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Lesson Review

Author: Rowan Driscoll
Title: Biofuel Project Part 1: Sample Collection Of Experimental Bacteria
Company: SynBERC and Joint BioEnergy Institute
Grade Level(s): 9,10

Subject Areas

- Science

California Standards

Cell Biology

1. The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept: a. Students know cells are enclosed within semi permeable membranes that regulate their interaction with their surroundings. c. Students know how prokaryotic cells, eukaryotic cells (including those from plants and animals), and viruses differ in complexity and general structure. h. Students know most macromolecules (polysaccharides, nucleic acids, proteins, lipids) in cells and organisms are synthesized from a small collection of simple precursors. Genetics 2. Mutation and sexual reproduction lead to genetic variation in a population. As a basis for understanding this concept: e. * Students know how exogenous DNA can be inserted into bacterial cells to alter their genetic makeup and support expression of new protein products. Evolution 7. The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept: a. Students know why natural selection acts on the phenotype rather than the genotype of an organism. c. Students know new mutations are constantly being generated in a gene pool. d. Students know variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions. 8. Evolution is the result of genetic changes that occur in constantly changing environments. As a basis for understanding this concept: a. Students know how natural selection determines the differential survival of groups of organisms. b. Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment. d. Students know reproductive or geographic isolation affects speciation. e. Students know how to analyze fossil evidence with regard to biological diversity, episodic speciation, and mass extinction.

Lesson Abstract:

The biofuel project is a collection of 6 multi-faceted lessons which deal with the bacterial deconstruction of cellulose polymers in the experimental process of developing a new generation of biofuels to serve as a more sustainable energy alternative to current fossil fuels. The lessons were developed in coordination with the work conducted in the deconstruction department of the Joint Bio-Energy Institute in Emeryville, CA. Industry scientists have expressed a need to prepare high school students for the work force with practical experiences engaging the scientific process. JBEI's Introductory College Level Experience in Microbiology (iCLEM) program was created to give underserved youth an opportunity to gain practical skills and literacy in the field of biochemical engineering. These lessons can be used as stand alone activities, but the true intention is to engage and practice a range of professional skills and concepts in pursuit of a relevant and more sustainable answer to our energy demands. The six lessons engage students across a range of standards and issues. The order of lessons is as follows:

Biofuel Project part 1: Sample Collection of Experimental Bacteria
Biofuel Project part 2: Gram Staining and Bacterial Cell Wall Phylogenesis
Biofuel Project part 3: Preparing Growth Medium and Serial Dilutions
Biofuel Project part 4: Genomic Preparation
Biofuel Project part 5: 16s ribosomal sequence preparation and identification
Biofuel Project part 6: CMC and congo red stain plate assay

This lesson is **Part 1 of the biofuel project: Sample Collection of Experimental Bacteria**. Students collect samples from different locations in their neighborhood and plate bacteria on st21cx or m9 media with filter paper for screen isolation of cellulose degrading microbes. The control is a rich media of Luria Broth .

Students learn how to prepare experimental plates and are introduced to the concepts of eukaryotes and prokaryotes, rates of growth, evolution, ecological habitats, biofuels industry research as well as google maps and longitude and latitude.

Procedures:

Biofuels Project Lesson 1-Sample Collection of Experimental Bacteria (2 weeks)

Abstract

This lesson is Part 1 of the biofuel project: Sample Collection of Experimental Bacteria. Students collect samples from different locations in their neighborhood and plate bacteria on st21cx or m9 media with filter paper for screen isolation of cellulose degrading microbes. The control is rich media of Luria Broth. Students learn how to prepare experimental plates and are introduced to the concepts of eukaryotes and prokaryotes, rates of growth, evolution, ecological habitats, biofuels industry research as well as google maps and longitude and latitude.

Schedule

Underlined articles/rubrics/ppts/activities are located in *chronological* order on the IISME community site including this outline. All textbook readings and section reviews come from Holt, Rinehart and Winston's *Biology, Principles and Explorations*.

