Midterm 1 Practice Questions
For MC Questions, correct answers are highlighted in Green in the Answer Key.
For T/F Questions, ones that are True are highlighted in Green in the Answer Key.

Lectures 1-4.
Practice T/F Questions.

1. For a given number of taxa, there are more unrooted trees than rooted trees. T
2. Unrooted trees lack a root branch and do not convey the timing of speciation events. T
3. The presence or absence of ribosomes can be used to infer relationships on the tree of life. F
4. A grouping of taxa that excludes some, but not all, descendants of a MRCA is paraphyletic. T
5. Polytomies show areas of uncertainty on phylogenies. T
6. Unrooted trees completely specify relationships among a set of taxa. F
7. Flight is a homoplasy among animals. T
8. If clades A and B are sister groups, then together they form a monophyletic group. T
9. In a cladogram, the branch lengths are proportional to the amount of character change. F
10. Cladograms allow us to identify which of the study species are primitive or advanced. F
11. On a given phylogeny, sister taxa split from a common ancestor at the same time T

1) The statement is False because there are more rooted phylogenetic trees than unrooted ones for a given number of taxa, due to the additional possible configurations from designating a root and direction of time.

2) The answer is True because unrooted trees, without a designated root, do not provide information about the temporal sequence of speciation events, hence they don't convey the timing of these events.

3) The statement is false because **all living organisms**, from bacteria to humans, **have ribosomes**. Therefore, the presence or absence of ribosomes does not provide any distinctive information to infer relationships on the tree of life.

4) The statement is true because a **paraphyletic** group includes an ancestor and **some**, but **not all**, of its descendants. This means it excludes certain lineages that descended from the most recent common ancestor (MRCA).

5) The statement is true because **polytomies** in a phylogenetic tree represent a point where **more than two lineages** emerge. This typically indicates an **uncertainty** or lack of resolution, as it's unclear which lineages are most closely related.

6) The statement is false because **unrooted trees** do not specify the direction of ancestry and descent, and thus, they **do not completely clarify the relationships** among a set of taxa. They only show the relationships of closeness but do not indicate which taxa are ancestral or derived.

7) The statement is true because **flight** has evolved independently in different animal groups such as birds, bats, and insects. This is an example of **homoplasy**, where a trait has arisen separately in different lineages, rather than being inherited from a common ancestor that shared that trait.

8) The statement is true because sister groups are two clades that are each other's closest relatives, meaning they share a recent common ancestor. When clades A and B are sister groups, together they form a monophyletic group, which includes an ancestor and all of its descendants

9) In a cladogram, the branch lengths do not represent the amount of character change or time. Instead, they simply illustrate the pattern of descent and ancestry. The branch lengths in a cladogram are not proportional to time or genetic change, which is a characteristic of phylograms and chronograms

10) cladograms do not provide information about which species are primitive or advanced. They only depict relationships based on shared derived characteristics, not on the progression or advancement of traits

11) a phylogeny, sister taxa are two lineages that emerge from the same node, representing a common ancestor. This implies that they split from this common ancestor at the same point in time.

Lecture 1-4.
Practice Multiple Choice Questions

1. What is a function of outgroup species in phylogeny estimation?
   a. It indicate which character state is primitive/derived
   b. It allows one to root a unrooted tree
   c. It indicate which character state is ancestral/advanced
   d. It resembles the MRCA of the ingroup
   e. It indicates the ancestral condition of the ingroup

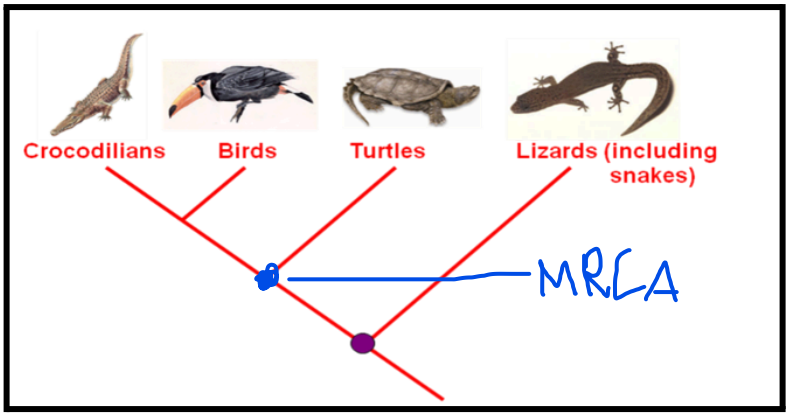
an outgroup in phylogeny estimation is a species or group known to be closely related to, but not part of, the group (ingroup) being studied

The outgroup provides a point of comparison and allows us to infer the evolutionary relationships within the ingroup. By comparing the ingroup to the outgroup, we can identify which traits are ancestral and which are derived, allowing us to root an unrooted tree

2. Comparing rooted and unrooted trees:
   a. unrooted trees are less informative about relationships than rooted trees
   b. for a given character/taxon matrix, unrooted trees require fewer steps than rooted trees
   c. unrooted trees depict sister group relationships, while rooted trees do not
   d. phylogeny estimation is easier when working with rooted trees
   e. all of the above

3. In addition to showing relationships among taxa, all phylogenies include the:
   a. proportion of genetic change represented by branch lengths
   b. number of extinction events across the tree
   c. interactions among populations within a species
   d. order of splitting events among lineages
   e. absolute dates of splitting events on the tree

