COSMOS LESSONS

Biology

Kingdoms: Crossing the boundaries

The life around you is incredibly diverse and all life belongs to a kingdom.

In this lesson you will investigate the following:

- How have our notion of kingdoms changed over time?
- What are the names of the six kingdoms?
- What are the similarities and differences between ferns and fungi?

Let's have some fun exploring the natural world around us.

This is a print version of an interactive online lesson. To sign up for the real thing or for curriculum details about the lesson go to **www.cosmosforschools.com**

Introduction: Kingdoms (P1)

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Ferns are among the most ancient members of the plant kingdom. They were here before the dinosaurs. So it's amazing that it has taken us until now to make a new key discovery about how they live.

All members of the plant kingdom need sunlight because they use its energy to make their own food through photosynthesis. But ferns live in the shadows, usually on the forest floor, where tall trees block out the Sun's rays. So how do they survive with so little sunlight? Scientists have just discovered their mysterious secret.

Sunlight is made up of many colours. Most plants can only detect blue light to perform photosynthesis. But blue light is blocked by the forest canopy, so the light that makes it through is mostly red. To compensate, ferns have a special light-sensing protein that enables them to detect the red light that they can use for photosynthesis. That way they can live happily in the shadows.

But there is more to the story of how the ferns adapted to life on the forest floor than that.

The plants can use the red light because of a gene they have that produces the special protein. Usually animals and plants inherit genes from their parents but the ferns got theirs from another member of the plant kingdom altogether – a sort of moss called the hornwort.

But there is still a mystery for the scientists to work out. No one is sure exactly how the gene moved from the hornwort to the fern. But for the fern, it sure was a lucky gift.

Read or listen to the full *Cosmos* magazine article here.

Ferns have acquired a moss gene via a natural process, but with genetic engineering it is possible to transfer a gene from one species to another artificially. GloFish have been genetically engineered with the jellyfish gene that gives them their glowing colour. They were originally designed to help scientists study pollution but are now marketed as the first genetically altered house pet. Credits: Anna Utkina / Getty Images and GloFish / Getty Images.

Question 1

Imagine: You discover a way to acquire a gene from another species. If you had to choose one characteristic to acquire from another species, what characteristic would you choose and why?

Gather: Kingdoms (P1)

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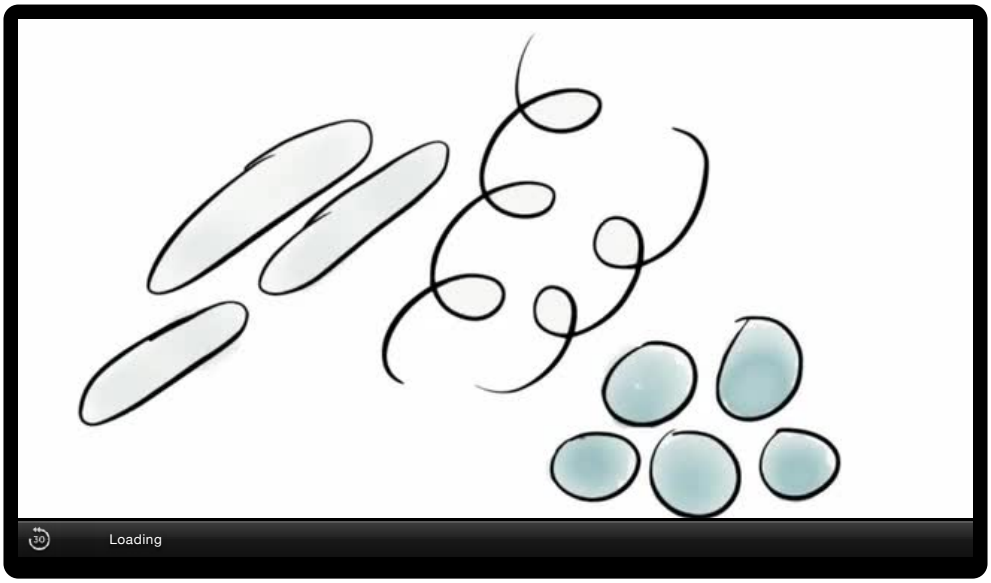


Credits: Mark Drollinger / YouTube.

Question 1

Recall: All living organisms can be grouped into kingdoms. How many kingdoms are there?

- [ ] Two
- [ ] Three
- [ ] Four
- [ ] Six

Question 2

Recall: What is the scientific term used to describe organisms that obtain energy via photosynthesis?

