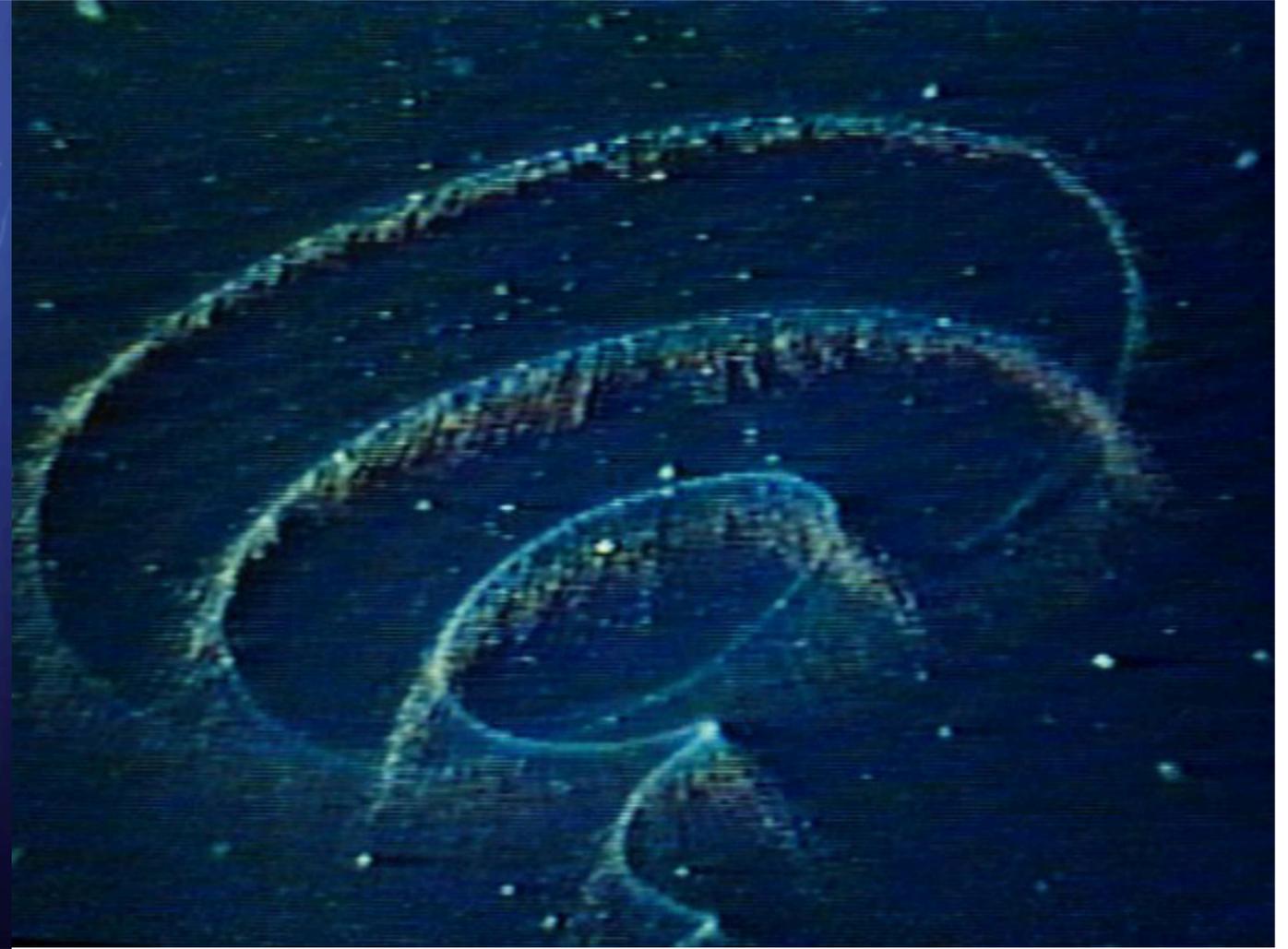
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**Is this alive?**

