Part 1.

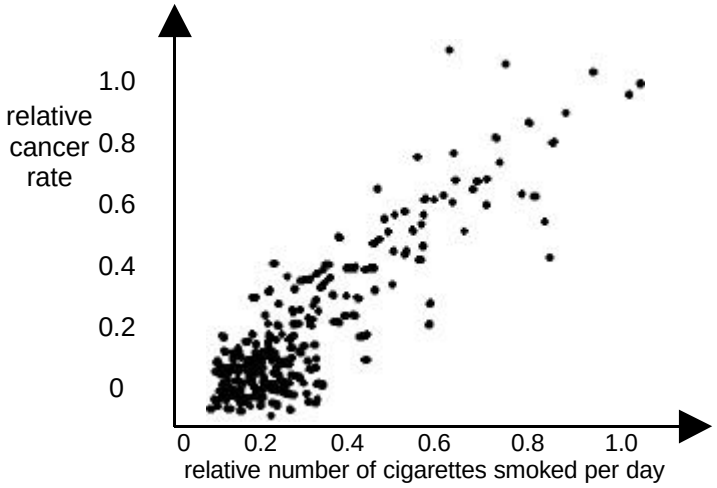
#1. Please state in a phrase what are the 2 major objectives of this course according to the syllabus? 2 pts.

objective #1 -

objective #2 -

#2. Smoking tobacco (and the ammonia compounds added to cigarettes by some tobacco companies) has been a widely popular activity in this country for several decades.

In the figure at right appears a typical relationship between the number of cigarettes smoked per day and the risk of lung cancer by the smoker. What is your response to the newspaper reporter who said that "**this graph shows that smoking caused these cancers**".



Is this conclusion ⟶ **VALID** or **NOT VALID** 1 pt.

{circle your choice}

#3. Different isotopes of the same element (such as carbon) differ in their number of which of the following: *{circle your choice}* 1 pt

a. protons
b. electrons
c. bosons
d. none of the above

#4. Currently, astronomers theorize that the Universe began with a "big bang" approximately how many years ago? _____ 1 pt.

#5. Currently, astronomers theorize that the Earth, our Sun, and our solar system were formed approximately how many years ago? _____ 1 pt.

#6. Geologic evidence suggests that photosynthesis evolved approximately how many years ago? _____ 1 pt.

#7. Please list four different gasses that were major components of the atmosphere of the early Earth. 2 pts.

1 –
2 –
3 –
4 –

#8. Briefly explain why life as we know it would most likely <u>never have evolved</u> on Earth if there had been an appreciable amount of oxygen in the atmosphere of the early earth?

2 pts

#9. Briefly explain why did it take tens of millions of years after photosynthesis evolved for there to be any net increase in the atmospheric oxygen concentrations.

2 pts.

#10. Please briefly explain "osmosis".

2 pts.

#11. Diagram and briefly describe how it is that **clay** is able to catalyze biochemical reactions to occur. Use your knowledge of the composition and structure of clay in your diagram and description.

2 pts.

#12. Please state each the four major categories of organic molecules used by all living organisms today and what are the basic "monomers" of which each is comprised?

major categories	monomers	2 pts.
1 -	comprised of:	
2 -	comprised of:	
3 -	comprised of:	
4 -	comprised of:	

#13. Please briefly explain why it is that phospholipids spontaneously form bilayer sheets and spheres (i.e. "cells") when dissolved in water? You must use some sort of sketch in addition to your written response, please.

2 pts.

#14. Please briefly explain the concept of "**natural selection**". In general, how did natural selection lead to the evolution of improvements in protein function, metabolism, replication, etc. of the earliest cell lines?

4 pts.

#15. Please diagram and explain exactly how a single change in the sequence of nucleic acids on the DNA can affect the function of the protein for which that DNA encodes.

4 pts

#16. Please define the term "**gene**":

2 pts

#17. Please define the term "**evolution**." 2 pts

#18. Please briefly explain the key steps in the process by which the first enzymes, which were RNA, were replaced by protein enzymes.

3 pts

The chart at right shows the abbreviated amino acid name corresponding to each of the possible combinations of nucleotide triplet codes used in protein synthesis. Please refer this chart to answer the next several questions on protein synthesis.

#19. Which amino acid is added to a newly forming protein if the nucleic acid sequence is GGA

1 pt.

#20. Which amino acid is added to a newly forming protein if the nucleic acid sequence is UUG?

1 pt.

#21. Exactly what happens if a code of UAA, UAG, or UGA is given? Please include necessary details.

2 pts.

