



Lesson #2

What is Biocomplexity?

Objectives:

- The learner will demonstrate comprehension of the components of biocomplexity by discussing different aspects of biocomplexity.
- The learner will demonstrate synthesis of complex concepts by creating before and after posters expressing how the concepts of biocomplexity have been internalized.

National Science Education Standards:

UCP 1, LS 3, ESS 1, ST 1, ST 2, SPSP 1, HNS 2

Benchmarks:

3B, 4C, 4E, 5A, 5E, 11A, 12D

Materials:

Television and VCR

“Volcanoes of the Deep” – NOVA Videos

Colored pencils

White paper (8 ½ X 11) both sides will be used as small posters

Background:

What is Biocomplexity? This is a question which many researchers grapple with every day. The world of biocomplexity research encompasses the efforts of many different types of scientists all working towards a common goal, how living things interact with and affect the environment and each other.

It is very hard to find a good definition for biocomplexity. It includes areas of biology, chemistry, engineering, oceanography, geology, microbiology, genetics, and ecology. The National Science Foundation explains that it “refers to phenomena that arise from dynamic interactions that take place within biological systems and between these systems and the physical environment.” (<http://www.nsf.gov>)

Biocomplexity issues will be explored in the following lessons. These lessons reflect the current research which is being done in various areas of biocomplexity. More specifically, these lessons will focus on the ways in which microbes interact with their environment and modify it.

The unique environments found at hydrothermal vents will be used as an example of biocomplexity in this lesson because they have relatively few components. The bacteria living at the vents are using the dissolved minerals in the hot water as a source of energy. These bacteria, in turn, allow for other organisms to survive at the vents. This is a wonderful example of biogeochemical cycles at work. See the next lesson for tie-ins!

Preparation:

Very little preparation is required for this lesson. You should have a VCR and TV available along with the “Volcanoes of the Deep” video. If you do not have this video, please



see the section on variations for information about using other resources. If you would like to order the video, you should contact WGBH Boston Video at 1-800-949-8670 or www.wgbh.org

Warm-Up:

Ask your students what they think the word “Biocomplexity” means? Briefly discuss the word parts “bio” and “complexity”.

Procedures:

1. After the warm-up, ask students to spend 10 min writing and drawing what they think biocomplexity is. Students should use only one side of the poster. Do not give the students the biocomplexity definition at this time. This activity will help them to create the definition on their own. Do not label this poster.
2. Students will view “Volcanoes of the Deep”. As students are viewing, they should record any facts which they feel may be related to biocomplexity. Students should also think about and record how living things are interacting with the environment. (If you decide the use only a part of the video due to time constraints, please be sure to include one of the portions showing the hydrothermal vents and discussing the importance of the bacteria which live around these vents. They will be key in helping students to understand biocomplexity.)
3. After the video, allow the students 15 minutes to describe biocomplexity, in pictures and words, on the other side of the poster. Encourage students to be as descriptive as possible and to include ideas about biocomplexity that relate to environments other than just the black smokers. (It is important that students take the time to do this individually so that they can express their own ideas). Again, do not label this as pre or post video.
4. Collect the posters and place them around the room. Some should have the first side showing and others should have the second side showing.
5. Allow students time to walk around the room in pairs (You may want to give each pair 2 min. at the picture and then have them move to the next picture) and record whether they think the picture displays the before or after side. This strategy is often referred to as a “gallery walk.”
6. After students have viewed the pictures, ask, “How did you decide whether the pictures represented students before or after ideas?” Discuss these answers and allow students to share their new ideas on biocomplexity.
7. Keep these pictures. You will be using these after finishing all of the lessons so that students can see what they thought biocomplexity was from the beginning of the lessons.

Variations and Follow-Up Activities:

If you do not have “Volcanoes of the Deep”, or can not get it, you still have many options which will allow you to teach this lesson. There are many excellent videos available with footage of black smokers (deep sea hydrothermal vents). You may have an appropriate video in your school or local library. If using a video is not an option, the internet is a great place to get information on black smokers. The following two sites are suggested for use with students because they have excellent images and are suitable for middle school students.



http://www.amnh.org/nationalcenter/expeditions/blacksmokers/black_smokers.html
<http://www.thirteen.org/savageearth/hellscrust/html/sidebar2.html>

For students with interest in this area, but who are limited in their reading skills, the book *The Deep-Sea Floor* is an excellent addition to this lesson. Written by Sneed B. Collard III and illustrated by Gregory Wenzel, this book gives important information in an easy to read format with wonderful pictures to accompany the text. Published by Charlesbridge. [(617) 926-0329 or www.charlesbridge.com]

Assessments:

This activity provides for multiple assessment opportunities. During the lesson, students can be assessed via their video notes and their descriptions of biocomplexity, both pre and post video. Comparing the pre and post video descriptions can also give an assessment of students understanding of the concepts being presented in the video. While students are walking around the room viewing the posters, assessments of their understanding can be made by simply listening to their comments. This will also allow for an assessment of students' group work skills.

