



MARINE BIOTECHNOLOGY & BIOINFORMATICS FOR TEACHERS
MOSS LANDING MARINE LABS NSF ITEST GRANT
WEBQUEST¹
INTRO TO THE BIOTECH LAB

Introduction to the Biotechnology Lab

Teaching students safe lab practices while dissecting a mussel to collect a tissue specimen for DNA Extraction

Designed by

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Introduction

This lesson was developed as part of the Marine Biotechnology and Bioinformatics For Teachers grant sponsored by Moss Landing Marine Labs and funded by the National Science Foundation ITEST Office.

Did you enjoy your day collecting mussels? Today you will dissect them, prepare a sample of the mussels gill tissue for DNA extraction, learn how to use a pipette to add reagents to the tissue, and finally share with us your experience by producing a 3-5 Slide PowerPoint Presentation.

The purpose of this activity is to introduce you to the Biotechnology Lab, [Lab Safety](#) , [Lab Practices](#), the lab equipment and give you an opportunity to use your knowledge from the previous day to learn more about mussels in general and the bay mussel in particular.

Each Lab Group of students will be given two bay mussels to dissect and collect material for [DNA Extraction](#). You have learned that not all mussels are the same and that some mussels from other countries are replacing the native bay mussel, *Mytilus trossulus*. You will be given the opportunity to take a sample of your mussel and through the process of DNA extraction determine if it is a *M. trossulus*, an invader *M. galloprovincialis* or a hybrid. You will also have an opportunity to learn good Pipetting technique, which you will use in this, and subsequent labs.

Learners

This lesson is a laboratory-based inquiry lesson designed to explore the topic of biotechnology for the high school student. If students will not be required to do the complete extraction of a purified sample of DNA it can be adapted to the middle school level.

Students will need to have a basic knowledge of what DNA is and where it is found in the cell as well as the function of DNA. Tutorials provided in the WebQuest allow them to review this information if they need it. It is also helpful if students have used microscopes before this lesson and know the proper method of preparing a wet mount and observing the same on a compound microscope under low, medium and high power. Students will also need to be proficient in basic computer techniques including web searches and basic PowerPoint operation.

¹ WebQuest model adapted with permission from Dr. Bernie Dodge - <http://webquest.sdsu.edu> Marine Biotechnology and Bioinformatics for Teachers - Moss Landing Marine Labs NSF ITEST Grant

Curriculum Standards

State Standards: This project-based multimedia learning activity fulfills the following State of California Science Standards:

On completion of this lesson students should be able to:

- 1) Identify the internal anatomy of a mussel and distinguish a bay mussel from a California mussel. CA STD: Biology
 - a. Grade 7: 5a, b
 - b. Grades 9-12: 9a, b, c, d, e, f, g, h, i
- 2) Use their skills in dissection to remove a piece of the mussel's gill and prepare it for DNA extraction. CA STD:
 - a. Chemistry
 - i. Grade 8:6c, IE a
 - ii. Grade 9-12: 6, 7, 8
 - Biology
 - Grade 7: 2e, 3a, IE a
 - Grade 9-12: 2, 7, IE b
- 3) Use their skills in Pipetting to add the appropriate reagents to the gill specimen as part of the DNA extraction. CA STD: Chemistry
 - a. Chemistry
 - i. Grade 8: 6c, IE a
 - ii. Grades 9-12: 6, 7, 8, 10a
 - b. Biology
 - i. Grade 7: 2e, 3a, IE a
 - ii. Grades 9-12: 2, 4, 5, IE b
- 4) Understand purpose of DNA extraction and relate it to several real world problems. CA STD:
 - a. Biology
 - i. Grade 7: 3a
 - ii. Grades 9-12: 2, 7, IE b
- 5) Use computer technology to aid them in the dissection of the mussel, identifying the internal anatomy, and preparing a specimen for DNA extraction including the use of pipettes. (NETS 3)
- 6) Use a digital camera to record their activities in this lab and then use those pictures in their PowerPoint presentation. (NETS 3, 5)
Create a PowerPoint presentation of their activities in this lab as an assessment of their learning. (NETS 5)

National Standards: This project-based multimedia learning activity fulfills the following National Science Standards:

Content Standard A: Science as Inquiry
Content Standard B: Life Science
Content Standard E: Science and Technology

This lesson involves the use of the following thinking skills: Inference, inquiry, observation, and comparison. It also requires that students work together as a team to complete the activity and use their creativity and computer production skills to complete the summary of their work.

Process

1. First you'll be assigned to a team of 4 students and a lab table to work at. Each table is labeled with a letter identifier, which you will use to label your Eppendorf tubes. Each table will have a two person partners that will do the lab together and then the table will summarize their work as a team. Partners will label all their tubes with an identifier such as A1 or A2, B1 or B2, etc.

