

Name: _____

Base your answers to questions 1 through 3 on the chart below showing mRNA base sequences and the amino acids for which they code.

Universal Genetic Code Chart
Messenger RNA Codons and the Amino Acids for Which They Code

		Second Base				
		U	C	A	G	
First Base	U	UUU } UUC } PHE UUA } UUG } LEU	UCU } UCC } UCA } SER UCG }	UAU } UAC } TYR UAA } UAG } STOP	UGU } UGC } CYS UGA } STOP UGG } TRP	U C A G
	C	CUU } CUC } LEU CUA } CUG }	CCU } CCC } CCA } PRO CCG }	CAU } CAC } HIS CAA } CAG } GLN	CGU } CGC } ARG CGA } CGG }	U C A G
	A	AUU } AUC } ILE AUA } AUG } MET or START	ACU } ACC } ACA } THR ACG }	AAU } AAC } ASN AAA } AAG } LYS	AGU } AGC } SER AGA } AGG } ARG	U C A G
	G	GUU } GUC } VAL GUA } GUG }	GCU } GCC } GCA } ALA GCG }	GAU } GAC } ASP GAA } GAG } GLU	GGU } GGC } GLY GGA } GGG }	U C A G

- Identify *one* of the mRNA codons that would stop the coding process.
- Which three codons would code for a different amino acid sequence from that coded for by the mRNA base sequence AGU-UCA-CCA?
 - AGC-UCU-CCU
 - AGU-UCC-CCG
 - ACC-UCA-CUU
 - AGU-UCG-CCC

3. Fill in an mRNA codon that would code for each amino acid shown.

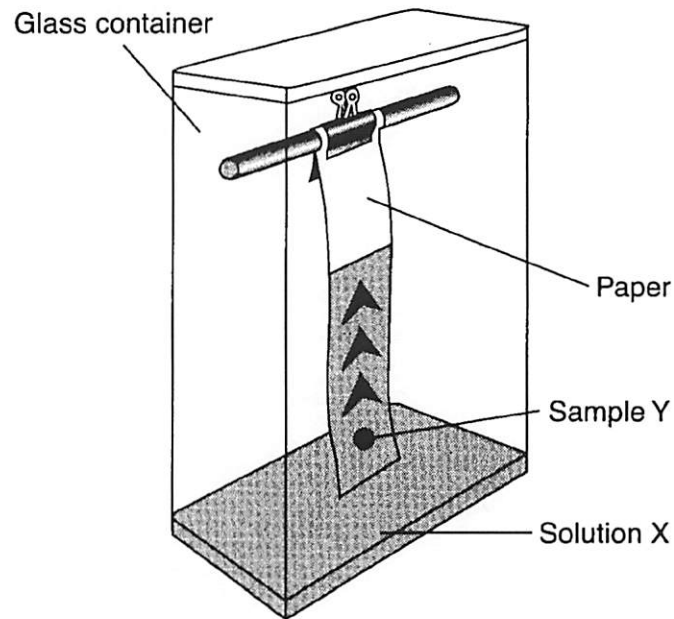
Amino acid: ASP TRP CYS

mRNA codon: _____ _____ _____

-
- Paper chromatography is a laboratory technique that is used to
 - separate different molecules from one another
 - stain cell organelles
 - indicate the pH of a substance
 - compare relative cell size
-

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5. The diagram below represents a laboratory apparatus.



This apparatus is used to

- 1) identify the molecular bases in DNA
- 2) detect chemical toxins in the air
- 3) stain specimens before observing them with a microscope
- 4) separate a mixture of plant pigments

6. In preparation for an electrophoresis procedure, enzymes are added to DNA in order to

- 1) convert the DNA into gel
- 2) cut the DNA into fragments
- 3) change the color of the DNA
- 4) produce longer sections of DN

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7. DNA electrophoresis is used to study evolutionary relationships of species. The diagram below shows the results of DNA electrophoresis for four different animal species.

Species A	Species X	Species Y	Species Z
—	—	— —	— —
—	— —	—	— —
—	—	—	—
—	—	—	—
—	—	—	—

Which species has the most DNA in common with species A?

1) X and Y, only

2) Y, only

3) Z, only

4) X, Y, and Z

Base your answers to questions 8 through 10 on the Universal Genetic Code Chart and on your knowledge of biology. Some DNA, RNA, and amino acid information from four similar sequences of four plant species is shown in the chart below.

