

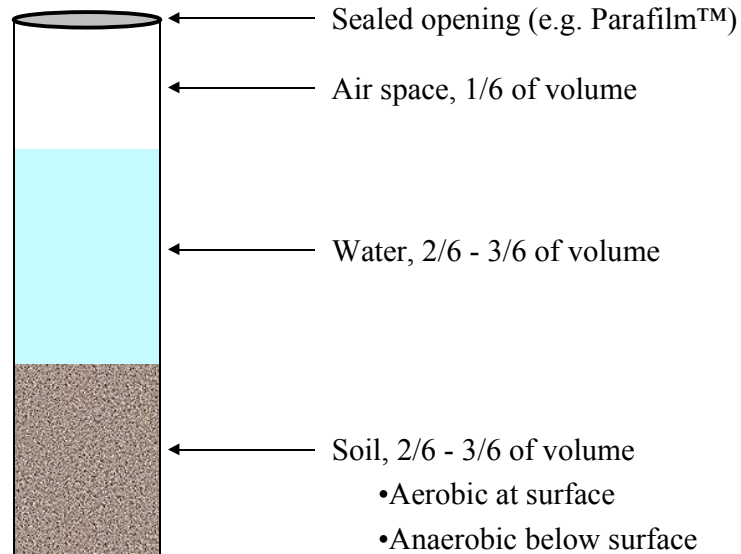
# The Winogradsky Column

## Introduction

The Winogradsky column, named after Sergei Winogradsky, is a self-contained, miniature ecosystem used for studying microbial communities. Sergei Winogradsky was one of the pioneers of the field of microbial ecology. Much of what we know about the biological cycling of sulfur and nitrogen comes from Winogradsky's work.

A Winogradsky column is essentially a "core sample" of a larger ecosystem. However, columns also can be created "from scratch" using materials from different ecosystems. A typical column consists of a long, narrow cylinder into which soil and water are placed and allowed to settle. The column is sealed to prevent gas exchange with the outside. Over a relatively short period of time, the lower parts of the soil become anaerobic. Oxygenic photosynthetic microorganisms keep the water layer and the surface of the soil aerobic. Microbial populations within the column reach equilibrium with each other, and the column community can survive for many years.

## “Typical” Winogradsky Column



## *Procedure*

Virtually any transparent column can be used. One-liter graduated cylinders work well, but they are expensive. In this exercise, a two-liter soda bottle is used. In addition to being inexpensive, it includes a sealing cap.

1. Obtain a two-liter, clear soda bottle with cap. Remove the label and rinse the inside with tap water.
2. Fill the bottle approximately 2/3 full with moist soil. Any soil may be used, but marsh sediment tends to be more diverse than others. Soil from a freshwater or a saltwater environment may be used.
3. Fill the remainder of the bottle with water, leaving approximately 1/6 of the volume as air. The water may be from any source, but works best when it is from the same source as the soil.
4. Cap the bottle tightly, and place it in an area that receives bright, indirect light with a relatively constant temperature.
5. Observe the colors in the column over time. Do they change? After 6-8 weeks (or longer), use a thin pipette to take samples from various levels of the column. These can be cultured and/or examined microscopically.

## *Variations*

Winogradsky columns provide unique, inexpensive opportunities for experimentation. Many different variables can be manipulated to determine the effects on community structure, succession and composition. Some ideas are listed below.

- "Typical" Winogradsky columns include added sulfate (5 g  $\text{CaSO}_4$ ) and cellulose (5-10 g) in the soil. Although these ingredients were left out of the above instructions, they could be added and compared to a column without them. If purified chemicals are not available, two egg shells and a finely shredded sheet of white paper will have a similar effect.
- What happens when other nutrients are added to the soil? Liquid plant foods like Miracle-gro<sup>®</sup> contain inorganic phosphorus, potassium and nitrogen. These nutrients, and others, also could be added singly.
- Try making a functioning microbial ecosystem "from scratch" using sterilized soil and water. Can you add enough different pure cultures of microorganisms to make a functioning community?
- What happens if the airspace is filled with some other gas, like  $\text{N}_2$  or  $\text{CO}_2$ ?
- Does the quality of light have any effect on community structure? Try using fluorescent or incandescent lights in place of sunlight. Caution: incandescent lights emit large amounts of infrared radiation, which could adversely increase the temperature in the column.
- Try varying the temperature. Does it have an effect?