Name: K. More; A. Tabernilla; M. Atalla
Lesson Title: Exploring Diversity and its necessity in understanding Evolution.
SSI Topic: Evolution

Lesson Length: 5 periods/1 week
Grade Level(s): Biology 9-10

Appropriateness for High School Students
Videos, lecture discussion, reading and experiments utilizing procedures developed by Dr. Choe's lab and Sciencetakeout.com Yeast Lab will be used to allow students to conceptualize the ideas behind evolution and natural selection by recognizing behavioral observations and speculating where those variations come from i.e.: genetic diversity in single species, genetic mutation and recombination.

Background
Many believe they understand the concept of evolution and its mechanism, natural selection. What they often don’t understand is the connection to genetics and the development of diverse populations.
Variation through mutation is understood but how that connects to the environment and the selective pressures that act on the populations leading to diverse populations is less understood.

Florida State Standards (NGSSS)
SC.912.L.15.15 as AA (M) Describe how mutation and genetic recombination increase genetic variation.
SC.912.L.15.3 na (M) Describe how biological diversity is increased by the origin of new species and how it is decreased by the natural process of extinction.

Connect to:
SC.7.L.15.2 Explore the scientific theory of evolution by recognizing and explaining ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.
SC.7.L.15.3 Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

Performance Objectives
- Students will be able to recognize different behavioral responses to a changing environment due to genetic diversity.
- Students will be able to explain how genetic diversity increases the chance of an individual species surviving.
- Students will be able to recognize that if a species is not genetically diverse then its potential for extinction will increase.

Materials List and Student Handouts

Adapted from UFTeach
Materials, equipment, and supplies needed for the lesson are outlined in “What Worms Can Do For You” provided by the Choe Lab.  
Sciencetakeout.com Yeast lab and Materials  
Youtube.com (included in appropriate “E”)  
Diagram for labeling S&F of C. Elegans (included in appropriate “E”)

5E Lesson Template

**ENGAGE**

Students will watch a video on *C. elegans* to introduce them to the organism and its life history.

http://www.youtube.com/watch?v=c-86OQgcMTM  C. elegans fluorescence joining together/ why?
Food?

http://www.youtube.com/watch?v=BWCm20gXnEs  harlem shake video…parlay into actual behavioral difference.

Activities (Teacher or Student Actions) | Probing Questions
--- | ---
Students will complete an Annotated Student drawing/diagram of *C. elegans* so they may become more familiar with the structures of the organism.

http://www.wormatlas.org/ver1/handbook/anatomyintro/anatomyintro.htm  structure diagram (have students complete to use for explore)

FA: Self Check and correct the Annotated Student Drawings.

What might be influencing the worms’ different behavior?

**EXPLORE**

Overview  Introduce the CONCEPT of changing environments affecting growth of organisms by using the Yeast lab THEN take it a step further by using Osmomolarity concentration differences as presented in the Choe Lab protocol for students to witness/explore/learn from observations of C. Elegans behavior(s).

Activities (Teacher or Student Actions) | Probing Questions
--- | ---

What might be influencing the worms’ different behavior?
### Yeast Populations

- **Yeast Populations** Catalog# STO-123 from Science Take-out: Test samples from a yeast population to determine yeast population size, the pH of the environment, and the amount of sugar present.
- **FA:** Graph your results and compare them with results from another researcher. (shortened version)

<table>
<thead>
<tr>
<th>Activities (Teacher or Student Actions)</th>
<th>Probing Questions</th>
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<tbody>
<tr>
<td>Start with Pre-Quiz on Structure/Function of C elegans</td>
<td>What is it about the worm's structure that might allow for the observed behavior?</td>
</tr>
<tr>
<td>Teacher must have knowledge of the WT and Mutant characteristics – genetically and phenotypically in order to properly guide students to more realistic conclusions.</td>
<td>How would these worms develop different responses to their environment?</td>
</tr>
<tr>
<td>Collaborative Clued Corrections/Controlled Class Discussion revisiting the observed worms: Using Structure/Function diagram and</td>
<td>(if need more prompting) What is the source for the differences observed in the worm?</td>
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</tbody>
</table>

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<tr>
<th>IFF microscopes with actual worms and different concentration of osmomolarity are not available then use these videos.</th>
<th>What environmental factors might affect this organism?</th>
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<tbody>
<tr>
<td><a href="http://www.youtube.com/watch?v=ToLYgB_bxqM">http://www.youtube.com/watch?v=ToLYgB_bxqM</a> WT C elegans – student observe/document behavior</td>
<td>Are all worms responding the same way to their environments?</td>
</tr>
<tr>
<td><a href="http://www.youtube.com/watch?v=GgZHziFWR7M">http://www.youtube.com/watch?v=GgZHziFWR7M</a> Bio-RAD stock video of worm movement</td>
<td>Prompting the students to ask inquiry into the possible stimuli influencing the worms.</td>
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<tr>
<td><strong>FA:</strong> Check/Compare Observations</td>
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### EXPLAIN

**Overview**

Using Structure/Function diagram and descriptions (other background info) guide students through the process of speculating/explaining the different behavior unknowns/possibilities with the information they have while subtly leading them to factual conclusions of the behavior.
descriptions (other background info) guide students through the process of speculating/explaining the different behavior unknowns/possibilities with the information they have while subtly leading them to factual conclusions of the behavior. Post-Quiz Structure/Function of C Elegans

### ELABORATE

**Overview**

HOMEWORK:
Quick opportunity for those students that are already at the point of recognizing that the behavioral responses are due to genetic differences and can display that understanding in the following write up BEFORE Formal Assessment where the questions will be more leading for those that may not have on their own taken it to that level...

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<tr>
<td>HOMEWORK:</td>
<td>Delivered in the class while HW is being assigned:</td>
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<tr>
<td>Written Assignment to be handed in:</td>
<td></td>
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<tr>
<td>1. What is the relationship between the study of worms and yeast?</td>
<td></td>
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<tr>
<td>2. What similarities do these organisms have that enabled them to respond to a changing environment?</td>
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### EVALUATE

**Overview**

Students will complete the following prompt individually as an evaluation and graded by the attached Rubric:

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<td>PROMPT: Write a scenario for a factual OR fictitious organism that demonstrates the relationship between genetic diversity and an ability to respond to a changing environment.</td>
<td>Provided in the explanation for this evaluation we will be sure to direct with these probing questions: Why might this organism be a good model to study variation in a population and evolution? What evidence was observed while working with worms and yeast that support variations in species leading to evolution?</td>
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</tbody>
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RUBRIC for 5E EVALUATE:

4 - Students apply information mastered to a new and original idea explaining concepts addressed in lesson in an innovative manner.
3 - Students describe information learned and use that information to correctly explain concepts addressed in the lesson.
2 - Students describe information learned with few mistakes leading to an overall understanding of the basic concept in the lesson.
1 - Students identify some understanding of the concept but do not come to the correct conclusion that was being probed throughout the lesson.
0 - Students did not show an understanding of the concepts OR students did not answer prompt.