2. Once you've picked a role to play, as cameraman, dissector, reader, pipetter, or slide maker look over the handout and realize that everyone will get a chance to play each role. Always keep the Safety Rules and Practices in mind. At this point everyone should glove up.
3. Your instructor will give you a handout of the activity as well as provide some visual clues during the activity to help you complete it more quickly. Be sure to stop what you are doing and look up when the request, "class please look forward and note this..." is given. Raise a hand if you or your group needs help.
4. You will be asked questions throughout this exercise that need to be answered by everyone in the group on your Worksheet. Additionally the WebQuest may direct you to a new topic or reference information which you can access by clicking on the link in blue.
5. Complete the Pipetting Exercise for Students after your Instructor models it. Use this link to review a PowerPoint of this activity, [Pipetting Exercise](#).
6. After you complete the Pipetting Exercise you will be given a Mytilus species to dissect. Your instructor will give you some advice on how to do this, however the dissection guide can be found at this link: [Mussel Dissection PowerPoint](#). Use it to help you with the dissection.
7. Label the Eppendorf tube with the letter identifier of your group's table and follow with a 1 or 2 depending on whether you are the first or second pair to complete the labeling. The first thing you want to do once you receive a Mytilus species whose adductor muscle has been cut by your instructor is to identify the gills and take a piece of it about the size of three rice grains and place it in the labeled Eppendorf tube. You will then need to add 30ul of DNA Extraction Buffer to the tube using the techniques you have just learned.
8. Next you will want to attempt to identify the gonads, gills, stomach, foot, valves, and know the posterior, anterior, ventral and dorsal positions of the Mytilus.
9. Then separate out a gill and place on a glass slide and view under the dissection microscope.
10. To view the sperm or oocytes you will make a "squash" of the gonadal tissue and observe under the microscope. Follow the instructions in the Student Handout "Mussel Dissection. Do not use the oil immersion lens!
11. Complete the Student Worksheet. If you need help raise your hand and ask for help.
12. At this time we will review what you have completed and then begin to clean up your area according to the directions of your instructor. Keep your gloves on until all clean up has been accomplished and your Instructor has the class remove their gloves and place in the trash. Then wash your hands with soap and water and dry completely.

Second Block of 2-hour Instruction in the Computer Lab or with the Lab Computers

13. Now that you are in the computer lab you will be creating a PowerPoint Project using a template we have saved for you. Right click and save this link [Your PowerPoint Presentation](#) to your desktop. The grading rubric is found at the bottom of this page.

Variations

If the teacher has access to a virtual dissection computer program it could be modified to do a portion of it as a dry lab. Also in areas where mussels may be difficult to acquire in nature they may be purchased or another organism, such as a freshwater mussel may be used. This lab can easily be divided into at least three separate 1-hour lab sessions, Pipetting, Mussel Dissection and PowerPoint summary.

Resources Needed

The Instructor will need to acquire and set up these materials for the lab.

Dissection Activity: Materials/Resources

In order to complete this lesson, the following materials are needed for 10 mussel dissections. We will have 5 groups of 4/table

- 5% bleach solution in a wash bottle
- Paper towels
- Weigh boats (1 per mussel)
- Razor blades (straight edge, 1 per 4 students)-5
- Microscope slides (1 box)
- Slide cover slips (1 box)
- Dissection kit (1 - per 2 students/10)
- Cutting board (1 per 2 students/10)
- Compound microscopes (several recommended)
- Stereomicroscopes or hand lenses (1 per table)-5
- Solid waste containers (e.g. plastic 500 ml beakers, 1 per group) NOTE: Mussel tissue can be thrown in the trash. (5)
- Sharp waste container (for blades and broken microscope slides)

Gloves (1 pair per student)-19 Assorted sizes

Pipetting Exercise: Materials/Resources

The following materials are needed to complete this lesson. Organize students into groups (4 per group is recommended). We will have 5 groups.

- 1.5 ml microtube per student)-19
- 50 ul colored water in tube for each group (5)
- 50 ul loading dye (1 microtube per group)
- Parafilm (1, 2x2 inch square per 2 students)-10
- Pipette tips (1 box each of 200 ul, per group)-5
- Pipettors (1 set of 20 ul, per group)-5
- Tube racks (1 per group)-5
- Gloves (1 pair per student)-19

Dry Waste container/table-5

Computer Lab:

- E-mail accounts for all students or file sharing files
- PowerPoint, Internet Explorer or other browser

This activity works well with one teacher and a lab assistant, which can be an upper grade student who has completed the lab and has worked with the teacher on other lab activities.

Evaluation

Your group will be assessed on your knowledge of the material provided in this activity and the biotechnology skills and computer skills based on your groups PowerPoint Presentation which you will be given time to complete after lunch. Use the Task List above and the Grading Rubric Below to guide your preparation and construction of a short five slides or less PowerPoint presentation.

Conclusion

This lesson introduces students to some of the many skills and practices that scientists use daily in their work. It also offers students the opportunity to relate real world activities with the lessons on DNA and its many uses. Students learn that good techniques prevent contamination and protect the inquirer from harm. They see that some scientific skills require practice and that many of them are very good at these tasks. And hopefully it allows them to expand their knowledge of the uniqueness of living organisms as well as the similarities of all life.

Credits & References

The team would like to thank our Lab TA's Cristie Kirlin, Hillary Hayford, and Erinn McKell for their encouragement and help in procuring and standardizing the lab materials and to Dr. Simona Bartl of Moss Landing Research Lab for her allowing us to participate in the seminar from which much of this material originates and Dr. Henrik Kibak of CSUMB for the use of his lab for beta testing this lesson.

Reference:

Career Connection

All science careers begin with a desire to know. To know the visible and invisible universe and better understand its workings. In this lab you utilized some of the observation skills, inquiry skills inference and and comparison skills real scientist use in their work. You also learned a few new psychomotor skills such as using a pipette and dissection instruments that many scientist use daily in their search for new information about the world around us.

Who are these scientists? They are marine biologist, ecologist and chemist who work at the many marine research centers, such as Moss Landing, Monterey Bay Aquarium, Hopkins Marine Station and Scripps Institute all in California. They are the pharmaceutical researchers at the many drug research labs across the world looking for new cures. They are also the technicians, lab assistants, secretaries, office staff who support the researchers, provide the computer skills, administrative skills and business skills that allow the researchers to carrying on their work. A PowerPoint on STEM careers is provided as part of this lesson as an addendum.

