

## **Action proposal 2012 ICORE**

**Title: Personal Knowledge---Global Action!**

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### **Abstract (150 word limit)**

The purpose of this research is to empower students in their personal decision making in regards to personal health and reproductive success, educational and career choices, and to understand they are citizens of the world and to act upon it. The work will be accomplished through lectures, labs, guest speakers and fundraising centered on the connection between sickle cell disease, malaria, evolution, genetic screening, and low cost prevention measures. Data will be measured qualitatively via open ended pre and post questionnaires.

**Rationale:** I am going to plan a unit around the idea of seeing human evolution in action via the superiority of the heterozygote for sickle cell disease and the selective pressure of the malaria plasmodium carried by mosquitoes in tropical climates driving this evolution. I also want students to become more scientifically literate in regards to the concepts of evolution, genetics, pathogens, vectors, and immune responses, manifestation of symptoms of disease, and treatments. Students will be comparing the geographical distribution of malaria in the equatorial regions of the globe with the occurrence of the sickle cell allele. Students will also take in a historical prospective of the disease and how effective the current prevention measures and treatments are working to combat the disease.

I also want students to think of themselves as citizens of the world. The population at my school is approximately 13% African American and about 45% Hispanic. Both of these populations have significant numbers of sickle cell trait carriers. Not only do I want students to learn about the disease I want them to partake in the solution. Genetic testing methods and options for reproducing couples will be discussed as well as bioethics in general. For example, what genetic disorders are newborns tested for when they are born and does it vary from state to state and does it vary according to race and ethnicity? This knowledge may prevent students from having children with sickle cell disease or preventable genetic disorders such as cystic fibrosis. Other personal actions may also have global consequences. I need them to realize that a small action on their part-donating money for insecticide treated mosquito nets—can and does save lives, especially the lives of children. We will do a fund raiser and donate the money to the organization, Against Malaria, that provides insecticide treated mosquito nets to Tanzania or another Sub-Saharan African country in need. I also plan of giving a bit of a history lesson about Sub-Saharan Africa, culminating in a slide show from my trips to South Africa and Tanzania.

I want students to understand that they have power over their individual decisions as well as being able to contribute to the betterment of the world as a whole.

**Description of teaching unit or modules, including expected outcomes:**

**Students will realize the interconnectedness of the environment, pathogens evolution, selective pressures, and genetic diversity among peoples.**

- Demonstrate understanding of core concepts in biotechnology including (but not limited to) cellular biology, DNA to RNA to protein pathway and core concepts in genetics.
- Identify and follow common protocols used in a biotechnology laboratory (i.e. DNA extraction, PCR, gel electrophoresis, identifying bands and base pair maps, introduction to bioinformatics.)
- Identify the causative agents of malaria, the disease, its symptoms, prevention, and prevalence in the world.
- Students will realize that they have personal power over their reproductive choices and global power through action.

These objectives will be reached via the following activities:

Teaching of Chapters 1-3 in Genetics A Conceptual Approach 4<sup>th</sup> ed. by Benjamin Pierce.

Power point by Dr. Connelly about historical and mosquito borne pathogens in Florida

My power point about sickle-cell disease, malaria and their connection.

Mosquito hatching and observation and students will develop experiments to test variable locations/conditions versus hatch rate.

Guest speaker from the Lee County Health Extension Service to speak about sickle cell disease.

Guest speaker—genetic counselor

Designer pipette lab

Biorad PV92 PCR Informatics Kit 166-2100-EDU

Thermocycler from ICORE and supportive supplies

- The NGSSS that will be addressed are:

- SC.912.L.14.52: Explain the basic functions of the human immune system, including specific and nonspecific immune response, vaccines, and antibiotics.
- SC.912.L.16.3: Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information.
- SC.912.L.16.4: Explain how mutations in the DNA sequence may or may not result in phenotypic change. Explain how mutations in gametes may result in phenotypic changes in offspring.
- SC.912.L.16.5: Explain the basic processes of transcription and translation, and how they result in the expression of genes.
- SC.912.L.16.7: Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology.
- SC.912.L.16.10: Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.
- SC.912.L.16.12: Describe how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, polymerase chain reaction, ligation, and transformation) is used to construct recombinant DNA molecules (DNA cloning).
- SC.912.L.18.4: Describe the structures of proteins and amino acids. Explain the functions of proteins in living organisms. Identify some reactions that amino acids undergo.
- SC.912.N.1.3: Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented.
- SC.912.N.1.4: Identify sources of information and assess their reliability according to the strict standards of scientific investigation.
- SC.912.L.15.1, SC.912.L.15.13, SC.912.L.15.15, SC.912.L.16.4, SC.912.L.15.14,

**Data collection techniques and/or student assessments:** Students will take a pre/post survey/open ended questionnaire. They will take it on day one of school and then after we finish the unit I am planning. By that time they will have had the Introduction to Genetics chapter, The Chemical Nature of DNA chapter and Basic Mendelian Principles Chapter—all necessary background knowledge for the planned unit. They will also have had experience pipetting, making gels and running pre-cut Lambda DNA gel electrophoresis. The PCR procedure and understanding primers will be new concepts for them. I am choosing to do a qualitative data retrieval because I feel open ended questions reveal more about background knowledge, depth of learning gains and attitudes about the project. I also plan on taking many pictures during the lab time. Sample questions for the questionnaire may read something like this: What is malaria? What is sickle cell disease? Can you give an example of humans being affected by evolution? Do you wish to know your genetic status in regards to a genetic disorder, why or why not? If you had it in your power to positively affect the lives of those affected by disease would you do it? Do you think you have that power? How would you do it?

**Proposal differential:** Normally I would not teach about the detailed lifecycle of the mosquito, nor would I have the ability to do PCR without the support of ICORE. I always encourage genetic screening for potential carriers but with the lab I will be able to illustrate it with and for the students. I would not be adding the fundraising component either or the larger extension of epidemiology and biotechnology careers without the knowledge gained at this two week program.

### **Use of equipment lockers**

Designer pipette locker, thermocycler, mosquito hatcheries and supportive supplies

### **ICORE summer institute elements specifically included (UF connections)**

Dr. Connelly power point, part of Dr. Gabriel power point for PCR explanation

### **Literature cited (needs to be done properly)**

"Malaria." *WHO*. N.p., n.d. Web. 03 Aug. 2012.  
<<http://www.who.int/topics/malaria/en/>>.

Pierce, Benjamin A. *Genetics A Conceptual Approach Fourth Edition*. New York: Freeman, 2012. Print.

Reilly, Philip. *Is It in Your Genes?: The Influence of Genes on Common Disorders and Diseases That Affect You and Your Family*. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory, 2004. Print.

Ridley, Matt. *Genome: The Autobiography of a Species in 23 Chapters*. New York: HarperCollins, 1999. Print.

"Stay Healthy with Sickle Cell Disease." *Centers for Disease Control and Prevention*. Centers for Disease Control and Prevention, 18 Mar. 2012. Web. 03 Aug. 2012.  
<<http://www.cdc.gov/Features/SickleCell/>>.

### **Budget and budget justification**

\$ 248.75 for Biorad kit PV92 PCR Informatics Kit. This kit will be used in place of a real test for hemoglobin S. All the concepts can be taught because students will still be able to gain personal genetic knowledge, just not of a medical gene.

A grant will be written to secure funding for my other three genetics classes.