Name: _____

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EXTRA

Tracing Human Ancestry with DNA Microarrays
Instructions & Worksheet

Background Information:
You are a student genetic paleontologist on a dig of an ancient city, approximately 10,000 years old, in Eastern South America, what is known as Brazil today. You and your fellow student genetic paleontologists have been given the job of DNA testing any human remains that you find in order to help understand where the inhabitants migrated from, what their ancestry was, and to paint a fuller picture of the city, its inhabitants and their jobs or reasons for being in the city.

You have come across four different sites within the walls of this ancient city where you have found human remains entombed. You know from having studied about this ancient city and from what you can determine from the layout of the city that it was a Mecca of civilization. Having found walls and artifacts, the city appears to have had many streets with shops selling food, ceramics, and other household goods.

Remains of residences are quite abundant also. You can assume that the city was host to many different peoples who either lived there or traveled there.

Using DNA microarray technology, you will be able to determine the ancestry of the four humans you have sampled.

The results will help establish migration routes to the city from other parts of the world.

Microarray Instructions and Worksheet (16 points)

You will now be mimicking the DNA microarray process, with an on-paper assignment. The steps on this worksheet correspond to the steps on the page entitled "How a Genetic Ancestry Kit Works".

Step 1 (Sample Collection): Instead of taking a cheek swab as you would do in a home DNA kits, assume that you have collected soft tissue from one person buried at each of the four different sites.

Step 2 (DNA Isolation): The tissue samples contain cells that have both mitochondrial DNA and DNA from the Y-chromosome, but back in the lab, you can assume that you have isolated the mitochondrial DNA from the other cellular material.

Step 3 (Replication, Chopping, Splitting, Marking): The DNA has been replicated to give cDNA. The cDNA is then split into single strands, giving the four sets of cDNA in front of you. Cut the four sets of cDNA using scissors if they are not yet cut so that the strands are distributed between group members. Color the strands using a colored pencil or highlighter if they are not yet colored.

Now compare the cDNA strands. It will help to line up the four strands and use the edge of a ruler to see the similarities and differences.

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a) How many of the bases are the same across all four strands?_____

b) How many of the bases are different? _____

Next, chop the strands using scissors as a "restriction enzyme." The restriction enzyme is a protein that cuts DNA in specific points so that DNA can be sequenced. For this experiment, cut the cDNA strands at every fourth base -- your cDNA pieces should each have four bases. Then mark the 5' end of each cDNA fragment with an asterisk (*) signifying that the fragment has been tagged with a dye.

Step 4 (The DNA Microarray): Familiarize yourself with the DNA microarray master grid. This microarray has markers for five populations corresponding to mitochondrial DNA haplogroups. Mcroarrays can measure mutations as single nucleotide polymerisms (SNPs) or microsatellites. This microarray examines SNPs found in mitochondrial DNA.

c) For the DNA on the microarray, which end points up, the 3' end or the 5' end? _____

Step 5 (Hybridization): Hybridize your chopped cDNA fragments to the complementary base sequences on the microarray grid master by attaching them with a glue stick or tape. You will need to remember or look up which bases hybridize.

Fill in the blank with the letter of the base that hybridizes with the bases listed below:

d) Adenine (A) : ____

e) Thymine (T) : ____

f) Guanine (G) : ____

g) Cytosine (C) : ____

h) How many of your fragments hybridized with the DNA microarray? _____

i) Are there any DNA fragments from your sample that did not hybridize to the Microarray Grid Master? _____

What is the most likely explanation for the non-hybridization of the fragment?

j) _____

_____

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Step 6 (Analysis): Once everyone on your team has attached all his/her fragments, take a look at the Microarray Master Grid. Look carefully at where the different colored fragments have been placed, then fill in the microarray analysis grid for your sample. This mimics the "readout" process of the DNA microarray.

Determine which haplogroup (and location) each sample belongs to:

k) Sample #1 Haplogroup:_____ Location: _____

l) Sample #2 Haplogroup:_____ Location: _____

m) Sample #3 Haplogroup:_____ Location: _____

n) Sample #4 Haplogroup:_____ Location: _____

What conclusions can you make about the composition of the human population of this ancient city based on your analysis of the four different humans whose remains you analyzed?

o) _____

_____

_____

Congratulations! You have determined genetic ancestry information by analyzing DNA with a microarray!