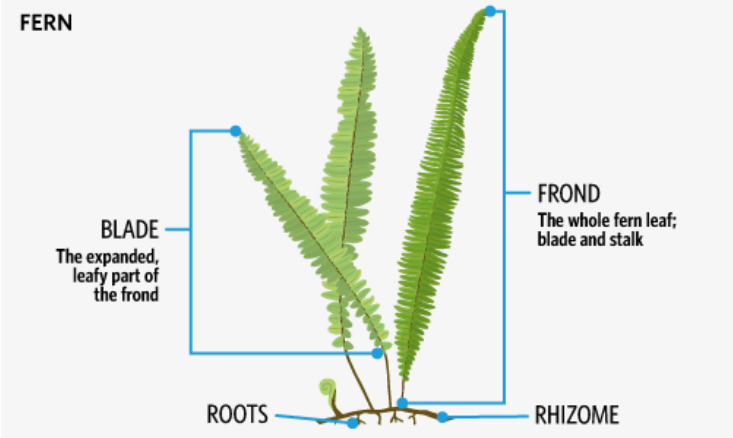
- [ ] Autotrophs
- [ ] Phototrophs
- [ ] Multitrophs
- [ ] Heterotrophs

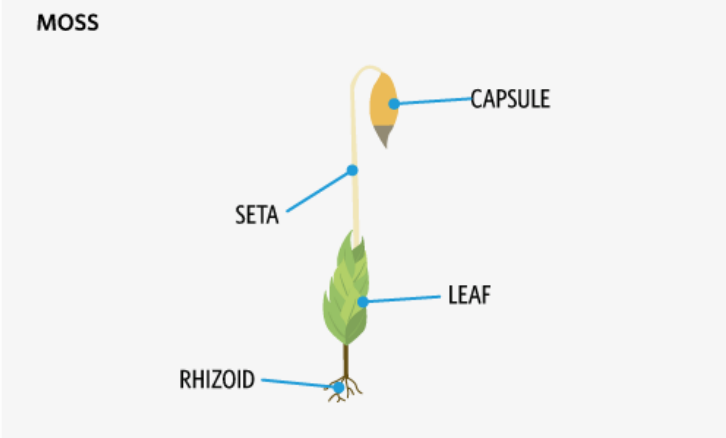
Question 3

Place: Complete the following table below by adding the missing information.

Hint: An internet search will help you if you get stuck.

Organism	Kingdom	Unicellular or multicellular?	How it obtains energy	Additional information
Bear			Eats food	
	Plants			Usually immobile. Cells have cell wall.
Mushroom		Multicellular		Cells have cell wall.
Salmonella			Absorbs nutrients from its surroundings	No nucleus
Amoeba	Protists	Unicellular		Has nucleus
Halobacteriales	Archaea	Unicellular	Absorbs nutrients from its surroundings	