## 2. What is life?



**Siphonophore**

## 2. What is life?

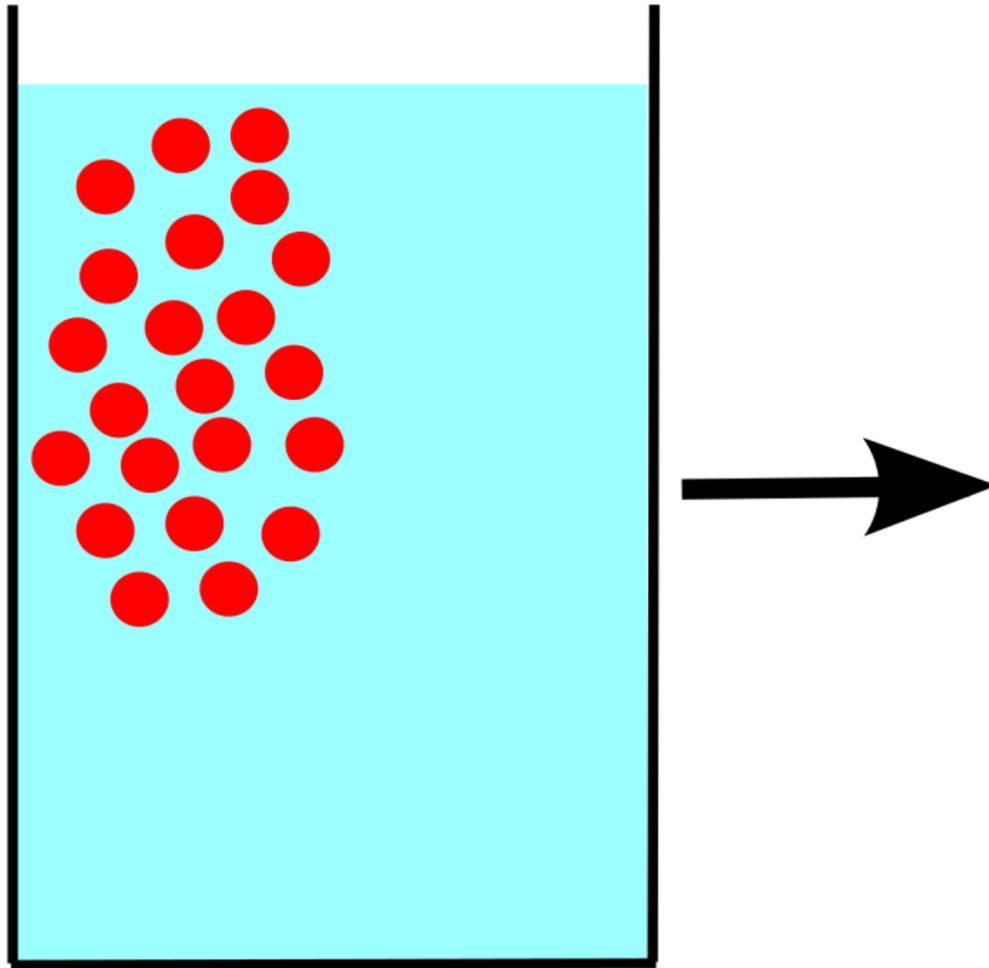


**Siphonophore**

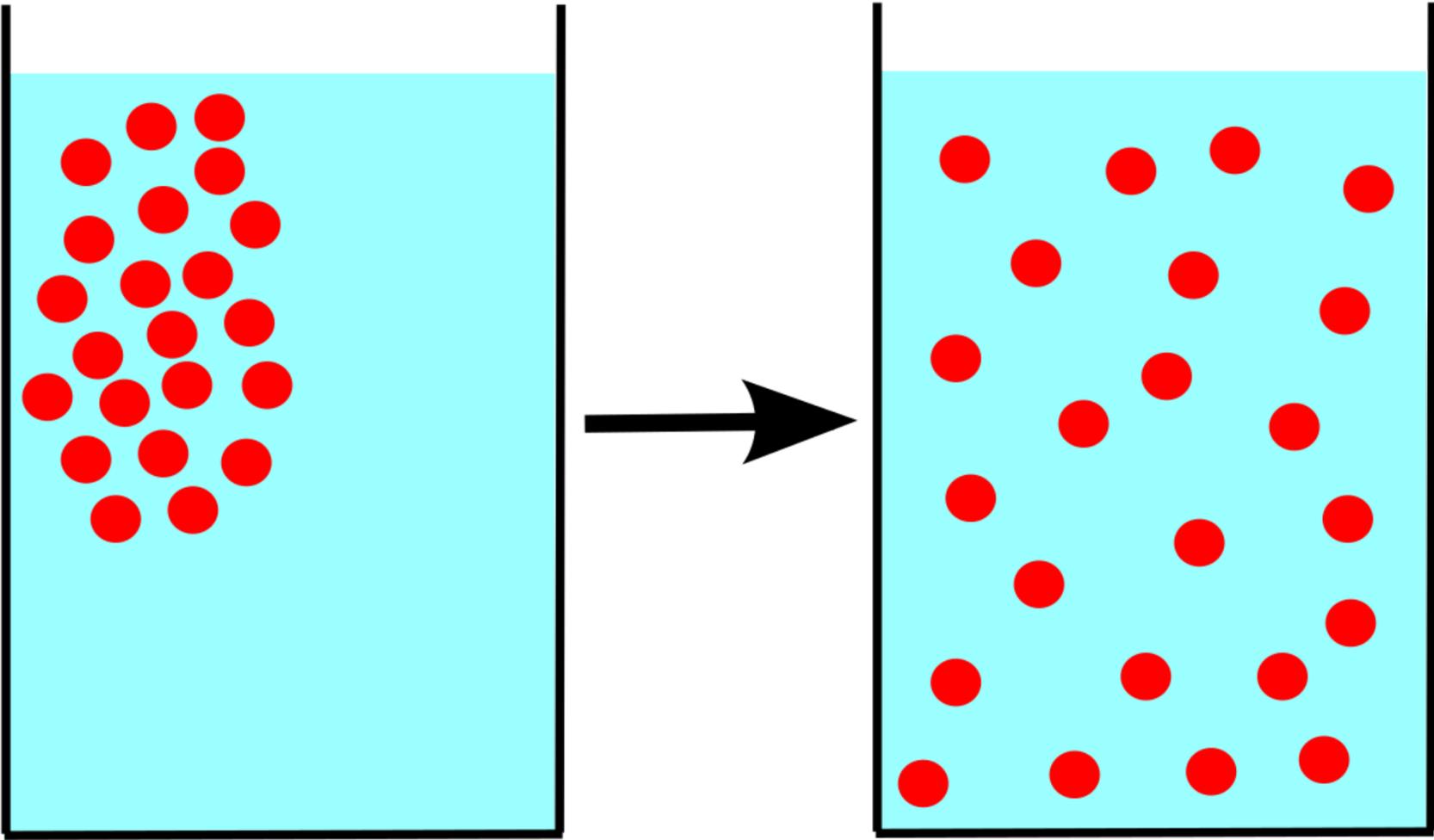
Siphonophores are highly polymorphic and complex organisms.<sup>[4]</sup> Although they may appear to be individual organisms, each specimen is in fact a **colonial organism** composed of **medusoid** and **polypoid zooids** that are **morphologically** and functionally specialized.<sup>[5]</sup> Zooids are multicellular units that develop from a single fertilized egg and combine to create functional colonies able to reproduce, digest, float, maintain body positioning, and use jet propulsion to move.<sup>[6]</sup> Most colonies are long, thin, transparent floaters living in the **pelagic zone**.<sup>[7]</sup>

