Body Building

Activity 2: Grades 5-8

Encouraging Cell Growth

As you learned in "Body on a Bench," researchers have been able to culture liver stem cells onto the surface of a silicon chip. The chip has been riddled with tiny channels that allow nutrients to flow continuously past the developing cells. The flow within these artificial "vessels" also allows for the removal of waste materials, just as blood vessels do in a real liver. In fact, the entire chip functions just like a living liver, encouraging the liver stem cells to develop just as they would in a living organism.

This liver chip could provide scientists with a valuable tool in the study of liver treatment and disease. This tiny artificial liver can offer a closed living system in which to test various drugs and their interactions with liver cells. By administering such drugs to laboratory-maintained tissues, researchers are able to control and evaluate the actions of various therapies without using animals or endangering a living patient. The success of this culturing technique may one day lead to the development of a whole host of organ "chips," and radically reduce the need for organ transplants in the future.

Substrate Enhancement

In order to coax liver cells into growing on silicon chips, the exposed surface of the chip must be specially prepared. First, it is finely etched with a texture of microscopic pores. Then, the surface is chemically treated to mimic the structural elements of the liver's natural environment. The result is an artificial scaffolding on which liver cells adhere and function.

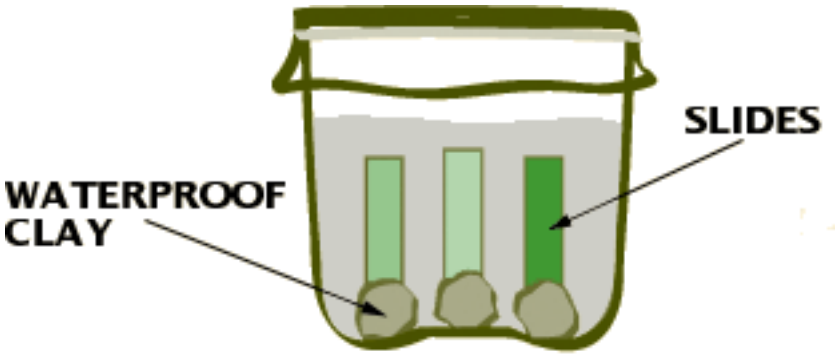
In this activity, you'll have the opportunity to test how the surface coating of a substrate affects the success of a biofilm. A biofilm is a sticky, slimy coating made from carbohydrates. It is produced by colonies of bacteria and algal cells.

This activity page will offer:

- Insight into factors that affect cell adhesion.
- An opportunity to observe the production of a biofilm.
- An opportunity to test the effects of surface coatings on the production of biofilms

MATERIALS

- Plastic 2-liter container (with top half removed)
- Spring water
- Cup of water from an aquarium overgrown with algae
- Plastic slides
- Cup
- Waterproof clay (from florist supply store or craft store)
- Plastic wrap
- Petroleum jelly
- Suntan lotion



PROCEDURE

1. Obtain a plastic 2-liter container that has been prepared by your instructor.
2. Fill the container 3/4 full with spring water.
3. "Inoculate" the container by adding a cup of water that has been taken from an aquarium environment overgrown with algae.
4. Coat both sides of a plastic microscope slide with a thick layer of petroleum jelly.
5. Place one end of the coated slide into a marble-sized lump of waterproof clay, then place the coated slide into the container, clay-side down. Make sure that the clay offers a stable base to keep the slide supported upright in the water column.
6. Repeat step 5 using a slide that has been coated with suntan lotion.
7. Repeat step 5 using a slide that has not been coated with any material.
8. Cover the top with plastic wrap to prevent the evaporation of water.
9. Place the covered container with its three upright slides in a location

where the setup will not be disturbed.

10. Wait about ten days. Carefully remove the slides. Do not disturb any film that may have grown on the surface of the slides.
11. Closely examine the surface of each slide by holding it up to a light. Which slide appears the least transparent, having the most dense bioflim coverage? Now touch each surface. Compare and contrast their appearances and feel.

Questions

1. Where did the slime-producing microorganisms come from?
2. In step 7, a slide that was not coated with any materials was placed into the container. Explain.
3. How did the biofilm coverage compare? What factors seemed to promote the growth of a biofilm?
4. How can you apply what you've learned in this activity to the content of this segment of SAF?

EXTENSIONS

3D Sculpture

Remember how the liver chip looked in the program? Think about its pitted surface and the network of pores that transported nutrients and waste to and from the liver cells. Then, use a variety of art materials to construct a sculpture that represents the liver chip. Your sculpture can either be a scientific model that accurately portrays this liver chip or it can be a creative, artistic representation.

Science Fiction Writing

Imagine being inside a microscopic submarine whose mission is to explore the liver chip. Using this unique perspective, create a fictional log that describes what you observe as you navigate in and around the chip structure.

WEB CONNECTION

Liver Cell

http://ilil.essortment.com/liverscellsstr_ricl.htm
This site offers an overview of liver cell structure and function.

CNEWS Science

http://www.canoe.ca/CNEWSScience0104/23_liver-ap.html
An online article for the general public that describes the success in culturing liver cells on a silicon chip.

Artificial Liver Trial

http://www.uchospitals.edu/news/ELAD.html
This site describes the use of liver cell cultures in assembling an artificial liver.

The activities in this guide were contributed by Michael DiSpezio, a Massachusetts-based science writer and author of "Critical Thinking Puzzles" and "Awesome Experiments in Light & Sound" (Sterling Publishing Co., NY).

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Answers

Questions

1. Where did the slime-producing microorganisms come from?
   (They were in the aquarium water that was used to inoculate the test container).
2. In step 7, a slide that was not coated with any materials was placed into the container. Explain.
   (This uncoated slide was a control.)
3. How did the biofilm coverage compare? What factors seemed to promote the growth of a biofilm?
   (Smallest amount of coverage occurred on suntan lotion-covered slide, medium coverage on control, and the most coverage on petroleum-covered slide.)
4. How can you apply what you've learned in this activity to the content of this segment of SAF?
   (The plastic slide was used as a substrate on which living cells were coaxed into growing, just as the silicon wafer was in the show. The nature of the slide surface coating affected the success of this growth. Petroleum jelly provided an optimal surface for organisms to adhere to and encouraged the most growth. In contrast, suntan lotion discouraged growth. Likewise, chemical factors that are added to the surface of the silicon wafer also affect the success of the liver cell adhesion.)

CURRICULUM LINKS

Life Science:

Scientific Design, Bio-Technology, Liver Cells, Culture growth and substrates, Algae blooms

NATIONAL SCIENCE STANDARDS (Grades 5-8)

Science as Inquiry- Content Standard A

Students will identify and control variables in an experiment.

Students will understand how their model compares to current scientific design.

Students will use observation and critical thinking to determine cause and effect relationships.

Life Science - Content Standard C

Students will explore the function and structure of cells.

Students will learn that cells grow and divide in order to reproduce.

Students will see that one system of organs aids in the survival of the entire organism.

Science and Technology- Content Standard E

Students will assess the cost and benefit of bio-technology and learn how science and technology can engineer solutions to human problems.