

Name: _____

UNIT: APPLICATIONS OF GENETICS

TOPIC: SELECTIVE BREEDING, GENETIC ENGINEERING, AND CLONING

1) Scientists have genetically altered a common virus so that it can destroy the most lethal type of brain tumor without harming the healthy tissue nearby. This technology is used for all of the following *except*

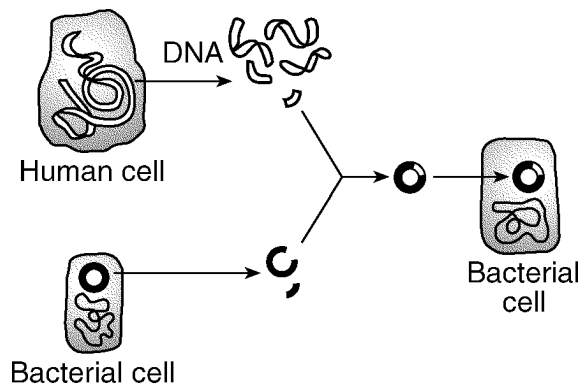
- 1) controlling the disease
- 2) diagnosing the disease
- 3) curing the disease
- 4) treating the disease

2) The headline "Improved Soybeans Produce Healthier Vegetable Oils" accompanies an article describing how a biotechnology company controls the types of lipids (fats) present in soybeans.

The improved soybeans are most likely being developed by the process of

- 1) asexual reproduction
- 2) natural selection
- 3) genetic engineering
- 4) habitat modification

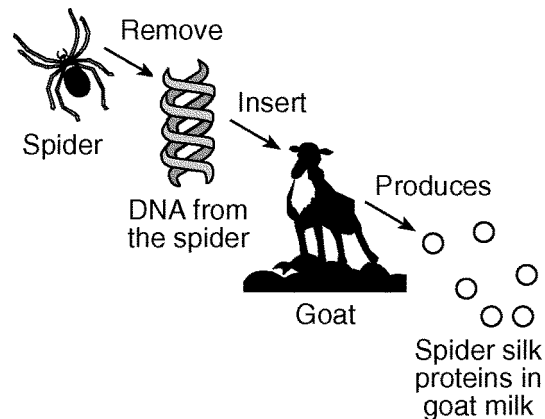
3) The diagram below represents a common laboratory technique in molecular genetics.



One common use of this technology is the

- 1) introduction of a toxic substance to kill bacterial cells
- 2) production of hormones or enzymes to replace missing human body chemicals
- 3) change of single-celled organisms to multicellular organisms
- 4) production of a human embryo to aid women who are unable to have children

4) What process is illustrated in the diagram below?



- 1) genetic engineering
- 2) direct harvesting
- 3) meiosis
- 4) chromatography

5) The flounder is a species of fish that can live in very cold water. The fish produces an "antifreeze" protein that prevents ice crystals from forming in its blood. The DNA for this protein has been identified. An enzyme is used to cut and remove this section of flounder DNA that is then spliced into the DNA of a strawberry plant. As a result, the plant can now produce a protein that makes it more resistant to the damaging effects of frost.

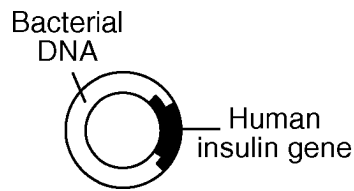
This process is known as

- 1) recombination of chromosomes
- 2) mutation by deletion of genetic material
- 3) sorting of genes
- 4) genetic engineering

6) The DNA of a human cell can be cut and rearranged by using

- | | |
|--------------|--------------------|
| 1) a scalpel | 3) enzymes |
| 2) hormones | 4) electrophoresis |

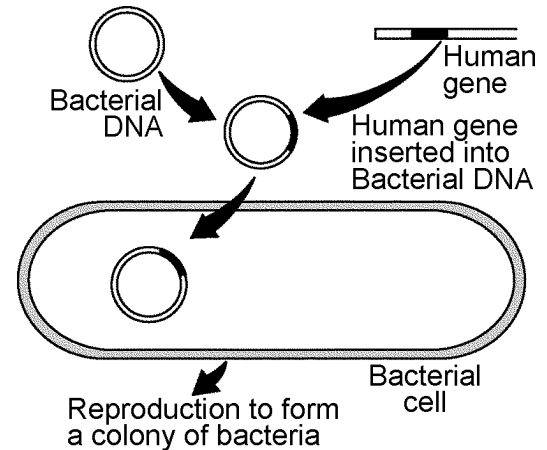
- 7) A product of genetic engineering technology is represented below.