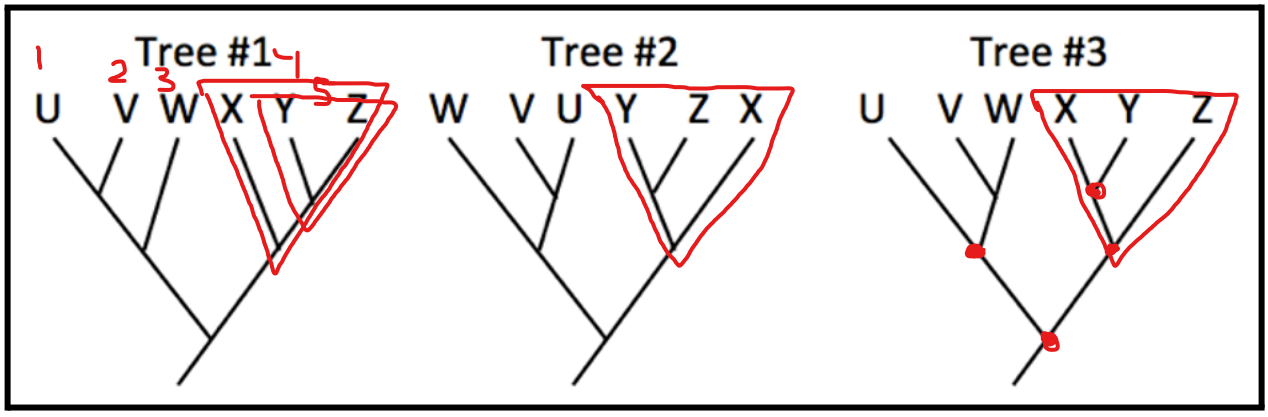
4. Given the cladogram shown below Reptiles, which of the following statements is true?



   a. turtles are more closely related to crocodilians than to lizards
   b. exclusion of birds would make Reptiles monophyletic
   c. lizards share a more recent common ancestor with turtles than with birds
   d. the sister group of (crocodilians + birds) is (turtles + lizards)
   e. birds could be a useful outgroup for studies of reptile phylogeny

Lectures 1-4.
Practice Tree Interpreting Questions

Tree Interpretation 1



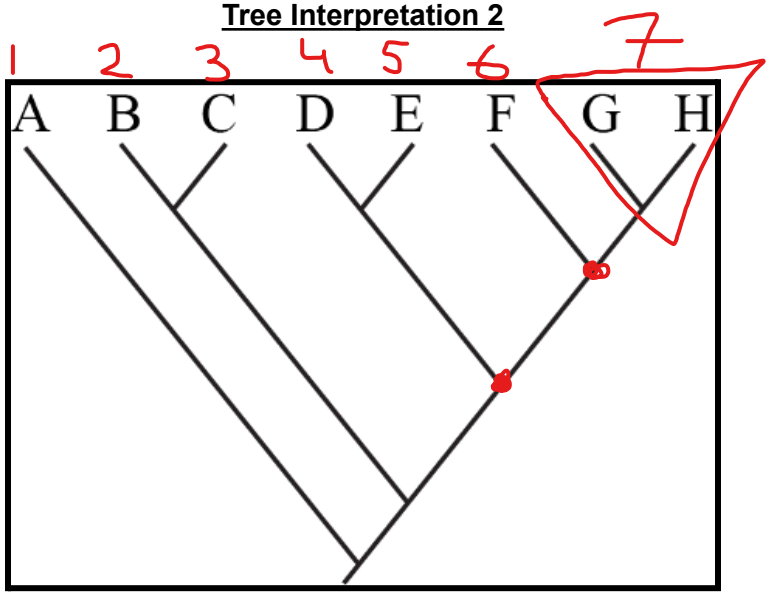
1. Considering the trees above, which of these statements is **true**?
   a. tree #1 = tree #2
   b. tree #1 = tree #3
   c. tree #2 =tree #3
   d. all three trees are equivalent
   e. all three trees are different

2. Considering the trees above, which of these statements is **true**?
   a. Z and Y form a monophyletic group in all trees
   b. X, Y and Z form a monophyletic group in all trees
   c. V and W form a monophyletic group in all trees
   d. U and V form a monophyletic group in all trees
   e. Z and Y are sister taxa in all trees

T/F questions about these trees (True highlighted in Green in Answer Key)

1. In Tree #1, the group of UVW is sister to the group of XYZ.
2. In Tree #3, Z is more closely related to Y than it is to X.
3. In Tree #2, W is more closely related to Y than it is to X.
4. In Tree #1, there are 5 monophyletic groups.
5. In Tree #3, Z is more closely related to U than it is to V.

