

## **The Good, The Bad and The Beautiful**

### The Beautiful: Winogradsky Column

#### **OBJECTIVES:**

At the end of this activity students will be able to

1. Explain the basic process of photosynthesis and chemosynthesis, identify how they are alike and how they are different.
2. Describe the conditions needed for photosynthesis and chemosynthesis and describe specific location where each occur.
3. Illustrate photosynthesis and chemosynthesis by building a Winogradsky Column and making observations of changes that occur in them.

#### **PROCEDURE:**

##### **Part 1 – Winogradsky Column**

1. Set up a Winogradsky Column. Directions are available at [Winogradsky\\_CMORE.pdf](#)  
The following modification should be made:
  - Container – use a tennis ball can
  - Enrichment – use the following materials in the mud: shredded paper (cellulose), a broken egg with shell (protein/sulfur and calcium) and a nail (iron)
  - put 4 microscope slides in the top layer to collect biofilms.
2. Make observations on day one – color, odor, etc. Make a drawing or photograph your Winogradsky Column
3. Set the Winogradsky Column in the greenhouse. Put a small piece of tape on the sunny side. It will be important to keep this side facing the same direction. You will want to compare the light side to the dark side to compare the colors and types of microbes that may be present.
4. Continue to make observations on a weekly basis.
5. At two week intervals, remove a slide from the top of the column. Dip it in pond water to remove excess mud if necessary. Dip the slide in dilute methylene blue for 30 seconds, add a cover slip and observe through the microscope. Look for a biofilm and changes that you may see over time.

##### **Part 2 – How Do Microbes Obtain Energy**

1. Describe Photosynthesis and Chemosynthesis by visiting the following links: “Dive and Discover – Light Snacks and Food Chemistry: Photosynthesis and Chemosynthesis: <http://www.divediscover.who.edu/expedition13/hottopics/chemosynthesis.html> and Microbial Activities in Geochemical Environments: <http://player.vimeo.com/video/78232937>
  - a. Take notes making sure you can explain the basic processes of photosynthesis and chemosynthesis. Identify the steps of both process, identify the types of organisms that carry out each process and the setting where each can occur.
2. Deep Sea Thermal Vents are area deep in the ocean. They are far below the region where light penetrates. Watch the following animation: “Chemosynthesis and Hydrothermal Vent Life”  
<http://oceanexplorer.noaa.gov/edu/learning/player/lesson05.html>
  - a. Take notes while watching the video making sure you can explain where hydrothermal vents are located, how organisms get their food, the role microorganisms play in the process.

##### **Part 3 – What happens in a Winogradsky Column?**

1. Watch this animation - <http://www.sumanasinc.com/webcontent/animations/content/winogradsky.html> to get a better understanding of what happens in a Winogradsky Column. Also, look at this poster - <http://www.hhmi.org/biointeractive/poster-winogradsky-column-microbial-evolution-bottle>
2. Take notes while viewing the animation and poster.

##### **Part 4 – Write a lab report**

Your lab report should include the following sections:

1. Title and names of group members
2. Introduction
  - a. Purpose of your experiment. What is your research question?
  - b. Background information
    - i. What is a Winogradsky Column and what can we learn from it?

- ii. Explain the processes of photosynthesis and chemosynthesis, the types of organisms and conditions where each occurs.
  - iii. Describe how a biofilm forms and the importance of it for a microbial community.
  - iv. Provide a brief description of hydrothermal vents and the type of metabolism used by the microbes in this environment. Why is that valuable for the ecosystem?
3. Materials and Methods
  - a. Describe the procedure you followed in setting up your Winogradsky Column.
  - b. Include the materials that you used
  - c. You can add diagrams if that help to explain what you did.
  - d. This should be detailed enough that someone else could repeat what you have done.
4. Results
  - a. Record all observations made (using as many senses as appropriate). This should include a description of the original Winogradsky Column and the changes that occurred each time you observed it. Make sure to include descriptions of both the light and dark side. Also include colored drawings or photographs.
5. Discussion
  - a. Do not just restate your results. Instead, interpret what you observed relating them to the information you provided in your introduction.
  - b. Based on what you learned about about chemosynthesis and photosynthesis, did your results turn out as expected? Suggest why or why not.
  - c. What improvements could you have made in your experimental design?
  - d. What new questions did you have while conducting your experiment? Suggest other experiments that could be done to answer them?
6. Literature Cited
  - a. List books, article, websites, etc. that you used alphabetically.
  - b. Use this general format:
    - i. Books – Author(s). “Title”. Publisher. City. Year
    - ii. Research Article – Author(s). Journal. Year. Volume. Page
    - iii. Web – Author. Title. URL.
    - iv. Human – Name. Personal Communication

### **TOOLKIT CREDITS:**

Developed by Rebecca Kapley, (Cuyahoga Community College, OH), with support by the rest of the C-DEBI Collaborative Toolkit Team.

### **WEBSITE:**

[http://www.coexploration.org/C-DEBI/toolkits\\_biology.html](http://www.coexploration.org/C-DEBI/toolkits_biology.html)