Which substance was needed to join the insulin gene to the bacterial DNA as shown?

- 1) a specific carbohydrate
 - 2) antibodies
 - 3) hormones
 - 4) a specific enzyme
- 8) Researchers Cohn and Boyer transferred a gene from an African clawed frog into a bacterium. To accomplish this, these scientists had to use
- 1) radiation to increase the gene mutation rate of the bacterial cells
 - 2) enzymes to cut out and insert the gene
 - 3) hereditary information located in amino acids
 - 4) cancer cells to promote rapid cell division
- 9) A biotechnology firm has produced tobacco plants that synthesize human antibodies that prevent bacterial diseases. One of the first steps in the production of these plants required
- 1) inserting human DNA segments into the cells of tobacco plants
 - 2) using selective breeding to increase the number of antibody genes in tobacco plants
 - 3) growing tobacco plants in soil containing a specific fertilizer
 - 4) using natural selection to increase the survival of antibody-producing tobacco plants

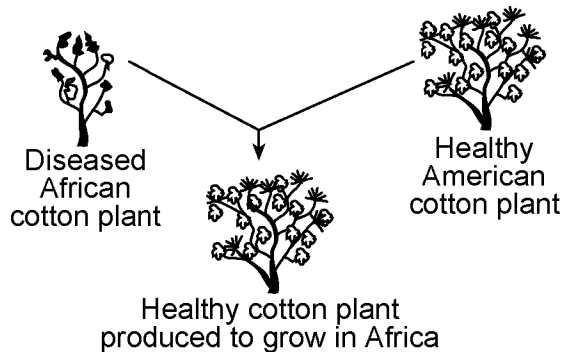
- 10) The diagram below represents a genetic procedure.



Which statement *best* describes the outcome of this procedure?

- 1) Bacterial cells may form a multicellular embryo.
 - 2) Bacterial cells will destroy defective human genetic material.
 - 3) The inserted human DNA may direct the synthesis of human proteins.
 - 4) The inserted human DNA will change harmful bacteria to harmless ones.
- 11) A gene that codes for resistance to glyphosate, a biodegradable weedkiller, has been inserted into certain plants. As a result, these plants will be more likely to
- 1) produce chemicals that kill weeds growing near them
 - 2) convert glyphosate into fertilizer
 - 3) die when exposed to glyphosate
 - 4) survive when glyphosate is applied to them
- 12) Steps in a reproductive process used to produce a sheep with certain traits are listed below.
- STEP 1** — The nucleus was removed from an unfertilized egg taken from sheep *A*.
- STEP 2** — The nucleus of a body cell taken from sheep *B* was then inserted into this unfertilized egg from sheep *A*.
- STEP 3** — The resulting cell was then implanted into the uterus of sheep *C*.
- STEP 4** — Sheep *C* gave birth to sheep *D*.
- Which sheep would be *most* genetically similar to sheep *D*?
- 1) sheep *B*, only
 - 2) both sheep *A* and *C*
 - 3) both sheep *A* and *B*
 - 4) sheep *A*, only

- 13) Which statement *best* describes a population of organisms if cloning is the only method used to reproduce this population?
- 1) The mutation rate in the population would be rapid.
 - 2) The population would evolve rapidly.
 - 3) There would be little chance for variation within the population.
 - 4) The population would be more likely to adapt to a changing environment.
- 14) Which statement provides accurate information about the technique illustrated below?



- 1) New varieties of organisms can be developed by this technique known as selective breeding.
 - 2) Since the development of cloning, this technique is no longer used in agriculture.
 - 3) This technique is used by farmers to eliminate mutations in future members of the species.
 - 4) This technique results in offspring that are genetically identical to the parents.
- 15) In order to produce the first white marigold flower, growers began with the lightest yellow flowered marigold plants. After crossing them, these plants produced seeds, which were planted, and only the offspring with very light yellow flowers were used to produce the next generation. Repeating this process over many years, growers finally produced a marigold flower that is considered the first white variety of its species.
- This procedure is known as
- 1) differentiation
 - 2) selective breeding
 - 3) gene insertion
 - 4) cloning
- 16) One variety of strawberry is resistant to a damaging fungus, but produces small fruit. Another strawberry variety produces large fruit, but is not resistant to the same fungus. The two desirable qualities may be combined in a new variety of strawberry plant by
- 1) direct harvesting
 - 2) selective breeding
 - 3) cloning
 - 4) asexual reproduction

- 17) For centuries, certain animals have been crossed to produce offspring that have desirable qualities. Dogs have been mated to produce Labradors, beagles, and poodles. All of these dogs look and behave very differently from one another.

