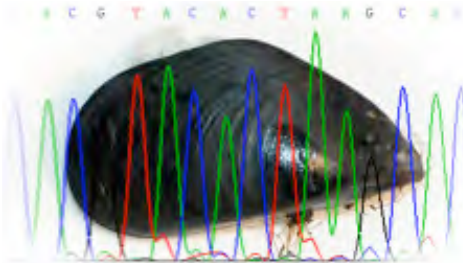


# Marine Biotechnology and Bioinformatics



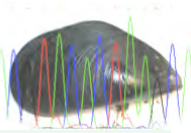
A program of ITEST (Information Technology Experiences for Students and Teachers) funded by the National Science Foundation



## Making Protein from DNA

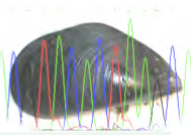
Science 7  
(7<sup>th</sup> Grade Level)

Timothy Hiler  
Marina Middle School  
San Francisco, California



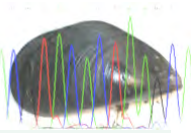
## Background Context

- ▶ Students know that DNA codes for RNA and that RNA codes for amino acids.
- ▶ How can proteins come from base pairs?
- ▶ Students will model how DNA and RNA work to achieve protein construction.



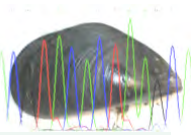
## Instructional Goal

- ▶ Students will model RNA transcription from DNA sequences.
- ▶ Students will model amino acid coding from transcribed RNA.
- ▶ Students will construct model proteins using amino acid sequences.



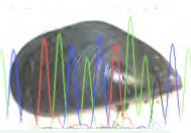
## State Standards

- ▶ Genetics (2 b, c, d, e).
- ▶ Structure and Function in Living Systems (5 a).
- ▶ Investigation & Experimentation (7 b, c, d, e).



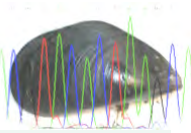
# Instructional Objectives

- ▶ Students will create a model of messenger RNA using nuclear DNA base pairs.
- ▶ Students will create a model of transfer RNA using messenger RNA base pairs.



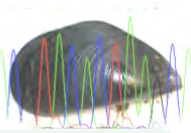
# Instructional Objectives

- ▶ Students will identify sequences of transfer RNA base pairs that code for amino acids. Students will assemble models of amino acids to form proteins.
- ▶ Students will infer that multiple permutations for specific amino acids can provide a defense against genetic mutations.



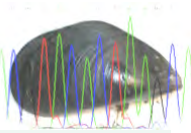
# Materials and Resources

- ▶ Scissors
- ▶ strips of grid paper
- ▶ a photocopy of two complementary DNA base pairs
- ▶ an open reading frame
- ▶ Candy
- ▶ toothpicks
- ▶ Website: [www.bioinformatics.org](http://www.bioinformatics.org)
- ▶ Textbook: Coolidge-Stoltz, Elizabeth: *Focus on California Life Science*. Boston, 2008; Pearson Education, Inc.



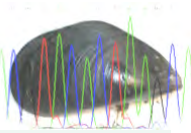
# Instructional Strategies

- ▶ Students work in pairs to transcribe messenger RNA from DNA, and transfer RNA from messenger RNA.
- ▶ Students work in pairs to identify amino acid permutations from transfer RNA. Students construct models of proteins determined by the sequence of amino acids in their transfer RNA.



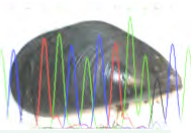
## Assessment

- ▶ Pairs of students “trade” DNA samples and transcribe messenger RNA, transfer RNA, and check one another’s work for accuracy.
- ▶ Protein models that reflect accurate RNA transcription and amino acid coding are given the highest score on a 4-point rubric.



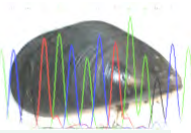
## Learning Outcomes

- ▶ Students know how proteins are realized from DNA sequences. Students know that multiple permutations for RNA make protein mutations difficult.
- ▶ *"It's hard to get a mutation. I wanted one."*
- ▶ *"RNA protects us from bad DNA."*



## Lessons Learned

- ▶ Grouping students in pairs is essential.
- ▶ Students must present a voucher for each amino acid coded to prevent candy manipulatives from being consumed.
- ▶ Using pairs to check the work of other students is an effective assessment tool.



## Contact

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  - ▶▶ Email: [thiler@sfusd.edu](mailto:thiler@sfusd.edu)