

Using Collagen in Cell Cultures

Subject Area(s) (Select from [TE Subject Areas](#))

Cell Biology - Biotechnology

Using Collagen to promote covalent bonding and cell growth in laboratory cell cultures

Grade Level 9th grade

Time Required 3 day lesson

Summary

This lesson is designed to create class discussions on the topics of cells, cell cultures, proteins and real life applications of cell biology and biotechnology. It also will provide an opportunity to talk about covalent bonding which will prepare the students for chemistry on their next school year.

Engineering Category =

Choose the category that best describes this lesson's amount/depth of engineering content:

1. Relating science and/or math concept(s) to engineering

Keywords

Cell, Cell Biology, Cell Culture, Collagen, Covalent bonding

Educational Standards (List 2-4)

[State STEM Standard](#) (required)

[SC.912.L.16.10](#) Evaluate the impact of biotechnology on the individual, society and the environment, including medical and ethical issues.

[ITEEA Standard](#) (required)

Standard 14: Organization and Development of Living Organisms (9-12)

[NGSS Standard](#) (strongly recommended)

Content Standard C: As a result of their activities in grades 9-12, all students should develop understanding of The cell Molecular basis of heredity Biological evolution Interdependence of organisms Matter, energy, and organization in living systems Behavior of organisms

Pre-Requisite Knowledge

This lesson requires students to already have covered the cell theory and the basic structure and function of the eukaryote cell. It would be a good extension activity after discussions on biotechnology and the potential of science to advance and improve our lives have taken place with the class.

Learning Objectives

After this lesson, students should be able to:

- Students will explore cell cultures and their importance in biotechnology as well as all the requirements and procedures to grow cells in the lab.
- Students will also see the importance of having a sugar solution and the proper temperature for the cells to grow
- Finally, students will recognize the use of a protein (collagen) to create covalent bonds and produce better results when growing cells in the laboratory.

Introduction / Motivation (5E – Engage)

On the first day of the lesson, the students will be presented with a few images of examples of biotechnology. Also the teacher will bring a couple of short articles (with complexity level adjusted according to the reading level of the class) to open a discussion on what biotechnology is and how it can impact our lives. At least one of the articles should be about biomedical applications and laboratory research including cell cultures. A search of articles related to cell cultures with applications in cardiovascular disease research should yield a few options for the teachers to decide based on their knowledge of the students and their reading and comprehension level.

Lesson Background & Concepts for Teachers (5E – Explain)

Cell Culture: process by which cells are grown under controlled conditions, generally outside of their natural environment. In practice, the term "cell culture" now refers to the culturing of cells derived from multi-cellular eukaryotes, especially animal cells.

Collagen: The English word "collagen" comes from the Greek word "kola", which means glue. Collagen is a connecting and supporting protein essential for proper condition of hair, skin, bone, tendons, muscle and cartilage inside joints.

Bovine Collagen comes from cows. More specifically, it is a naturally-occurring substance found in the skin, muscle, bones and tendons of cows. By isolating and purifying bovine collagen, scientists created a ready supply of collagen

Covalent Bond: A covalent bond is a chemical bond that involves the sharing of electron pairs between atoms. These electron pairs are known as shared pairs or bonding pairs and the stable balance of attractive and repulsive forces between atoms when they share electrons is known as covalent bonding

Associated Activities (5E – Explore)

1. On the first day, students will prepare two sets of slides. One set will be the control without any treatment and the second set will be coated in a Collagen solution prepared beforehand by the teacher. After the treatment, both sets will be stored in oven overnight. For the collagen solution protocol as well as the coating procedure for the slides, the collagen manufacturer and supplier company (Advanced BioMatrix) sets guidelines which can be followed. For those guidelines please refer to the end of this lesson plan.
2. On the second day, students will procure the slides from the oven and with the help of a toothpick, perform a swab of the inside of their cheeks and plant them on the 4 slides. Two with the collagen treatment and 2 without. Then the slides will be left on the oven overnight for incubation
3. On day 3 the students will use the microscope and observe all the slides.

Lesson Closure

On day 3, after observing and comparing both sets of slides, students will create drawings of each and create their own hypothesis as to the results they are observing. The teacher will start a class discussion to compare all the different theories on the results. The best possible outcome is to create a space where student led discussions can be achieved.

Assessment (5E – Evaluate)

Pre-Lesson Assessment

During the discussions on day 1, the teacher will get a feeling for what the students know about biotechnology and cell biology as well as their own opinion on this topic. A good alternative is to use Philosophical Chairs (an AVID strategy) which will extend the duration of the lesson by one day but allows for a good opportunity for assessment in groups and individually.

Post-Introduction Assessment

During the lesson, particularly during the laboratory work, the assessment will come in two ways. First, laboratory procedures and microscope use quiz will provide one grade. Also, a second grade will be earned with the results of the lab, reflected in the student's drawings or images of their slides

Lesson Summary Assessment

At the end of the lesson the students will present their observation in a lab report along with their hypothesis on the explanation for their results.

Also the final discussion and closing of the lesson will provide another opportunity for assessment.

Lesson Extension Activities (5E – Extension)

A great extension activity can happen in the laboratory during the next 2 or 3 days after the initial incubation period. After the first incubation day, students will check for cell growth every day for the next 3 days and produce a lab report with their findings as well as a reflection on what they learned.

Advanced BioMatrix Coating Procedure. (Copyright, 2011. PureCol Packet Insert)

1. Remove required quantity of collagen and dispense into a dilution vessel.
2. Dilute PureCol in water to 50 to 100 micrograms per milliliter (1:30). A 0.01 N HCl solution may also be used.
3. Swirl contents gently until material is completely mixed
4. Add appropriate amount of diluted PureCol solution material to the culture surface ensuring that the entire surface is coated.
5. Incubate at room temperature or 37C, covered for at least 2 hours. In our case, due to classroom period times, we will incubate for 24 hours.
6. After incubation, aspirate any remaining material
7. Rinse coated surfaces carefully with sterile medium or PBS, avoid scratching surfaces.
8. Coated surfaces are ready for use. They can also be stored at 2-8 C damp or air dried if sterility is maintained.

Acknowledgements

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Classroom Testing Information

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