

**2008
Winning Lesson Plan
from Concord, California**

*ROOTS: Tracing Our
Ancestral Origins via
Biotechnology*

by Victoria Acquistapace,
De La Salle High School

Subject: Honors Biology
Grade Level: 10
Duration: Six Class Periods

Overview and Purpose

Eight years ago, I formed a partnership with a college in our area (Saint Mary's College). The Dean of Sciences agreed to let my Honors Biology students work in the Life Science labs during January Term break. This allows my high school students access to better equipment and facilities. It allows them to study enrichment topics. Over the years, my classes have studied neurology, embryology, genetic engineering, fossil evidence, phylogeny and evolution, etc. They have even studied human cadavers. Below is one of my favorite January Term Units.

I teach at an all-boys school. With pride, students call it "The Brotherhood". This lab is meant to show the students the biological truth of that statement.

Students will extract DNA from their hair follicles. Purify it. Amplify it (the mitochondrial DNA hypervariable 1 region – material lineage exclusively) and confirm it via gel electrophoresis. The DNA will be sequenced at UC Berkeley, then the students will analyze their SNPs (single nucleotide polymorphisms) and derive their halogroups or ancestral lineage (back 50,000 years).

Innovation

What makes this lab sequence innovative is the fusion of ancient human history and biotechnology. This "story" takes students farther back in time—before the well-studied Romans, the Greeks and the Egyptians. What makes this lab sequence innovative is how personal it is—how intimate the data is for the student. The data will ALWAYS be remembered. Another breakthrough is how the data unites students who didn't even fathom that they could be related. See photograph 15. These students have identical DNA sequences and a common female ancestor. They belong to ancestral group U.

In the summer prior to Honors Biology, my students read Guns, Germs & Steel by Jared Diamond. Diamond explains, in detail, human migration out of Africa. The theme of this book is "geographic determinism" which explains that wherever people settled, the native crops and animals determined the rate at which cultures could grow and advance. Asymmetrical global growth lead to European domination over Native Americans as an example. This doesn't explain modern times in total, but it does rebut racism and the belief that certain cultures are genetically superior to others.

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Innovation (Cont'd)

With this lab, students revisit human migration and the concept of a common ancestor. Students can hopefully pinpoint the migration of their personal ancestors. Did they remain close to Africa (as mine did) or did they venture across land bridges to the Americas? By pinpointing a homeland, students can deduce the hardships or advantages of their ancestors. They can even find relatives (with identical DNA sequences) in the classroom! I believe that these are powerful revelations for any person. How do young people view this world of diverse skin colors and diverse incomes after seeing the data? Hopefully, as "The Brotherhood".

Unit and Goals

This lab sequence is taught during a unit on Molecular Biology (January) Semester 2. The goals of the unit are to expand the students' knowledge of cell biology, DNA, fertilization, mutation rate, biotechnologies (PCR, gel electrophoresis, DNA sequencing), human history, etc. It supersedes the fundamental curriculum in order to challenge the students, inspire them and advance their preparation for college and the work force.

California State Standards

Genetics	4C	mutations
	5B	DNA structure
	5D	DNA technology
Evolution	7C & 7D	impact of mutations
	8F	use of biotechnology to determine evolutionary sequence

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Objectives

Students will:

- refine basic biotechnology techniques such as pipetting accurately (See photos 1-3)
- isolate their DNA (hair follicles) (See photos 4 & 6)
- amplify the mitochondrial hypervariable 1 region
- purify their DNA and prepare it for sequencing (See photos 5, 8, 9)
- verify the DNA via gel electrophoresis (See photos 10, 11, 12, 14)
- analyze their DNA sequence and determine their ancestral halogroup (back 50,000 years) (See photos 13 & 15)

Materials

Razor blades	Eluting chambers
Micro centrifuge tubes	Micropipette tips
Micropipettes	PCR
Proteinase K	Nucleotide cocktail
Chelex	Ice buckets
Water baths	Centrifuges

Procedures

In lieu of lab handouts, I have included a student lab report which itemizes the procedures.

Activities Outside the Classroom

Students watch as much of the National Geographic DVD regarding the Global DNA Sequencing project (the Genographic Project) as possible. The DVD demonstrates how their work approaches this professional effort.



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