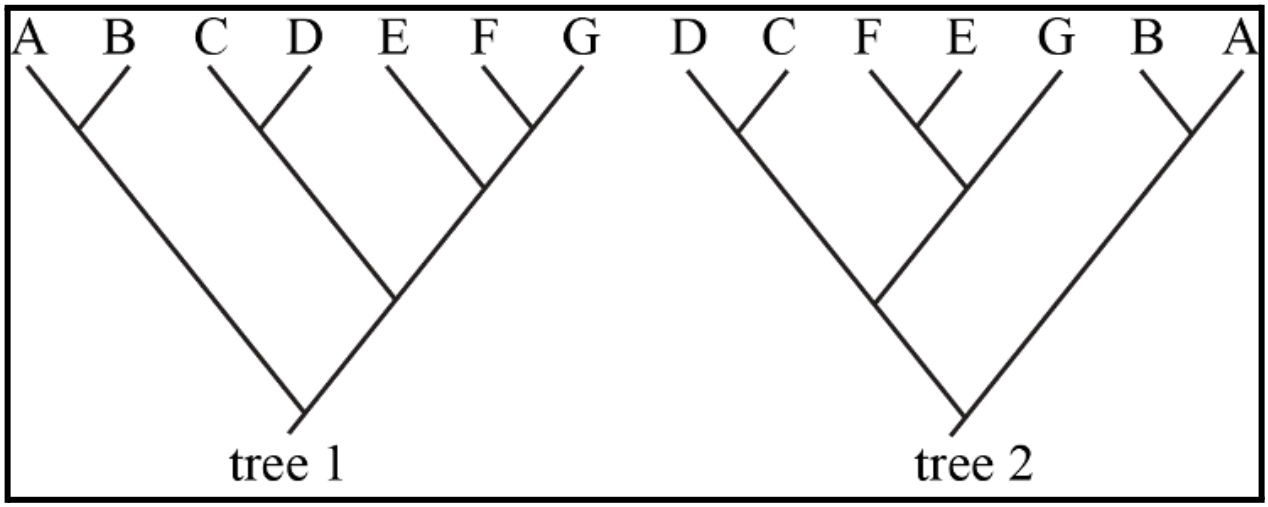
Tree Interpretation 2



T/F Questions About This Tree

1. A group including D, E and F and their most recent common ancestor is a clade F ✓
2. A group including G and H and their most recent common ancestor is a clade T ✓
3. A group including D, E, F, G, and H and their most recent common ancestor is paraphyletic F ✓
4. A group including F, and G and their most recent common ancestor is paraphyletic T ✓
5. A group including B and F is polyphyletic T ✓
6. D is more closely related to F than it is to G. F ✓
7. There are 7 monophyletic groups in this tree T ✓
8. A group including F, G and H and their most recent common ancestor is a natural group T ✓

Tree Interpretation 3.

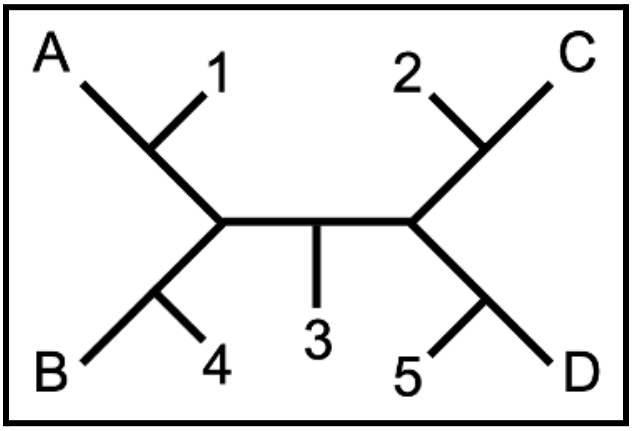


T/F Questions About This Tree

1. Trees 1 and 2 specify identical relationships among species A–G F ✓
2. Trees 1 and 2 do not specify identical relationships among species A–G T ✓
3. ~~X~~ The branch lengths in cladograms are arbitrary, so we cannot infer species relationships in these two trees, ~~T~~ F even though the branch lengths in cladograms are arbitrary and do not represent time or genetic change, the branching order does convey meaningful information about species relationships

   The statement is false because the ability to infer species relationships from a cladogram is not hindered by the arbitrary branch lengths. Instead, it's the branching order that matters.

Tree Interpretation 4



On this tree, the taxa are represented by A, B, C, D and 1-5 represent alternate rooting options. More than one answer may be possible for some questions - **mark all choices that apply.**

1. At which point(s) could we root this tree so that taxon C is sister to taxon D?
   - a. 1
   - b. 2
   - c. 3
   - d. 4
   - e. 5
   - f. not possible on this tree

2. At which point(s) would we root this tree so that taxa B, C, and D form a monophyletic group?
   - a. 1
   - b. 2
   - c. 3
   - d. 4
   - e. 5
   - f. not possible on this tree

3. If taxon D is the outgroup relative to the other taxa, where would you place the root?
   - a. 1
   - b. 2
   - c. 3
   - d. 4
   - e. 5
   - f. not possible on this tree

4. At which point(s) would we root this tree so that taxon A is sister to taxon D?
   - a. 1
   - b. 2
   - c. 3
   - d. 4
   - e. 5
   - f. not possible on this tree

