



MARINE BIOTECHNOLOGY & BIOINFORMATICS FOR TEACHERS
MOSS LANDING MARINE LABS NSF ITEST GRANT
TEACHER LESSON PLAN FOR CLASSROOM USE
Mussel Dissection and Nucleotide Differences

Mussel Dissection and Nucleotide Differences

Designed by

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Background:

Middle school students will perform a mussel dissection, identify gametes with a compound microscope, and compare databased mussel DNA sequences using an online open reading frame. Students will then research occupations that use DNA technology and prepare group presentations.

Description of Audience: 7th grade science students.

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

Genetics

2. A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:

1. Students know the differences between the life cycles and reproduction methods of sexual and asexual organisms.
2. Students know sexual reproduction produces offspring that inherit half their genes from each parent.
3. Students know an inherited trait can be determined by one or more genes.
4. Students know plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
5. Students know DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.

Evolution

3. Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:

1. Students know both genetic variation and environmental factors are causes of evolution and diversity of organisms.

Structure and Function in Living Systems

The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:

1. Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.

Scientific Investigation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

1. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

National Standards: This biotechnology/bioinformatics activity fulfills the following National Science Standards:

- **Structure and Function in Living Systems**

STEM Connection. What careers are tied to this activity? Specifically highlight the career connections.

**Marine Biologist
Science Educator
Aquaculture Technician
Ecosystems Analyst**

Technology Integration. What technology does the lesson use? What new and/or emerging technology do students learn? Students use basic dissection technology. Students will use an online Open Reading Frame finder to determine nucleotide differences between two different mussel species.

Goals(s):

The goal of this lesson is to (List overall goals. What do YOU, as the teacher, set up for students to learn?):

- **Basic mussel anatomy and dissection techniques. How to assemble a microscope slide and identify gametes using a compound microscope.**
- **Differences in nucleotide sequences between species can lead to physical differences.**
- **Working in small groups to present research relating to occupations that routinely use DNA sequencing.**

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?):

- Students will be able to:**
- Dissect a mussel and identify five major organs.**
 - Demonstrate correct use of dissection tools.**
 - Assemble a microscope slide in order to identify gametes in gonad tissue.**
 - Distinguish nucleotide differences between two DNA strands.**
 - Work in teams of four to present research data about four different occupations that routinely use DNA sequencing.**

Purpose/Rationale

***Why am I teaching this lesson this way?

What is the significance, relevance, reason for teaching & learning this lesson?
What are the standards that are addressed in this lesson? ***

Students need to be able to open a mussel identify its parts, and extract tissue for building microscope slides in order to understand basic mussel anatomy as well as structure and function of reproductive tissues. Students need to learn correct techniques for using a microscope. Students need to learn that differences between nucleotide base pairs can translate into physical differences that distinguish one mussel species from another. Students need to learn collaborative presentation skills.

Materials/Resources

In order to complete this lesson, the following materials are needed: (Make a vertical list. Include quantities, resources, & websites)

Mussels (obtained from Costco), one for every pair of students (about 18 per class).
One large anatomical poster illustrating internal and external mussel parts.
Single edge razor blades, 18 per class.
Dissection kits, 9 per class.
Dissection map and tray, 18 per class.
Microscopes, 18 per class.
Microscope slides and cover slips, 2 each for every team.
Worksheets outlining mussel dissection steps.
Website: www.ncbi.com.
Accession numbers for Mytilus Trossulus and Mytilus Gallocalifornianus.
Antibacterial soap, water, and paper towels for cleanup.

Prior Teacher Preparation

What did you have to do to get ready for this lesson? (research, purchases, organization)

Purchase mussels from Costco
Purchase single edge razor blades.
Xerox mussel dissection handouts.
Organize classroom materials.

3-Step Procedure

#1 Introduction

- 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).

Students will be directed to refer to the anatomical charts posted at the front of the classroom.

Students will be asked to answer the following questions in groups of four, and record their responses on sheets of butcher paper.

- **What is DNA?**
- **Mussels are part of what larger group of organisms?**
- **How do you safely cut a dissection specimen?**
- **How do you assemble a microscope slide?**
- **What do differences in DNA mean for different species?**

#2 Exploration

- Describe in detail the activity or investigation students will pursue with clear directions.
- Describe the path of inquiry or process of discovery to be followed - What questions will you ask? - LIST THEM!
- Prepare a lab sheet for students to record data, answer questions. This can be done in science journals.
- Students Predict / Explain. Then Explore and Discuss. Finally they revise their explanations and theories.
- Conclude, share results, discuss, ask and answer questions, evaluate lesson, assess student understanding.