This technique of producing organisms with specific qualities is known as

- 1) gene replication
 - 2) random mutation
 - 3) natural selection
 - 4) selective breeding
- 18) In 1993, there were only 30 panthers in Florida. They were all closely related and many had reproductive problems. To avoid extinction and restore health to the population, biologists introduced 8 female panthers from Texas. Today, there are more than 80 panthers in Florida and most individuals have healthy reproductive systems. The success of this program was most likely due to the fact that the introduced females
- 1) solved the reproductive problems of the species by asexual methods
 - 2) produced more reproductive cells than the male panthers in Texas
 - 3) increased the genetic variability of the panther population in Florida
 - 4) mated only with panthers from Texas
- 19) Some farmers currently grow genetically engineered crops. An argument against the use of this technology is that
- 1) it produces insect-resistant plants
 - 2) its long-term effects on humans are still being investigated
 - 3) it always results in crops that do not taste good
 - 4) it increases crop production
- 20) In the United States, there has been relatively little experimentation involving the insertion of genes from other species into human DNA. One reason for the lack of these experiments is that
- 1) the subunits of human DNA are different from the DNA subunits of other species
 - 2) human DNA always promotes human survival, so there is no need to alter it
 - 3) inserting foreign DNA into human DNA would require using techniques completely different from those used to insert foreign DNA into the DNA of other mammals
 - 4) there are many ethical questions to be answered before inserting foreign genes into human DNA

- 21) One variety of wheat is resistant to disease. Another variety contains more nutrients of benefit to humans. Explain how a new variety of wheat with disease resistance and high nutrient value could be developed. In your answer, be sure to:

- (1) Identify *one* technique that could be used to combine disease resistance and high nutrient value in a new variety of wheat.
- (2) Describe how this technique would be carried out to produce a wheat plant with the desired characteristics.
- (3) Describe *one* specific difficulty (other than stating that it does not always work) in developing a new variety using this technique.

- 22) Scientists have successfully cloned sheep and cattle for several years. A farmer is considering the advantages and disadvantages of having a flock of sheep cloned from a single individual.

Discuss the issues the farmer should take into account before making a decision. Your response should include:

- (1) How would a cloned flock differ from a noncloned flock?
- (2) State *one* advantage of having a cloned flock.
- (3) State *one* disadvantage of having a cloned flock.
- (4) Discuss *one* reason that the farmer could not mate these cloned sheep with each other to increase the size of his flock.
- (5) Name *one* reason that the offspring resulting from breeding these sheep with an unrelated sheep would *not* all be the same.

- 23) Knowledge of human genes gained from research on the structure and function of human genetic material has led to improvements in medicine and health care for humans.

- (1) State *two* ways this knowledge has improved medicine and health care for humans.
- (2) Identify *one* specific concern that could result from the application of this knowledge.

Questions 24 through 26 refer to the following:

IN SEARCH OF A LOW-ALLERGY PEANUT:

Many people are allergic to substances in the environment. Of the many foods that contain allergens (allergy-inducing substances), peanuts cause some of the most severe reactions. Mildly allergic people may only get hives. Highly allergic people can go into a form of shock. Some people die each year from reactions to peanuts.

A group of scientists is attempting to produce peanuts that lack the allergy-inducing proteins by using traditional selective breeding methods. They are searching for varieties of peanuts that are free of the allergens. By crossing those varieties with popular commercial types, they hope to produce peanuts that will be less likely to cause allergic reactions and still taste good. So far, they have found one variety that has 80 percent less of one of three complex proteins linked to allergic reactions. Removing all three of these allergens may be impossible, but even removing one could help.

Other researchers are attempting to alter the genes that code for the three major allergens in peanuts. All of this research is seen as a possible long-term solution to peanut allergies.

- 24) Allergic reactions, such as the one mentioned in the reading passage, usually occur when the immune system produces
- 1) antibodies against usually harmless antigens
 - 2) antigens against usually harmless antibodies
 - 3) antibiotics against usually harmless antigens
 - 4) enzymes against usually harmless antibodies
- 25) How does altering the DNA of a peanut affect the proteins in peanuts that cause the allergic reactions described in the reading passage?
- 1) The altered DNA is used as an enzyme to break down the allergens in peanuts.
 - 2) The altered DNA is the code for the antibodies against the allergens.
 - 3) The altered DNA is used to synthesize changed forms of these proteins.
 - 4) The altered DNA leaves the nucleus and becomes part of the allergy-producing protein.
- 26) Explain how selective breeding is being used to try to produce the commercial peanuts, mentioned in the reading passage, that will *not* cause allergic reactions in people.