5. If **taxon C** is the outgroup relative to the other taxa, where would you place the root?

a. 1
- b. 2 ✓
c. 3
d. 4
e. 5
f. not possible on this tree

6. At which point would you root this tree, so that taxa A, C, and D form a **monophyletic group**?

a. 1
b. 2
c. 3
- d. 4 ✓
e. 5
f. not possible on this tree

7. At which point would you root this tree, so that taxon B is sister to taxon D?

a. 1
b. 2
c. 3
d. 4
e. 5
- f. not possible on this tree ✓

8. At which point would you root this tree, so that taxon A is sister to taxon B AND taxon C is sister to taxon D?

a. 1
b. 2
- c. 3 ✓
d. 4
e. 5
f. not possible on this tree

9. At which point would you root this tree, so that taxon B is sister to taxon C?

a. 1
b. 2
c. 3
d. 4
e. 5
- f. not possible on this tree ✓

Lecture 5-8 Practice Questions

Practice T/F Questions

1. The Last Universal Common Ancestor probably had a nucleus, but not ribosomes.
2. The use of ribosomes for translation is an example of a universal homology.
3. The use of water by cells is an example of a universal trait.
4. Universal homologies are traits shared by all organisms that could not have arisen in separate origins of life and thus are evidence for common ancestry.
5. LUCA most likely used RNA to encode its genetic information.
6. The use of ribosomes and DNA as the genetic material are universal homologies.
7. All organisms can trace their origins to two separate origins of life.
8. Universal homologies support the fact that all life evolved from a single, common ancestor.
9. The use of ribosomes for translation in different organisms is an example of homoplasy.
10. "The Central Dogma" can be represented as "DNA -> RNA -> protein".
11. Universal traits are traits shared by all organisms that could not have arisen in separate origins of life and thus are evidence for common ancestry.
12. If you discovered a living organism on Mars and showed it had ribosomes this would mean that that life on Mars must share a common ancestry with life on Earth.
13. The closest relatives of Eukaryotes are Asgard Archaea.
14. Bacteria and Archaea lack ribosomes.
15. Asgard Archaea have a nucleus.
16. Prokaryotes are monophyletic in the Two Domain Tree of Life.
17. The unrooted tree of life from Woese's work showed that Archaea and Eukaryotes are sister taxa.
18. More microbes are present in an environment than can be grown in lab cultures.
19. There are colonial examples of Bacteria, "prokaryotic Archaea" and Eukaryotes.
20. Many Bacteria and "Prokaryotic Archaea" are multicellular.
21. The placement of the root of the tree of life has been determined by analyzing fossils.
22. Some "prokaryotic Archaea" have a nucleus.
23. In the Two Domain Tree of Life, Asgard Archaea are more closely related to other "prokaryotic Archaea" than they are to Eukaryotes.
24. Lokiarchaea could not be studied until they could be cultured in the lab.
25. Asgard Archaea have traits that were previously thought to only be present in Eukaryotes.
26. In the Two Domain Tree of Life, Bacteria are more closely related to "prokaryotic Archaea" than they are to Eukaryotes.
27. The Tree of Life cannot be rooted using a normal outgroup species.
28. The cell wall is made out of peptidoglycan only in Gram negative bacteria.
29. Gram positive bacteria are distinguished from Gram negative bacteria by the presence of peptidoglycan.
30. Gram negative bacteria are called "negative" because they are missing cell membranes.
31. The cell wall is thicker in Gram positive bacteria than in Gram negative bacteria.
32. The cell wall is a target for antibiotics in Gram negative but not Gram positive bacteria.
33. Gram negative bacterial cells are surrounded by two membranes.
34. Peptidoglycan is a synapomorphy of prokaryotes.
35. Gram negative bacteria have two cell walls while Gram positive bacteria have only one.
36. Gram positive bacteria have thin peptidoglycan cell walls.
37. Peptidoglycan is found in both Gram positive bacteria and Gram negative bacteria.
38. Peptidoglycan is not a target for antibiotics because bacteria do not need it.

39. Colonial organisms do not have division of labor.
40. In colonial organisms and multicellular organisms cells are usually all the same genotype.
41. Most archaea are multicellular.
42. Most bacteria are colonial.
43. Most archaea are unicellular.
44. Most bacteria are unicellular.
45. Many bacteria are multicellular.
46. All eukaryotes are colonial or multicellular.

Practice Multiple Choice Qustions

1. In the Two Domain Tree of Life, which group is the sister group to Asgard Archaea
   a. "prokaryotic Archaea"
   b. Bacteria
   c. Eukaryotes
   d. Archaea
   e. None of the above

The Two Domain Tree of Life proposes two primary domains of life: Bacteria and Archaea. Eukaryotes, organisms with complex cells, are believed to have emerged within the Archaea. Asgard Archaea is a group within the Archaea that shares many genes with Eukaryotes. These shared genes are primarily related to complex cellular functions. This has led scientists to propose that Eukaryotes emerged from within the Asgard Archaea. Therefore, in the Two Domain Tree of Life, the sister group to Asgard Archaea is the Eukaryotes.

2. The Three Domain Tree of Life and "Modern" Two Domain Tree of Life differ in:
   a. Whether or not Prokaryotes are monophyletic
   b. Whether or not Eukaryotes are polyphyletic
   c. Whether or not Bacteria are monophyletic
   d. Whether or not prokaryotic Archaea are monophyletic
   e. Whether or not Eukaryotes are monophyletic

Three Domain Tree of Life and the "Modern" Two Domain Tree of Life is whether or not the prokaryotic Archaea are considered monophyletic, meaning they all descended from a common ancestor. The Three Domain model views Archaea as a separate, monophyletic group, while the Two Domain model does not, suggesting some Archaea (Asgard Archaea) are more closely related to Eukaryotes.

3. Which of the following is NOT a universal trait of all of life?
   a. Made up of cells
   b. Carries out transcription and translation
   c. Extracts energy from the environment
   d. Uses a universal molecular code to make proteins
   e. Possesses cell walls

The answer is "possesses cell walls" because not all life forms have cell walls. While many organisms, like plants and bacteria, do have cell walls, others, such as animals and many protists, do not. Therefore, possessing cell walls is not a universal trait of all life.

4. Of the following universal traits, which would be the best evidence that life shares a common ancestry?
   a. Made up of cells
   b. Uses DNA as a genetic material
   c. Live on Earth
   d. Store energy in chemicals
   e. Acquires energy from environment

The fact that all known life forms use DNA as their genetic material is the best evidence of a common ancestry, as it suggests that this fundamental trait was present in the last universal common ancestor and has been inherited by all its descendants.

5. Of the following universal traits, which would be the least useful in showing that life shares a common ancestry?
   a. Uses a three letter genetic code
   b. Uses DNA as a genetic material
   c. Uses ribosome for translation
   d. Stores energy in chemicals
   e. Uses the bases ACTG in DNA

The trait of storing energy in chemicals is the least useful in showing that life shares a common ancestry because it's a basic survival mechanism found in all life forms, and even in some non-living systems

doesn't provide specific information about evolutionary relationships or shared ancestry, as it's too universal and not unique to a particular lineage or group of organisms

6. Suppose you discovered three different living organisms on Mars. What is the maximum number of "Trees of Life" you would need to show their evolutionary history?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 6

The maximum number of "Trees of Life" needed to show the evolutionary history of three different organisms on Mars is 3, as each could represent a separate origin of life with its own unique evolutionary history.

