Lab 16 - Relationships and Biodiversity

Name _____

Introduction

Botana curus is a valuable plant because it produces Curol, a compound used for treating certain kinds of cancer. Because *Botana curus* grows very slowly and is endangered, scientists are searching for a plant that is closely related (plants that are more closely related are more likely to produce the same compound)

Three similar plant species (X, Y, and Z) may be related to *Botana curus*. You will work as a researcher to:

-Gather structural and molecular evidence to determine which plant species is most closely related to the hypothetical species, *Botana curus.*

-Use this evidence to decided which plant species is most likely to serve as a source of the important substance Curol.

Structural Evidence for Relationships (Tests 1-3)

Perform the following tests and record your observation in Table 1.

Test 1 – Structural characteristics of Plants

a. DO NOT remove the plant samples from the plastic bags
b. Compare the structural characteristics of the plant samples. Record your observations in Table 1

Did all the plants have the same physical characteristics? Explain?

_____

_____

_____

Test 2 – Structural Characteristics of Seeds

a. DO NOT remove the plant samples from the plastic bags
b. Compare the structural characteristics of the seed samples. Record your observations in Table 1

Did all the seeds have the same physical characteristics? Explain?

_____

_____

_____

Test 3 – Microscopic Internal Structure of Stems

a. Observe the printed images that show cross sections of plant stems. Compare the arrangements of the bundles of connecting tissue in the specimens. Record your observations in table 1

Did all the stems have the same physical characteristics? Explain?

_____

Figure 1

_____

_____

_____

Hypothesize: Tests 1-3

a. Based on your data for structural relationships, which species (X, Y, or Z) would you hypothesize is most likely to produce Curol? _____
b. Explain how the evidence from your data table supports your hypothesis

_____

_____

_____

Molectular Evidence for Relationships (Tests 4-7)

Test 4 – Paper Chromatography

a. Please go to station 4 and follow all directions for the paper chromatography
b. Once the chromatogram is done, record your observations of the colors and relative amounts of pigments in Table 1

Test 5 – Indicator Tests for Enzyme M

a. Please go to station 5 and follow all directions for the enzyme indicator test
b. It is not practical to test a plant directly for Curol. However, if enzyme M is present, a plant may produce Curol. Test the plant extract from Botana curus for the presence of Enzyme M. A fizzing reaction indicated the enzyme is present. Next, test the other plant extracts for Enzyme M and record in Table 1.

Test 6 – Using Gel Electrophoresis To Compare DNA

a. Please go to station 6 and follow all directors for the gel electrophoresis
b. To compare DNA molecules, scientists use enzymes that bind to and cut specific base sequences within the DNA. Scientists then use Gel Electrophoresis to separate the DNA fragments resulting from this binding and cutting process.
c. Observe and record the gels, recording similarities to Botana curus in Table 1.

Test 7 – Translating the DNA Code to Make a Protein

a. The sequences of DNA bases below represent parts of the genes responsible for the production of one type of protein, an enzyme, produced by Botana curus and Species X, Y, and Z.
b. Under each DNA sequence, write the complimentary messenger RNA base sequence that each of these gene fragments would produce.
c. Use the universal genetic code table to translate the mRNA base sequences into sequences of amino acids in the protein produced by each species.

Botana curus **CAC GTG GAC TGA GGA CTC CTC**
Sequence of bases in mRNA produced _____
Amino Acid sequence in the protein _____

Species X **CAC GTG GAC AGA GGA CAC CTC**
Sequence of bases in mRNA produced _____
Amino Acid sequence in the protein _____

Species Y **CAC GTG GAC AGA GGA CAC CTC**
Sequence of bases in mRNA produced _____
Amino Acid sequence in the protein _____

Species Z **CAC GTA GAC TGA GGA CTT CTC**
Sequence of bases in mRNA produced _____
Amino Acid sequence in the protein _____

State how the amino acid sequence you obtained from the gene fragment for *Botana curus* compares with the sequences for the other three species.

