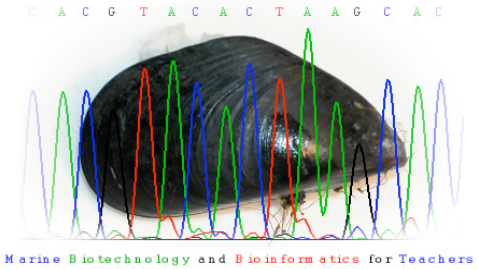

MARINE BIOTECHNOLOGY & BIOINFORMATICS FOR TEACHERS
MOSS LANDING MARINE LABS NSF ITEST GRANT
TEACHER LESSON PLAN FOR CLASSROOM USE
SPECIES DETERMINATION

Title of Lesson: ***
An Exploration into the Determination of an Elkhorn Slough Species Using a Virtual Field Study/Gel Electrophoresis and Wet Lab

Date: July 24, 2007
Period and Location: Thursday, July 26, 2007, CSUMB

Designed by
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Background
The lesson is an inquiry based lesson on an invasive species of snail. Students will learn about the Elkhorn slough and the animals that inhabit it. They will be given a bag of snails to observe. The problem they will arrive at is "why are there large snails and small snails?" Students will brainstorm (due to previous lessons, they should decide that they are different species of snail). Students will confirm species ID using virtual gel electrophoresis and BLAST searches. Once students see that both large and small snails are the same species, they will use lab investigation to find other reasons why their size is so variable. They will be introduced to the concepts of invasive species and parasitism during this lab investigation.

Description of Audience: This biotechnology/bioinformatics activity is designed for use by High School student.

State Standards: This biotechnology/bioinformatics activity fulfills the following State of California Science Standards:

2.e. Students know DNA is the genetic material of living organisms and is located in the chromosomes of each cell.
3.e. Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.
5.b. Students know organ systems function because of the contributions of individual organs, tissues and cells. The failure of any part can affect the entire system.
7.0. Select and use appropriate tools and technology to perform tests, collect data, and display data.
7.b. Students use a variety of print and electronic resources to collect information and evidence as part of a project.
7.c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
7.e. Communicate the steps and results from an investigation in written reports and oral presentations.

STEM Connection. Careers that are connected to this particular experience for students include: field biology, parasitological, educators, oceanography, ecology, and international business researchers.
Technology Integration. Students will use electrophoresis apparatus, pipettes, compound microscopes, glass slides, slide covers, forceps, dissection probes, computers and computer data bases.

Goals(s):

• Goal 1 – Students will learn about invader and native species in the Elkhorn Slough and the distinction between those concepts.
• Goal 2 – Students will learn how restriction enzymes "cut" strands of DNA.
• Goal 3 – Students will learn how to "read" electrophoresis bands and distinguish between different species and complement species.
• Goal 4 – Students will learn how to use deductive reasoning and propose various hypotheses to explain the causes for size differences of snails that are the same species.

Learning Objective(s)

Upon completion of this lesson, students will be able to (Include process skills but be specific. What will the STUDENTS be able to do/demonstrate as a result of this lesson?):

• Objective 1: Students will be able to use bioinformatics to confirm species ID
• Objective 2: Students will be able to use wet lab techniques in order to investigate hypotheses
• Objective 3: Students will use inductive reasoning to solve a problem.

Purpose/Rationale

We tried to create an inquiry based lesson that brings students through the scientific process, using inductive reasoning skills. We tried to incorporate many different activities that were united by a central question. We also provided students with both lab experience and computer experience and brainstormed a lot as a group to show them that there are many different ways to "do science" and answer questions.

Materials/Resources

Computers
20 Rulers
10 snails (*Battilaria*) per group (various sizes)
1 Dissecting microscope per group
1 Compound light microscope per group
Hammers (at least 1 per group)
Markers
Poster paper

Prior Teacher Preparation

We had to collect the *Battilaria* prior to the lab and separate into bags (10 snails/group). We had to create a power point for presentation and a lab packet for each student. We had to research *Battilaria* and find suitable DNA sequences so that students could successfully run a virtual gel and conduct a valid BLAST search.

3-Step Procedure

#1 Introduction

Teachers will introduce themselves.
Students will be introduced to the lesson as an extension built on from the other group lessons.
We will tell them the following:

- We will be exploring virtually a field study project, an actual Gel Electrophoresis with DNA sequences and look at a species found in Elkhorn Slough.
    - The Brainstorming Activity will proceed with key terms/words explored to tap prior knowledge about those terms/words.
    - The Concept Map Activity using web sites will also allow students to use prior knowledge of computer skills and prior knowledge of Elkhorn Slough or similar environments.
- Students will view a PPT showing native and invasive species.

Make connections between prior knowledge and experiences with what is presented.

- Find out what students ideas are on this topic - uncover misconceptions!
- Review what was learned in prior lessons - then introduce content and vocabulary necessary for today's lesson.

- Use teaching charts, video clips, books, presentation software, instructional software, articles, tapes, overhead projector, handouts, models, etc. to accent instruction.
- Create and describe the structure for group learning (if applicable), whole class discussion, and individual work (journal, worksheet).

#2 Exploration

- Introduction of teachers and Icebreaker (icebreaker about "How do you feel today" warm up. Give post it's to students and have them 4 feelings- excellent, good, ok, asleep.)
- Webquest-biodiversity in the Elkhorn Slough
- Discussion of quest
- Snail morphological observation.
- Snail ppt. (backround and discussion of invasive species)
- Bioinformatics- are the 2 types of snails the same species.
- Brainstorming-what else could cause variation in size.
- Wet lab- dissection and then do parasite lab.
- Conclusion and reflection.

#3 Application

- Students learn about the differences between native and invasive species.
  Students discover how scientists use biotechnology and bioinformatics to identify a species.
  Students will learn some internal organs of the snail.
  Students will discover that size is controlled by parasitism.
  How can the value of this lesson be made relevant in their lives?
- This study can be extended by adding a fieldtrip to the collection area to learn proper collection techniques. We could also add a population density portion.

- A STEM portion of this lesson could include a webquest search of biotechnology and bioinformatics jobs. Also speakers can visit the classroom.

Assessment

- Small group debriefs were given after each activity or lab to check students focus and understanding of each step of the lesson. Students were given individual help by other teachers and peers and handled all aspects of the virtual and wet labs with expected written and oral results.
- A written/print or electronic assessment with questions and a final task using selective vocabulary in a poem, story, song or poster of the relevance of invader species, their release into Elkhorn Slough and support data of the extinction of the native species finalizes student understanding of the need for dual analysis of genetic data through gel electrophoresis and Blasting using bioinformatics.

Teachers' Self Evaluation

The lesson went extremely well. The combination of short lecture sections combined with relevant activities in the morning worked well with concept flow. The wet lab ran smoothly too, but would have been better if there had been more than two dissecting scopes.