Questions 27 through 31 refer to the following:

BETTER RICE:

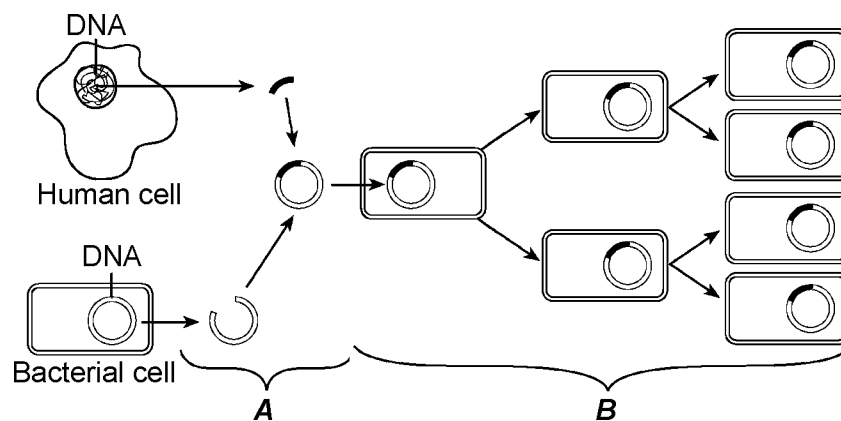
The production of new types of food crops will help raise the quantity of food grown by farmers. Research papers released by the National Academy of Sciences announced the development of two new superior varieties of rice—one produced by selective breeding and the other by biotechnology.

One variety of rice, called Nerica (New Rice for Africa), is already helping farmers in Africa. Nerica combines the hardiness and weed resistance of rare African rice varieties with the productivity and faster maturity of common Asian varieties.

Another variety, called Stress-Tolerant Rice, was produced by inserting a pair of bacterial genes into rice plants for the production of trehalose (a sugar). Trehalose helps plants maintain healthy cell membranes, proteins, and enzymes during environmental stress. The resulting plants survive drought, low temperatures, salty soils, and other stresses better than standard rice varieties.

- 27) Based on the reading passage, why is the production of new varieties of food crops necessary?
- 1) World population continues to increase.
 - 2) Technology for producing fresh water for agriculture has improved.
 - 3) Burning fossil fuels has decreased agricultural areas.
 - 4) Essential food crops are rapidly becoming extinct.
- 28) Which substance from bacteria was most likely inserted into rice plants in the development of the trehalose-producing rice discussed in the reading passage?
- 1) enzymes
 - 2) trehalose
 - 3) sugar
 - 4) DNA

Questions 34 and 35 refer to the following:



- 34) In the procedure indicated by letter *A* in the diagram shown, DNA segments from humans and bacteria are joined by the action of
- 1) starch molecules
 - 2) hormones
 - 3) enzymes
 - 4) simple sugars
- 35) Which process is indicated by letter *B* in the diagram shown?
- 1) sexual reproduction
 - 2) gene deletion
 - 3) natural selection
 - 4) asexual reproduction

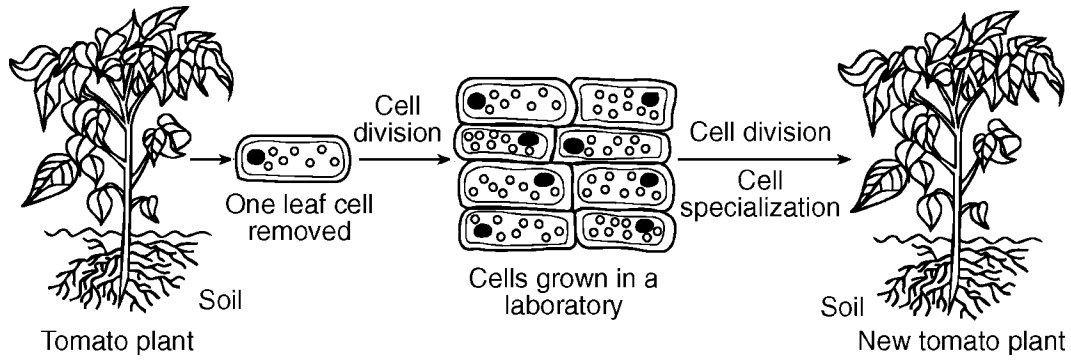
- 29) Based on the reading passage, Nerica was most likely produced by
- 1) cloning genes for hardiness and weed resistance from Asian rice
 - 2) crossing a variety of African rice with a variety of Asian rice
 - 3) using Asian rice to compete with rare African varieties
 - 4) inserting genes for productivity and faster maturity into Asian rice
- 30) Which strain of rice mentioned in the reading passage was produced as a result of genetic engineering? [*Support your answer.*]
- 31) State *one* reason that further testing must be done before rice plants that produce the trehalose mentioned in the reading passage are approved for human consumption.