Universal Genetic Code Chart
 Messenger RNA Codons and the Amino Acids They Code For

SECOND BASE		FIRST BASE				
	U	C	A	G		
FIRST BASE	U	UUU } PHE UUC } UUA } LEU UUG }	UCU } SER UCA } UUA } UAG }	UAU } TYR UAC } UAA } STOP UAG }	UGU } UGC } UGA } UGG }	UCU } UCC } UCA } UCG }
	C	CUU } CUC } CUA } CUG }	CCU } CCC } CCA } CCG }	CAU } HIS CAC } CAA } CAG }	CGU } CGC } CGA } CGG }	CUC } CUC } CUA } CUG }
	A	AUU } AUC } AUA } AUG }	ACU } ACC } ACA } ACG }	AAU } AAC } AAA } AAG }	AGU } AGC } AGA } AGG }	AUG } AUG } AUA } AUC }
	G	GUU } GUC } GUA } GUG }	GCU } GCC } GCA } GCG }	GAU } GAC } GAA } GAG }	GGU } GGC } GGA } GGG }	GUA } GUA } GUA } GUA }
STOP						

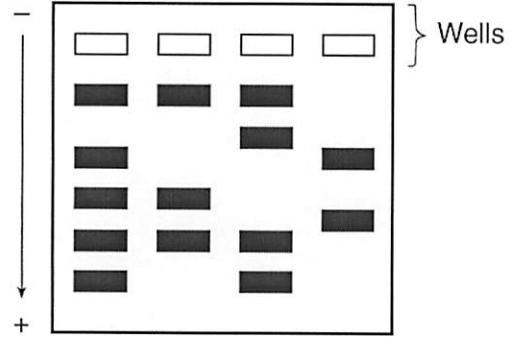
Species	DNA base sequence	mRNA base sequence	Amino acid sequence
Species A	CCG GCG GTA	GGC CAU GTA	GLY HIS HIS
Species B	TGC TGC GTA	TGC ATA GTA	THR VAL HIS
Species C	CCG TGC GTT	GGC ATA CAA	GLY THR GLN
Species D	CCT GGA GTC	ACG GUG CAG	THR VAL GLN

8. Using the Universal Genetic Code Chart, fill in the missing amino acid sequence for species C in the chart below.

Name: _____

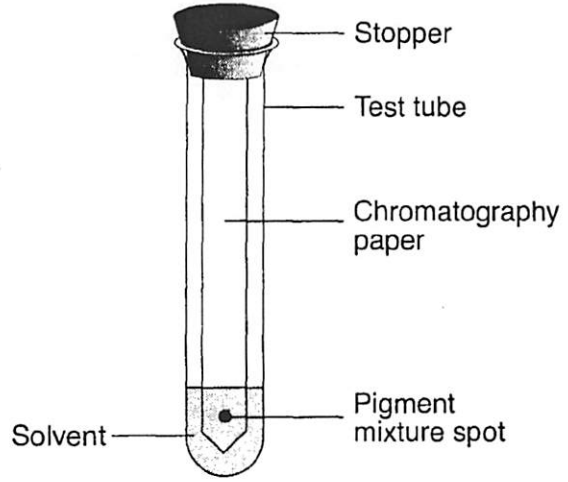
9. Using the information given, fill in the missing mRNA base sequence for species *B* in the chart.
10. According to these amino acid sequences, which *two* plant species are the most closely related? Support your answer.
- Species _____ and _____

Base your answers to questions 11 and 12 on the diagram below that illustrates the results of a laboratory technique and on your knowledge of biology.



11. The results of which laboratory technique are represented in the diagram?
1) chromatography 2) manipulation of genes 3) genetic engineering 4) gel electrophoresis
12. State *one* way the information obtained by this technique can be used.

13. A chromatography setup is shown below.



Identify *one* error in the setup.

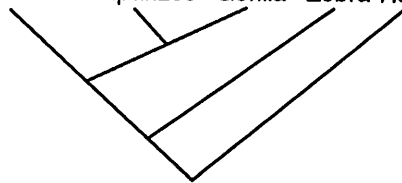
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14. Base your answer to the following question on the chart below and on your knowledge of biology.

