

## Group Project—Compare and Contrast the Prokaryotic and Eucaryotic Cell, Eubacteria, and Archeabacteria.

Your group just came back from an expedition to South America. While you were there you isolated four organisms from the environment. Your group's job is to determine if each organism is a eukaryote, eubacteria, or archeabacteria and decide into which kingdom in the five-kingdom classification system (i.e., Plantae, Protista, Fungi, Animalia, and Monera) it fits. Below is a list of data acquired from each of the organisms. Please indicate for **each piece of information** which type and kingdom of organism could have the characteristic. At the end, please indicate whether you believe each cell is a eukaryote, eubacteria or archeabacteria and to which kingdom you believe the organism belongs (e.g., characteristic analyzed: has a cell membrane; type: eukaryote, eubacteria, archeabacteria; and possible kingdoms: Plantae, Protista, Fungi, Animalia, Monera).

### Organism 1

Characteristic analyzed	Result	Type of organism which could have this result: eubacteria, eukaryote or archeabacteria. List all possibilities.	Kingdom to which an organism with this result could belong. List all possibilities.
1. Cell membrane components	Ester-linked straight chain fatty acids and cholesterol	Eukaryote only	Plantae, Protista, Fungi, Animalia
2. Chlorophyll	Absent	Eukaryote, eubacteria, archeabacteria	Monera, Protista, Fungi, Animalia, rare plantae
3. Cell division	Mitosis	Eukaryote only	Protista, Fungi, Animalia, Plantae
4. Ribosome size	70S and 80S	Eukaryote: 80S in cytoplasm, 70S in mitochondria	Plantae, Protista, Fungi, Animalia
5. Motility	Yes, using cilia	Eukaryote only	Protista
6. Mitochondria	Present	Eukaryote only	Plantae, Protista, Fungi, Animalia
7. Cytoskeleton	Present	Eukaryote only	Plantae, Protista, Fungi, Animalia
8. Cell wall composition	No cell wall present	Eukaryote, eubacteria, archeabacteria	Protista, Animalia, Monera

Conclusions: using all of the information above, is this organism an eukaryote, eubacteria, or archeabacteria, and to which kingdom does it belong and why? Hint this organism is single celled. Nonphotosynthetic protozoa: we know it is not Animalia because it is not multicellular (if it was sperm it would have flagella). It has no cell wall or chlorophyll, therefore it is not in the kingdom Plantae. It has organelles and a cytoskeleton, so it is not in the kingdom Monera. It has no cell wall therefore it is not in the kingdom Fungi.

## Organism 2

Characteristic analyzed	Result	Type of organism which could have this result: eubacteria, eukaryote or archaeobacteria. List all possibilities.	Kingdom to which an organism with this result could belong. List all possibilities.
1. Cell membrane components	Ester-linked straight chain fatty acids, and hapanoids	Eubacteria	Monera
2. Chlorophyll	Present	Eukaryote, eubacteria	Plantae, Monera, Protista
3. Cell division	Binary fission	Eukaryote, eubacteria, archaeobacteria	Protista, Monera
4. Ribosome size	70S	Eubacteria, archaeobacteria	Monera
5. Motility	Yes, using flagella	Eukaryote, eubacteria, archaeobacteria	Protista, Fungi, Monera, Animalia (sperm only)
6. Mitochondria	Absent	Eukaryote, eubacteria, archaeobacteria	Protista, Monera
7. Cytoskeleton	Absent	Eubacteria, archaeobacteria	Monera
8. Cell wall composition	<i>N</i> -acetylglucosamine, <i>N</i> -acetylmuramic acid, and amino acids	Eubacteria	Monera

Conclusions: using all of the information above, is this organism an eukaryote, eubacteria, or archaeobacteria, and to which kingdom does it belong and why? Hint this organism is single celled.

Eubacteria, Monera: the type of cell wall tells you it is an eubacteria. The lack of sterols in the membrane, mitochondria, 80S ribosomes, and cytoskeleton indicate it is not eukaryotic. Although there are protozoa without mitochondria, the membrane and cell wall tell you it is not a protozoa.

### Organism 3

Characteristic analyzed	Result	Type of organism which could have this result: eubacteria, eukaryote or archaeobacteria. List all possibilities.	Kingdom to which an organism with this result could belong. List all possibilities.
1. Cell membrane components	Ether-linked branched chain fatty acids	Archaeobacteria	Monera
2. Chlorophyll	Absent	Eukaryote, eubacteria, archaeobacteria	Protista, Fungi, Animalia, Monera, rare Plantae
3. Cell division	Binary fission	Eukaryote, eubacteria, archaeobacteria	Protista, Monera
4. Ribosome size	70S	Eubacteria, archaeobacteria	Monera
5. Motility	None	Eukaryote, eubacteria, archeabacteria	Plantae, Protista, Fungi, Animalia, Monera
6. Mitochondria	Absent	Eukaryote, eubacteria, archaeobacteria	Protista, Monera
7. Cytoskeleton	Absent	Eubacteria, archaeobacteria	Monera
8. Cell wall composition	<i>N</i> -acetylglucosamine, <i>N</i> -acetylalosaminuronic acid, amino acids	Archaeobacteria	Monera