Questions 32 and 33 refer to the following:

Selective breeding has been used to improve the racing ability of horses.

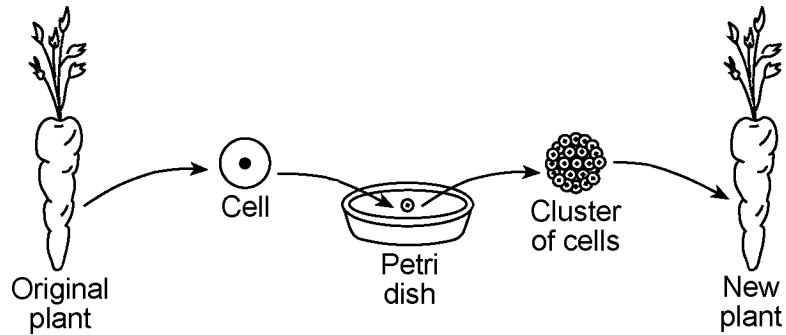
- 32) Define selective breeding and state how it would be used to improve the racing ability of horses.
- 33) State *one* disadvantage of selective breeding in race horses.

36) A technique used to produce new plants is represented in the diagram below.



Which statement is *best* supported by the information in the diagram?

- 1) The new tomato plant will not be able to reproduce sexually because it was produced by mitotic cell division.
 - 2) The one leaf cell removed formed a zygote that developed into a new plant by mitotic cell division.
 - 3) This procedure is used to produce new tomato plants that are clones of the original tomato plant.
 - 4) The cell taken from the leaf produced eight cells, each having one-half of the genetic information of the original leaf cell.
- 37) The diagram below represents the cloning of a carrot plant.

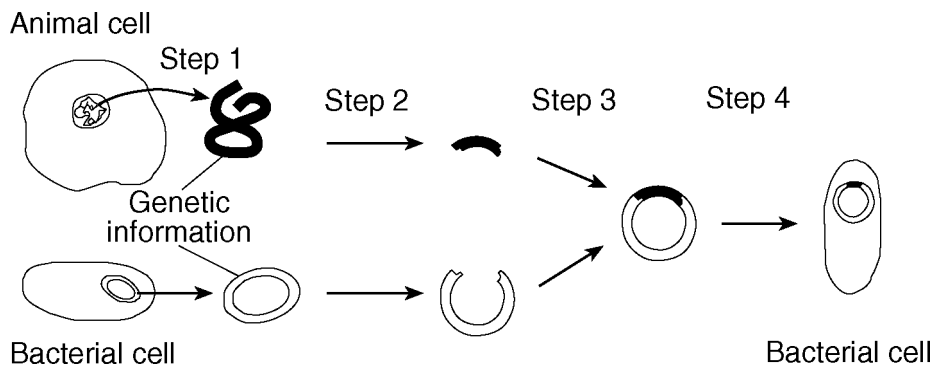


Compared to each cell of the original carrot plant, each cell of the new plant will have

- 1) half the number of chromosomes but different types of genes
- 2) the same number of chromosomes but different types of genes
- 3) the same number of chromosomes and the same types of genes
- 4) half the number of chromosomes and the same types of genes

Questions 38 and 39 refer to the following:

The diagram below illustrates some steps in genetic engineering.

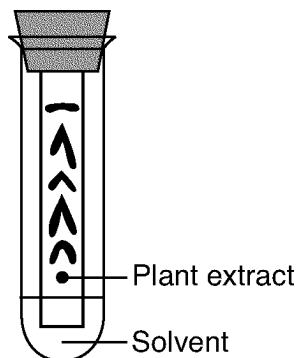


- 38) What is the result of step 3 in the given diagram?
- 1) DNA from different organisms is joined together
 - 2) a new type of molecular base is formed
 - 3) different types of minerals are joined together
 - 4) DNA from the bacterial cell is cloned

- 39) State *one* way that the enzymes in the given diagram are used in step 2.