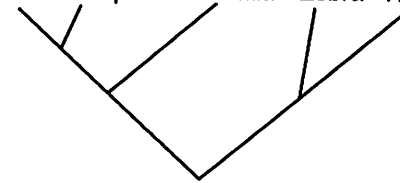
Species	Sequence of Four Amino Acids Found in the Same Part of the Hemoglobin Molecule of Species
human	Lys-Glu-His-Phe
horse	Arg-Lys-His-Lys
gorilla	Lys-Glu-His-Lys
chimpanzee	Lys-Glu-His-Phe
zebra	Arg-Lys-His-Arg

Which evolutionary tree best represents the information in the chart?

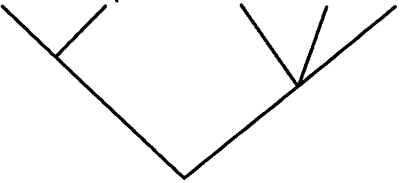
1) Human Chimpanzee Gorilla Zebra Horse



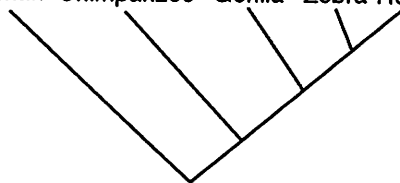
3) Human Chimpanzee Gorilla Zebra Horse



2) Human Chimpanzee Gorilla Zebra Horse



4) Human Chimpanzee Gorilla Zebra Horse



Base your answers to questions 15 through 17 on the information below and on your knowledge of biology.

A series of investigations was performed on four different plant species. The results of these investigations are recorded in the data table below.

Characteristics of Four Plant Species

Plant Species	Seeds	Leaves	Pattern of Vascular Bundles (structures in stem)	Type of Chlorophyll Present
A	round/small	needle-like	scattered bundles	chlorophyll a and b
B	long/pointed	needle-like	circular bundles	chlorophyll a and c
C	round/small	needle-like	scattered bundles	chlorophyll a and b
D	round/small	needle-like	scattered bundles	chlorophyll b

15. State *one* reason why scientists might want to know if two plant species are closely related.

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16. Based on these data, which two plant species appear to be most closely related? Support your answer.
17. What additional information could be gathered to support your answer to question 16?

Base your answers to questions 18 through 20 on the information below and on your knowledge of biology.

Cytochrome c is an enzyme located in the mitochondria of many types of cells. The number of differences in the amino acid sequences of Cytochrome c from different species are compared to human Cytochrome c in the data table below.

Differences in Amino Acid Sequences

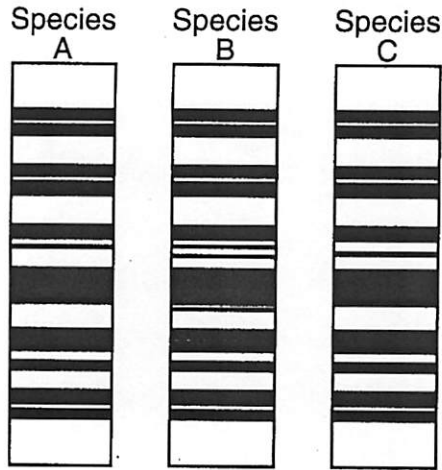
Organism	Number of Differences in Cytochrome c Compared to Humans
tuna	21
mold	48
moth	31
dog	11
horse	12
chicken	13
monkey	1

18. The fact that all of these organisms contain Cytochrome c could lead to the inference that
- 1) Cytochrome c is essential for the reproduction of all organisms
 - 2) these organisms have all evolved from an ancestor that produced Cytochrome c
 - 3) mutations in genes that code for Cytochrome c always occur during DNA replication
 - 4) only heterotrophs make Cytochrome
19. Of the organisms listed below, which one has a DNA code for Cytochrome c that is most similar to that of a human?
- 1) tuna
 - 2) chicken
 - 3) moth
 - 4) dog
20. Cytochrome c is most likely a
- 1) protein molecule
 - 2) material containing genes
 - 3) carbohydrate that is absorbed by cells
 - 4) component of the membrane around the cell

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Base your answers to questions 21 through 24 on the information and diagram below and on your knowledge of biology.

The DNA of three different species of birds was analyzed to help determine if there is an evolutionary relationship between these species. The diagram shows the results of this analysis.



