

Common Ancestry

Learning objective 7.7.A Describe structural and functional evidence on cellular and molecular levels that provides evidence for the common ancestry of all eukaryotes.

Name: _____ Date: _____ Period: _____

Use the tool **What Every Eukaryote Kept**. Parts 1 and 2 use **Who has what**, Part 3 uses **One code, every organism**, and Parts 4 and 5 use **A bacterium inside you**. This topic asks a narrower question than it first appears. Not what shows that life shares an ancestor, but what shows that all **eukaryotes** do. Those are different questions with different answers, and answering the first when you were asked the second is the commonest way to lose the point here. Keep the two lists separate.

Part 1 · Sorting the evidence

Ten features, three domains of life. For each, record which domains have it, and then which claim it supports.

Feature	Bacteria	Archaea	Eukarya	Evidence about
DNA as the genetic material				
The same genetic code				
Ribosomes				
ATP as the energy currency				
A phospholipid plasma membrane				
Glycolysis				
Membrane-bound organelles				
Linear chromosomes				
Genes containing introns				
A cytoskeleton of actin and tubulin				

1. Describe the structural and molecular evidence for the common ancestry of all eukaryotes.

2. Describe the evidence for the common ancestry of all life, and explain why it is a different list from your answer to question 1.

Part 2 · What each eukaryotic feature is for

Open the panel headed **What each eukaryotic feature is actually for**. The exam asks you to name these features; it also asks what they do, and the two questions are not the same.

Eukaryote-only feature	What it is	What it does for the cell
Membrane-bound organelles		
Linear chromosomes		
Genes containing introns		
A cytoskeleton of actin and tubulin		

3. Explain what membrane-bound organelles do for a eukaryotic cell.

4. Explain what introns are and why their presence in every eukaryote is evidence of common ancestry.

Part 3 · One code, every organism

Go to **One code, every organism**. Step through the first **19** codons of the human beta-globin gene, reading each with the standard genetic code. Fill in the first six rows as you go.

Codon number	Codon	Amino acid	Peptide so far
1			
2			
3			
4			
5			
6			

5. Explain why the genetic code being the same in a human and a bacterium is evidence of common ancestry rather than a coincidence.

6. Human insulin has been made in E. coli since 1978 by inserting the human gene into a bacterial plasmid. Explain why that works.

Part 4 · A bacterium inside you

Go to **A bacterium inside you**. For each trait, decide whether the mitochondrion resembles a free-living bacterium or the eukaryotic cell it sits inside.

Trait	In a bacterium	In a mitochondrion	Matches which?
Genome shape			
Ribosome type			
Divides by			
Number of membranes			
Introns in its own genes			
Sensitive to antibiotics that block bacterial ribosomes			

7. Describe the evidence that mitochondria descend from free-living bacteria.

8. A student says the mitochondrion's double membrane is a problem for endosymbiosis. Explain why it is the opposite.

Part 5 · Answering the question that was asked

Read the table headed **The two answers, kept apart**. For each piece of evidence, say what conclusion it supports and — just as important — what it does not.

Evidence	Supports	Does not support
The same genetic code in bacteria, archaea and eukaryotes		
Membrane-bound organelles		
Linear chromosomes with telomeres		
Genes containing introns		
Mitochondrial 70S ribosomes and circular DNA		

9. A question asks for evidence of the common ancestry of eukaryotes and a student answers “they all use ATP.” Explain what is wrong with that answer and give a correct one.

10. Explain why the evidence for the endosymbiotic origin of mitochondria does not, on its own, tell you where eukaryotic cells came from.

What the model simplifies

The grid treats each feature as simply present or absent across a whole domain. Biology has exceptions to nearly all of them: some bacteria have linear chromosomes, some archaea have introns of a different kind, and a few eukaryotes have lost their mitochondria. The pattern is strong and the exceptions are real, so a claim of the form “no prokaryote has X” is safer stated as “X is a general feature of eukaryotes and not of prokaryotes”.

Archaea appear as a single column. They are as different from bacteria as from eukaryotes in several respects — their membrane lipids use ether linkages rather than ester, and their transcription machinery is closer to the eukaryotic kind — which is itself evidence about the shape of the tree, and belongs to Topic 7.9.

The genetic code is described as “the same” everywhere. There are small documented variants, notably in mitochondria and in a few ciliates, where a handful of codons read differently. Those variants are themselves informative: they are rare, minor, and nested inside particular lineages, which is what descent with modification from a shared code looks like.

The mitochondrion's traits are given as a clean yes or no. In reality most of the original bacterial genome has moved into the nucleus over two billion years, so a mitochondrion today cannot live independently. That is expected after an obligate partnership of that length and is not evidence against the origin.