TOPIC: RELATIONSHIPS AND BIODIVERSITY LAB

- 40) Paper chromatography is a laboratory technique that is used to
- 1) compare relative cell sizes
 - 2) stain cell organelles
 - 3) separate different molecules from one another
 - 4) indicate the pH of a substance
- 41) A laboratory technique is illustrated in the diagram below.



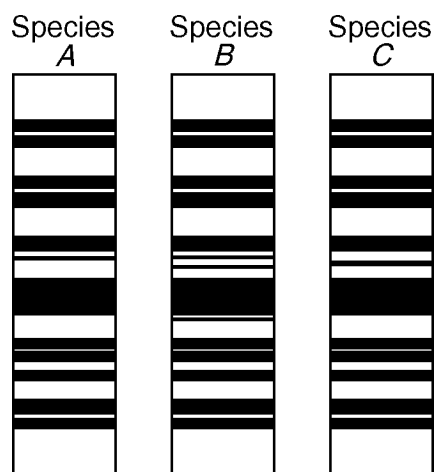
This technique is used to

- 1) separate molecules in a mixture
 - 2) determine volume
 - 3) analyze data from an experiment
 - 4) measure length
- 42) Electrophoresis is a method of
- 1) indicating the presence of starch
 - 2) separating colored compounds on a strip of paper
 - 3) changing the genetic code of an organism
 - 4) separating DNA fragments
- 43) In preparation for an electrophoresis procedure, enzymes are added to DNA in order to
- 1) produce longer sections of DNA
 - 2) cut the DNA into fragments
 - 3) change the color of the DNA
 - 4) convert the DNA into gel
- 44) Relationships between plant species may most accurately be determined by comparing the
- 1) shape of their leaves
 - 2) habitats in which they live
 - 3) base sequences of DNA
 - 4) structure of guard cells

- 45) A student was comparing preserved specimens of three plant species, X, Y, and Z, in a classroom. Which statement is an example of an observation the student could have made and *not* an inference?
- 1) The leaves produced by plant X are 4 cm across and 8 cm in length.
 - 2) Plant Y has large purple flowers that open at night.
 - 3) The flowers of plant Z are poisonous to household pets.
 - 4) Plant X produces many seeds that are highly attractive to finches.

Questions 46 through 48 refer to the following:

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.



- 46) Identify the technique normally used to separate the DNA fragments to produce the patterns shown in the diagram.
- 47) The chart below contains amino acid sequences for part of a protein that is found in the feathers on each of the three species of birds represented in the diagram.

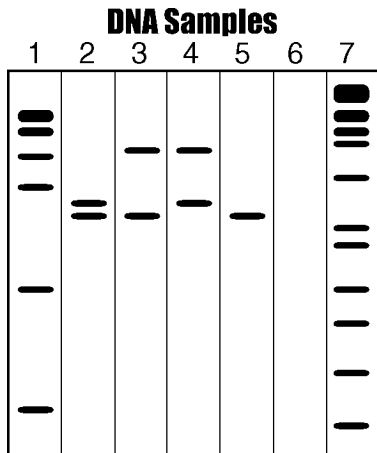
Species	Amino Acid Sequence
A	Arg-Leu-Glu-Gly-His-His-Pro-Lys-Arg
B	Arg-Gly-Glu-Gly-His-His-Pro-Lys-Arg
C	Arg-Leu-Glu-Gly-His-His-Pro-Lys-Arg

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

- 48) Other than using the data shown in the diagram, state *one* type of additional information that could be used to determine if the three species of birds are closely related.

Questions 49 through 51 refer to the following:

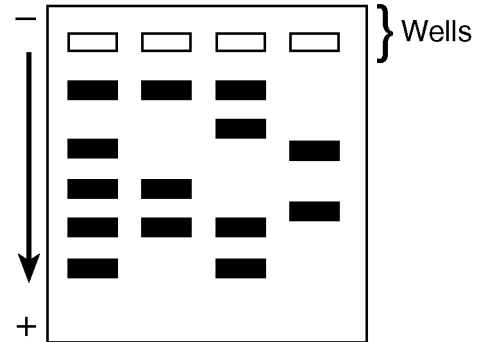
The diagram below shows the results of a technique used to analyze DNA.



- 49) The DNA analysis technique shown in the diagram directly results in
- 1) removing the larger DNA fragments from the samples
 - 2) producing genetically engineered DNA molecules
 - 3) synthesizing large fragments of DNA
 - 4) separating DNA fragments on the basis of size
- 50) The laboratory technique shown is known as
- 1) protein synthesis
 - 2) gel electrophoresis
 - 3) DNA replication
 - 4) genetic recombination
- 51) State *one* specific way the results of the laboratory technique shown could be used.