7. Which of the following is a trait found in eukaryotes but not "prokaryotes"
   a. Binary fission
   b. RNA genome
   c. Circular genome
   d. Haploid genome
   e. Meiosis

It's a type of cell division that results in four daughter cells each with half the number of chromosomes of the parent cell.
This process is fundamental to sexual reproduction and genetic diversity, and it's a trait found only in eukaryotes.
Prokaryotes, which include bacteria and archaea, reproduce asexually through a process called binary fission and do not undergo meiosis

8. Which of the following is a trait found in “prokaryotes” but not eukaryotes
   a. DNA genome
   b. RNA genome
   c. Circular genome
   d. Cell wall
   e. Mitosis

9. The Three Domain Tree of Life shows which of the following patterns:
   a. Archaea are monophyletic
   b. Eukaryotes are not monophyletic
   c. Prokaryotes are monophyletic
   d. A and C
   e. None of the above

Three Domain Tree of Life proposes that all life can be divided into three domains: Bacteria, Archaea, and Eukaryotes

Each domain is monophyletic, meaning that all members of each domain are descended from a single common ancestor unique to that domain

Archaea are considered to be monophyletic, having all descended from a single common ancestral Archaea

10. The Two Domain Tree of Life shows which of the following patterns:
   a. Prokaryotic archaea are monophyletic
   b. Eukaryotes are not monophyletic
   c. Prokaryotes are monophyletic
   d. A and C
   e. None of the above

Two Domain Tree of Life proposes that:
Prokaryotic archaea are not monophyletic. Instead, some archaea (the Asgard archaea) are more closely related to eukaryotes.

Eukaryotes are monophyletic, not non-monophyletic. They are believed to have emerged within the archaea.

Prokaryotes are not monophyletic because this group includes both bacteria and archaea, which are considered separate domains in this model.

11. Which of the following is NOT seen in the Two Domain Tree of Life?
   a. Bacteria are monophyletic
   b. Prokaryotic Archaea are more closely related to Eukarya than they are to bacteria
   c. Eukarya are monophyletic
   d. “Prokaryotic Archaea” are monophyletic
   e. Prokaryotic organisms are not monophyletic

In the Two Domain Tree of Life, prokaryotic Archaea are not considered monophyletic, meaning they don't all descend from a single common ancestor, which is why "Prokaryotic Archaea are monophyletic" is not seen in this model.

12. Which of the following is NOT true of Asgard Archaea
   a. They are more closely related to Animals than they are to Bacteria
   b. They have traits that were previously thought to only be present in Eukaryotes.
   c. They are prokaryotic
   d. They are a sister group to other “Prokaryotic Archaea”
   e. They have circular genomes

Answer is D. because:
Two Domain Tree of Life, Asgard Archaea are not a sister group to other Prokaryotic Archaea. Instead, they are more closely related to Eukaryotes, suggesting that Eukaryotes emerged from within the Asgard Archaea

13. Which of the following is thought to have evolved after the existence of the common ancestor of eukaryotes and the Asgard Archaea?
   a. DNA genomes
   b. The nucleus
   c. Binary fission
   d. Circular chromosomes
   e. Chromatin

14. Of the following traits, which of the following is the best evidence for the common ancestry of all life on Earth?
    a. Use of cells
    b. Use of DNA as the genetic material
    c. Use of DNA with A, C, G, T bases as the genetic material
    d. Use of peptidoglycan in cells
    e. All of the above are equally strong evidence

15. Which of the following is not seen in the Two Domain Tree of Life?
    a. Bacteria are monophyletic
    b. Eukaryotes are monophyletic
    c. Prokaryotic organisms are not monophyletic
    d. Bacteria are more closely related to "Prokaryotic Archaea" than to Eukarya
    e. All "Prokaryotic Archaea" are more closely related to eukaryotes than they are to Bacteria

In the Two Domain Tree of Life, Bacteria and Archaea are separate domains, and some Archaea (Asgard Archaea) are more closely related to Eukarya, so the statement "Bacteria are more closely related to Prokaryotic Archaea than to Eukarya" is not seen in this model.

16. Which of the following distinguishes the cell wall in Gram positive versus Gram negative bacteria?
    a. The cell wall is missing in Gram negative bacteria
    b. The cell wall is made out of peptidoglycan in Gram positive but not Gram negative bacteria
    c. The cell wall is thicker in Gram positive bacteria than in Gram negative bacteria
    d. Gram positive bacteria have two cell walls while Gram negative bacteria have only one
    e. Some antibiotics work better at targeting the cell wall in Gram positive negative than in Gram negative bacteria

17. Why is "uses water as a solvent" NOT considered a universal homology?
    a. It is not universal
    b. It could potentially have evolved easily in separate origins of life
    c. It is a form of homoplasy
    d. There is water on other planets
    e. Organisms use different types of water

18. Which is NOT an example of a universal homology?
    a. The use of a three-letter genetic code.
    b. The use of A,C, T and G bases in DNA.
    c. The use of ribosomes for translation.
    d. The use of ribosomal RNA in the ribosome.
    e. The use of ether linkages in membranes.