Like other **hydrozoans**, some siphonophores emit light to attract and attack prey. While many sea animals produce blue and green **bioluminescence**, a siphonophore in the genus *Erenna* was only the second life form found to produce a red light (the first one being the scaleless dragonfish *Chirostomias pliopterus*).<sup>[8]</sup>  
<sup>[9]</sup>

## 2. What is life?



# 2. What is life?

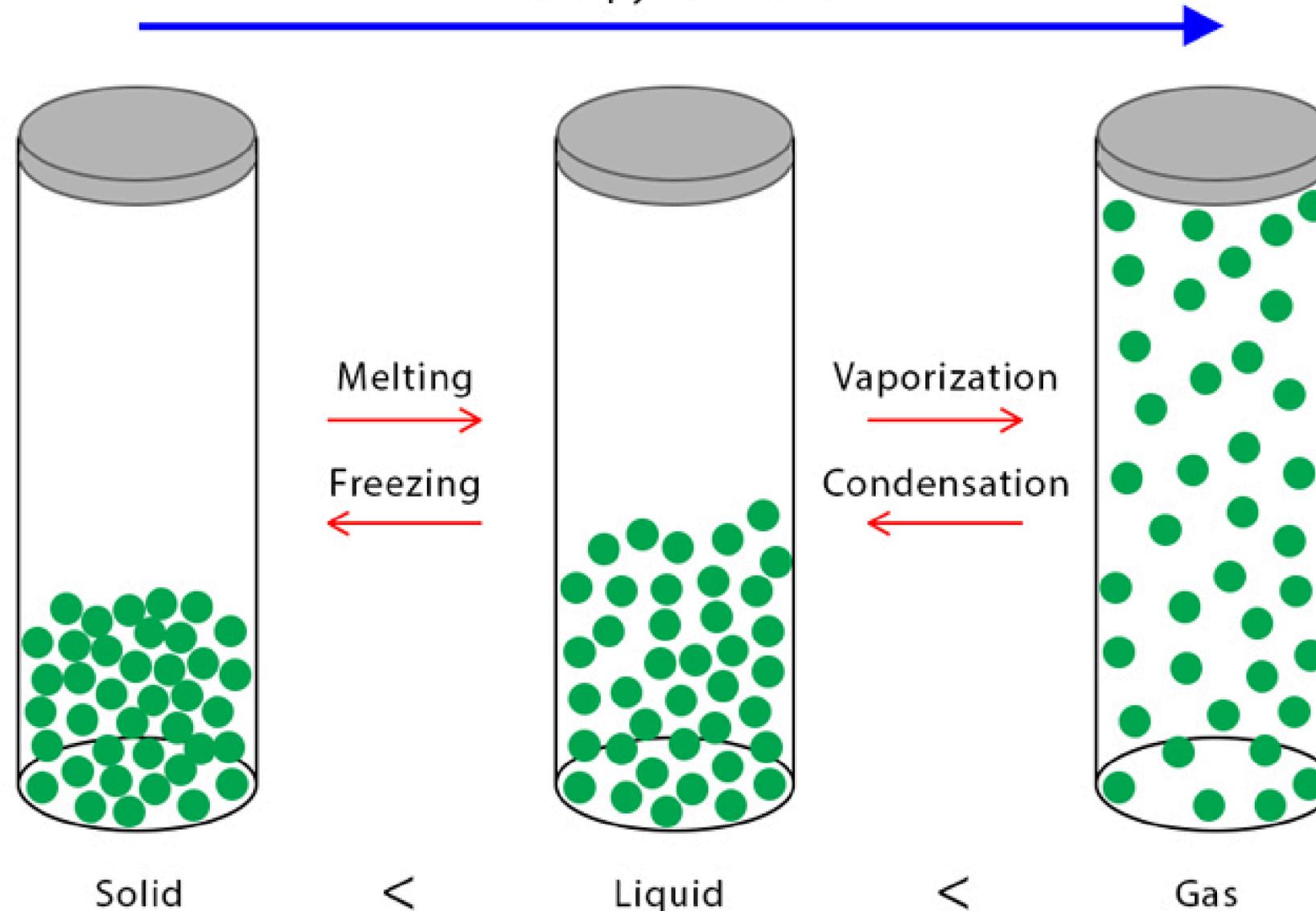


# 2. What is life?

## Entropy

Entropy is the measure of the disorder of a system

Entropy increases



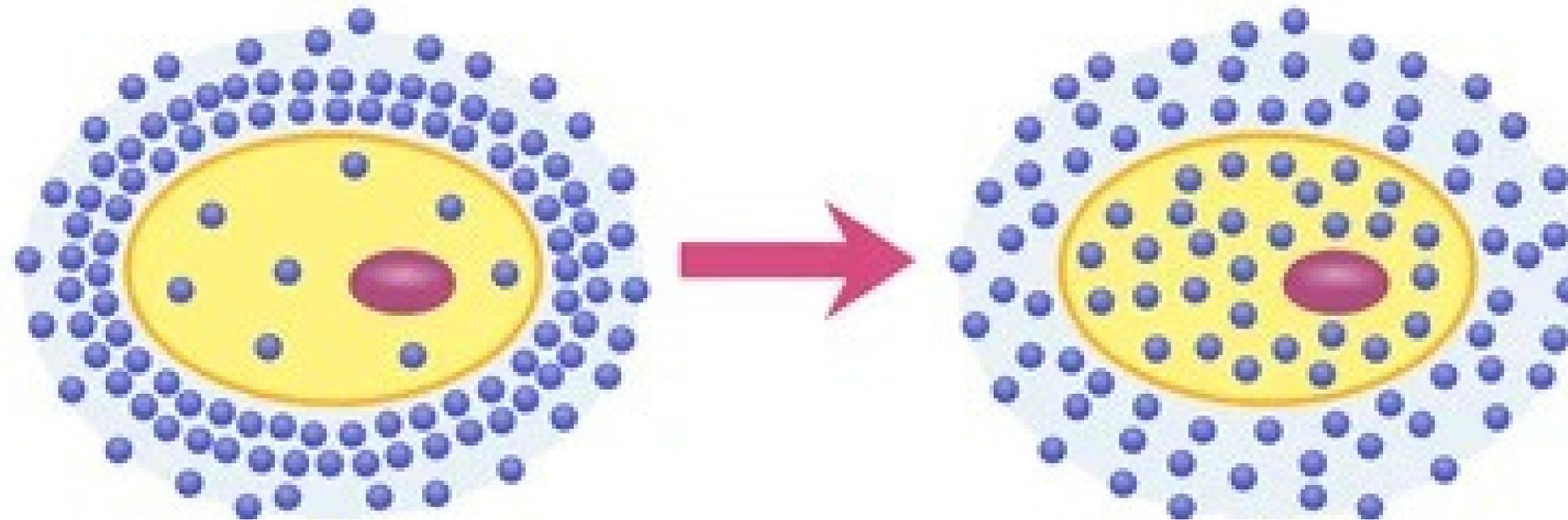
## 2. What is life?

### Cells and Entropy

- The term *entropy* is used to indicate the *relative state of disorganization*.
- Cells need a constant supply of energy to maintain their internal organization.
- Complex molecules like glucose tend to break apart into their building blocks, in this case carbon dioxide and water.
- This is because glucose is more organized, and thus less stable, than its breakdown products.
- The result is a loss of potential energy and an increase in entropy.

## 2. What is life?

DIFFUSION



# 2. What is life?

The Nobel Prize in Physiology or Medicine  
2023

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Katalin Karikó and Drew Weissman

“for their discoveries concerning nucleoside base modifications that enabled the development of effective mRNA vaccines against COVID-19”