Questions 52 through 55 refer to the following:

The four wells represented in the diagram were each injected with fragments that were prepared from DNA samples using identical techniques.



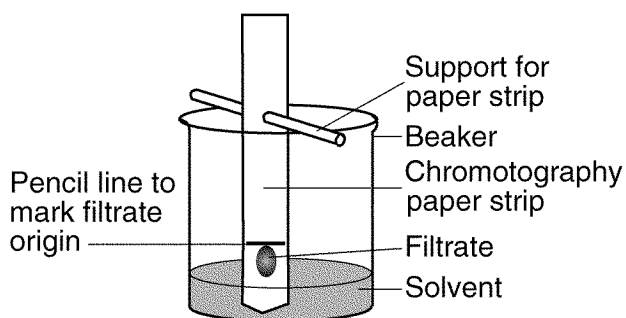
- 52) The laboratory procedure shown is known as
- 1) gel electrophoresis
 - 2) use of a dichotomous key
 - 3) cloning
 - 4) chromatography
- 53) The arrow in the diagram represents the direction of the movement of the DNA fragments. What is responsible for the movement of the DNA in this process?
- 54) The four samples of DNA were taken from four different individuals. Explain how this is evident from the results shown in the diagram.
- 55) Identify the substance that was used to treat the DNA shown in the diagram to produce the fragments that were put into the wells.

Questions 56 through 58 refer to the following:

Paper chromatography can be used to investigate evolutionary relationships.

Leaves from a plant were ground and mixed with a solvent. The mixture of ground leaves and solvent was then filtered. Using a toothpick, twenty drops of the filtrate (material that passed through the filter) were placed at one spot on a strip of chromatography paper.

This procedure was repeated using leaves from three other species of plants. A separate strip of chromatography paper was prepared for each plant species. Each of the four strips of chromatography paper was placed in a different beaker containing the same solvent for the same amount of time. One of the laboratory setups is shown below.



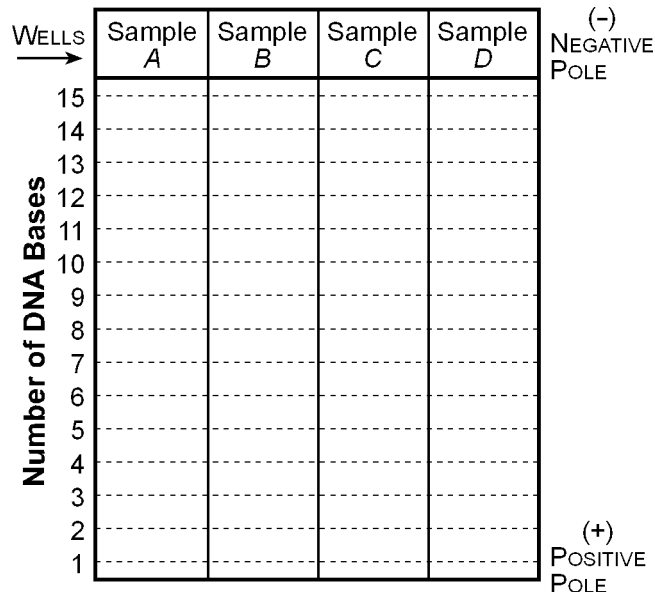
- 56) Based on the given data, state *one* reason for using a new toothpick for the filtrate from each plant.
- 57) Based on the given data, state *one* way the four strips would most likely be different from each other after being removed from the beakers.
- 58) State how a comparison of the resulting chromatography strips in the experiment described could indicate evolutionary relationships.

Questions 59 through 61 refer to the following:

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.

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

- 59) 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 described when electrophoresis is completed.



- 60) Which *two* DNA samples in the given table are the most similar? [Support your answer using data from the given investigation.]
- 61) State *one* specific use for the information obtained from the results of gel electrophoresis.

Questions 62 through 64 refer to the following:

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

- 62) Based on the data shown, which *two* plant species appear to be most closely related? [Support your answer.]
- 63) What additional information could be gathered to show a relationship between the plant species shown in the given table?
- 64) State *one* reason why scientists might want to know if two plant species are closely related.

Questions 65 and 66 refer to the following:


Scientists found members of a plant species they did not recognize. They wanted to determine if the unknown species was related to one or more of four known species, A, B, C, and D.

The relationship between species can be determined most accurately by comparing the results of gel electrophoresis of the DNA from different species.

The chart below represents the results of gel electrophoresis of the DNA from the unknown plant species and the four known species.