The answer is "e. The use of ether linkages in membranes" because this is not a universal trait across all life forms. Ether linkages in membranes are primarily found in Archaea, while Bacteria and Eukaryotes typically have ester linkages in their membrane lipids

the other options (a-d) represent traits that are universally found across all domains of life, making them examples of universal homologies

19. Which of the following methods is used for determining the optimal growth temperature of organisms?
    a. Culturing
    b. DNA sequencing
    c. Microscopy
    d. Plate counting
    e. PCR

20. Which of the following distinguishes cells of Gram positive and Gram negative bacteria?
    a. The cell membrane is missing in Gram negative bacteria
    b. The cell wall is made of chitin in Gram positive but not Gram negative bacteria

c. The cell wall is thicker in Gram positive bacteria than in Gram negative bacteria
d. Gram positive bacteria have a thick cell membrane while Gram negative bacteria have a thin cell membrane
e. Most antibiotics are equally effective at targeting cells of both

21. Which of the following groups is most closely related to the Asgard Archaea?
a. Proteobacteria
b. Crenarchaeota
c. Spirochetes
d. Fungi
e. Firmicutes

Fungi are a group within the Eukaryotes, and in the Two Domain Tree of Life, Asgard Archaea are considered to be the closest prokaryotic relatives to Eukaryotes.
This is based on genetic similarities, particularly in genes related to complex cellular functions

22. Which of the following is a trait found in eukaryotes but not commonly found in “prokaryotes”?
a. DNA genome
b. RNA genome
c. Peptidoglycan
d. Pathogenicity
e. Linear genome

23. Which of the following is a trait found in eukaryotes but not found in “prokaryotes”?
a. DNA genome
b. Diploid genome
c. RNA genome
d. Peptidoglycan
e. Pathogenicity

Eukaryotes, unlike prokaryotes, have a diploid genome, meaning they have two sets of chromosomes, one from each parent. This is a key feature of sexual reproduction, which is common in eukaryotes

On the other hand, prokaryotes, which include bacteria and archaea, typically have a single, circular chromosome and reproduce asexually through a process called binary fission. Therefore, a diploid genome is a trait found in eukaryotes but not in prokaryotes

The other options (a, c, d, e) can be found in both eukaryotes and prokaryotes to varying degrees

24. Which of the following is **FALSE** regarding peptidoglycan?
a. It is not found in "prokaryotic Archaea"
b. It likely was present in the Bacterial Common Ancestor
c. It is missing from Gram negative bacteria
d. It is present in a thick layer in Gram positive bacteria
e. It is a target for antibiotics in Gram positive and Gram negative bacteria

25. Which of the following groups is most closely related to the Asgard Archaea?
a. Actinobacteria
b. Euryarchaeota
c. Animals
d. Chlamydia
e. Korarchaeota

Animals are a group within the Eukaryotes, and in the Two Domain Tree of Life, Asgard Archaea are considered to be the closest prokaryotic relatives to Eukaryotes
Animals, being Eukaryotes, would be the most closely related to Asgard Archaea

The other options (a, b, d, e) are all groups within the Bacteria or Archaea domains, which are not as closely related to Asgard Archaea as Eukaryotes are

Practice Questions Lectures 9-12

Practice T/F Questions

1. The bacteria in tubeworms could not be studied until they could be grown in the lab.
2. Chemolithoautotrophs get their electrons from inorganic sources.
3. Chemolithoheterotrophs get their electrons from organic sources.
4. All parasitisms are symbioses.
5. All symbioses are mutualisms.
6. Most microbes in the human microbiome are parasitic.
7. Most microbes in the human microbiome are mutualistic.
8. Commensalism is a class of interaction in which both organisms will benefit from the relationship.
9. There are no known prokaryotic Archaea that cause disease.
10. One hypothesis for the origin of viruses is that they are escaped portions of cells.
11. Thermophily has only evolved once in the history of life.
12. Thermophiles are monophyletic.
13. Extreme halophiles are monophyletic.
14. All parasites are pathogens.
15. Bacteria can evolve resistance to phage but not antibiotics.
16. Lateral gene transfer can help bacteria become resistant to antibiotics.
17. The genomes of viruses are always made up of RNA.
18. Viruses do not evolve.
19. Viruses do not have their own genomes.
20. Lateral gene transfer is unidirectional.
21. Lateral gene transfer is only seen in bacteria.
22. Lateral gene transfer only occurs over small evolutionary distances.
23. Some viruses may have originated as highly reduced parasites.
24. One reason some people think viruses are alive is that they have metabolism.
25. Most viruses today can be described as ancient.
26. Some viruses may have evolved from cellular organisms.
27. One reason some scientists think viruses are alive is that they mutate and evolve.
28. The interaction between tubeworms and chemosynthetic bacteria can be described as commensalism.
29. The human microbiome is thought to include many commensalisms.

Practice Multiple Choice Questions
Lecture 9-12

1. An organism obtains energy from inorganic compounds like H2S and carbon from carbon dioxide (CO2). This organism would be best described as a:
   a. Chemoheterotroph
   b. Chemoautotroph
   c. Photoheterotroph
   d. Photoautotroph
   e. Chemolithotroph

Chemoautotroph because it obtains energy from inorganic compounds like H2S (chemical energy) and uses carbon dioxide (CO2) as its carbon source, which is a characteristic of autotrophs

They are able to use inorganic energy sources, such as hydrogen sulfide, to convert carbon dioxide into organic matter

2. Which of the following is TRUE regarding extremophiles?
   a. They are only seen in Archaea
   b. They cannot be grown in the laboratory
   c. They never undergo convergent evolution
   d. Thermophily has evolved more times than halophily
   e. No bacteria are thermophiles

thermophily (the ability to thrive at relatively high temperatures) is a trait that has evolved multiple times in different lineages across the tree of life, including both Archaea and Bacteria

halophily (the ability to thrive in high salt concentrations) is less common and has evolved fewer times.

extremophiles are not only seen in Archaea (option a), many can be grown in the laboratory (option b), they can undergo convergent evolution (option c), and there are indeed bacteria that are thermophiles (option e)

3. Current COVID19 infections can be detected using which of the following:
   a. Test for the presence of antibodies in blood
   b. Test for the presence of DNA from the virus
   c. Test for the presence of RNA from the virus
   d. A and C
   e. B and C