First base (5′ end)	Second base: U	Second base: C	Second base: A	Second base: G	Third base (3′ end)
U	UUU Phe	UCU Ser	UAU Tyr	UGU Cys	U
	UUC Phe	UCC Ser	UAC Tyr	UGC Cys	C
	UUA Leu	UCA Ser	UAA Stop	UGA Stop	A
	UUG Leu	UCG Ser	UAG Stop	UGG Trp	G
C	CUU Leu	CCU Pro	CAU His	CGU Arg	U
	CUC Leu	CCC Pro	CAC His	CGC Arg	C
	CUA Leu	CCA Pro	CAA Gln	CGA Arg	A
	CUG Leu	CCG Pro	CAG Gln	CGG Arg	G
A	AUU Ile	ACU Thr	AAU Asn	AGU Ser	U
	AUC Ile	ACC Thr	AAC Asn	AGC Ser	C
	AUA Ile	ACA Thr	AAA Lys	AGA Arg	A
	AUG Met or start	ACG Thr	AAG Lys	AGG Arg	G
G	GUU Val	GCU Ala	GAU Asp	GGU Gly	U
	GUC Val	GCC Ala	GAC Asp	GGC Gly	C
	GUA Val	GCA Ala	GAA Glu	GGA Gly	A
	GUG Val	GCG Ala	GAG Glu	GGG Gly	G

#22. Please write down the basic equation for the exothermic (heat releasing) chemical reaction that propels NASA's space shuttle into orbit.

2 pts.

_____ + _____ → _____ + energy!!!

#23. Please write down the basic chemical equation for photosynthesis: 4 pts.

_____ + _____ $\xrightarrow{\text{light}}$ _____ + _____

#24. Please write down the basic chemical equation for aerobic metabolism (anaerobic+aerobic):

4 pts

_____ + _____ → _____ + _____ + ATP

OPTIONAL EXTRA CREDIT QUESTION:

EX#1. According to the seminar by Dr. Robert Curry on the cooperative breeding in Florida scrub jays,

(a). what was the exact family relationship between the bird who was the "helper" and the breeding pair of birds who were the parents of the offspring the "helper" helped to raise?

(2 pts)

(b). how exactly did the **helper** bird benefit from helping out at the nest?

(2 pts)

Part 2.

Question #1. Please briefly explain the key differences between Inductive and Deductive reasoning in the scientific method. In addition, you must use a figure to illustrate your explanation.

Question #2. This question will assess your understanding of basic chemistry. (note: this entire page counts as one question)

(a). Please briefly explain why are some covalent bonds "polar" and others "non-polar"? (4 pts)

(b). What are "weak bonds" and what role do they play in the explanation of why some molecules dissolve in water (ie. are "hydrophilic"). (3 pts)

(c). Please briefly explain how "**cohesion"** helps pull water upward in the microscopic vessels of plants. (3 pts)

Question #3. This question will assess your understanding of the four necessary conditions for the first life to evolve. (note: this entire page counts as one question)

(a) Please explain how the earliest cell membranes formed. What were the principal molecules that comprised these membranes and how and where did these membranes most likely form? (2.5 pts)

(b) Please state what were the first energy and raw materials sources (monomers), how were these formed, and how did the earliest cells acquire these resources? (2.5 pts)

(c) Please explain what was the basic metabolic process that arose in the earliest cells to generate energy for biosynthesis, what was the short term energy carrier, and how did the network of enzymes needed to start this metabolism originally get "into" this cell? (2.5 pts)

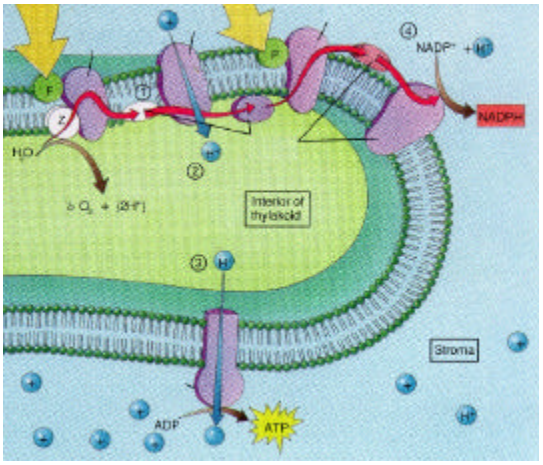
(d) Please explain how the earliest cells reproduced. Please also explain what was the "mechanism of inheritance" in these earliest of cells, i.e. what was the guarantee that the daughters resembled the parental cells? (2.5 pts)

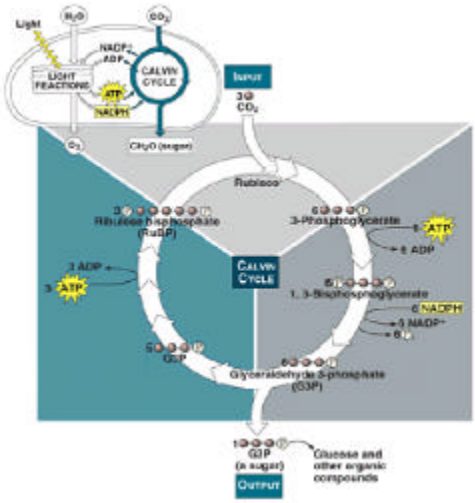
Question #4. The fact that phospholipids form the cell membranes of all living organisms on Earth today is powerful evidence that all life presently inhabiting Earth derived from the same bacterial cell line that originated and evolved between 4.5 and 3.5 billion years ago.
Please describe at least 4 other major lines of evidence (i.e. specific features of cell structure or function that solve the challenges to the origin of life) that indicate that all life on Earth shares a common ancestry.