Species	Amino Acid Sequence
A	Arg-Leu-Glu-Gly-His-His-Pro-Lys-Arg
B	Arg-Gly-Glu-Gly-His-His-Pro-Lys-Arg
C	Arg-Leu-Glu-Gly-His-His-Pro-Lys-Arg

21. State *one* type of additional information that could be used to determine if these three species are closely related.
22. Identify the technique normally used to separate the DNA fragments to produce the patterns shown in the diagram.
23. The chart above contains amino acid sequences for part of a protein that is found in the feathers on each of these three species of birds.

State one way this data supports the inference that these three bird species may be closely related.

24. State one type of additional information that could be used to determine if these three species are closely related.

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Base your answers to questions 25 through 27 on the information below and on your knowledge of biology.

In an investigation, DNA samples from four organisms, A, B, C, and D, were cut into fragments. The number of bases in the resulting DNA fragments for each sample is shown below.

Data Table

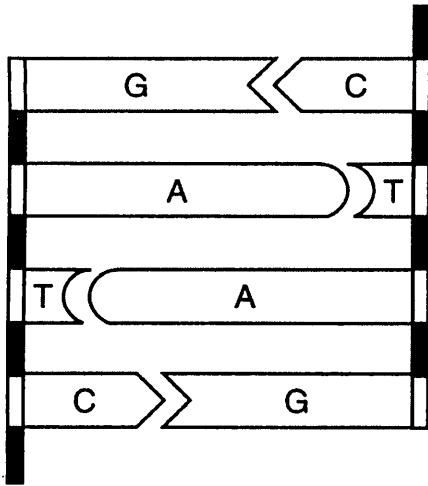
Sample	Number of Bases in DNA Fragments
A	3, 9, 5, 14
B	8, 4, 12, 10
C	11, 7, 6, 8
D	4, 12, 8, 11

25. State *one* specific use for the information obtained from the results of gel electrophoresis.
26. The diagram below represents the gel-like material through which the DNA fragments moved during gel electrophoresis. Draw lines to represent the position of the fragments from each DNA sample when electrophoresis is completed.
27. Which *two* DNA samples are the most similar? Support your answer using data from this investigation.

Samples _____ and _____

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Base your answers to questions 28 through 30 on the diagram below, which represents a portion of a type of organic molecule present in the cells of organisms.



28. State *one* specific way the results of this laboratory technique could be used.
29. This technique used to analyze DNA directly results in
- 1) synthesizing large fragments of DNA
 - 2) separating DNA fragments on the basis of size
 - 3) producing genetically engineered DNA molecules
 - 4) removing the larger DNA fragments from the samples
30. This laboratory technique is known as
- | | |
|------------------------|--------------------------|
| 1) gel electrophoresis | 3) protein synthesis |
| 2) DNA replication | 4) genetic recombination |
-

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Base your answers to questions 31 through 34 on the information below and on your knowledge of biology.

To demonstrate techniques used in DNA analysis, a student was given two paper strip samples of DNA. The two DNA samples are shown below.

Sample 1: ATT**CCGG**TAAT**CCCG**TAAT**GCCG**GATAATA**CTCCGG**TAATATC

Sample 2: ATT**CCGG**TAAT**CCCG**TAAT**GCCG**GATAATA**CTCCGG**TAATATC

The student cut between the C and G in each of the bolded **CCGG** sequences in sample 1 and between the As in each of the bolded **TAAT** sequences in sample 2. Both sets of fragments were then arranged on a paper model of a gel.

31. State *one* way that the arrangement of the two samples on the gel model would differ.
 32. The action of what kind of molecules was being demonstrated when the DNA samples were cut?
 33. Identify the technique that was being demonstrated when the fragments were arranged on the gel model.
 34. The results of this type of DNA analysis are often used to help determine
 - 1) the number of DNA molecules in an organism
 - 2) if two species are closely related
 - 3) the number of mRNA molecules in DNA
 - 4) if two organisms contain carbohydrate molecules
-

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35. Base your answer to the following question on the information and data table below and on your knowledge of biology.

Body Structures and Reproductive Characteristics of Four Organisms

Organism	Body Structures	Reproductive Characteristics
pigeon	feathers, scales 2 wings, 2 legs	lays eggs
A	scales 4 legs	lays eggs
B	fur 2 leathery wings, 2 legs	gives birth to live young provides milk for offspring
C	fur 4 legs	lays eggs provides milk for offspring

Explain why it would be different to determine which one of the other three organisms from the table should be placed in box 1.