Results of Gel Electrophoresis of DNA from Five Plant Species

Unknown Species	Species A	Species B	Species C	Species D
—			—	—
—	—	—	—	—
—		—	—	
—		—	—	
—	—	—	—	—
—	—	—	—	—

KEY:
 = Band in the gel

- 65) The unknown species in the electrophoresis shown is most closely related to which of the four known species?
[Support your answer.]
- 66) (a) Identify *one* physical characteristic of plants that can be readily observed and compared to help determine the relationship between two different species of plants.
- (b) Explain why comparing the DNA of the unknown and known plant species in the electrophoresis shown is probably a more accurate method of determining relationships than comparing only the physical characteristic you identified in *part (a)*.

Questions 67 through 70 refer to the following:

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: ATTCCGGTAATCCCGTAATGCCGGATAATACTCCGGTAATATC

Sample 2: ATTCCGGTAATCCCGTAATGCCGGATAATACTCCGGTAATATC

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

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

71) The data below shows a portion of a mRNA codon chart.

AUU } AUC } AUA }	ILE (Isoleucine)	ACU } ACC } ACA }	THR (Threonine)	AAU } AAC }	ASN (Asparagine)	AGU } AGC }	SER (Serine)
AUG }	MET (Methionine)	ACG }		AAA } AAG }	LYS (Lysine)	AGA } AGG }	ARG (Arginine)

Series *I* represents three mRNA codons. Series *II* includes a mutation of series *I*.

Series I: AGAUCGAGU

Series II: ACAUCGAGU

How would the amino acid sequence produced by the mutant strand (series *II*) compare to the amino acid sequence produced by series *I*?

- 1) One amino acid in the sequence would change.
- 2) More than one amino acid in the sequence would change.
- 3) The amino acid sequence would remain unchanged.
- 4) The amino acid sequence would be shorter.

72) Some DNA, RNA, and amino acid information from four similar sequences of four plant species are shown in Table 2: *Universal Genetic Code Chart* below.

Species A	DNA base sequence mRNA base sequence Amino acid sequence	CCG GGC GLY	TGC ACG THR	ATA UAU TYR	CAG GUC VAL	GTA CAU HIS
Species B	DNA base sequence mRNA base sequence Amino acid sequence	 THR	TGC THR	ATA TYR	CAG VAL	GTA HIS
Species C	DNA base sequence mRNA base sequence Amino acid sequence	CCG GGC 	TGC ACG 	ATA UAU 	CAG GUC 	GTT CAA
Species D	DNA base sequence mRNA base sequence Amino acid sequence	CCT GGA GLY	TGT ACA THR	ATG UAC TYR	CAC GUG VAL	GTC CAG GLN

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

- Fill in the missing mRNA base sequence for species B in the student table (Table 1).
- Fill in the missing amino acid sequence for species C in the student table (Table 1).
- According to these amino acid sequences, which *two* plant species are the most closely related? [Support your answer.]

Questions 73 through 76 refer to the following:

Some DNA, RNA, and amino acid information from the analysis of a gene present in five different species is shown in table 1 below. The Universal Genetic Code Chart is shown in table 2 below.

TABLE 1: Student Table

Species A	DNA base sequence mRNA base sequence Amino acid sequence	TAC AUG _____	CGA GCU _____	CCT GGA _____	TCA AGU _____
Species B	DNA base sequence mRNA base sequence Amino acid sequence	TAC _____ MET	TTT _____ LYS	GCA _____ ARG	GGA _____ PRO
Species C	DNA base sequence mRNA base sequence Amino acid sequence	_____ AUG MET	_____ UUU PHE	_____ UGU CYS	_____ CCC PRO
Species D	DNA base sequence mRNA base sequence Amino acid sequence	TAC AUG MET	GTA CAU HIS	GTT CAA GLN	GCA CGU ARG
Species E	DNA base sequence mRNA base sequence Amino acid sequence	TAC AUG MET	TTC AAG LYS	GCG CGC ARG	GGT CCA PRO

TABLE 2: Universal Genetic Code Chart

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

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| <p>73) Using the Universal Genetic Code Chart, fill in the missing amino acids in the amino acid sequence for species A in table 1.</p> <p>74) Using the Universal Genetic Code Chart, fill in the missing mRNA bases in the mRNA strand for species B in table 1.</p> | <p>75) Using the Universal Genetic Code Chart, fill in the missing DNA bases in the DNA strand for species C in table 1.</p> <p>76) According to the given information, which two species are most closely related? [Support your answer.]</p> |
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