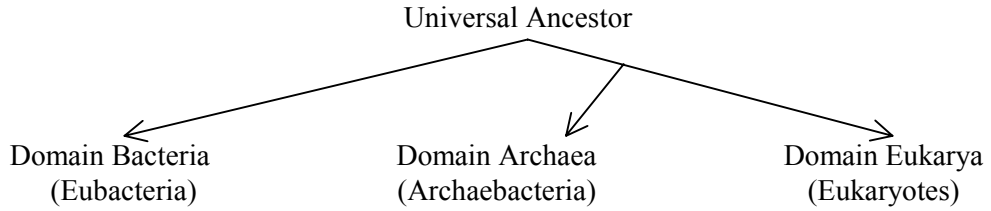
3. Scientists recently have proposed a reorganization of the phylogenetic system of classification to include the domain, a new taxonomic category higher (more inclusive) than the Kingdom category, as shown in the following diagram.



- **Describe** how this classification scheme presents different conclusions about the relationships among living organisms than those presented by the previous five-kingdom system of classification.
- **Describe** three kinds of evidence that were used to develop the taxonomic scheme above, and **explain** how this evidence was used. The evidence may be structural, physiological, molecular, and/or genetic.
- **Describe** four of the characteristics of the universal ancestor.

4. Scientists seeking to determine which molecule is responsible for the transmission of characteristics from one generation to the next knew that the molecule must (1) copy itself precisely, (2) be stable but able to be changed, and (3) be complex enough to determine the organism's phenotype.

- **Explain** how DNA meets each of the three criteria stated above.
- Select **one** of the criteria stated above and **describe** experimental evidence used to determine that DNA is the hereditary material.

END OF EXAMINATION

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Question 3

For full credit, a student must receive at least one point from each section I, II, and III.

Section I
Describe how this classification system presents different conclusions about the relationships among living organisms than those presented by the previous five-kingdom system of classification.

Maximum of 4 points from this section

(1) Not all prokaryotes are closely related (not monophyletic).
(1) Prokaryotes split early in the history of living things (not all in one lineage).
(1) Archaea are more closely related to Eukarya than to Bacteria.
(1) Eukarya are not directly related to Eubacteria.
(1) There was a common ancestor for all extant organisms (monophyletic).
(1) Eukaryotes are more closely related to each other (than Prokaryotes are to each other)
(1) Correct description of the five-kingdom system.

Section II
Describe three kinds of evidence that were used to develop the taxonomic scheme above, and **explain** how this evidence was used. The evidence may be structural, physiological, molecular, and/or genetic.

Maximum of 6 points, 3 points from the first three descriptions of evidence mentioned and 3 from the explanations. The explanations must differentiate between at least two of the groups.

Descriptions	**Explanations**		
Differences	Eukaryotes	Archaea	Eubacteria
Habitat - mostly extreme (halophilic, thermophilic, acidic)	-	+	-
Reproduction	Mitosis/meiosis	Binary fission	Binary fission
Multicellularity exists	+	-	-
Nucleus	+	-	-
Membrane-bound organelles	+	-	-
Microtubules/ microfilaments	+	-	-
Cell walls with peptidoglycan	-	-	+

Question 3 (cont.)

Chromosomes: Shape Number Histones present	Linear More than one +	Circular One +	Circular One -
Ribosomes: Size Base sequence of rRNA	Large Similar	Small Similar	Small Unique
Structure of tRNA	Similar	Unique	Similar
RNA polymerase	Multiple types	Multiple types	Single type
Introns	Present	Some	None
Operon organization of genes	-	+	+
Initiator amino acid in protein formation	Methionine	Methionine	formyl-methionine
Phospholipids: Bonds Hydrocarbon structure	Ester Unbranched	Ether Branched	Ester Unbranched
Can be pathogens	+	-	+
Response to antibiotics such as streptomycin or chloramphenicol	-	-	+
Response to diphtheria toxins	+	-	-
Metabolism Can be methanogens	-	+	-
Enzymatic make-up differs Enzyme location differs Photosynthetic pigments differ	Must correctly describe what the difference is.		
Differences in gene sequences of DNA	Must correctly describe what the difference is.		
Differences in whole genome sequences	Must correctly describe what the difference is.		

Question 3 (cont.)

Section III
Describe four of the characteristics of the universal ancestor.

Maximum of 4 points for this section. Described characteristics can earn one point each OR one point may be earned for a list of the first four correct characteristics.

Characteristic (possible explanations)
(1) Small (surface to volume ratio, no internal transport system)
(1) Unicellular (all functions self-contained)
(1) Prokaryote (no membrane-bound organelles).
(1) Had cell membrane (containment, protection, semipermeable)
(1) cell membrane made of a phospholipid bilayer (barrier).
(1) cytoplasm (different from external environment)
(1) DNA for the genetic material (**or** nucleic acid **or** RNA)
(1) mRNA for information transfer (common to all organisms)
(1) tRNA to carry amino acids and/or aminoacylsynthetase (common to all organisms)
(1) ability to reproduce (asexual)
(1) ability to mutate, adapt, or evolve through natural selection
(1) ability to make proteins **or** had ribosomes on which proteins could be constructed
(1) metabolism: carbon-based **or** organic; Energy transformations, ATP as energy molecule
(1) enzymes for amino acid, nucleotide, and coenzyme synthesis as well as enzymes for glycolysis and the Krebs cycle (common to all organisms)
(1) Heterotrophic/Autotrophic* with explanation (* not photosynthetic)
(1) Anaerobic/aerobic with explanation
(1) Aquatic with explanation