COVID-19 virus, SARS-CoV-2, is an RNA virus. This means its genetic material is RNA, not DNA.
Testing for the presence of this viral RNA is a direct method of determining if the virus is currently present in the body

testing for antibodies (option a), would indicate a past infection, not a current one. Testing for DNA (option b) would not be effective because SARS-CoV-2 does not contain DNA

4. Which of the following is thought to have evolved after the existence of the common ancestor of eukaryotes and the Asgard Archaea?
   a. DNA genomes
   b. The nucleus
   c. Binary fission
   d. Circular chromosomes
   e. Chromatin

5. What is the difference between photolithoautotrophy and chemolithoheterotrophy?
   a. The source of electrons
   b. The source of energy
   c. The source of carbon
   d. A and C
   e. B and C

6. What is the difference between photolithoheterotrophy and chemolithoheterotrophy?
   a. The source of electrons
   b. The source of energy
   c. The source of carbon
   d. A and B
   e. B and C

7. What is the difference between chemolithoautotrophy and photolithoautotrophy?
   a. The source of electrons
   b. The source of energy
   c. The source of carbon
   d. A and C
   e. B and C

8. What is the difference between photolithoheterotrophy and chemoorganoheterotrophy?
   a. The source of electrons
   b. The source of energy
   c. The source of carbon
   d. A and B
   e. B and C

9. An antibiotic that targets those organisms that are surrounded by a single membrane and a thick peptidoglycan cell wall would be useful in targeting which of the following diseases
   a. Malaria
   b. Chlamydia
   c. Lyme disease
   d. The plague
   e. Anthrax

"Anthrax" because it is caused by the bacterium Bacillus anthracis, which is surrounded by a single membrane and has a thick peptidoglycan cell wall. Antibiotics that target these characteristics would be effective against this type of bacteria.

10. Which of the following diseases is caused by a eukaryotic pathogen?
   a. Anthrax
   b. The plague
   c. Malaria
   d. The flu
   e. Tuberculosis

Malaria because it is caused by Plasmodium species, which are eukaryotic parasites

other diseases listed are caused by bacteria (Anthrax, The plague, and Tuberculosis) or viruses (The flu), all of which are prokaryotic or non-cellular pathogens, not eukaryotic

Eukaryotic pathogens, like the Plasmodium species that cause Malaria, have a nucleus and other complex cell structures

11. Which of the following is most closely related to the cause of tuberculosis?
   a. The cause of anthrax
   b. The cause of flu
   c. The cause of Ick
   d. The cause of HIV
   e. The cause of sudden oak death

Both anthrax and tuberculosis are caused by bacteria. Anthrax is caused by the bacterium Bacillus anthracis, and tuberculosis is caused by Mycobacterium tuberculosis.

Both of these organisms are bacteria, making them more closely related to each other than to the causes of the other diseases listed

caused by viruses (flu, HIV), a eukaryotic parasite (Ick), or a water mold (sudden oak death).

12. Which of the models of virus origins is most similar to the model "Viruses are escaped portions of cells?"
   a. Viruses are the outgroup to cellular life
   b. Viruses have a separate origin from cellular life
   c. Viruses are reduced versions of parasitic cells
   d. Viruses are cellular symbionts
   e. Viruses are replicative elements

This model suggests that viruses originated from bits of DNA or RNA that "escaped" from the genes of larger organisms, which is akin to the concept of viruses being reduced versions of parasitic cells.

13. Which of the following viruses or kinds of viruses have DNA genomes?
   a. Coronaviruses
   b. Influenza virus
   c. HIV virus
   d. Phage
   e. Polio virus

Phage" because phages, also known as bacteriophages, are a type of virus that have DNA genomes. They infect and replicate within bacteria and archaea

The other viruses listed - Coronaviruses, Influenza virus, HIV virus, and Polio virus - are all RNA viruses, meaning their genetic material is made up of RNA, not DNA

14. The symbionts of giant tubeworms allow the worms to function as which of the following:
   a. Chemolithoheterotrophs
   b. Chemolithoautotrophs
   c. Chemoorganoheterotrophs
   d. Photolithoautotrophs
   e. Photoorganoheterotrophs

Chemolithoautotrophs because the symbiotic bacteria living inside the giant tubeworms are capable of chemosynthesis.
They obtain energy by oxidizing inorganic chemicals, such as hydrogen sulfide from hydrothermal vents (which makes them "chemolitho-"), and they use this energy to convert carbon dioxide into organic compounds (which makes them "-autotrophs").
This allows the tubeworms, which lack a digestive system, to receive nutrients

15. Fecal transplants are used to treat an infection caused by
    a. A Gram positive bacterium
    b. A Gram negative bacterium
    c. An RNA virus
    d. A DNA virus
    e. A eukaryote

fecal transplants are often used to treat infections caused by Clostridium difficile, which is a Gram-negative bacterium
Bacterium can cause severe diarrhea and other intestinal diseases. Fecal transplants help to restore the balance of bacteria in the gut, which can be disrupted by C. difficile infection

16. Which of the following is a eukaryotic group for which members look like fungi but for which this similarity is not due to homology?
    a. Actinomycetes
    b. Opisthokonts
    c. Ooymetes
    d. Diplomonads
    e. Firmicutes

Oomycetes form a distinct phylogenetic lineage of fungus-like eukaryotic microorganisms within the Stramenopiles.
They are filamentous and heterotrophic, similar to fungi, but this similarity is not due to homology as they are not actually fungi

17. Which of the following is most closely related to the cause of anthrax?
    a. Cyanobacteria
    b. Lokiarchaea
    c. Fungi
    d. Flu virus
    e. Ooymcete

Anthrax is a bacterium called Bacillus anthracis. Among the given choices, Cyanobacteria is the only one that is also a type of bacteria

