

# Marine Biotechnology and Bioinformatics

for Teachers

## Who is the Sea Otter related to? A study into the Mustelidae Family



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### Introduction/Background/Context

In this lesson students will gain insight into the genetic relationships between organisms within the Mustelidae family. They will base their findings on the genetic sequence of the protein Rhodopsin.

This protein, known as the "purple protein" functions in sight in vertebrates, specifically night vision.

Published research suggests this protein is most helpful in constructing the phylogeny for organisms belonging to the family Mustelidae.



Students taking an advanced Biology or AP Biology class are becoming increasingly aware of how molecular genetics is being used to solve questions of animal ancestry and relatedness.

This lesson addresses basic biological concepts involving polypeptide sequences, evolution, and the diversity of life.

This lesson also introduces Bioinformatics as a tool to examine the relationships of organisms.

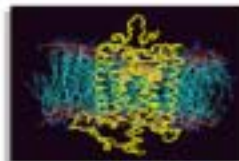
### Instructional Objectives

- To reinforce the importance of genes and their translation into functional proteins.
- To demonstrate how amino acid sequences can be used to show evolutionary relationships.
- To expose students to online biological databases (NCBI) and other programs that are used in Bioinformatics studies.

### Method

Students will have already received lessons on protein synthesis, molecular genetics, and evolution.

- Students will be given a list of animals within the Mustelidae Family for their research.
- Students will be given a tutorial on how to access and use the NCBI website, as well as ClustalW.
- Once students have their protein and organisms they will search the NCBI website for the amino acid sequence.
- A master file will be produced to allow students to clean up their files and formatting.
- Once students have their sequences in the correct format, they will use the ClustalW website to align and execute a phylogenetic tree.



A computer model of the Rhodopsin protein. The protein allows us to see at night.

The American Society for Biochemistry & Molecular Biology website. Students will use this site to find their amino acid sequences.



The ClustalW website. Students will upload their sequences and execute a phylogenetic tree.

### Results/Learning Outcomes

The expected outcome is students will start to appreciate what molecular genetics and bioinformatics has done to help humans understand how animals are related.

Before the use of decoding genes and using computers, Biologists had to simply rely on examining anatomic structures to find relatedness.

This method obviously led to many misconceptions or wrong information.

By analyzing specific proteins that are common in several types of organisms, students and teachers can get a clearer idea of how those organisms relate.

It is the intention of this lesson/activity that students may become excited about bioinformatics and would encourage them to pursue their own questions and ideas.



The final model (3D visualization) showing the evolutionary relationships between Mustelidae.



With the rapid advancement of biotechnology and information, there has been a steady rise in careers dealing with the acquisition, organization, and use of biomolecular information.

This lesson hopes to spark further interest in high school aged student to pursue some of these career opportunities.

Students should keep in mind that this is just one aspect of how biotechnology has improved our understanding of life.

From gene sequencing to species identification, the fields of ornithology, medicine, genetic counseling, and population biology are all experiencing tremendous growth and expansion.

With these new lesson being introduced at the high school level, it is the hope the up and coming generation will assist and lead in the development of modern Biology.

### Conclusion/Lessons Learned

Students will understand the relationships between animals within the Mustelidae Family.

Students will be able to access molecular genetic information through the websites used in this lesson.

Students will be able to construct their own phylogenetic tree based on organisms of their own interest.

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