

### Lab: Making a Winogradsky Column

Cyanobacteria, formerly known as blue-green algae, are bacteria capable of photosynthesis to produce oxygen. They are some of the most primitive cells found on the Earth today since their cells lack formal structures such as nuclei or other membrane covered organelles. Cyanobacteria exist in extreme environments such as hot springs or ice, making them extremophiles. These cyanobacteria also formed some of the oldest fossils found on Earth thus far called stromatolites and are thought to be responsible for oxygen formation in Earth's primeval atmosphere. Stromatolites still form today in both freshwater and salt water in algal mats, where many other organisms cannot exist because of the extreme conditions.

The purpose of this lab is to create an artificial environment where ecological succession of a photosynthetic community can be easily studied utilizing a device called a Winogradsky column. This was first demonstrated by a Russian scientist named Sergio Winogradsky in the early 1900's (Vandervoort, 1991). Typically, at least four different types of cyanobacteria exist on Earth today; the green sulfur, the purple sulfur, the purple non-sulfur bacteria, and the brownish non-sulfur Heliobacterium (Sagan and Margulis, 1988 in Vandervoort, 1991.)

#### Materials

1 liter or larger clear plastic bottle or large graduated cylinder  
mud and or sand from an outdoor source from a marshy area, can be a  
freshwater or saltwater source  
water from an outdoor source preferably from the same or similar marshy  
source  
calcium sulfate from a hard boiled egg, cheese or any other source of sulfur  
such as elemental sulfur, magnesium sulfate or other sources  
shredded paper, newsprint works best, about 10cm x 10 cm, as a carbon  
source

#### Procedure

1. Cut the top of bottle with razor or other cutting source to make bottle easier to fill.
2. Add the soil or sand mixture by layering it, packing it down with a rod or even a stick, adding a little water after each packing.
3. Continue with this until bottle is about 2/3 full.
4. Pour water over the top of this mixture leaving some unabsorbed water over the top of the mixture. Leave an air space at the top.
5. Cover the bottle with plastic film and secure it with a rubber band. Place it in a sunny window.
6. The cyanobacteria will begin to grow in a few weeks. Observe changes over time. The ecological succession will occur over a period of several weeks to several months.

#### Discussion

1. Describe the changes that occur over time and record observations in a table.

2. Graph the growth time vs. changes.

3. How is a Winogradsky column similar to ecological succession in a pond or marshland?

### Extensions

Elementary students can observe and record the changes. Pictures and diagrams of the changes that occur could be a way to demonstrate this.

Middle school students could take a pipette and remove samples to make microscope slides of the algal masses to observe what types of algae forms.

High school students and upper middle level students can pull samples and make microscopic slides for identification of the algae. If samples come from different areas, a sampling of ecological diversity in your community could be obtained.

Upper high school students, if they have the proper equipment, could do more advanced chemical and biological quantitative and qualitative analyses.