Lokiarchaea is a type of archaea, Fungi is a kingdom of eukaryotes, Flu virus is a virus, and Oomycete is a type of eukaryotic microorganism

18. If you find a new pathogen, what type of organism is it NOT likely to be?
    a. Virus
    b. Eukaryote
    c. Bacteria
    d. Prokaryotic Archaea
    e. Parasite

Prokaryotic Archaea because while they are prokaryotes like bacteria, they are not typically associated with diseases in humans. Most known pathogens fall into the categories of viruses, bacteria, eukaryotes (such as fungi and protists), and parasites

19. Which of the following is true about multicellularity?
    a. It is seen in many bacteria
    b. It is seen only in plants and animals
    c. It is seen in most Archaea
    d. It involves cells of different genotypes living together
    e. It involves cells of different functions living together

multicellularity is defined as a condition where an organism is composed of more than one cell, with these cells performing different functions and having different characteristics

20. Which of the following is thought to represent the evolutionary process that led to the origin of retroviruses?
    a. They have a separate origin from cellular life
    b. They are an escaped cellular component
    c. They are an outgroup to cellular organisms
    d. They arose via an anciently duplicated gene
    e. They are a reduced cellular parasite

Retroviruses, such as HIV, are thought to have originated from the escape of cellular components, specifically RNA molecules, which were then able to independently infect other cells.

This process is facilitated by the enzyme reverse transcriptase, which allows the viral RNA to be transcribed into DNA and integrated into the host genome

21. Which of the following is not one of the mechanisms discussed as a possible way that bacteria can limit the effectiveness of antibiotics?
    a. Biofilm formation
    b. Formation of endospores
    c. Mutations
    d. Growing faster
    e. Lateral gene transfer

the mechanisms that bacteria use to limit the effectiveness of antibiotics typically involve structural or genetic changes such as biofilm formation, formation of endospores, mutations, and lateral gene transfer. Simply growing faster is not a recognized mechanism for antibiotic resistance.

22. Which of the following diseases is NOT caused by a bacterial pathogen?

a. Anthrax
b. The plague
c. Giardia
d. Chlamydia
e. Tuberculosis

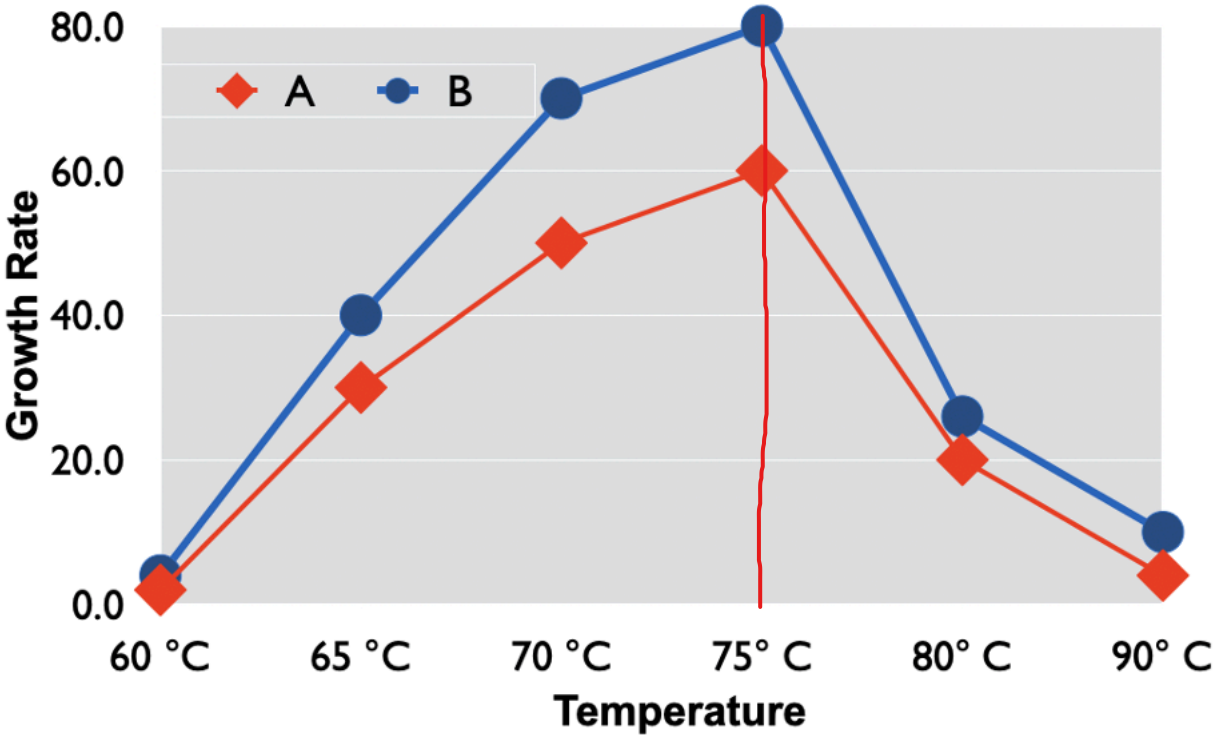
Giardia is a microscopic parasite that causes an infection in the small intestine known as giardiasis. Unlike the other options, it is not a bacterial pathogen but a protozoan parasite.

23. Which of the following diseases is caused by a bacterial pathogen?

a. Flu
b. Tuberculosis
c. Malaria
d. Giardia
e. Measles

Tuberculosis is a disease caused by the bacterium Mycobacterium tuberculosis. This bacterium primarily infects the lungs but can also affect other organs, and it spreads through the air when infected people cough, sneeze, or spit

24. Given the chart below, which organism has the higher optimal growth temperature?



a. A
b. B
c. Cannot determine
d. A and B have the same optimal growth temperature
e. A but only if it is an Archaea