Students will be instructed in mussel dissection technique. Students will be directed to identify the following organs: byssus, foot, gonad, gill, adductor muscle and mantle. Students will be directed to identify the external parts of the muscle: anterior end, posterior end, ventral and dorsal sides.

Techniques for opening the mussel will be demonstrated by the teacher. The instructor will then circulate among the tables and distribute mussels. Students will send a representative from each table to get dissecting equipment, gloves, and paper towels. (These items will be pre-assembled in kits for distribution.)

Students will be issued worksheets to guide them through the dissection process. When all students have finished their dissection and their worksheets, the teacher will stop the class and instruct them in preparing microscope slides.

“Take your tweezers and remove one rice grain of gonad tissue. Set it on a clean microscope slide. Take a cover slip and smear the tissue until you see a yellow paste. ”

“Mount the slides on your microscope. Remember to focus upwards, so that your objective lens does not make contact with the slide. Using the low-power objective, focus until your image is as clear as it can be.”

“What do you see?”

(Student responses will vary).

“Since sperm cells have to move rapidly, how would a male tissue sample differ from a female?”

(It would show moving particles; female reproductive tissue would be static).

The teacher will ask students whether their mussels were male or female. Students will be directed to record this information on their worksheets.

The teacher will then review worksheets with the students and allow them to make any corrections. Students will be instructed to retain their worksheets. They will then be directed to clean up their work stations.

#3 Application

- How can the student apply what was learned today in his/her experience?
- How can the value of this lesson be made relevant in their lives?
- How can interest be extended?
- What is a good follow-up activity to reinforce concepts learned today?
- Provide relevant homework, class work, parent-involvement activity, research assignment...
- Career Connection. At this point write a paragraph describing careers in bioinformatics and biotechnology related to this activity. Describe how this activity contributes to students' understanding of science careers. You may also choose to list specific careers related to this activity.

Discussion:

“How could we use this mussel tissue to learn more about these mussels?”

“If we knew the basic DNA types of most mussels, and could check the DNA of these mussels, could we tell what kind of mussels we had?”

“How could we get the DNA out of this tissue?” (Student responses will vary).

Students will be issued a sheet of paper with two contrasting DNA sequences printed on them. For homework, they will be asked to access the NCBI website and “Blast” the two nucleotide sequences in order to identify the corresponding mussel species. They will also be instructed to research the process of DNA extraction and list the major steps involved in obtaining a viable nucleotide sequence (extraction, cleaning, and measurement). They will then be instructed to list at least 4 occupations that routinely extract DNA from tissues for purposes of identification and/or classification, and report on the education required for each of these positions as well as the incomes generated by these occupations.

Assessment

- How do you know if they GOT IT?
- Design a worksheet, journal recording, test, quiz, or performance-based activity for students to demonstrate what they have learned.
- Have your Goals and Learning Objectives been met?
- How will you do to assist those who do not "get it"? Provide an alternative activity for a student with a special need.
- How might you extend the lesson, dig deeper, go beyond?

Please include several copies of students' work, ideas, journals, and completed lab sheets. Include copies of any text pages you used as well as any handouts, lab sheets, and workbook pages.

Students will take their homework results and prepare a group presentation that includes the following components:

- **An illustration which correctly identifies external and internal mussel parts identified in the prior dissection.**
- **The differences between the nucleotide sequences and the identification of the two different mussel species.**
- **The steps involved in purifying DNA for nucleotide sequencing.**
- **A description of four different occupations that routinely use DNA sequencing for purposes of identification, the education required for these positions, and their salaries.**

Each presentation will take the form of a lesson which each group presents to the class. Each LESSON must include a brochure for every member of the class, an activity (skit, video clip, or interactive power point presentation), an in-depth exploration of only ONE occupation that routinely uses DNA sequencing (guest speakers encouraged), and an assessment (Question and Answer, Bingo or Jeopardy game, or a short written quiz.)

Presenters will be responsible for assigning themselves specific roles. At the end of the presentation, they will be responsible for completing a written self-reflection piece that will include the following questions:

“List 3 things that went as planned in today’s lesson.”

“What would have improved them?”

“How do you know if the class learned from your presentation?”

“What would you do differently if you could make this same presentation a second time?”

Teachers’ Self Evaluation

Reflect on strengths and weaknesses of the lesson as taught.

- Describe individual student responses to techniques used. How did they react?
- Discuss student "thinking" and ideas.

- Include samples of students answers on lab sheet or journal entry (photocopy is fine).
- Ask students for a brief evaluation of lesson. Include their responses.
- Discuss fulfilled and unfulfilled expectations. Any surprises?
- In retrospect, how would you modify this lesson?