Conclusions: using all of the information above, is this organism an eukaryote, eubacteria, or archaeobacteria, and to which kingdom does it belong and why? Hint this organism is single celled. Archaeobacteria, Monera: cell wall composition and membrane composition indicate that this is an archaeobacteria, kingdom Monera. The type of fatty acids and the way they bond the membrane, the 70S ribosomes, and the lack of mitochondria and cytoskeleton tell you this is not an eukaryotic cell.

## Organism 4

Characteristic analyzed	Result	Type of organism which could have this result: eubacteria, eukaryote or archaeobacteria. List all possibilities.	Kingdom to which an organism with this result could belong. List all possibilities.
1. Cell membrane components	Ester-linked straight chain fatty acids and cholesterol	Eukaryote	Plantae, Protista, Fungi, Animalia
2. Chlorophyll	Absent	Eukaryote, eubacteria, archaeobacteria	Protista, Fungi, Animalia, Monera, Rare Plantae
3. Cell division	Mitosis	Eukaryote	Plantae, Protista, Fungi, Animalia
4. Ribosome size	70S and 80S	Eukaryote	Plantae, Protista, Fungi, Animalia
5. Motility	None	Eukaryote, eubacteria, archaeobacteria	Plantae, Protista, Fungi, Animalia, Monera
6. Mitochondria	Present	Eukaryote	Plantae, Protista, Fungi, Animalia
7. Cytoskeleton	Present	Eukaryote	Plantae, Protista, Fungi, Animalia
8. Cell wall composition	Cellulose	Eukaryote	Plantae, Protista, Fungi

Conclusions: using all of the information above, is this organism an eukaryote, eubacteria, or archaeobacteria, and to which kingdom does it belong and why? Hint this organism is multicellular. Eukaryotic, Fungi (although it could be a rare nonphotosynthetic plant): the cell membrane, and cell wall type tell you this is an eukaryotic cell; the lack of chlorophyll tells you this is most likely not in the kingdom Plantae. The presence of the cell wall tells you this is not in Animalia. The fact that it is multicellular tells you it is not in the kingdom Protista (they are all unicellular; the red and brown sea algae are in the kingdom Plantae). If this was a single-celled organism, it could have been a single-celled fungi or a Protista. Putting organisms into kingdoms is often not as easy as it seems!

#### Common features

1. Have a cell membrane.
2. Have phospholipid bilayer cell membranes.
3. Cell membranes follow fluid mosaic model (phospholipids with intrinsic and extrinsic proteins, etc.).
4. Membranes are semipermeable barriers to the outside world.
5. Ribosomes present.
6. Ribosomes make proteins.
7. Have chromosomes.
8. Have cytoplasm.
9. Cytoplasm is mostly water.
10. Can be motile.

#### Common features

1. Have a cell membrane.
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5. 70S ribosomes present.
6. Ribosomes make proteins.
7. Have circular chromosomes.
8. Have cytoplasm.
9. Cytoplasm is mostly water.

#### Separating features

1. Only eukaryotes have phospholipid bilayer-bound organelles.
2. Only eukaryotes have histones around DNA.
3. Eukaryotes have much more DNA.
4. Mammalian and eukaryotic chromosomes are linear; prokaryotic chromosomes are circular.
5. Eukaryotic DNA in nucleus; prokaryotic in nucleoid.
6. Prokaryotes have plasmids.
7. Eukaryotic RNA is spliced; prokaryotic is not.
8. Eukaryotic RNA is more complex.
9. Different sized ribosomes.
10. Eukaryotic motility is more complex, can use cilia, pseudopodia.
11. Eukaryotic cytoplasm is more complex: has structure.
12. Eukaryotes and prokaryotes have different promoters for txn.
13. Mammalian cells have no cell wall.
14. Mammalian cells cannot make endospores.
15. Eukaryotes reproduce by mitosis; prokaryotes by binary fission.
16. Prokaryotic cells can exchange genetic information via transformation, conjugation, etc.
17. There are different steroids in the cell membrane.
18. Eukaryotes do not have a periplasmic space.

#### Separating features

1. Same-sized ribosomes are structurally different.
2. Not equally susceptible to antibiotics that inhibit ribosome function.
3. Different lipids in the membrane; branched chains in archaeobacteria only.
4. Ester-linked lipids only in eubacteria, ether linked in archaeobacteria.
5. Eubacteria are widespread; archaeobacteria live in harsh environments.