_____
_____
_____

*****Summarize your observations of the number of differences in Table 1*****

Base your answers to questions 8 through 10 on the reading passage below and on your understanding of biology.

The Biodiversity Crisis

Plant and animal species are being lost at a rate that is unprecedented in the history of life. Human activities are responsible for much of this biodiversity crisis. Some biologists estimate that within the next century, half of Earth's current species may become extinct.

Extinction and the loss of biodiversity occurs when species do not have adaptations that enable them to survive environmental changes. Human activities such as destruction of natural habitats and pollution are thought to be the major environmental factors causing the decline of species, but others are also important. Overhunting, introduction of foreign species that compete with native species, and removal of predators have also played a significant role in endangering some species.

Why should we worry about the loss of biodiversity? We depend on many species for food, clothing, shelter, oxygen, soil fertility—the list goes on and on. Large-scale extinctions of other species may be a warning to us that we are altering the biosphere so rapidly that our species is threatened too.

Biodiversity ensures the availability of a rich variety of genetic material that may lead to future agricultural or medical discoveries having significant value to humankind. Some species have been used as sources for medicines and other useful products. Scientists now use genetic engineering to transfer desirable genes from one species to another. As diversity is lost, potential sources of these genetic materials may be lost with it.

Biodiversity also increases the stability of the ecosystem. Every population is linked, directly or indirectly, with many others in an ecosystem. Disruptions in the numbers and types of one species can upset ecosystem stability. This means that extinction of one species can accelerate the rate of extinction for other species.

Endangered species hold medicinal, agricultural, ecological, commercial, and aesthetic value. They must be protected so that future generations can experience their presence and value.

Assume that the plant you identified as being closely related to *Botana curus* grows rapidly, survives in many environments, and produces Curol. News reports indicate that *Botana curus* plants may become extinct unless expensive efforts are made to preserve the species. Members of your research team disagree as to whether or not *Botana curus* should be saved.

8. State three examples of human activities that could endanger *Botana curus*.

9. State three reasons why it might be important to preserve *Botana curus*.

10. State two arguments people might make for NOT preserving *Botana curus*.

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Table 1: Comparison of *Botana curus* with Species X, Y, and Z

	Structural Evidence			Molecular Evidence			
Species	**Structural Characteristics of Plants**	**Structural Characteristics of Seeds**	**Microscopic Stem Structure**	**Paper Chromatography**	**Test for Enzyme M**	**Differences in Amino Acid Sequences**	**Gel Electrophoresis DNA Banding Pattern**
Botana curus							
Species X							
Species Y							
Species Z							

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Analysis of Results

1. Using the information in Table 1, identify which plant is most closely related to *Botana curus* and therefore most likely to produce Curol. _____
Explain your choice by citing specific evidence from your research.

_____
_____
_____
_____

2. Did the addition of molecular evidence support or refute the hypothesis that you made earlier based on structural evidence only? _____
Explain why or why not.

_____
_____
_____

3. Which kind of evidence – structural or molecular – is most helpful in making decisions about relationships between species? _____
Explain why.

_____
_____
_____
_____

4. Based on your observations, list three characteristics (structural or molecular) that all four species have in common.

_____
_____
_____
_____

5. Rank the organisms in order of relationship to *Botana curus*. Which organism is the most closely related? Which is the least closely related? Why?

_____
_____

Conclusion (Printed): DUE FRIDAY

- Looking at your data, was your hypothesis accurate? (You must specifically reference your data in this section!!)
- What conclusions can you make from the data you collected?
- What patterns did you observe in your data collection?
- How are the skills used in this lab connected to what we learned in class?
- What sources of error could have occurred? How did this error effect your data collection? (THERE ARE ALWAYS POTENTIAL SOURCES OF ERROR)
- What improvements could have been made in your data collection? (THERE ARE ALWAYS IMPROVEMENTS)
- What recommendations for further research would you suggest to improve your lab skills even more?

Universal Genetic Code Chart

Messenger RNA codons and the amino acids they code for.

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

Note: Amino acid abbreviations are in bold type (*e.g.*, PHE, LEU, SER, etc.)

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