After all of the lessons are completed, students will be revisiting these descriptions and drawings. When they comment on their own work after completing the series of lessons, assessments can be made on students' understanding of the module as a whole.

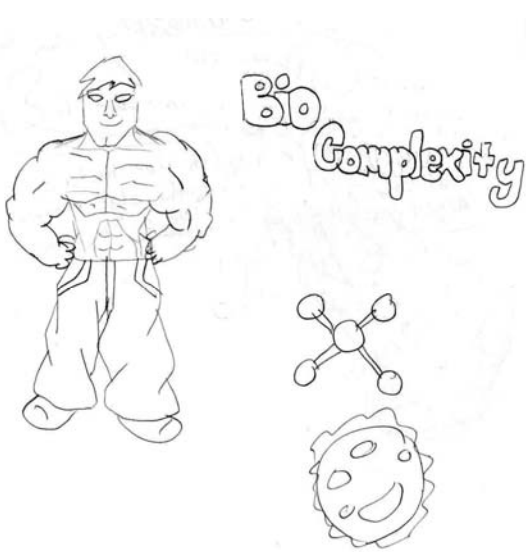
Observations:

My students got much more out of focusing on the big ideas in this lesson rather than trying to create the perfect definition of biocomplexity. Remember, it is very difficult to pin down a good definition for biocomplexity even as an adult. For students this can be even more difficult. Be sure to focus on the concepts which students will be learning about as well as their ideas of what biocomplexity could be.

I found that my students needed to have some time to think about their ideas and share these ideas with partners before addressing the class as a whole. Many of the students wanted to tell the other students what they were thinking and then get feedback from classmates before sharing with the whole class. For concepts which can be difficult for students to understand, the time taken to allow students to share ideas will be well worth it later on when their understanding of these ideas is more critical.

Encourage your students to share "wrong" ideas as well as "right" ideas. There were many instances where my students found that discussing why a definition was incorrect helped to form ideas about what biocomplexity could be.

The following two pages show some of the work produced by my students.



Before



After



Before



After

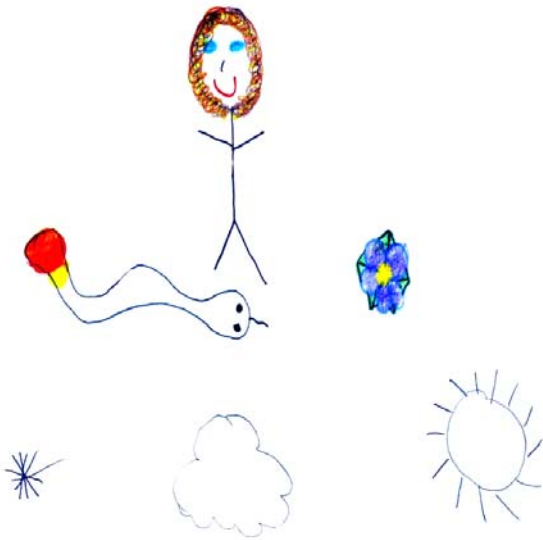


Before

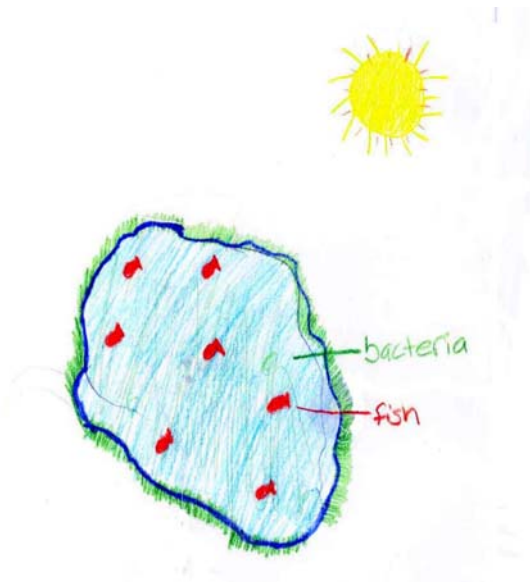


Two bacteria are looking at a mineral.

After



Before



After