Day 1

1. students read NYTimes article as SSR and journal/share out goals/feedback (15mins) using the prompts and questions posed in the supplemental document
2. instructor presents biofuel project introduction: review lab journal rubric/lab writeup rubric and guidelines for lab documentation. Students participate and complete presentation rubric based on the teacher presentation modeling (30 mins)
3. students read/prep Sample collection data sheet

Day 2

1. students peer assess each other's lab journal and share out to partner (25 mins)
2. students view google maps demo (15)
3. students read about bacteria from chapter 21.2 of the Holt Rinehart Winston text *Biology, Principles and Explorations*, form an initial draft of their hypothesis and review literacy cards PPT and complete literacy cards for selected terms (see attachment)

Day 3

1. Students are paired with their lab partner and complete the Plating of Environmental Samples on Media (30 mins)
2. Students revise and enter product nomenclature and numbers into their lab journals (10 mins)
3. students complete their journal for the lab activity and finish readings and literacy cards for bacteria terms, see day 2. (10 mins)

Day 4

1. Students take observations of their plates and enter data into their journals (12mins)
 2. students review intro to bacteria ppt (18 mins)
 3. students discuss presentation (10 mins)
 4. students complete Bacteria Cells Assessment (10 mins)
- Students read "microbe munchers" article

Day 5

1. Students discuss the Microbe Munchers article using the Plastic Munchers Discussion Questions (12 mins)
2. Students observe plates and record data (12 mins)
3. Students review the assessment data and are assigned a 4 person team and a topic question for further study and presentation

- prokaryote
- decomposers
- binary fission
- conjugation
- passive transport
- active transport

1.

4. Students research their presentation topic, cite sources and share their sources slide/doc

Day 6

1. Students team up to prepare their presentation (45 mins)
2. Students complete their slides and share their topic ppt/activity plan with the entire class
3. Students view the "Tree of Life" presentation if more time permits

Day 7

1. Teams present their slides/activity to the class and are assessed for their presentation using the presentation rubric (50 mins)
2. Students prepare a concept map using their literacy terms using the concept map intro document to scaffold their comprehension

Day 8

1. Students prepare new plates using the restreaking bacteria protocol
2. Students submit concept maps and are reassessed using the bacteria cell assessment.
3. Students review the protocols they've completed and use the lab writeup rubric to connect the work completed with the final summative assessment.

****Assignments in italics will be completed outside of class by the students, i.e. homework****

Materials

- LB plates (100+)
- M9 or ST21CX plates (100+)
- sterile filter papers (100+)
- inoculating loops (100+)
- parafilm (3+ rolls)
- scissors*
- sterile transportation container
- bunsen burners (12)*
- "falcon tubes" or liquid culture tubes (300+)























Assessment Tools

- Literacy Cards
- Bacteria Cell Topic Presentation
- Standards Based Assessment
- Discussions
- Concept Map
- Journal

Keywords:

Biofuel, Decomposers, Bacteria, Ecology, Growth Rates

Attachments:

-  [Biofuels Part 1 Abstract.doc](#)
-  [Biofuel Outline Part 1 .doc](#)
-  [Alfredo Quiñones-Hinojosa - A Surgeon's Path From Migrant Fields to Operating Room - New York Times.pdf](#)
-  [Alfredo Quinones-Hinojosa Questions.doc](#)
-  [Biofuels Project Intro.ppt](#)
-  [Journal Rubric1.doc](#)
-  [Lab Writeup Rubric1.doc](#)
-  [Guidelines for lab documentation.doc](#)
-  [Presentation Rubric.doc](#)
-  [Sample Collection Sheet](#)
-  [Literacy_Cards.ppt](#)
-  [BP Part 1 Literacy Terms.doc](#)
-  [Plating Environmental Samples on Media1.pdf](#)
-  [Introduction to BACTERIA .ppt](#)
-  [Bacteria Cells Assessment.pdf](#)
-  [Bacteria Cell Answer Sheet.pdf](#)
-  [Bacteria Cells Assessment \(TE\).pdf](#)
-  [Plastic Munching Microbes.pdf](#)
-  [Plastic Muncher Discussion Questions.pdf](#)
-  [Tree of Life](#)
-  [Restreaking Unknown Environmental Sam .doc](#)
-  [Concept Map Intro.pdf](#)