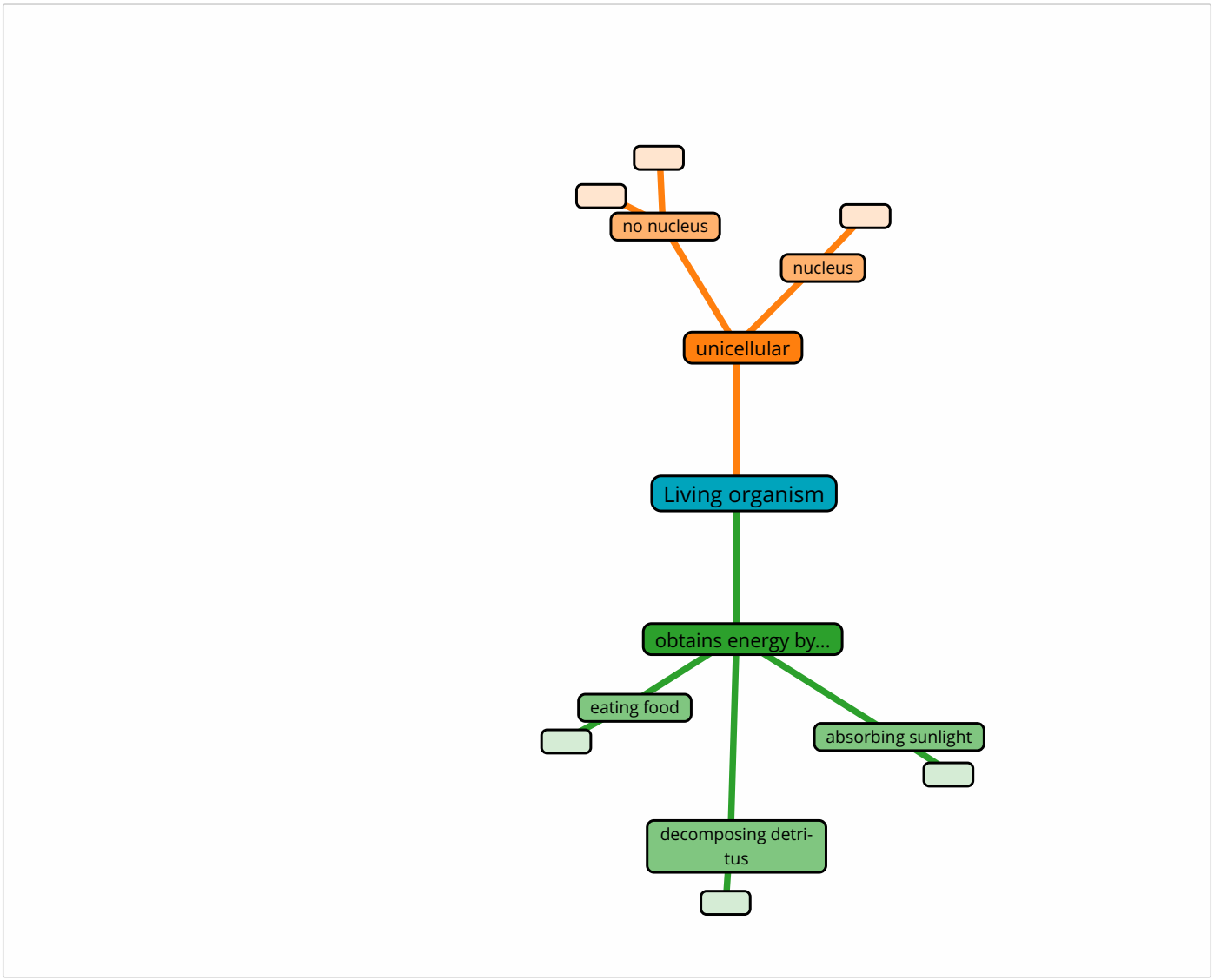


Question 4

Describe: The *Cosmos* article reveals that ferns acquired a gene from a moss. Examine the above images and identify the features that place ferns and mosses in the plant kingdom.

Question 5

Place: Label the appropriate kingdom into the empty boxes below.



Process: Kingdoms (P1)

Mushrooms and ferns, members of two different kingdoms, have lived side by side on the forest floor for millions of years. Credit: iStock.

Question 1

Calculate: One of ferns' defining characteristics is their beautiful unfurling fronds. Frond blades are made up of pinnae (smaller segments of the blade) and each pinna is made up pinnules (the little leaves). If a fern has 6 fronds, with each frond having 12 pinnae and each pinna having 32 pinnules, how many pinnules does the fern have in total?

Credits: Global zoo / YouTube.

Credits: NW documentary / YouTube.

Question 2

Distinguish: Having watched the two videos, describe the distinguishing features between fungi and ferns.

Question 3

Think: Which of the following do ferns and fungi have in common?

- [ ] Need for sunlight
- [ ] Need for water
- [ ] Need for carbon dioxide

Question 4

Sequence: The nutrients from a rotting tree can be reused by:

- [ ] First fungi then ferns
- [ ] First ferns and then fungi
- [ ] The order is irrelevant

Question 5

Compare: Scientists used to classify organisms as either plant or animal. Under which classification do you think bacteria were placed? Explain your answer.

Question 6

Explain: If you had difficulty deciding on your response to *Question 5* you would have found yourself in good company in the 1950s and 60s. In order to deal with these classification problems scientists expanded the number of kingdoms to five. The sixth group, archaea, was not added until the 1970s. Why do you think this final kingdom was added later than the others?

Apply: Kingdoms (P2)

Activity: Kingdom cards

CLL_Kingdom_printable.pdf

Question 1

It took the discovery and examination of hundreds of organisms before scientists were able to settle on the six kingdoms we know today. Now it is time for you to forget about the kingdoms you have learnt about in this lesson and propose *your own* kingdoms!

Examine the *Cosmos* printable cards provided for download above. You may view these on your screen or print and cut them out. Using the information and images provided on the cards, group the organisms into *three new kingdoms.* Make sure to name each of your kingdoms and explain your groupings.

Once you have finished, you may add your own organism onto the blank card. This can either be an existing organism or one that you made up. Which of your kingdoms does the organism belong to? Swap cards with a neighbour and identify which of your kingdoms their organism belongs to.

Hint: You may find the table builder or mind map tool useful for grouping your organisms.

Career: Kingdoms (P2)

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Brought to you by Macquarie University

Kevin Rowe is a molecular biologist who works with the extensive mammal collection at the Melbourne Museum to find out more about the animals we share our planet with.

Kevin Rowe is on a mission to discover new species. Once he has, he must classify them to work out how they are related to species we already know. Credit: Museum Victoria

Growing up in sunny Southern California, Kevin didn't know if he wanted to be a poet, a biologist or an engineer. In high school and university, he studied everything from anthropology to biology but one thing remained constant – his great love for nature and the wilderness.

This passion led Kevin to pursue a career in biology and in 2001 he joined the Melbourne Museum. The museum is home to hundreds of carefully preserved animals, some of which are more than 100 years old. Even so, Kevin is determined to discover new animals to further expand the museum's collection.

There isn't a typical work day for Kevin. There are the quiet days he spends working in the lab, analysing DNA from the museum's specimens to understand how these animals evolved to cope with changing conditions over time. And then there are the days he spends slogging through the hot, humid rainforests of Indonesia in search of new species.

Although we have managed to identify around 1.2 million species of living organisms, there are still six times that many species out there yet to be discovered, says Kevin. And he loves finding new species. Kevin has discovered rats in the Indonesian rainforest that no one previously knew existed. Classification is a crucial part of Kevin's work, and he spends a lot of his time working out how these newly discovered species are related to known species.

In his spare time, Kevin enjoys outdoor activities, including hiking, gardening, and swimming.

Question 1

Propose: If you had the opportunity to direct Kevin to a location in the world to find a new species where would you send him and why?

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