1 – 2.5 pts
2 – 2.5 pts
3 – 2.5 pts
4 – 2.5 pts

Question #5. Please explain the key steps involved in photosynthesis. Your explanation should be brief and concise, should refer to the figures, and should use the following key words correctly:

ATP synthase, Calvin cycle, carbon fixation, chlorophyll, chloroplast, CO_2, cytochrome, electron transport chain, glucose, hydrolysis of water, light reactions, oxygen O_2, photosystems 1 and 2, proton pump, reaction center

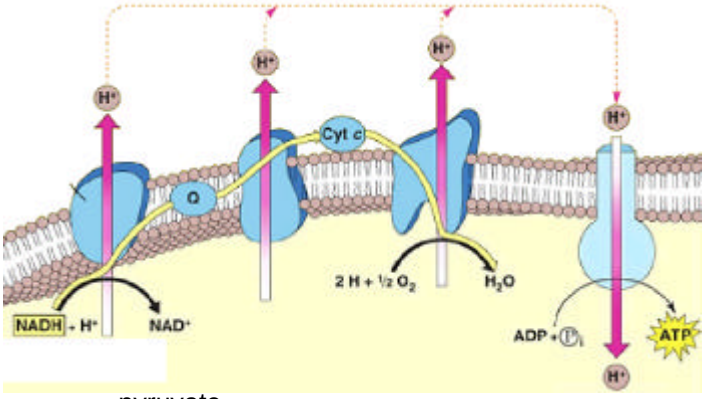




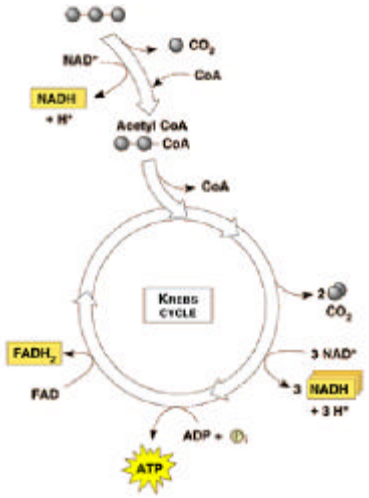
10 pts

Question #6. Please explain the key steps involved in aerobic respiration. Your explanation should be brief and concise, should refer to the figures, and should use the following key words correctly:

ATP synthase, CO_2, cytochrome, electron transport chain, glucose, glycolysis, Krebs cycle, formation of water, mitochondria, oxygen O_2, proton pump, pyruvate (see figure),



pyruvate



10 pt

Question #7. This question will assess your understanding of protein synthesis and the Central Dogma of Molecular Biology. Please read all parts of this question before beginning.

(a). In a phrase, what does the "central dogma" state about the process of protein synthesis?

2 pts.

(b). Please diagram and explain the first major step of protein synthesis.

2 pts.

(c). What are ribosomes, of what type of organic molecule are they made, and what specific role do they play in protein synthesis?

3 pts.

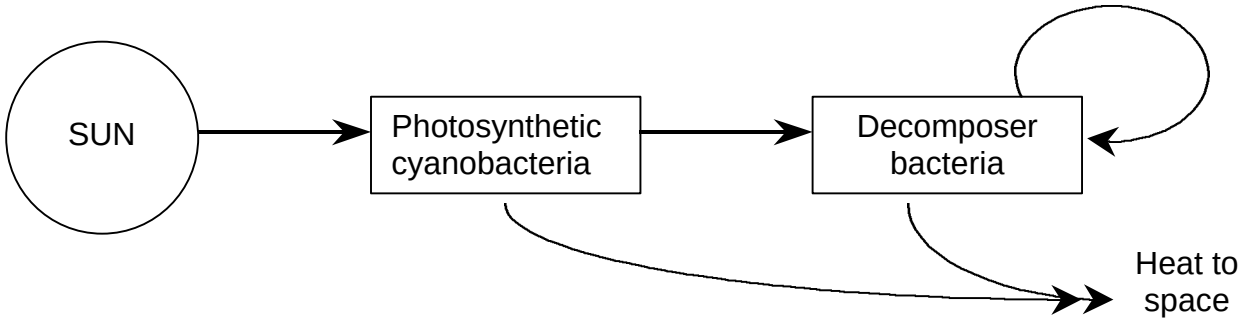
(d). Please briefly describe and diagram the genetic basis to the identity of each amino acid added to the newly forming protein.

3 pts.

Question #8. Please explain the endosymbiotic hypothesis for the origin of higher (eukaryotic) cells leading to animals, plants, and fungi from the available groups of prokaryotic bacteria. Also, please include the principal evidence to support this hypothesis. Please use diagrams in your explanation.

10 pts

Question #9. Below is a basic ecosystem diagram for energy flow of the early earth at about 3.5 billion years ago (just after the evolution of photosynthesis).



(a). Please diagram the basic ecosystem diagram for energy flow of the present day.

6 pts

(b). Please briefly explain the role of "predation" in the evolution of biological and ecological diversity. How did the evolution of predation occur, and how did it lead to this increase in ecosystem complexity?

4pts